ROUTLEDGE INTERNATIONAL HANDBOOKS



The Routledge Handbook of Environmental History

Edited by Emily O'Gorman, William San Martín, Mark Carey and Sandra Swart

THE ROUTLEDGE HANDBOOK OF ENVIRONMENTAL HISTORY

The Routledge Handbook of Environmental History presents a cutting-edge overview of the dynamic and ever-expanding field of environmental history. It addresses recent transformations in the field and responses to shifting scholarly, political, and environmental landscapes.

The *Handbook* fully and critically engages with recent exciting changes, contextualises them within longer-term shifts in the field, and charts potential new directions for study. It focuses on five key areas:

- Theories and concepts related to changing considerations of social justice, including postcolonial, antiracist, and feminist approaches, and the field's growing emphasis on multiple human voices and agencies.
- The roles of non-humans and the more-than-human in the telling of environmental histories, from animals and plants to insects as vectors of disease and the influences of water and ice, the changing theoretical approaches and the influence of concepts in related areas such as animal and discard studies.
- How changes in theories and concepts are shaping methods in environmental history and shifting approaches to traditional sources like archives and oral histories as well as experiments by practitioners with new methods and sources.
- Responses to a range of current complex problems, such as climate change, and how environmental historians can best help mitigate and resolve these problems.
- Diverse ways in which environmental historians disseminate their research within and beyond academia, including new modes of research dissemination, teaching, and engagements with stakeholders and the policy arena.

This is an important resource for environmental historians, researchers, and students in the related fields of political ecology, environmental studies, natural resources management, and environmental planning.

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INTRODUCTION

Framing environmental history today and for the future

Emily O'Gorman, Mark Carey, William San Martín, and Sandra Swart

Environmental history is both an established and continuously innovative field, shaped and reshaped within global networks of researchers, teachers, and practitioners. It emerged as a self-defined and conscious field in the United States in response to the environmental movement of the 1970s. Nevertheless, broader intellectual and socio-political trajectories from more diverse origins and spatial and temporal scales have also influenced its methods, approaches, and guiding questions. These trajectories include, among others, the earlier work of scholars in the French *Annales* school in the 1930s concerned with the *longue durée* of interlinked human and geographical history, and contemporaneous questions of land ownership in former settler colonies within history, historical geography, and other disciplines (see McNeill 2003; Griffiths 2003; O'Gorman and Morgan 2021; Sutter 2013; Winiwarter et al. 2004). Transnational trajectories, such as the United Nations Conference on the Human Environment in 1972, the struggle over decolonisation, conservation, and self-determination to manage natural resources in the post-colonial world, movements opposing development projects during the Cold War, and the rise of sustainable development in the 1980s have also informed the global rise of environmental history beyond the specific scales and scopes of the field in the United States.

Globally, environmental history emerged as a distinct field in the discipline of history; however, it did so in close dialogue with the natural sciences and geography. Environmental history continues these connections while also integrating closely with other fields such as animal studies, political ecology, ecocriticism, anthropology, environmental studies, ethics, and science and technology studies (STS) (Sutter 2013; O'Gorman and Morgan 2021). The field's blurring of human and non-human worlds, of nature and culture, as well as its analysis of various agencies and species interactions has much to offer other environmental researchers working broadly in coupled natural-human systems, sustainability sciences, and climate adaptation that are more recently seeking the kind of depth and nuance inherent to environmental history scholarship.

Today, the field of environmental history encompasses a wide range of issues around the globe, from planetary questions of climate change and entangled social and ecological impacts of colonisation, to questions of ethical and sustainable management of natural

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resources and non-human historical agencies. In all of these areas, environmental historians examine not just how various people and societies have influenced the non-human world across time and space, but also how environments – from pastures and farms to glaciers and whale pods – are products of a long and dynamic interplay between human and non-human forces. This interchange of forces means that ideas, discourse, and politics are as important to our studies as the material effects of climate, toxins, and species population changes. Environmental historians are thus equipped with a valuable interdisciplinary set of skills to examine some of the most pressing socio-ecological issues of our time, such as climate change, species extinction, sustainable development, and the governance of environmental commons.

This *Handbook* seeks to provide novel and important contributions to environmental history while stimulating and inspiring new types of scholarship in the history of human-environment dynamics. As a handbook, rather than, say, an edited volume of essays, it seeks to be more widely accessible and comprehensive in coverage and approaches, although no volume could ever be fully comprehensive. It is intentionally organised thematically – rather than geographically or regionally – in order to bring the histories of different regions into conversation with each other and, more importantly, to underscore new approaches and trends in the field rather than specific places and time periods. That said, the work in this *Handbook* is grounded in time and space, with many of the chapters highlighting specific issues or places. Our goal is thus to broaden the approaches and make them accessible to scholars working in all subfields, places, and time periods while providing concrete examples. To be more wide-ranging and globally accessible in terms of topics and approaches, this *Handbook* is also global in nature. Firstly, it features approximately 72 authors from 27 countries. It also covers a wide array of world regions and countries, with the objective that authors working in distinct places find it easy to use, relatable, and relevant to their own work. Additionally, the *Handbook* works to advance new and innovative methodological approaches, such as through new sources and evidentiary bases, through co-authorship, or through different approaches such as oral history, Geographic Information Systems (GIS), and more ethics-based approaches.

This introductory chapter frames and explains the suite of essays in this *Handbook*. Really, it is intended as a kind of prolegomenon as it offers an overview and contextualisation that both introduces and interprets that which follows. Overall, the *Handbook* strives both to capture some of the most groundbreaking, interesting, and stimulating recent trends in the field and to open new paths forward for environmental history research globally. The chapters exemplify environmental history's disciplinary responses to shifting scholarly, political, socio-economic, and environmental landscapes. Indeed, over the last decade, the field has changed significantly as it has responded to new opportunities, such as those presented by engagements with new academic fields like the environmental humanities, as well as global challenges, including climate change, biodiversity loss, health and socio-economic inequalities, and the growth of nationalisms. This expansion offers a wonderful – and crucial – time to take stock of where the field is now and, much more importantly, chart some new directions that showcase where the field can go. We explore what exactly environmental history brings to related fields, to other disciplines, to current policymaking, and to the fundamental and urgent need to address environmental injustices and inequalities. As environmental historians know very well, the framing of these societal and environmental problems often lacks context and historical understandings, which shape not just what these "wicked problems" have come to be, but also what can be done about them and who gets to decide. As such,

the audience for this *Handbook* is well-established environmental historians as well as undergraduates and graduate students trying to make their way into environmental research and practitioners beyond academia. Of course, as scholars in the environmental humanities, political ecology, environmental studies, natural resources management, environmental planning, and other cognate fields wrestle with similar topics, the volume strives to reach them as well, engaging in the important ways environmental historians contribute to these pressing issues.

A cross-cutting concern among many *Handbook* authors is with past and ongoing legacies of imperialism and colonisation over the last 400 years. Chapters largely focus on the period since 1600. Yet they engage with multiple temporalities, including a consideration of Deep Time and the longer timescales implicated in the Anthropocene. Key concerns that cut across the volume are the current planetary crises of biodiversity and habitat loss coupled to the collapse of ecosystems, the loss or liminalisation of local environmental knowledge, accelerating pollution and toxicity, and climate change. A core theme with which several authors engage is novel ways of grappling with "agency". This volume explicitly aims to push (and push at) the boundaries of the field. It engages with emerging approaches as well as suggesting future pathways that build on, dialogue with, and depart from more traditional practices in environmental history.

The *Handbook* also purposefully engages with intellectual inquiries and research outside of the academic circles in the north Atlantic and the Global North. In short, it seeks not just global coverage and international topics, but more global intellectual inquiries—with questions, approaches, and academic contexts that expand beyond and sometimes differ from those posed in North America and Western Europe. It encourages conversations about global (in)justices and power disparities that integrate underrepresented agents (e.g., Indigenous peoples and knowledges, sexual and gender minorities, and grassroots movements, among others), non-humans (e.g., animals, plants, technologies, and landscape elements), future generations (intergenerational justice), and mobile entities (e.g., chemical forms, knowledge and cultural systems, waste, and governance architectures) into a broader understanding of socio-ecological change across scales. We also actively sought to feature a range of authors coming from diverse backgrounds, institutional affiliations, positions, and places, such as authors from the Global South and Global North as well as both early career and senior scholars.

Another innovative feature of this volume stands out immediately even with just a quick glance at the Table of Contents: every chapter and every piece of the *Handbook* is co-authored and co-edited. The *Handbook* was built through collaboration and partnership, through sharing and helping, through countless conversations and compromises that we believe improve the scholarship and its contributions. Sole authorship remains the norm in environmental history (and, indeed, in history more generally) but there is a great deal to be gained from co-authorship and collaboration, especially in a volume such as this that benefits from including a range of perspectives and geographical diversity. A recent call for greater collaboration in our field further explains that:

> collaboration is especially important in Environmental History because answering complex questions about past environmental conditions, biophysical changes in the environment, and human-environment relations requires eclectic theories and methods that no one scholar can ever hope to master.
>
> *(Alagona, Carey, and Howkins 2023)*

Co-authorship offers many benefits. It can expand geographical and temporal coverage while also building international relationships, networks, and communities. Some author teams help increase demographic diversity (gender, race, age, region, career stage, type of institution, and so on) when they choose co-authors from different backgrounds or contexts. In some cases, co-authorship creates mentoring opportunities when early-career scholars collaborate with more experienced researchers. Given that each author brings their own networks to an author team, the research partnership can also help scholars reach new and larger audiences for their work, particularly when they collaborate with researchers outside their discipline. In this way, co-authorship can stimulate methodological innovation within and beyond environmental history. Finally, collaborative writing enriches learning and deepens analysis by requiring co-authors to decide how to write, organise, represent, compare, and share material. We believe something more profound happens when researchers co-author a chapter rather than just sharing a draft for comment. This was the case for co-editing this *Handbook*: we all learned from each other, and thus improved the volume, by working together, despite the challenges of collaborating across time zones in Australia, South Africa, and, in the United States, Massachusetts and Oregon.

We have thus actively encouraged co-authorship of chapters by scholars at different career stages and from different parts of the world, with attention to diversity of gender, professional affiliation, and cultural background. We believe addressing co-authorship with an intentional focus on diversity and inclusion can help address the unequal nature of academic labour and the disparities impacting early career scholars and practitioners, especially in low-income and post-colonial nations and in institutions affected by severe budgetary cuts after the Covid-19 pandemic. We also do so as we understand that the lack of diversity and global representation in the production of environmental knowledge creates epistemological gaps that compromise our understanding of complex socio-ecological issues (San Martín 2021). We moved from the premise that women, Black, Indigenous, and People of Colour (BIPOC) scholars and those from the Global South are under-cited (Ahmed 2017; Collyer 2018). So we took scholarly identity seriously to move toward a more just and less insular academic practice (Dworkin, Zurn, and Bassett 2020). We consciously tried to subvert existing inequities in global knowledge economies by developing new networks of citation through new collaborations.

Chapter authors have responded with enthusiasm, forming productive co-authorship teams that in many cases did not exist previously. The afterword of the volume – "Future directions" – has been written by a team of early-career environmental historians who have distilled where they see, and where they would *hope* to see, the field heading. This radical approach is a response to calls to increase diversity in academic institutions and research, to address issues of representation in environmental scholarship and activism, and to provide concrete platforms that overcome traditional structures and practices (Ferdinand 2021; García Peña 2022; Liboiron 2016; McKittrick 2021; Soto Laveaga 2020). Co-authorship provides one avenue to help address these issues because it inherently expands the ideas, scopes, and methods in a scholarly piece. Yet, as noted earlier, among environmental historians, this kind of collaboration is still relatively rare – although we believe it will be part of the future of the field. This volume, with its co-authored chapters, thus tries to take one small step toward implementing and practising these goals. Most collaborations in the *Handbook* are historians teaming with historians. But we hope this co-authorship model and its benefits will inspire historians to build teams beyond our field, to do more joint scholarship with biologists and ecologists, geologists and hydrologists, political scientists and philosophers,

which many of the *Handbook's* editors and authors already do. In short, we believe the co-authorship format helps deliver new content, diversify the discipline, and inspire new methodological approaches to environmental history.

The *Handbook* is structured in five parts, each of which centres on a key concern within environmental history: (1) new methods and innovative approaches; (2) non-human agencies; (3) engaging with the planetary and the Anthropocene; (4) power, flows, and knowledges; and (5) practices and actions for current socio-ecological crises. The remainder of this chapter outlines each of these themes within the field and introduces the chapters that address them.

New methods, innovative approaches

Environmental historians have always engaged with and combined a variety of different methods in their approaches to particular questions and topics. This has ranged from research of documentary archives to donning a pair of good boots for site visits (Worster 1989: 289), doing ethnographic fieldwork, and engaging with ecological or natural science studies, to understand aspects of the changing relationships among people, animals, plants, and geophysical forces. Analysis has long encompassed both qualitative and quantitative approaches, reflecting the interdisciplinary nature of the field. However, qualitative approaches have tended to predominate, perhaps due to the ongoing influence of the humanities. For similar reasons, research of documentary archives and text-based sources arguably has been the most common method used by environmental historians since the emergence of the field in the 1970s, as it has predominated in other sub-disciplines within the discipline of history. However, the questions, methodologies, and approaches environmental historians bring to researching and examining archives have changed over time, contoured by shifting global and local concerns, as well as by intellectual and technological breakthroughs within the field. A cross-cutting theme in the chapters throughout this *Handbook* is the importance of the researchers' positionality in examining archives. This reflects enduring and recent considerations within the field and more widely about the way a researcher's background (including cultural, gender, socio-economic, and so on) and/or emerging scholarly stances influence how they examine archives and other documentary sources. The chapters often foreground questions of asymmetrical power relationships and diverse agencies in their examination of archives and documents. For example, Chapter 10 examines how international agreements might be analysed in terms of non-human agencies, while Chapter 17 shows that archives related to the toxins produced by gold mining in Zimbabwe contain powerful evidence of race and class oppression.

Part I of the *Handbook* focuses on inventive approaches and new methods in the field beyond archival research and more traditional academic practices. Chapter 1 provides an overarching discussion of the role and importance of positionality, ethics, and justice in approaches to environmental history. It specifically considers the role of positionality in differing perspectives on justice, pondering on whose voices are amplified and muted in environmental histories, and how analyses of environmental justice have been shaped by competing views within and among different groups. These points are illustrated through three case studies, two from India and one from Australia.

Environmental history has all too frequently lacked critical reflection on the methodologies of oral history, or the challenges of working with memory as a historical source, as Williams and Riley (2020) have noted. The tendency has been to weave interview material

into an environmental analysis without critical reflection on the nature of the source, the significance of memory or, indeed, the methodologies used to collect such material. Combining approaches in environmental history, environmental humanities, and anthropology, Chapter 2 shows the potential uses of oral history as an explicit, reflexive methodology that helps decolonise research methodologies with Indigenous and marginalised communities, and that re-centres a more-than-human world.

Other sources beyond archives and oral histories also offer environmental historians rich material through which to examine the past. Chapter 3 examines emerging approaches to sound in environmental history research and analysis. It considers how we can think with sound in academic worlds dominated by the visual and reclaim soundscapes that no longer exist. It argues that examining the work of acoustic ecologists, experimental sound art, and the possibilities opened up by recording technology, audio software, and the digital, *sounding* environments – as both adjective and verb – can provide novel approaches to studying sound and silence, blurring the conventional categories of biophony and anthropophony in a context of crises and environmental inequalities.

Environmental historians have also turned to methods like GIS to serve as critical tools for examining the changing relationships between society and the environment graphically and spatially over time. Chapter 4 departs from the general assumption that GIS is only a tool to represent or examine spatial data. The authors instead demonstrate that GIS can provide a more complex analysis that integrates a spatial dimension along with other areas more broadly used by historians, such as social, cultural, economic, and political dimensions. This is demonstrated through two case studies: urban river basins in Brazil and toponymy in the Guarani Jesuit Missions.

Non-human agencies

Environmental historians are increasingly engaging with questions of non-human agency. These engagements have emerged in dialogue with work in animal history and studies (Aderinto 2022; Ritvo 2022; Tortorici and Few 2013), and more recently in interdisciplinary more-than-human and multispecies studies (O'Gorman and Gaynor 2020). In general terms, a concern with non-human agency aims to decentre purely human perspectives and instead centre particular non-humans or sets of more-than-human relationships in order to emphasise a more distributed historical agency (Doro and Swart 2022). These sorts of approaches have developed in response to mounting critiques of dominant ideas of human separation from and superiority over "nature" that have significantly contributed to past and current socio-ecological crises (Horsthemke 2015; Plumwood 2002) and have erased other ways of multi-species coexistence. Importantly, these perspectives emphasise diversity of both humans and non-humans, the connections between the real and represented species, the nuances of change in complex multi-species assemblages and asymmetrical power relationships in their analyses.

Part II provides a set of perspectives on emerging considerations of non-human agency within environmental history. An underlying theme environmental historians grapple with is the scales at which we can examine changing and enduring non-human agencies, from particular places and specific periods, to landscapes as a concept that emphasise more-than-human relationality, and all the way up to the scale of global migrations of some species. Environmental historians can use the lens of domestication, as Chapter 5 does, to understand and analyse many of the different and shifting human-animal relationships that

have emerged over time. The authors consider a series of relationships, such as the extermination and then re-introduction of wolves into Yellowstone National Park in the United States, or recent attempts to resurrect mammoths using biotechnology.

Environmental historians have been changing and expanding the ways in which they approach and present animal agency. Chapter 6 focuses on a discernible "animal (agency) turn" within the field that has increasingly centred animals. In particular, the chapter shows three emerging research areas that exemplify this growing tendency within the field to engage with both animal cultures and the influence of animals on more-than-human cultural systems and assemblages: animal resignification of human-influenced environments, the roles of wild predators and their symbolism, and human-animal co-production of waterscapes.

How zoonotic diseases shaped history and how historians have captured the shifting bodies of knowledge about such diseases is another key area of research on non-human agency, explored in Chapter 7. It explains how the Covid-19 pandemic ignited fresh debate (from Twitter conspiracy theories to academic arguments) over the genesis and spread of diseases in a globalised world. These are obviously contested but increasingly popular processes and debates. The chapter shows how a term such as "One Health" makes a powerful argument about how human plans to alter the environment to avoid or eradicate disease have themselves led to the (re-)emergence of devastating diseases. In so doing, environmental historians can show the links between understandings of disease, environmental actions, and risks of future outbreaks.

Chapter 8 examines non-human agency and enrolments in agriculture from the perspective of environmental history. Focusing on the period since the nineteenth century, it argues that animals, plants, and soils involved in agricultural projects supported the global mobilisation of technologies. This is demonstrated through an analysis of efforts to increase production and modernise agriculture in particular places. This chapter exposes the uneven power relationships that have shaped the multiple scales of human and non-human relationships over time.

Landscape mobility and changes have shaped human and non-human histories in profound ways. Chapter 9 considers sand dunes as historical actors. Focusing on Mozambique in the twentieth and twenty-first centuries, it examines the role of sand dunes in shaping international and transnational human movements across time and space. Taking a transdisciplinary approach, it shows how a focus on these sand dunes can reveal new connections between local and international events and trends.

Chapter 10 argues that Actor-Network Theory (ANT) can be a critical tool for the study of international treaties specifically and more-than-human agency broadly. Treaties, conventions, and agreements involve not just mobilising humans and their institutions but also non-human organisms and technologies. The chapter grounds its analysis in two major transnational treaties for wildlife protection: the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the African-Eurasian Migratory Waterbirds Agreement (AEWA).

Events and disasters have shaped histories in sometimes dramatic ways. Chapter 11 explores a range of catastrophes – from earthquakes and volcanoes to extreme weather and insect plagues – while also examining a range of temporalities, from Deep History to the present. The chapter contends strongly that environmental history is useful in understanding disasters by explaining both failed and successful responses, and suggesting the general and contextually idiosyncratic factors that contour the outcomes.

Engaging with the planetary and the Anthropocene

The Anthropocene – a new framing of our current geological age, conceptualising from *anthropo*, for "human," and *cene*, for "new", as the epoch during which human activity has become the prevailing influence on climate and the environment – has become an important, yet controversial, concept in the humanities as well as the sciences. It usefully captures the unparalleled global scale of change. Yet since it was first coined as a term in 2000 (Crutzen and Stoermer 2000; Zottola and de Majo 2022), it has been contested because it implies a sweeping generalisation of all "humanity's" complicity in this, which masks how geographically, politically, generationally, and culturally situated such causes and impacts have always been. Nevertheless, in this very debate, it also prompts a useful interrogation of the politics, ethics, and economics of global change, as well as a range of explanations for historical causes and hence for future solutions. Environmental historians and others have debated and utilised this concept in relation to past socio-ecological transformations, including the role and experiences of Indigenous people (Bashford 2013; Whyte 2018), and developed alternative propositions such as the "noösphere" (Vernadsky, cited in Rispoli 2022), "chthulucene" (Haraway 2015), "plantationocene" (Moore et al. 2019), "pyrocene" (Pyne 2021), "capitalocene" (Moore 2016), and "wasteocene" (Armiero 2021). Indeed, environmental historians have become some of the leading humanities researchers and thought-leaders in this area (Warde, Robin, and Sörlin 2017).

Arguments over the concept of the Anthropocene (and many other-cenes) expose deep inter- and even intra-disciplinary fissures between the natural and social sciences/humanities. In fact, many chapters in this volume continue a trend among scholars in environmental history, history of science, and in the interdisciplinary environmental humanities and social sciences of critiquing Earth system science and the grip it has had on our understanding of planetary configurations of space, time, and people. These homogenous and sweeping depictions of global processes erase social difference, power imbalances, colonialism, and the uneven effects of natural resource extraction, among many other social and environmental problems. Environmental historians challenge these simplistic framings of the Anthropocene, global climate change, and many other planetary depictions that have gripped the public and policymakers. Challenges to Earth system science have long shown how modelling global processes or depicting places from satellites – the supposed "view from nowhere" – erases societal variation and the uneven effects of climate change (e.g., Borie et al. 2021; Hulme 2010; Shapin 1998). Environmental historians also expose how climate records, such as from ice cores, also vastly oversimplify and homogenize global time as well as space, including Earth time, human time, and future time – temporalties born in scientific studies that have also had far-reaching public effects on (mis)understandings of history (Antonello and Carey 2017).

Yet the debates about the Anthropocene and discussions about scientific representations of Earth's processes and timescales also promise potential for fresh and unusual collaborations across disciplines. After all, and as John McNeill has explained, the evidence for understanding climatic changes and other planetary shifts is no longer coming just from government documents and other archival sources (texts) that historians are accustomed to using. Instead, the data come from ocean and ice cores, tree rings, marine corals, and speleothems. Environmental history is "undergoing a renaissance," suggests McNeill, as the natural sciences create a "volcano-like eruption of new historical data" that are inspiring an ever-increasing number of cross-disciplinary collaborations (McNeill 2016: 19, 20). At the

same time, and relatedly, growing concern over the deterioration of a variety of interlinked planetary processes – from biodiversity to climate systems – has brought environmental historians into a more acute awareness of past and ongoing global issues and wicked problems such as species extinction.

Part III centres on some of the key considerations environmental historians are grappling with in engaging with the planetary and the Anthropocene. Conceptualisations of the Anthropocene, global climate change, and other planetary framings have in many ways erased humanity and ethics. Chapter 12 examines how such configurations of the planetary have drawn heavily from Earth system science. The authors show how this effort to provide a view from nowhere essentially helps perpetuate a trajectory of modern science that proclaims to capture some objective reality. The chapter argues for "provincialising the Anthropocene" through a "view from somewhere". Moreover, they draw on the work of First Nations and Global South scholars to humanise the Anthropocene, to ground the global in time and place, and to challenge single and simplistic narratives that are so often embedded in framings of climate change and the Anthropocene.

Chapter 13 explores how environmental historians have engaged with extinction to try to help understand not only how, when, and why extinction happens, but to go further and grapple with multifaceted issues like the difficulties of actually classifying a being as "extinct" and the complexities of extinction versus extermination. Taking a historical lens to this category shows that extinction is not a teleological binary of "dead or alive", but rather a deeply contested process that is historically contextualised.

Examining the emergence and changes in post-war Earth system science and climatology is important for understanding these contemporary debates. Chapter 14 argues that the emergence of climate knowledge during this period was also crucial to understanding and managing time. Climate archives, such as ice- and deep-sea cores and computer models, served as time-making technologies to document and predict human-induced changes. This chapter demonstrates that looking at notions of time and practices of time-making in environmental sciences can better inform the planetary turn in environmental history and the humanities.

The reliance of many people and economies on fossil fuels continues to be an ongoing issue in addressing climate change. Chapter 15 examines how path-dependency on fossil fuels emerged. It traces this through the dynamic of extraction and emission, focusing on perspectives from the Global South. Importantly, this approach highlights the planetary and interconnected nature of this issue and centrality of empire making and coloniality in its history.

Power, flows, and knowledges

Environmental historians have always been concerned with the changing ways that diverse social groups have known and experienced environments. Increasingly, these are being brought into dialogue with questions of justice and power, and with human and non-human movements across time and space. Historians interested in the environment have been concerned with environmental justice and environmental racism, some stemming from outrage after hazardous pollutants and toxic waste were abandoned near African American communities in the 1980s, making it starkly clear how environmental issues connect with sociopolitical injustice. A separate seam of research developed from concerns by historians over how marginalised people suffer from coercive extraction, being forced from their land,

forced into exploitative labour regimes, and compelled to live with mining's toxic by-products. Another seam of research has focused specifically on those removed from their land under duress (and thus severed from both culture and livelihoods) – because of colonisation, for commercial agriculture and resource extraction (Guha and Martínez-Alier 1998), or because of "fortress conservation" in game reserves and so-called "pristine" wilderness areas, which dispossessed Indigenous peoples in creating national parks like Yellowstone and Kruger National Park (Dlamini 2020; Wakild 2013). There is also increasing concern among those investigating environmental justice over how environmental burdens and the effects of anthropogenic climate change have been increasingly carried by the Global South.

Part IV on power, flows, and knowledges tackles these and related issues over time and space. The chapters ask who controls the flows of water, food, energy, and goods – and with what consequences for diverse social groups, particularly in the Global South. Focusing on places like Latin America, Africa, and Asia, they examine local places where people experience these injustices and global processes, from mines and oil wells to urban infrastructure and riverbanks. While environmental histories of colonialism and capitalism have long concentrated on resource extraction and the harsh, often deadly, impacts on workers and neighbouring populations, the chapters in Part IV incorporate new approaches, themes, and topics as well. Many focus on systems of scientific knowledge, unmasking the globalising efforts that not only deny the geography of science in practice. Moreover, they also reveal the ways in which scientific framings and processes, such as through Environmental Impact Assessments (EIAs) or the Anthropocene, remove humanity, erase the local, and feed state and corporate power. To rectify that framing, these chapters turn to micro-histories or place-based analyses. They scrutinise "expert power", whether to enact quotas on fishing or to approve a mine through EIAs. While focusing on the local, they also trace a variety of flows and intertwined linkages that run from the global to the local (and vice versa), from the North to the South, from hinterlands into cities, from labour to corporate profits. While exposing environmental narratives and storylines that empower some at the expense of others, the chapters in Part IV also analyse material environments, showing also the physical flows, as with energy, toxins like cyanide, water in cities, and fish into families and local economies. Grappling with all these issues leads many chapters to address directly, or have implications for, issues of care, trust, and ethics, thereby making this section important for the ways in which environmental historians engage with environmental justice.

Chapter 16 examines relationships between environment, labour, and energy, particularly in Asia and Africa, with broader implications for anyone investigating histories of colonialism and capitalism. The authors challenge universalist claims or assumptions that scholars can make about concepts (such as justice, labour, environment) and processes (such as labour exploitation). Instead, through their close historiographical analysis of labour and environment in Asia and Africa as well as their case study focusing on Nigeria, the authors make a case for putting the study of labour and environment into distinct temporal and spatial contexts, rather than importing notions from existing literatures produced in North America or Europe.

Questions of power, flows, and knowledges further draw attention to questions of chemical use in production techniques and historical environmental injustices. Chapter 17 examines the history of gold mining in Zimbabwe (then Southern Rhodesia) in terms of its effects on subaltern bodies. It specifically examines the impacts of colonial mining company's use of cyanide in their processes from 1900, which significantly affected the health of workers. Environmental history is an important means for analysing these sorts of past and ongoing

environmental injustices, and this chapter draws the field into closer dialogue with multidisciplinary research and concepts. It also shows just how crucial it is to centre not only investigations of power, contamination, and the human body, but also the intersectionality of race, capitalism, colonialism, and labour.

Chapter 18 is a bold call for environmental history to stop the Manichean division of "ways of knowing" between "science" and vernacular or local empirical knowledge. It uses the case study of artisanal fishing techniques in two very different ecological and socio-political settings, the Danube Delta in Eastern Europe and Lake Guiers in West Africa. By putting these two case studies in conversation with each other, the authors illustrate the struggle between state-sponsored models and the tacit, vernacular, or traditional ways of "knowing and being" of the fishers. Notwithstanding enduring conflict between local and scientific approaches, both groups understand the ecological assemblages – especially the fish – in ways that are neither entirely different nor disconnected.

Changing environmental management processes have further been implicated in concerns over power, flows, and knowledges. Chapter 19 analyses the rise and fall of EIAs since the 1960s, with a case study examining Chile that has broader implications for understanding the international expansion and failure of these assessments. Importantly, the chapter does not simply condemn EIAs for being neoliberal tools pushing destructive, science-led, technocratic, and anti-democratic policies—though the chapter does show these results over time. Yet the authors argue that with care, trust, and legitimacy built into EIA processes, the assessments could, in fact, become tools that recognise the needs of social groups and multiple life forms.

The shifting metabolic flows and far-reaching impacts of cities have further been a key consideration of environmental historians. Chapter 20 provides an overview of how environmental historians have engaged with cities. It develops the concept of "bubbles" as a means for understanding and examining the far-flung environmental and economic flows between cities and the places on which they depend. This analysis is grounded in examples from India, China, and the United States.

Chapter 21 examines South Asian urban environmental governance, offering methodological and topical innovations by linking environmental history with political ecology. The chapter contends that researchers can uncover new historical processes and narratives of urban environmental governance when they combine historical archival research with political ethnography. The result is what they call Historical Urban Political Ecology. This approach helps deeply illuminate the place of religion, caste, class, ethnicity, institutions, and bodies in the colonial and postcolonial projects governing urban environments in South Asia, with larger implications for broader debates about power relationships between the North and South.

Practices and actions for current socio-ecological crises

The many, and mounting, current socio-ecological crises – from climate change to water scarcity – have led environmental historians to reconsider how they undertake their existing practices to better address these. Already in a field that grapples with questions of environmental change, many environmental historians have further reoriented their academic research and writing to engage with these issues more directly. But environmental historians have also rethought other aspects of their practices or developed new avenues for actions to address urgent issues, some embracing the approach of "applied history" to help understand

present-day environmental conditions by investigating historical patterns and analogues (Guldi and Armitage 2014). This kind of engaged history writing is inspired by a current crisis and then tries to understand it by using the past as a source of explanation to offer deeper understanding. This helps us suggest probable further consequences and encourages imaginative solutions – and even propose possible policy interventions.

Part V focuses on some of the key ways that environmental historians are reorienting their practices and actions for pressing times. It explores how we are moving *beyond* conventional research and more traditional forms of scholarly writing such as journal articles and books published by academic presses. Chapter 22 grapples with university teaching, arguing for the importance of inspiring students to be hopeful and imaginative rather than only despairing. Teachers can thereby empower students to experiment with new ways of engaging with history and the world. More specifically, the chapter focuses on the possibilities that stem from centring multispecies approaches, imaginative learning, and process-driven pedagogies.

Environmental historians have also engaged in various forms of activism within and beyond their academic work. Exploring this theme, Chapter 23 focuses on several new ways to engage with current crises, including social media, blogs, and filmmaking. However, opportunities for activism by academics are shaped by inequities, access to skills and technologies, and opportunities to work across disciplines and in teams. Activism in the field is also difficult to define and, in many instances, almost impossible to fully separate from scholarly practices, and therefore to identify as such. There may be possibilities for activism, however, if environmental historians remain open to them.

Relatedly, environmental historians have sought to reach audiences beyond the academy. Chapter 24 focuses on the imperative for environmental historians to communicate their research to diverse audiences. It grapples with the promises and limitations of online platforms as a means for doing so, giving practical recommendations and guidance. Environmental history's long-standing engagement with online listservs and other online communication platforms means it is well placed in this regard now and in the future.

Environmental history has also been important in other spheres and organisations that are seeking to address contemporary crises. Chapter 25 focuses on how museums and galleries are using environmental history to engage with the past and promote dialogue amongst audiences about current and future challenges. It grounds its analysis in examples from Australia, Estonia, and Germany, arguing that environmental history offers museums and galleries an important channel for engaging with the Anthropocene.

Finally, Chapter 26 centres on the relationships between environmental history and policy. Examining how environmental historians have engaged with policy in the past and more recently, it offers useful examples, frameworks, and concepts that can assist these efforts into the future. While engaging with policymaking can be difficult and time-consuming, if approached with patience and determination, it can make important differences.

Future directions in environmental history

Six early career scholars and practitioners met for two months across time zones to assess the past and present of environmental history and reimagine its future paths at a time of ecological crises, job market constraints, and long-lasting neocolonial research practices. As a result of an open call, this co-authorship team brought together researchers with global expertise from Australia, South Asia, Latin America, southern Africa, and Southeast Asia.

Their work goes beyond academia and profoundly engages with local organisations, Indigenous communities, educational institutions, museums, and public scholarship. Building on their areas of expertise, shared views, and differing visions, this afterword calls to accept the coloniality of environmental history knowledge and research practices and unveil the role of Western epistemologies in the field. The authors do so not only to provide a thoughtful diagnosis of the challenges of the environmental history field and the profession but also to provide a series of paths to heal and reconcile the work we do with more-than-human worlds, the communities with whom we work, and historical trajectories that cannot be reducible to the harms of colonialism, hetero-patriarchy, and the colonial archive. The afterword is a grounded call to action and a hopeful plea to amplify the everyday small and affirming relations that can help us build a better future for the environmental history field and the communities we care about within and beyond academia.

As co-editors and scholars, we believe that during this critical moment of global crisis, our generation has the urgent job of negotiating new ways to be in the world. We need an understanding of how we got here, if not to reverse, then at least to navigate and ameliorate perhaps the most extreme challenges humanity has ever confronted. The viability of our future depends on an understanding and a reckoning with our past, building towards a more ethical and more sustainable world than the one we live in now.

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PART I

New Methods, Innovative Approaches


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1

ETHICS, JUSTICE, AND ENVIRONMENTAL HISTORIES

Heather Goodall, Madhuri Mondal, and Meera Anna Oommen

Introduction: Rethinking environmental histories

The histories we write are always entangled with the present. What troubles us now pushes us as historians to ask the questions we do of the past. We want to know not only how we came to be where we are today, but how we might make futures with greater justice. This motivation – to turn to the past for insights into the present – points to the central role of our work as historians, which is to trace and analyse change. We are pushed to recognise that what we see today may have little resemblance to what has been present or has taken place in the past.

To better understand change among humans, historians have turned increasingly to archaeology, literature, and cultural studies. The conventional view has been that *ethics* is our obligation to interpret whatever type of evidence we use as carefully, honestly, and completely as possible, creating historical accounts which are drawn directly from these sources (Denial with Harvie 2010; Tapper 2010; Nash 2000). Yet change has occurred as much in the "natural" world as in the world of humans, demanding that historians draw more actively on the work of ecologists and geographers. If we hope to learn from the past in order to create more just futures, it is necessary to recognise what has been obscured, in both the human and non-human worlds (Macintyre 2004; Caruthers 1995, 2014; Cederlof and Sivaramakrishnan 2014; Shahabuddin and Rangarajan 2007). This means asking what might have been excised from the dominant historical narrative altogether. At whose cost, human and non-human, has change taken place? Whose voices have been ignored in accounting for changes and their impacts? To what extent have attempts to build ethical relationships with nature led to exclusionary processes erasing both humans and non-humans (Sivaramakrishnan 2015)?

This chapter has been written by analysts and activists from both the Global South and the Global North. The dialogue, including its tensions, which takes place in and between our case studies, may open up wider perspectives on the questions surrounding both ethics and justice in our environmental histories, an issue which we discuss further as we conclude.

The term "environment" itself emerged only recently, as Warde, Robin, and Sörlin (2018) have shown, and has only in the last few years been understood to encompass the "more-than-human"

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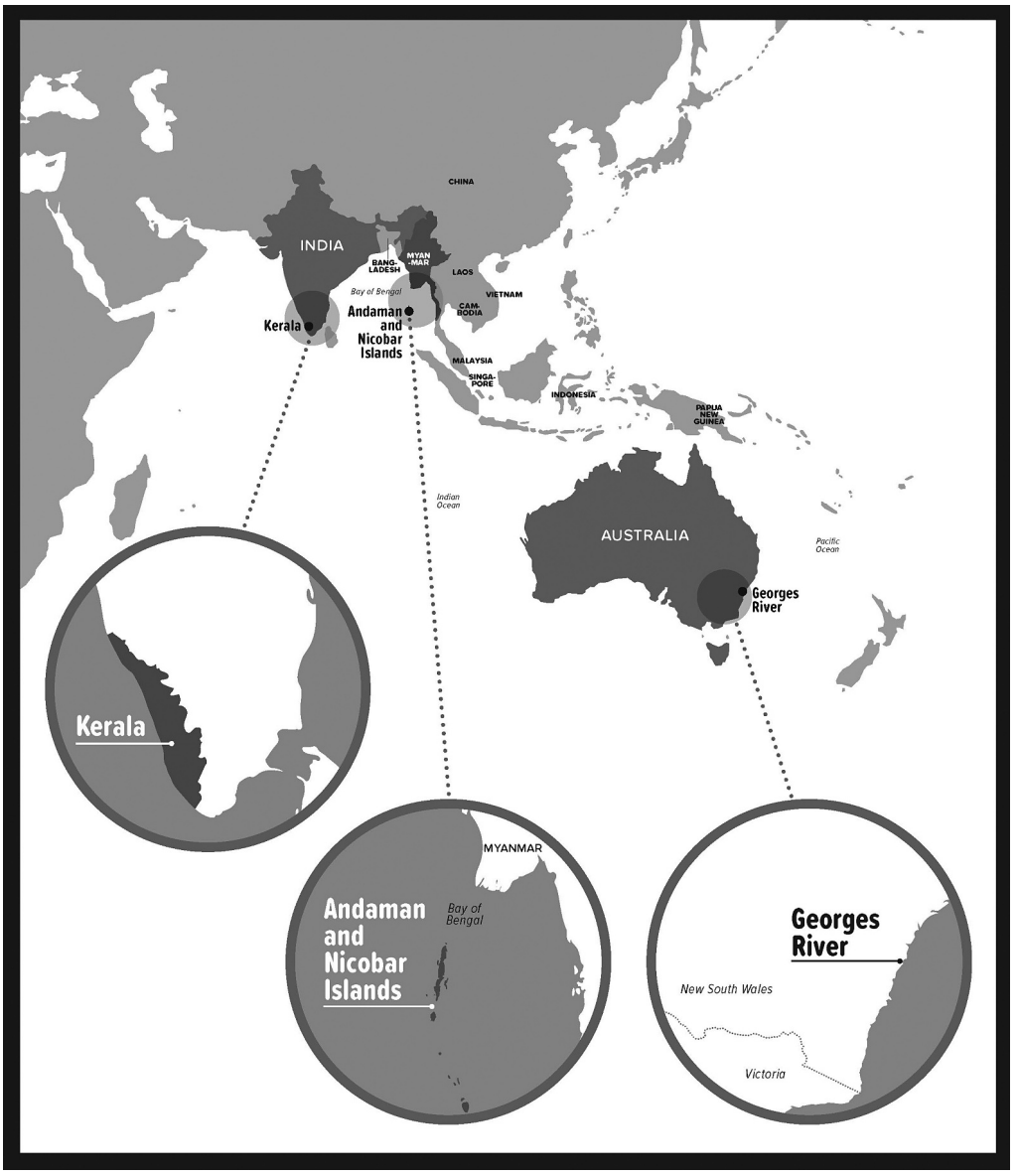


Figure 1.1 Case studies from India and Australia: ethics, justice, and environmental history. Map by Sharon Harrup.

world, which, including humans, interacts with the geological, hydrological, and climatic conditions (O'Gorman and Gaynor 2020). When the United States' version of environmental history emerged, during the 1960s and 1970s, it did so in close association with the conservation movement, which had assumed that "pristine wilderness" existed, untouched by humans, ignoring the many generations of Indigenous people who had interacted with the land (White 1985, 2001; McNeill, 2003). It was feared that rapid development would damage such remaining

"wilderness" places. This was a "nature" that was fragile and could suffer damage, rather than the robust, deterministic "nature" of earlier histories (e.g., Turner, 1893). Such "environmentalism" would later be termed "post-materialist": only societies and economies which had reached a high living standard, it was argued, could afford to "care" about the "natural" world. Poverty was seen to cause damage to "nature" and – as Brundtland, on behalf of the UN, argued in *Our Common Future* (1987) – the solution must be the eradication of poverty through "sustainable development". The hope was that that development could take place to increase productivity and income but at the same time be managed to avoid damage to the environment of the planet.

Cronon (1995) had challenged the concept of a "pristine wilderness" – demanding recognition that humans have changed environments across the planet, including those which recent settlers claimed to have been the first to see. Yet there has still been little recognition of the movements among working and colonised people who had called for recognition that environments could be harmed – but also be harmful – long before the conservation movement in North America. Few of these movements had been analysed by academic historians before the publication of the Global Northern histories which badged themselves as "environmental". Yet the people suffering the impact of these environmental pressures and changes had long been directly expressing their concerns and arguing their analysis of environmental vulnerabilities. Ramachandra Guha and Juan Martinez-Alier collaborated in *Varieties of Environmentalism* (1997) to argue for the long existence of the "environmentalism of the poor". They accused Global North historians of ignoring these subaltern interests in the environment when they wrote their early environmental histories. Guha and Martinez-Alier argued instead that the affluence which had nurtured the conservation movement's goal of protecting imaginary "wilderness" had been built on the exploitation of the land and resources of colonised and working people in rural and urban environments. They drew on examples from their own work in India and Peru respectively, as well as the emerging theoretical approaches of Wallerstein (1980) and others in world systems theory to argue that attention to environmental change and damage was widespread among those who suffered the impacts of colonialism and international trade.

The historical work documenting the environmentalism of the poor has emerged long after those movements themselves had commenced, being published only in more recent decades (Shahabuddin and Rangarajan 2007). Rather than being identified as "Environmental History", however, these analyses of the histories of the environmentalism of the poor have often been classified as "Environmental Justice" (e.g., Hood Washington 2004; Lakshmi and Sharma 2017; Steyn 2006), "Industrial relations" (e.g., Burgmann and Burgmann 1998) or "Indigenous Studies" (e.g., Goodall and Cadzow 2009; White 1991). Nevertheless, these publications have identified the histories of changing environments at the same time as documenting the complex human interactions taking place in relation to those changes with living species and the lands and waters of those environments. Each of them has identified justice as a central concern (see also Chapter 16, this volume).

In our case studies, we build on these four genres: environmental history, environmental justice, industrial relations, and Indigenous studies – before and beyond formal colonialism, drawing on the insights not only of anthropologists, archaeologists, and political scientists, but also those of geographers and ecologists. We aim to suggest how environmental history might take greater account of the voices, both human, e.g., settler and Indigenous, as well as non-human, which have been ignored or erased in the dominant historical narratives of each of these areas. Our first study is set in the Andaman group of islands, in the eastern Bay of Bengal, situated between the Indian mainland and the coast of Myanmar. Once a penal

colony under British colonial rule, the islands were made a Union Territory of the Republic of India in 1956. The current situation in the islands exemplify dilemmas surrounding mainstream development and environmental protection, as well as the challenges in balancing settler livelihoods with the preservation of Indigenous cultures, such as those of the Jarawa. Our second case study is focused on a mountain landscape in the Western Ghats of Kerala on the Indian mainland, with its complex and changing interactions of both Indigenous peoples and settlers with forest wildlife, including conflict with charismatic conservation icons like elephants and tigers who pose a danger to people and to livelihoods. Our third case study takes us to a highly conflicted and culturally diverse area of suburban Sydney in south-eastern Australia – the estuary of the Georges River. Here too, both people (settler and Indigenous) and wildlife have interacted in complex ways over decades, sometimes reaching mutual accommodations and at other times intensifying conflict. In all three sites, questions can be raised about the definition of "settlers", often simplistically portrayed as homogeneous and in binary opposition to Indigenous colonised peoples, who themselves are diverse and have varying interactions with other human communities and the natural world. Similarly, all three sites can be characterised by varied entanglements with its wildlife and other natural elements – be it questions about the indigeneity of species, conflict with people, or their role as conservation icons.

Although engaging primarily with human perspectives, each case study suggests that a broader vision can be brought to environmental histories to produce more inclusive histories by recognising change and seeking of more voices, including those of non-humans, in our understanding of the dynamics of change and the impact on human-environment relations. We continue to see human social, economic, and cultural processes – and the tensions and conflicts between different groups of humans (e.g., Indigenous people and settlers) – as powerful drivers of change. We have found that materialist, feminist, and intersectional theoretical work has been important in identifying these tensions and conflicts. (Cuomo 2015; Haraway 1988; Jørgensen et al. 2013) And yet, as we hope these case studies also show, we see environmental changes as interactions. Human engagements with and responses to the behaviours, forms, and changes of more-than-human ecologies shape the wider ongoing processes of historical change.

Case study 1: Andaman Islands, India

The Jarawa, one of the last remaining Indigenous communities of the Andaman Islands (located in the Bay of Bengal between mainland India and Myanmar), had coexisted with about ten Great Andamanese communities for at least several thousand years on these islands (Saini 2018), drawing on complex hunting and resource use patterns. During the pre-colonial period, different Indigenous groups used different territories within the islands based on availability of resources, including wild pig, honey, monitor lizard, the larvae of certain insects, turtles, fish, crabs, and molluscs, and a range of tubers and fruits. For most Andamanese, the availability of these resources, harvesting, and consumption had been season-specific and governed by strict taboos, myths, and rules (Pandya 1993), including various resource and habitat taboos such as age restrictions on eating pork, honey, or the fat of turtles and seasonal limits on hunting. The existence of such informal systems and cultural engagements among small bands are closely tied to the avoidance of overexploitation and the sustainability of terrestrial and marine resources over the long term (Oommen 2022).

British colonisation and control (between 1792 and 1947) ushered in an era of change and was spurred initially by commercial maritime interests, and then, after the First War of Independence (the "Mutiny") by the establishment of a penal colony for political prisoners. As in other colonial scenarios, the British saw the islands as "empty space", assuming that the Andamanese did not have a concept of land ownership (Pandya 2013). Administrators and ethnographers disparaged their foraging lifestyles for their lack of agriculture, mobility, and austere living arrangements. The hostility of the islanders (apparently in response to widespread regional slave-taking previously) simply confirmed to the colonisers their "brutish savagery" (Colebrooke 1799; Mouat 1867).

After the uprising of 1857, the British established a penal colony in the islands and transported several thousand convicts. Many initial arrivals succumbed to disease, and their deaths were blamed on the "miasmas" from the swamps around South Andaman, leading to the clearing of the wetlands (Shanks and Bradley 2010). The "Cellular Jail", an enormous panopticon prison constructed in the later 1800s following Jeremy Bentham's design ideals, was used into the 1930s, by which time it had housed more than 80,000 convicts, including criminals, political prisoners, and nationalist agitators (Anderson et al. 2016). Over this time, many Andamanese were confined and subjected to training for "civilisation" and to ethnographic and scientific study. The creation of "Andaman Homes" and greater contact with outsiders led to the outbreak of many communicable and sexually transmitted diseases, significantly depleting the Great Andamanese communities. (Pandya 2013).

From the late 1920s, the colonial administration began to seek suitable migrants to establish a free colony through agricultural expansion and commercial extraction of timber, especially Andaman *padauk* (*Pterocarpus dalbergioides*). Exploitation without adequate attention to regeneration and poor forestry practices resulted in vegetational shifts (Krishnakumar 2009). To alleviate the labour shortfall, the colonial administration brought in the Karen people, from Moulmein and surrounding areas in Burma. As the settlements expanded, the Jarawa frequently attacked convicts and laborers. Retaliative punitive expeditions were undertaken to control Jarawa attacks. This created a dangerous and hostile boundary between tribal forest and settlements. Containment and civilisation of the Jarawa was seen as the key solution for the maintenance of the settlement and to meet the needs for surveillance and observation for scientific studies.

During the first years of World War II, additional timber was extracted to meet wartime needs, while colonists' introduction of exotic timber species was also a threat. Several species of plants, snails, insects, fishes, birds, amphibians, and mammals were also introduced, with the most harmful, invasive ones including spotted deer (*Axis axis*), Indian bullfrog (*Hoplobatrachus tigerinus*), and feral dogs and cats. Elephants brought in for timber hauling became feral on some islands.

The Andamans came under Japanese control between 1942 and 1945, with Indigenous communities severely affected. The Japanese had treated them brutally because they accused the islanders of spying for the British, because of their mobility in moving frequently between Port Blair and the surrounding forests.

The colonial era saw the decimation of the Great Andamanese communities. A handful of individuals now remain confined on Strait Island (near Middle Andaman). The Sentinelese, a small population of islanders on North Sentinel Island, remain, largely hostile to contact. Several hundred Jarawa continue to inhabit the western and central areas of Great Andaman. After Indian independence (1947), the dual idea of "preserving" and "mainstreaming" the Jarawa, drawn directly from British colonial policy, became the foundation of succeeding tribal

policies. The government saw the Andaman tribal communities as part of India's cultural diversity, to be taken care of within the political structures of the new Republic. Nevertheless, as in other postcolonial situations, the Indian government has been as keen as the British Raj to use the land and natural resources of the islands.

In 1948, the government examined "the prospect of colonization and settlement" of the Andamans, observing that "there are large possibilities for settlement by those who take to cultivation or fishery as their principal occupation" (Sengupta 2017: 7). The significant Partition refugee exodus from East Bengal, combined with urgent labour needs, led to a new era of settlement between 1949 and 1956. Each refugee family was given five acres of hilly land for the plantation of cash crops, five acres of flat land for paddy cultivation, and one acre as homestead land. Settlers from Jharkhand, Telugu, Tamil, and Bengali communities were also brought in at various points from the Indian mainland.

As settlements grew, international organisations questioned the Indian state and expressed concern for Indigenous communities, arguing that the Indigenous "food-gatherers" were being increasingly surrounded by immigrant "food-growers". In 1956, the government responded by establishing the Andaman and Nicobar Islands Protection of Aboriginal Regulation (ANPATR), creating "Tribal Reserves" and directing the Islands' administration to exercise power in a "non-interfering" and "non-imposing" manner. The Jarawa Tribal Reserve was established in 1956, covering part of the western coast of the South and Middle Andaman (Chandi 2010). The autonomous Tribal Welfare Department for the islands was also established to befriend the Indigenous people in order ultimately to "develop" and transform them. After the enactment of the Wildlife Protection Act (WLPA) in 1972, national parks and sanctuaries were created in 1977 to conserve the wildlife of the islands. Ironically, the WLPA brought the spotted deer under protection all over India and failed to recognise its negative impact on the island forests. Even after creation of the tribal reserves and conservation laws, the future for the Jarawa remained insecure because of the rapidly growing settlements. By 1960–5, the settler population of the islands had reached 200,000 whereas the Indigenous population decreased to less than 500 (Pandya 2013).

To connect the expanding settlements in the north and the south, the 343-km-long Andaman Trunk Road (ATR) was built in 1978, passing through the Jarawa Reserve, fuelling further conflict between the Jarawa and the settlers. The road catalysed the creation of additional encroachment routes, providing easy access to outsiders for hunting and exploitation of the community. Forestry operations increased, while commercial species were also planted. Together, these factors constrained Jarawa hunting grounds and availability of food. The emerging tourism industry greatly increased vehicular traffic along the ATR, with some tour operators promoting an insidious form of "Jarawa tourism", where tourists stared at the passing Jarawa, handed food items, and photographed them. Close contact with the outsiders led to further epidemic outbreaks like measles.

Recognising detrimental impacts on the Jarawa, a group of organisations and activists appealed to the Supreme Court of India to close the ATR. Although the court ordered its complete closure in 2002, the road remains open because of appeals from tour operators and other setter groups without alternative transport. In 2013, when the court intervened again, the island administration promised to protect the Jarawa with an effective welfare policy, a buffer zone, and eventually to "mainstream" the community within island society (Pandya 2013). Contrarily, there have been continuing reports of poaching within the Jarawa Reserve for both terrestrial and marine wildlife and also sexual offences by settlers on Jarawa.

The continuing pressure on the Jarawa Reserve eroded its capacity to provide a secure livelihood. One young Jarawa man, Enmei, interviewed while in Port Blair Hospital, explained that:

> resource density has reduced in the Jarawa areas … the Jarawa now have to work more to gather their food, for instance, spend four hours instead of two on hunting a pig.
>
> *(Shekhar 2003)*

Over the last few years, Jarawa attacks have reduced and some Jarawa have approached the road to demand food and gifts. Further forms of transaction have arisen, including the exchange of venison and crabs from the reserve in return for tobacco and metal implements. Chandi (2010) notes that Jarawa do not always encourage hunting by visitors, but they contribute to the catch if provided drinks, gifts, and food. At no stage has the Forest Department called on the Jarawa to share their knowledge to enhance forest conservation and sustainability. Overall, protection strategies have had limited effectiveness and threaten to endanger both the Jarawa and their forests. Furthermore, their strategic transactions with tourists and settlers indicate pressure from the State and the tourism industry which demands "museumisation" – an insistence on the performance of unchanged and exotic customs. As Krishnakumar (2009) states, although the British Raj and the independent Indian state were both "primarily driven to exploit the islands to accrue capital, the former attempted this through the commodification of forests, while the latter framed its enterprise in terms of 'development' policies".

Case study 2: Western Ghats, India

Our second case study explores the dynamic of conservation and development in a forest-fringe landscape in the Ranni Forest Division, in the southern Indian state of Kerala. Located between two well-known protected areas, Periyar and Agasthyamalai, this landscape is characteristic of the Western Ghats mountains and is home to many species of conservation significance, including large mammals like elephants and large carnivores, as well as highly endemic herpetofauna. The region has a long history of human use and occupation, and now constitutes the current location of the forest fringe. This case study attempts a brief audit of social and environmental justice both from the perspective of human communities and their non-human counterparts who occupy the porous boundary between forest and field.

Examining human occupation here reveals a history that is at odds with the narrative of pristineness attributed to the region's forests by many contemporary conservationists. Ancient literary sources and coinage point to the presence of foragers, who secured a variety of forest products (ivory, cinnamon, cardamom, pepper, timber, etc.) for trade as part of the vibrant Indo-Roman exchange from the 3rd century BC onwards (Gurukkal 2010). At the same time, this landscape encompassed many hill-millet chiefdoms whose agriculture attracted crop-raiding elephants and pigs. Ancient literary texts (primarily, romantic Sangam-period bardic poetry) allude not only to conflict, but also peoples' acceptance of the sentience of species such as elephants and their coexistence (Oommen 2019). The poetics of the *kurinji* landscape (i.e., the mountains dominated by *Strobilanthes sp*.) reflects the fundamental semiotics of ancient Dravidian cultures to their ecotypes and the simultaneous threads of culture and subsistence binding people and nature (Gurukkal 2010). Complex

interactions bringing together the sacred and the emotive with pragmatic day-to-day subsistence use and sustainability has been a long-standing feature of various Indian landscapes including the Western Ghats. Multifaceted relationships with large iconic species, encompassing both conflict as well as acceptance, tolerance, and reverence, is also reflective of long-term coexistence (Oommen 2021).

From the 16th century onwards, the arrival of European colonial powers in southern India escalated the demand for timber and spices. Eventually, this induced scarcity and catalysed the plantation of species such as pepper and cardamom that were once exclusively wild-sourced. By the mid-1800s, coffee, cinchona, and tea had been planted under British colonial impetus. Colonial records show that by the early 1900s, rubber too was established. Timber extraction and plantations transformed landscapes and entailed habitat loss for large, free-ranging vertebrates such as elephants. They also resulted in loss of land and livelihoods for many of the region's diverse forest-dwellers, generically referred to as "hillmen". Some of these communities traditionally practiced slash-and-burn ("shifting"/ swidden) agriculture by girdling large trees and firing the land (Bourdillon 1893). Others, like the Hill Pandaram, were mobile foragers. British forestry officials, valuing timber, interfered in shifting agriculture because they considered it wasteful. Plantation agriculture edged out hill tribes from their traditional hunting and harvesting spaces, disrupting long-held traditions of movement and ritual. In 1909, under the "Hillmen Rules" (Rules for the Treatment and Management of Hillmen), such communities were made "wards" of the state and urged to settle down and cultivate. Restrictions were also imposed on the *viruppu* cultivators (agriculturalists from the plains who moved in seasonally to grow crops) for whom the forests served as a safety net during famines.

The steep slopes and marginal soils of the Ranni landscape prevented extensive plantation agriculture, but hydroelectric power and irrigation requirements in the plains led to the establishment of numerous dams within the forest catchments in the colonial period and after (e.g., the Sabarigiri network of dams). Protected areas too were a parallel development that began in the colonial period with the establishment of the Nelliyampathy Reserve in the mid-1930s, followed by the Periyar Tiger Reserve in 1950. Game preservation for hunting by Europeans was one reason for restricting Indigenous hunting and increasing protection. Elephants too became a protected species due to their economic and cultural importance. Ivory extraction, elephant capture (for countryside operations) and elephant labour (in timber hauling) were significant revenue earners for the government and some hill communities who traditionally specialised in their capture and management. Sportsmen's memoirs state that occasionally, laws were relaxed for sport hunting and for eliminating rogues and habitual crop-raiders. Elephants therefore enjoyed a paradoxical positioning, characterised by both protection and destruction.

In the early 1940s, two large-scale crises – the Bengal Famine and the Japanese occupation of Burma – resulted in widespread severe food shortages. The forests of the *ghats* were thrown open as short-term safety nets to impoverished migrants to cultivate food. The Ranni forests were promoted as Food Production Areas by the Travancore government under the national Grow More Food campaign (which continued post-independence), attracting migrants from the nearby plains. These migrant families faced the uphill task of settling in an unfamiliar landscape with dark, impenetrable forests. Their attempts to grow rice were foiled by frequent raids from crop-raiding elephants. Settlers were forced to take refuge in *madoms* or platforms built on forest trees. The odd *madom* still survives in this landscape as a testament to the past. Settler memories as recorded in oral histories recall that their trauma of

famine and displacement was compounded by their daily struggles with crop-raiding wildlife and an unsympathetic forest bureaucracy which treated them as unwanted elements who were usurping valuable forest land. Unable to cope, many families returned to the plains, but others remained. While some plots were eventually regularised, others are still considered as encroachments, and uncertainty over land tenure continues to this day.

Prior to India's independence in 1947, the Forest Department (FD) secured revenues from timber and other forest operations, including elephant capture and sale. After independence, reflecting a nationwide shift, influenced by Western conservation organisations and home-grown elite conservationists, its primary objective became the expansion of Protected Areas (PA) and the conservation of wildlife (Ranjitsinh 2017; Shanker et al. 2018). At first, animal depredations were primarily restricted to raids by elephants; however, as rice became unviable because of low prices and loss of topsoil, newer food crops such as tapioca came under attack from other species, especially wild pigs. Settler sharing of space over longer periods of time with elephants had resulted in a less hostile form of coexistence, as both elephants and people learnt from each other to avoid confrontations. Damage by elephants was, in any case, catastrophic, making it easier to quantify and receive compensation. Nightly raids by pigs, however, were a persistent, insurmountable challenge. With more stringent conservation legislation (e.g., the Indian Wildlife [Protection] Act, 1972), blanket protection was offered to wildlife and punishments meted out for "poaching".

Such "punitive" conservation engendered a view that wild animals that "transgressed" PA boundaries into private lands were now regarded as government property. New forms of resistance against conservation began to take shape, along with retaliation against the conserved species themselves. This form of social mobilisation embodied a moral economy of violence against protected wildlife and the state by local communities who perceive such conservation impositions as unjust. In another example, native tree preservation legislation that was implemented in the region meant that settler spaces faced bans against tree felling, whereas the landholdings in the plains were exempt from restrictions. Settlers began to view environmental protection as a burden borne only by them, whereas plains communities remained exempt yet enjoyed the benefits of settler struggles. These arguments foreground the question of distributive justice.

Migrant influx was viewed by both the government and settlers themselves as the colonisation of an empty forest. Neither group anticipated a need to treat these as peopled forests. The government allowed land acquisition without safeguarding communities such as the Hill Pandaram, who were primarily forest-dwelling and mobile. In some cases settlers actively deceived forest cultivators such as the Mala Araya to part with their land. A common tactic was to supply alcohol and tobacco (and goods such as rice, dry fish, iron implements, etc.) to increase their dependency and then induce them to sign away land for nominal returns. Interviews in the Ranni landscape reveal that contrary to the dominant narrative, not all interactions were antagonistic; in fact, many were mutually beneficial and cooperative. The Kurava and the Hill Pandaram routinely prevented settlers from starving during the initial years as they willingly supplied foods such as *Dioscorea* roots and wild honey, and provided guidance on living in the forest. But overall, this was an unequal relationship that eventually resulted in the large-scale diversion of the land in favour of the settlers and of the forests in favour of the FD.

The increasing FD control of land has become more pronounced over time because conservation resulted in steadily increasing restrictions on local tribes. In recent years, especially after the Forest Rights Act, 2006 (which aimed to set right historical injustices that

excluded forest-dwelling communities from their traditional lands), dominant social movements and support groups advocating for *adivasi* reacquisition of forest land have often prevailed upon smaller forest-dwelling tribal communities to articulate explicit ties to forests and land. This form of hegemonic articulation within Indigenous movements themselves eclipses alternative, yet equally significant forms of indigenism such as those of the Hill Pandaram, whose ties to land though equally strong may not be reflected in explicit ownership, strong rituals, or overt articulation.

Case study 3: Georges River, Sydney, Australia

Our third study is urban: the saline, tidal estuary of the Georges River, flowing east through today's south-western suburbs of Sydney. These are some of the most densely populated, culturally diverse, and heavily industrialised areas in one of Australia's largest cities. This study considers the environment and its relationships with three groups of residents: Aboriginal people, working-class Anglo-Irish settler descendants, and recent Vietnamese immigrants.

Indigenous people – Dharawal-speaking to the south and Dharug-speaking to the north – had lived for millennia along this estuary, but settlers found its saline water and sandy soil hard to farm. Some Indigenous people survived the invasion violence and introduced diseases. They were able to keep on living on their Country because they did so unobtrusively, in the areas especially hard for Europeans to colonise, like rugged banks and the many swampy wetlands along the river. Indigenous people were assumed to have disappeared, and so there are very few records documenting their presence.

These remaining Aboriginal people were joined by Aboriginal people from further away coming for work – fishing, farming, or labouring – while still harvesting traditional foods like the fat river worm, cobra. River knowledge was passed on to these newcomers, many of whom married into the surviving local families. So their children and grandchildren learned about traditional foods and medicines, at the same time as it became possible to sell local bush foods and wildflowers to the incoming white settlers. In this way, incoming Aboriginal people took on the responsibilities for caring for their new Country. Furthermore, despite violence, some interactions between settlers and Aboriginal people developed into long-term and mutually valued relationships.

Later still, as it became clear that the population identifying as Aboriginal was increasing, State government policies hardened. From the 1880s, there were forced dislocations, and children were taken from families to be "apprenticed". This caused still more rural Indigenous families to come to the unobtrusive camps along the rivers, hoping to escape government intervention (Goodall and Cadzow 2009).

It only becomes possible to explore this unobtrusive but tenacious Indigenous residence within settler cities by drawing on oral histories and, just rarely, on other records, like a short cinema news item, filmed in 1933 on the Georges River. In it, Joe Anderson, an Aboriginal man from the Georges River Aboriginal community, says:

> All the Black man wants is representation in Federal Parliament. There is also plenty fish in the river for us all, and land to grow all we want.
>
> One hundred and fifty years ago, the Aboriginal owned Australia, and today, he demands more than the white man's charity. He wants the right to live!
>
> (*Cinesound News Review,* No. 100)

Joe Anderson was speaking in very different conditions from those on the Georges River before the British invasion. Yet he and his community had not only survived but were taking active roles to shape their lives in these changed political, environmental, and cultural conditions. In 1933, he drew his authority from Aboriginal cultural tradition, but he demanded political power in the new settler parliamentary system, as well as fair access to the current resources of river and lands and recognition – *today* – of Aboriginal ownership. This rare filmic record is consistent with memories recorded more recently with people who grew up on the river. Although the Anderson family too were eventually forced to La Perouse, they did not forget their upstream connections. To this day, members of this family take active roles in environmental conservation on the estuary and continue to demand recognition of its Dharawal and Dharug heritage of stewardship.

Until World War II, because the Georges River estuary was not intensively farmed, it was popularly seen as a picnic river, with sandy beaches, good fishing, and netted swimming enclosures, lined with bushland, saltmarsh, and some mangroves along the shores. The population – with a continuing Aboriginal presence – consisted largely of working people employed as labourers or small farmers making a mixed income from orchards and fishing (Haworth 1995, 2003).

The war changed all this. To improve defence, the Federal Government increased migration and industrialisation, heavily impacting the Georges River (Butlin 1976; Coward 1988). Its undeveloped spaces became sites for factories and the housing needed for the many local and immigrant factory workers. Funds to extend sewage infrastructure to these working-class council areas were directed instead to dam-building to ensure drinking water for this rising population. The Georges River suburbs, in a class-based environmental injustice, were still unsewered into the 1960s, with human waste draining directly into the river (Aird 1961). Contamination by *E. coli* worsened: in 1962 the river was officially closed to all swimming and fishing, with headlines like "The Georges River is POISONED!" (*Propeller*, 26 Sept 1963, 1).

Over these decades, grey mangroves (*avicennia marina*), the dominant endemic mangrove species in the estuaries of many Sydney rivers, had begun to expand, perhaps because of the increasing human waste nutrients in this unsewered area, but perhaps also early climate change effects causing water level and temperature rises (Rogers et al. 2017; Saintilan et al. 2014, 2019).

European settlers had brought troubling myths about marshes, mangroves, and swamps – fears which were compounded by recent World War II Australian experiences of jungle warfare (Moreman 2005; *The Leader*, 7 Aug 1974, 2). These combined allowing local government councillors to call mangroves a "noxious weed" and a "cancerous growth", demanding that "anything that can rid the river of these unsightly mudflats and foul mangrove swamps should be applauded by everyone" (Hurstville Council Minutes, 6 March 1969).

But an even more pressing difficulty confronted Councils: economic changes caused "an explosion of garbage", the waste from working-class households as well as factories (Hunt 1968; Melosi 2004).

For local governments, bulldozing mangroves and dumping garbage in the river's many saltwater wetlands seemed to be an opportunity to solve their growing garbage problem, create a less troublesome environment, and – as a bonus – turn the reclaimed land into playing fields, satisfying local sports club lobbyists and offering competitive sport to discipline their rising numbers of working-class "baby-boom" youth.

The Councils met unexpected but determined opposition, although not from major conservation organisations which, in the 1960s and 1970s, were not interested at all in damaged city rivers, only in distant "wilderness". Instead, opposition came from local suburban residents – often working-class or tradespeople, sometimes teachers and small business people – for whom the river and its bush were all they had. Women campaigners seldom took public roles at that time but did circulate petitions among neighbours, feed participants at meetings, and at times take active roles in schools (Goodall 2022). All of them wanted to save the places where they had chosen to live, however damaged they had become.

These campaigns had major successes, saving much of each of the wetlands where local residents campaigned. Moreover, they built pressure on the State and Federal governments to strengthen air and water pollution laws through the following decades. These campaigns were conducted at great personal cost to local people who were attacked by Councillors and confronted by church leaders for defying authorities in their defence of the mangroves and wetlands. Each campaign responded to the targeting of mangroves by defending mangroves as their campaign focus. Saving mangroves – as the front line of "the bush" – seemed to be a way to save it all.

These small groups often believed that they followed Aboriginal approaches to conservation – such as never fishing or harvesting more than was needed for food. But they did not attempt to contact those Aboriginal people who still lived along the river. Instead, these groups were monocultural – not only failing to contact local Aboriginal people, but also ignoring immigrants. Nevertheless, they confronted government and developed innovative political as well as environmental strategies to save not only the mangroves but the wider public access to "bush" – to native species and public places along the river.

Yet rising government attention to environmental protection, won in difficult campaigns like those described earlier, also had ugly consequences. As demonstrated in the experiences of recent immigrants, it has allowed some white Australians to claim a new role as environmental defenders to the exclusion of others.

Like Indigenous people, non-Anglo immigrants have faced racism, and their environmental knowledge has been ignored by both government and conservationists (Armiero and Tucker 2017). Vietnamese people began to arrive after 1975 with the end of the American war. Initially welcomed as allies and expected to fill much-needed labour vacancies, these Vietnamese newcomers soon met discrimination arising from persistent Anglo-Australian hostility to Asians. Yet they brought much environmental knowledge with them from Vietnam, where rivers and waterways are common, even though it was a very different environment to Australia. In Australia, racism frequently excluded Vietnamese immigrants – both men and women – from recreational pastimes like bowls, but fishing was one in which men could take part, drawing on their own background knowledge and skills. (Byrne et al. 2013; Cadzow et al. 2012; Thomas 2002).

Continuing hostility included accusations that Vietnamese fishers either caught undersized fish or used nets – secretly – in prohibited areas (Recfish 1997). Such stigma has very concrete effects, leading to abuse as well as physical attacks (Cadzow et al. 2012). Yet Vietnamese people fished far more often in Australia than they had done in Vietnam, not for subsistence, but partly because it meant they could socialise with fellow Vietnamese Australians. But they fished particularly because it was a strategy for learning a new environment both biologically and socially. Fishing offered a socially acceptable way to interact with other fishers of all ethnicities who might be fishing along the river bank, sharing casual information about baits and catches. This has been a way to explore their new home by

using a skill they knew already to see how it worked in a very different place. Ironically, the pressure of racial hostility had led them to develop a substantial body of new – *localised* – environmental knowledge.

Since the 1970s, as ecology has become more widely known and understood, and white Australians have become less dependent on fishing – and less likely to fish in polluted rivers – it has become easy for local Anglo Australians to position themselves as defenders of fragile environments and to condemn newcomers who do fish. They have expressed their anxiety and hostility to incoming immigrants, including Vietnamese people, by criticising the way they fish. As observed in many settings (Sivaramakrishnan 2015), efforts to build an ethical relationship with nature can lead to exclusionary claims. Ironically, this white Australian claim to fish responsibly implies that only white Australians could call themselves "at home" while others were intruders.

Conclusion

Each of our three case studies demonstrates that change in the more-than-human-world has been contested; resisted or embraced by both human and non-human species. To understand how environments have changed – and why – historians need to investigate such complexities and conflicts, as well as to recognise the gaps and absences which have resulted. Only then can questions of justice be addressed. The three case studies here offer suggestions about how such questions might be explored.

First, our studies have much in common but also demonstrate the importance of positionality in conceptualising justice. The Australian case study reflects the situation where the country became self-governing with little effort in the late 1880s, with settlers as the dominant demographic and continuing to identify with British culture. So the impact of colonialism has receded from everyday consciousness among many settler descendants – although certainly not among Indigenous people! Environmental change – and damage – is attributed to contemporary economic and political pressures. In India, however, where independence was won only after intense struggle from a long-established, exploitative, and alien coloniser, the impacts of colonialism continue to be visible and are central to any inquiry about environmental and social change. Post-independence conditions too are judged in terms of how far they have really changed from colonial conditions. It has been harder for settler Australians or those from the United States, for example, to see themselves continuing as colonisers in relation to external territories like Papua New Guinea or the Philippines respectively, and, within their own borders, to recognise their continuing role as colonisers of the Indigenous peoples who remain excluded from power. It is also hard to recognise the inequalities of class and race in internal politics, economic and environmental conditions, whether urban or rural, which constitute discrimination and injustice.

Given that colonialism has had continuing effects in both the Global South and – even though seldom acknowledged – in the Global North, it is important to recognise that colonialism is the most widespread example of historical environmental injustice that has taken place across the world in the last few centuries. Whether viewed through the prisms of "sweetness and power" in West Indian plantations or the "heart of darkness" in Africa's interior, injustices and accompanying violence have been systemic features of colonialism, with major impacts on people, land, plants, and animals. The legacy of colonialism has persisted because decolonised and independent nations – in these case studies, India and Australia – have perpetuated the imprints of the colonial experiences, commodities, and

strategies. In the decades since nationhood, however, changes have continued – some entirely new but many building on colonial networks of the past. Not only has rapidly expanding air transport, tourism, manufacturing, and consumption contributed to population movement, but the many wars since the middle of the 20th century have damaged environments and added massively to displacement and the emergence of diasporic, marginalised communities. Each of these and many other processes have generated environmental impacts, extending or changing those generated by colonialism.

The second implication from our studies is shared among all of them: these changing conditions have meant that there are significant absences which we as historians have an ethical obligation to address – from the decimation of Indigenous communities, their loss of voice, traditions, and power, and the ravaging of native species and ecosystems. Each case study points to the erasure of people and species which once existed in the environments we are studying and whose disappearance has been forgotten or denied. Whether deliberate or not, such erasures need to be countered if historians hope to understand how and why environments have changed. Collaborations with many analysts – including ecologists, climate scientists, archaeologists, anthropologists, and cultural studies scholars – are needed to learn about the living species and non-living forms which may have been lost to view. Yet the most important of all sources will be the people whose memories can offer insights into their experiences of engaging with the more-than-human world or of losing their access to and rights over environments to which they belonged or hoped to make their own. Recent attempts to redress the injustices of colonial dispossession – like the Land Rights and Native Title Acts in Australia (e.g., 1975, 1983) and the Forest Rights Act in India (2006) – have used a "rights-based approach to identify and protect" the interests of "Indigenous and colonised peoples". Founded on the liberal concept of rights, such approaches have necessitated legal or bureaucratic judgements, incorporating Indigenous and culturally diverse people (that is, making them visible or "legible") to the state structures. Such legal processes often demand text or archival validation and lead to monetised and transactional valuing of land and social relationships (Ghosh 2022; Norman 2015). Memory – whose many forms include songs, dance, literature, creative art work, the recorded stories of oral histories, and many others – is a crucial resource for emotional meanings as well as empirical ones, all of which offer valuable resources for understanding environmental relationships and change (Portelli 1991). So memory is an important counter to such limitations of rights-based approaches, allowing a far wider body of meaning to be recognised.

The third implication from each of our studies is that both Indigenous people and settlers are diverse – the simple binaries of some "settler colonial" theories do little justice to the complex historical changes in the more-than-human-world which we as environmental historians are tracing (Konishi 2019; Shoemaker 2015). Just as some settlers in the Indian and Australian case studies are powerful and can control people and environments, there were and are others who are not powerful – whose voices are marginalised, and whose living and working environments are undermined. As the Western Ghats case study shows particularly clearly, it is also the case that Indigenous people are diverse and have conflicts around relative power and distributive justice which impact environmental relations. The corollary of this recognition of diversity brings each of our themes together in considering justice in the outcomes of environmental history. The positionality of Global North conservationists must be called to account where there is a failure to recognise the environmental histories of the Global South.

The Western Ghats case study brings this interaction directly into view, but so too does the Georges River study. In recent decades in India, despite independence and the earlier encouragement to take up land, settlers from nearby coastal regions are now viewed as exploitative by both Forest Department and conservationists. In Australia, it has been the immigrant settlers like the Vietnamese fishers, invited in as a labour force, who are now seen as exploitative. Like weeds, these migrants are viewed as being out of place, noxious, and invasive. This "punitive" feature of modern conservation blames both migrant and Indigenous groups for damaging biodiversity. In the Australian case, it reinforces settler-descendant claims to be the sole owners of the land. In both cases, this attitude goes hand in hand with the notion of preserving an imagined "pristine" nature that ignores prior use, rights, and traditional practices. Implicit within these ideas is a common narrative of local communities being unable to take care of themselves or their natural resources (Larsen and Brockington 2018; Shanker et al. 2018).

This has been accompanied by a change in values. In the case of the Indian case studies, although Indigenous groups and even settler communities had earlier had extensive subsistence and cultural uses for the non-human world, the modern conservation approach now offers only a much more narrowly circumscribed set of use possibilities. Notable in this approach has been the privileging of non-human species (even those involved in serious conflict) leading to the imposition of moral injunctions against any killing of animals which means the removal of the coexistence which had been a feature of past systems (Buscher et al. 2017). New conservation legislation has resulted in the denial of lived experiences and the creation of zones of protracted conflict between local communities and the Forest Department. This has resulted in a breakdown of relations between people on opposite sides of the conservation spectrum as well as retaliatory attacks on species of conservation significance, because local people have felt that the welfare of marauding wildlife was privileged over their own. These local communities have come to consider conservation and environmental protection as an unjust burden imposed by the government as well as by outside conservation groups, and often explicitly link these issues to distributive justice and moral economy. Ethical frameworks, therefore, need to take account of local sentiments and to build democratic consensus.

We argue that these three issues – considering our own positionality, seeking to identify absences and recognising diversity – are vital considerations to undertake ethical environmental histories which contribute to building justice in the future.

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2

ORAL AND ENVIRONMENTAL HISTORY

Time, place, decolonisation and the more-than-human world

Katie Holmes and Aet Annist

Introduction

As the field of environmental history expands and embraces new approaches, oral history is one of the methodologies environmental historians have increasingly turned to over the last decade. Attention to the ways people engage with and remember place, the stories they tell about it, the emotions it might evoke, and how these change over time, are all examples of the ways in which oral history can enrich our understanding of environmental history. Holmes and Goodall (2017) note that this embrace of oral history has not always been accompanied by a critical reflection on the methodologies of oral history, or the challenges of working with memory as a historical source. As with geographers and ecologists who have used oral history to chart environmental change, the tendency has been to weave interview material into an environmental analysis without critical reflection on the nature of the source, the significance of memory, or indeed the methodologies used to collect such material. The different intellectual origins of oral and environmental history – one focused on the human story, the other on the agency of non-human nature – mean that each has also asked different questions of their sources and prioritised different stories, be they primarily human or environmental (Sloan and Cave 2022).

In this chapter we examine some of the key areas where the use of oral interviews is bringing new and exciting dimensions to the field of environmental history. In many instances, the methodological and theoretical developments we canvas are happening across the field of environmental humanities more broadly: attention to decolonising research practices, to emotions, to story-telling, to place-based research, and to the more-than-human world. The integration of these concerns and approaches into environmental history through the use of oral interviews brings new insights to environmental change in the Anthropocene. Our methodologies have also been challenged and changed by the Covid-19 pandemic: online interviewing has been forced upon us, and we have gained new insights in the process.

While the practice of oral history has always been collaborative, researchers conducting interviews about climate change or about living in the Anthropocene share with their participants the experience of living with intensifying distress at the twin crises of climate

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change and biodiversity loss. We are all participant observers, embodied witnesses to the changes and experiences we seek to understand. For the discipline of anthropology, the methodological implications of this participation are familiar terrain. It is thus particularly appropriate that as authors of this chapter, we bring together expertise across the disciplines of history and anthropology. Both authors share the subject position of white, middle-class women academics. Aet Annist is a social anthropologist at Tallinn and Tartu Universities in Estonia. Having started as a sociologist working on theories and representations of youth, she has moved to the anthropology of development, studying foreign aid to community projects in post-socialist rural regions, and effects of heritage funding on social fragmentation. Her current research into emerging climate change-related socialities reflects her general focus on social change in response to or in anticipation of structural and institutional upheavals. Katie Holmes is an environmental historian based at La Trobe University in Melbourne, Australia. Her early research was in feminist and cultural history, in particular exploring the ways settler Australian women wrote about their lives and gardens in their diaries and letters. Her work on gardens led her into environmental history, where she has sought to integrate her interests in both gender and oral history. Central to her work has been the interplay between an individual, their culture and their environment, whether that be a garden, a farm, or an eco-region.

While history and anthropology share many common concerns, there are some differences that inform and reflect our approach which are pertinent to the ways in which we might typically use oral interviews in our research. For historians, oral history interviews are a method for researching the past, using memory as a key source. As the field developed, practitioners of oral history became as interested in the meanings people might give to past experience as in the past events themselves. This reflected interests about "the relationships between past and present, between memory and personal identity, and between individual and collective memory". Attention to the relationship between interviewer and interviewee has further helped oral historians understand the dynamics at play in the creation of the oral history archive (Perks and Thomson 2016: 3, 5). These interests in the past, in time, memory, and the oral history relationship, are critical to the methodologies that historians have developed in their use and interpretation of oral history interviews.

For anthropologists, oral history creates vitally important material for understanding the present realities of a society. It offers insight into the structure and variety of a society or culture, as can be gleaned from the participants' world views, cultural traits, and traditions (Dunaway 1996). Anthropologists recognise that the social history that emerges from such accounts is affected by the passage of time and the impact of place, as well as by the structural and power positions of the speaker. Understandings of time and place are thus clearly present in the anthropological collection and usage of oral histories, in the way past history informs the understanding and interpretation of today, but also of tomorrow. For both anthropologists and historians, in these slightly different ways, oral history interviews underscore this relationship with time and enrich our study of human relationships with the environment.

The Italian oral historian Alessandro Portelli characterises the oral history interview as "a moment in a relationship between times: the time of the events, the time of the telling, and, when we factor in the archive, the time of listening" (Portelli 2018: 246; Thomson 2019). "Time" is a key medium for historians. We are "time travellers" (Griffiths 2016: 3), "temporal thinkers" (Pietsch and Flanagan 2020), and thus it is a reasonable expectation that we should, when practicing oral history, be comfortable with holding different temporal

moments in view and in balance. For many environmental historians and other scholars involved in oral history and interviewing, the "time of the telling" has brought particular challenges to both our experiences of time and to the kinds of interviews we undertake. It adds another dimension to the rich exchanges happening across disciplines as scholars seek to respond to the challenges of climate change and biodiversity loss.

A critical contribution that environmental history adds to the oral historian's understanding of different time reference points is the significance of place. It is not only the time of an event, its telling and listening, that shape the way an event might be recalled and understood. Time and memory are experienced through an environment, a place where the interactions of the more-than-human world work to create particular memories, emotions, and affects. Integrating the insights of oral and environmental history enables the dynamic relationship between these two agents of history to be recognised and analysed. In the following discussion, we separate the two in order to delineate their significance more fully.

Time

Memory is the oral historian's archive, and time an active agent in its creation. Memories of places and people do not provide unfettered and unmediated access to the past. As Portelli observes, "Memory is not a passive depository of facts, but an active process of creation of meanings" (Portelli (1979) 2016: 54). Recollections about how a place might have changed will be infused with different kinds of meaning. Scientists Madeline Fernbach and Kate Nairn, using oral history in a study of the Great Barrier Reef, noted that people's memories were shaped more by their ongoing interactions with the Reef than by the time of their initial encounter with it (the "time of the event") (Fernbach and Nairn 2007). Their oral interviews provided "a valuable source of knowledge about local people's lived experiences and relationships with the Reef" (Gaynor and McCann 2017: 265). The "time of the telling" revealed the subjective nature of memory and thus insight into *why* people behaved as they did toward the Reef. Rather than this subjectivity being a problem, it is the gold at the heart of oral history, a path into the values and emotions people attach to the more-than-human world, their changing experiences of it, and the changing meanings such experience carries.

Historians have a particular interest in change as well as time. For the environmental historian, the relationship between the "time of the event" and the "time of the telling" can highlight critical insights about environmental change. An interviewee recalling the changes that an area has undergone will often ascribe their understandings of cause and effect. The time of the telling can also change the emotional impact of such change. Remembering a place after it has been ravaged by a disaster, such as a fire or a cyclone, is likely to be overlaid with shock and grief. Such memories recorded in the context of intensifying climate change are also likely to reflect a relatively new understanding about the cause of such catastrophes. The edited collection by McKinnon and Cook, *Disasters in Australia and New Zealand* (2020), offers many excellent examples of using oral history to explore environmental disasters, revealing the ways individual accounts of disasters can capture the grief and loss people experience, and serve as a corrective to collective memory. Oral history also enables the temporality of a disaster to be more fully recognised: individual, communal, and ecological trauma continues well beyond the headlines (Sellers 2022: 268).

Anthropological understandings of cultural and individual meanings of time provide another layer to our understanding of how time can be thought of in the context of oral

interviews: time and its passing will provide building blocks for the researcher's understandings of the present. In the context of the looming environmental and climate catastrophes, stories of the past need to be considered as reflecting our understanding of the future. We construct the past through the expectations of what happens next, through "the time of the coming". Just as the "time of the telling" shapes the way the past is recalled, so, especially in the context of intensifying climate breakdown, the anticipation of the future shapes how and why certain stories will be told. These themes are only beginning to emerge in oral histories of environment, but Ringel suggests some directions when researching memories and expectations in the urban post-socialist environment (2016) and when studying hope (2021). He argues for the need to attend to the ways the future is represented in the present, a theme also explored by Osterhoudt (2016). Osterhoudt's (2016: 274) "political ecology of memory" collects the stories of people's material relations to the forests and fields they farm, places where their own personal and political histories are located and articulated, and where "they cultivate shared stories of hope and resistance". Oral interviews could thus include insights into the memories of hope – what was hoped for before the future for our environment, and thus our world, became more threatening.

Concern about the rate of environmental change both past and present drives many oral and environmental history projects. When the opportunities to engage with people with deep intergenerational knowledge of places might be diminishing (Gaynor and McCann 2017), or rapid environmental change is destroying beloved environments, recording oral history can be regarded as urgent. As places change, whether through industrialisation, climate change, deforestation, or other processes, be they forces of human or non-human nature, memories of how a place once was are sometimes all that remain. In this way oral history bears witness to what was, how it has changed, and the meanings it carries – for the present and the past. It can also play a critical role in capturing emotions associated with environmental change. As discussed in this chapter, beloved places are capable or eliciting powerful emotions, be they joy, solace, grief, or rage in the face of their destruction. Humanities scholars have used the term "solastalgia" to capture the emotions – particularly grief and distress – caused by human-induced environmental change (Albrecht 2005). Oral history is ideally placed to capture such emotion, and future researchers will no doubt be able to use our interviews to identify the ways the expression of such emotions gathered pace as the impacts of climate change intensified. The "time of the coming" might be ever present in such recordings.

Not all researchers who engage with oral history are so concerned about layers of time and its meanings. Ecologists and other branches of environmental science have increasingly begun to use oral testimony to guide ecological restoration projects. There can be problems with using oral sources as a vast database, without accounting for the subjectivity of oral sources – they are more useful for establishing meaning than facts. Oral history can offer insight into the human impact of environmental change, its relationships to the human history of a place. Marrying local and scientific knowledge provides a richer understanding of environmental change (Lane 1997). More recent work marrying oral history and photography, where photographs capture evidence of ecological change over time, illustrate how combining such methods can "help land managers make sense of environmental change and degradation", and also reveal changing relationships with place over time (Pearce 2021: 166).

Just as oral sources need to be used reflectively by researchers, so the stories they may reveal are not neutral forms of conveying a message or meaning. Attention to the ways

stories are told, their intended audience, the time of the telling, and their narrative intent is critical if we are to use them in environmental research. Oral narratives can also unsettle historians' assumptions about temporality. Time might be fragmentary rather than linear; environmental changes experienced as episodic or less as an event than happening over generations (Sellers 2022).

Oral history can illuminate political struggles around environmental change. Tracking the emergence of environmental thought crucially relies on oral histories with people involved in environmental movements or caught up in environmental breakdown. In her online research about forest protection activism, Annist (2020) has considered the grief and lamentations in social media as witnessing, providing lasting and regular accounts of the relentless destruction. In his research of activists from poor countries, Nixon (2011) conceptualises the temporal dimension of the relentless destruction as "slow violence", of which activists' life histories provide evidence. Peša (2021) draws on oral history interviews and archival sources to understand how Central African environmental consciousness and knowledge evolved in the context of mining, health, and colonial power relations. Using intimate information from oral history interviews, combined with archives, Peša shows the slow violence of environmental degradation and debilitating power relations. She stresses the importance of oral history in identifying environmental values, which in turn "inform appraisals of and reactions to environmental change" (3).

Oral history helps us see how being subjected to such changes can also be part of a process of resignation, acceptance, adoption. For instance, Clapp et al. (2016) utilise oral history interviews to show how people living in the small American town of Ambler, Pennsylvania, are socialised to asbestos and its toxicity in their daily lives. Oral history illuminates the process of learnt indifference that Clapp suggests underlies the readiness to accept degradation and suffering. Accommodating such values – around water, health, pollution, cleanliness – alongside an embrace of modernity and the neoliberal stress on individual responsibility has meant that despite early and undoubted knowledge of environmental harm, "resignation towards industrial pollution has been more common than protest" (7). Indeed, Williams and Riley (2020) argue in their discussion about oral and environmental history that attention to the socio-environmental power relations involved in environmental change is one of the key interventions that can result from bringing together the two fields of practice.

Attention to the time of the listening is also critical in the use of oral interviews. As with any historical text, the greater the distance between the time of a recording and the time when a researcher encounters it, the sharper the historical context at the "time of its telling" will appear. The place of listening is also critical. Imagine returning to the site of an interview and listening as the narrator recalls in vivid detail the beauty of a place now changed beyond recognition. Time and place can weave powerful stories of environmental change in oral history, for the participant and the researcher alike.

Place

Place is central to environmental history: being in it, evoking it, understanding it, charting the changes in the ways people have imagined and interacted with it, capturing the entanglements of the "more-than-human" world (O'Gorman 2021: 7). To this focus, oral history brings added dimensions which require us to consider the affective and embodied experiences of place, the ways in which a place can elicit different kinds of memories depending

on individual or community experience. Places carry collections of meanings built up through patterns of behaviour and interaction, and through the wider connections people bring to their places of significance. Oral history grounds abstract ideas about place by locating the memory of particular experiences in particular places. Lee (2010) argues that oral history has the capacity to capture the sensory experience of being in a particular place, its sounds, smells, touch, sight: "the feel of wind, the sight of dead snags, the outward birdsong and inward drum of the human heart, the scent of water, and the sense of memory" (245). Lee and Newfont (2017) also suggest that the land itself "speaks", through the narratives of those who live and work on it. Conducting interviews "in place" adds a further dimension to the ways particular places might be understood. Karen Twigg notes that interviewing farmers while strolling across their paddocks "offered invaluable insights into the complex web of interconnections – ecological and social – that operate within a locality". The landscape and its features also spurred memory, "prompting stories that would otherwise have remained untapped" (Twigg 2017: 217).

Mobile methodologies and the mapping of memoryscapes have been the subject of increasing discussion amongst anthropologists over the recent years, with particular value for understanding the relations to or with the environment. Mathews (2018) combines oral histories with walking, as well as his own experiences as a walker to recount multiple histories of landscape change. He advocates an exposure to the wonder of the non-human world and the stories of landscape change which can emerge from such a place of engagement. Instead of "recounting a single history that produced a unified landscape", he describes "overlapping and interwoven throughscapes linked to multiple histories. From these storylines a different account of Anthropocene politics can emerge", and "the Anthropocene can be understood as having many beginnings and coexisting histories that give rise to multiple futures" (Mathews 2018: 387, 410).

Oral history can capture the "voice" of the places where interviews are conducted. Marianna Dudley, in writing about the Severn River, suggests that oral history provides an opportunity to better understand the changing nature of the relationship between environments and humans who live and work in them. The sonic environment of a place can provide information about "ecological health and environmental change". In this way, oral history can capture the "dynamic agency" of the non-human world, offering insights and information that cannot be gained through textual or non-audiovisual archival sources (Dudley 2017: 99). Recalling sound can also be a way of evoking place and change. "What we hear, or remember hearing, contributes to the construction of a sense of place and of self" (Chatterjee and High 2017: 202). Chatterjee and High (2017) write about the sounds of cities and industrialisation and the ways gentrification of a working-class neighbourhood changed its soundscape. They argue that the meanings and memories of industrial sound are shaped by class "and the sensibility, feeling and understandings that it produces" (202).

As the aforementioned quote from Lee suggests, memories of place are evoked by senses other than sight and sound. Paula Hamilton (2011) argues that smell, taste, and touch might be more deeply buried memories than sight and sound, but they are no less potent. Drawing on the work of anthropologist Constance Classen, she argues that our attention to the senses aims not only to describe what people smelt, heard, felt, saw, or tasted, but also to understand the meanings that their sensory memories carried for people. Attention to sensory memory offers us insights into an embodied experience of place.

But what happens to the idea of "place" in an increasingly globalised world? Ecofeminist philosopher Val Plumwood reminds us that our understanding of particular places needs to

be infused with a politics and ethics of place, that places are also revealing of power relationships – "whose place is made better, whose worse, and what patterns can be discerned" (Plumwood 2008)? She argues that in Western settler countries, the places which become idealised and identified with self and soul, are valued, while those unrecognised places on which our global economy depends, are "shadow places of the consumer self" – out of sight and mind, often degraded, discarded, and denied. Memories of idealised or nurturing places thus need to be interrogated for the ways that they can both reveal and mask such power dynamics.

Anthropology has had a long and thoroughly analysed relationship with place, especially in terms of the shared nature of experiences in a particular location, at a particular time. For environmental research in particular, place is paramount. Indeed, Moran (2011) has called environmental anthropology a "spatial science". However, remaining "local" is increasingly recognised as insufficient for fully comprehending human activities, impacts, and consequences in an interconnected and globally changing world. Collecting oral interviews needs to respond to such challenges. Local weather events, for example, may have their origins in the global phenomenon of climate change (see Falzon 2016). One of the challenges is to embrace multivocality – testimonies from different locations and witnesses – to arrive at a fuller account of events and effects. Fortun's research (2016) on the diverse responses to the 1984 Bhopal disaster – the world's worst industrial disaster in the Indian city of Bhopal, when 500,000 people were exposed to toxic gas – includes listening to multiple voices, from activists and journalists to legal texts, across a variety of locations and across times, and recognising the diversity of metaphorical, technological, discursive, legal "locations" involved in constructing "Bhopal".

Multi-sited research increasingly includes online research, even more so since the pandemic. Interviews can be conducted online and include multiple people from different places. Distance ethnography, first and foremost in online form, has been a critical change in social research. Rather than being in a physical place, the internet becomes a virtual place, able to integrate people from across the globe. Having been studied as a "virtual locale" since the very first online ethnographies (e.g., Markham 1998), life on the internet can traverse and expand locations. For example, when an environmental protest cannot take place at the site of an event, its presence online allows both witnessing and participation beyond its immediate location. It creates a new locale where activists and others impacted can congregate (Annist 2020). Online research allows a greater variety of people and groups to study with, and by avoiding travel, curbs emissions and increases inclusivity. Lee et al. (2019) point out that this further enables research into natural disaster regions where "physical immersion" is logistically difficult and impacts how oral histories could be collected. However, whilst reaching for stories from a distance has become far more common than before the Covid pandemic and increasing climate concerns, overall, the methods known for "being there" (Eakin 2006) remain vital. It provides access to the experience of place, to the unexpected (particularly relevant in environmental research), where direct responses to changing weather and environment, or climatic disruption, are available to the researcher for immediate conversational or retrospective interviews.

Researching "in place" connects memory to the source of its creation; it locates people and culture. For Indigenous researchers and communities, it also recognises the way epistemologies are rooted in place and "invites more embedded, expansive, material and respectful relations to people and lands" (Kanngieser and Todd 2020: 385).

Decolonising research

Western research practices have for centuries perpetuated colonial hierarchies of knowledge and power whereby Indigenous or marginalised people are the "researched", their knowledge and experience considered irrelevant or secondary to that of the Western-trained, invariably white researcher. The process and context of gathering oral histories are increasingly recognised as subject to the same colonising practices of much Western research. Critiques of such practices emerged from newly decolonised countries, in particular since the 1960s (e.g., Asad 1973; Fanon 1961; Said 1978; Spivak 1988). Poststructuralist critiques of the 1980s and for some disciplines, such as anthropology, further internal scrutiny of the writing practices in academia, have driven efforts to decolonise research across disciplines. Linda Tuhiwai Smith (2012) argues that for any field to overcome the legacies of its colonial origins, it must self-examine how it has historically produced knowledge, how those processes have been tied to dispossession, occlusion, erasure, and violence, and how its methods of so-called "data collection" and writing do or do not fit with Indigenous and other colonised or marginal peoples' epistemic practices.

Oral history is well positioned to recognise differences in stories that have been sidelined, ignored, or vilified for centuries. As Cunsolo Willox et al. (2012) note, "[n]arrative- and story-based methods are particularly beneficial and respectful strategies for engaging in research with indigenous communities and in indigenous contexts" (129). Such methods, led and created by participants and centred around their stories, can address the "colonization of research and Western analytic project" (Cunsolo Willox et al. 2012: 130). Cunsolo Willox and her team utilised a decolonised research methodology to understand the impact of changing climate on health and well-being in the southernmost Inuit community in the world. Their work in digital storytelling revealed lessons that enabled culturally relevant representation of people's own versions of their lives in the midst of changing climate.

Nepia Mahuika, writing from the perspective of the Ngāti Porou people, a Māori tribal community from Aotearoa New Zealand, argues that oral history for Indigenous peoples has different meanings and practices from those of traditional "Western" academic methods. In particular, it is "a collective enterprise essential to cultural survival, naming the world, asserting power and belonging, and narrating relationships across time and space to land, sea, sky. and each other" (Mahuika 2019: 1). Oral histories are living documents, and for Ngāti Porou it is an art form that includes speaking, listening, reading, and writing (Mahuika 2019: 40). Linda Tuhiwai Smith (2012) notes that oral history can enable Indigenous people to take ownership of the past: giving "testimony to the injustices of the past" can be a way of reclaiming their history (36). The process of redefining oral history "is a matter of power and liberation as much as it is a process of revitalisation and preservation" (Mahuika 2019: 41).

Indigenous historians are also developing oral history methodologies that are more culturally appropriate than conventional interview and narrator models. Lorina Barker (2008), a Muruwari woman from Western New South Wales, writes about "'hangin' out' and 'yarnin'" in her community and with family as crucial ways to re-immerse herself in the culture and allow her participants "to accommodate my research into their everyday lives" (9.4). Anderson et al. (2018) explain that yarning is a crucial way in which Indigenous Australians pass on knowledge; it "privileges Indigenous ways of knowing, being and doing". In "Australian Indigenous culture it has also been seen as the domain of women", a way in which knowledge is transferred from one generation to the next, often through stories "re-told and re-enacted in place" (Anderson et al. 2018: 171, 173). Thus the process of

yarning is intimately connected to the environment and embraces a practice of "deep listening", an exchange between speaker and listener.

In other contexts, as Yusoff (2018) and King et al. (2020) demonstrate, storytelling by black and Indigenous communities, especially those that tell of violence and colonisation, are also stories of our relations with the environment and environmental resources, stories of the Anthropocene unfolding. It is these groups who have experienced the destructive, world-changing effects of colonising mindsets. They can also tell us first-hand stories of the end of their world as colonisers destroyed it, as well as how they lived after that end.

Decolonising research practices reveals different kinds of environmental knowledge and understanding, challenges Western ideas about temporality, and can expose the assumptions many Western researchers would carry. For example, the experience of an urgent need to act in the face of intensifying climate change and biodiversity loss is not something experienced equally across cultures or countries. Weaver et al. (2022), worked collaboratively with communities in the trans-Himalayan region of Ladakh on the Climate Witness Project to understand the impacts of climate change and "capture traditional knowledge before it is too late". Ladakh, they suggest, "exhibits in microcosm the climatic extremes that will mark the Anthropocene", a place where "the pace of social change is dizzying, where an ancient agropastoral culture is passing away in the space of a single lifetime" (60). The project sought to allow the people experiencing climate change to "speak for themselves about the causes and consequences of climate catastrophes", enabling global environmental studies to recognise how communities are already engaged in figuring climate realities out for themselves. Rather than leading the "narrators" through "interviews founded on the historians' own cultural perspectives", the project experimented with community-based participatory research to collaborate and work "with, not for, community partners at every stage of the research process". Community members took the lead in formulating research questions, designing research, collecting, analysing, and taking ownership of data, and as a result, arriving "at a shared understanding of the meaning and purposes of interpretive research", and moving on to collaborative writing and sharing of the results. In a region "where life has never been easy", Weaver et al. note the calm with which communities faced the future, despite the rapidity of social and environmental change: "in some forty hours of interviews, this existential calm emerges as perhaps the most striking finding of the Climate Witness Project" (71).

De-centring the human

While the human-centred methodology of oral history might not seem well suited to enhancing our understanding of the non-human world, storytelling has become particularly important in picking apart and understanding exploitative relations, between humans and the non-human or more-than-human worlds. The notion of non-human divides the world in binary ways, where humans (usually) still occupy the dominant position. The idea of the "more-than-human world" foregrounds the fact that humans are always entangled with other organisms, elements, and forces and thus gives primacy to a relational approach to understanding the ways in which the more-than-human world is co-constituted (O'Gorman and Gaynor 2020: 716). Being attentive "to the entanglements of the more-than-human world" (277) is a critical step in noticing the ways in which it is co-created. Anthropologists such as Anna Tsing (2015) and Hugh Raffles (2010) have been leading thinkers in multispecies scholarship, and their work has provided critical ways of thinking about the

more-than-human world. Oral histories offer the opportunity for researchers to investigate how their participants understand their role in the co-creation of their shared more-than-human world, and to listen for its presence as well as its historical traces.

Attending to the non-human, the work of Twigg (2017) looks at what the narratives of farmers in the Mallee region of north-west Victoria, Australia, tell about weeds and climate change. By paying attention to these different narratives and the ways people utilise them to explain their actions in the world, Twigg argues that oral history helps tease open the entanglements between the human and non-human worlds, "illuminating the attitudes and perceptions, feelings and emotions that shape our responses to environment" (228). They also reveal the ways non-human actors, like weeds, respond to human actions but also impact upon human behaviour and subjectivity. Gaynor and McCann's article on oral histories with fishers and divers also offers an example of animal-human relationships and the ways fishers and divers have engaged with – and divers understood – each other's behaviour (2017).

Meera Oommen's (2017) work on the "entwined biographies" of elephants and migrants in the Travancore region of India explores the agency of the elephants, the "traces of memory" they left behind on the landscapes, and the human stories of their encounters. Oommen draws on Hayden Lorimer's work "Herding Memories of Humans and Animals" (2006) to interrogate the "diverse geographies that co-existing humans and animals create". Forced by famine to abandon their plain-dwelling lifestyle, migrants moved to the forested hills, cleared the trees and planted crops. The crops proved irresistible to the local elephants who helped themselves to the rice and banana trees, and terrified the settlers with their swinging trunks, gleaming tusks, and massive scale. The settlers constructed tree platforms to escape the raiding elephants, but the ignominy of this forced retreat, and the fear it reflected, remained fresh in the memory of Oommen's interviewees. Gradually, elephants and settlers learnt strategies of co-habitation and avoidance, and conflicts eased. Knowledge of these strategies appears to have been transmitted across generations by both elephants and humans (259). Some of the tree platforms remain in the forest, a reminder of the lingering presence of the elephants (252).

Anthropologists have drawn attention to the significance of the more-than-human, especially in the context of "witnessing". "Witnessing environments", suggest Vaughn and Fisher, "has two interrelated meanings: the critical task of bearing witness to disturbances and the describing of the sociopolitical frameworks that separate the human from the more-than-human" (2021: 389). Those frameworks can include the ways Western scholars presume and impose a separation of different aspects of the more-than-human world: the land, sea, plants, animals, people, and spiritual worlds. Kanngieser and Todd (2020) instead suggest that these are kin. Understanding these relationships involves a different kind of listening, "a practice of sensing, attunement, and noticing". Such attunement involves hearing the stories people tell, noticing the ways the more-than-human world interacts with the time of the telling – prompting memories of animal antics, storms or heat waves, floods or fires, for example – the ways it shapes memory and narrative, and in turn the particular ways the more-than-human world has been co-created in place.

Conclusion

The developments that we have outlined in this chapter reflect the vibrancy of oral-environmental history. In some areas researchers working with oral sources have pushed environmental historians to engage more critically with their sources, or have led the way in

attending to the significance of different layers of time, memory, or emotions in the oral interviews. In other areas, developments within environmental history or environmental humanities more broadly have pushed oral historians to pay attention to the agency of the non-human world of their participants, the significance of place, and the ways in which the crises of climate change and biodiversity loss are shaping the memories and meanings that individuals and communities ascribe to their past and present. Contributions from Indigenous scholars have led the way in de-colonised research practices and offered new ways of thinking about the environment, colonisation, and the Anthropocene. Bringing together the disciplines of history and anthropology and the ways they have engaged with oral and environmental research has revealed critical insights: the need to integrate attention to time and place, to recognise the agency of both in the oral history narrative, and the more-than-human world they have helped co-create.

Our collaboration on this chapter has also exposed the often-parallel paths our different disciplines have travelled in our use and understanding of oral and environmental sources, but how seldom they have engaged with each other. As the "time of the coming" further shapes the ways in which we understand the past and the present, we hope that our paths might more readily entwine, enriching our disciplines and the oral environmental history that is yet to come.

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3
SOUNDING ENVIRONMENTS

Hedley Twidle and Aragorn Eloff

In the winter of 2004, the calls of the Cape Robin, a bird native to southern Africa, were broadcast from speakers concealed in trees in Kitakyushu, Japan. Titled *There's No Place Called Home*, the installation by artist James Webb (2004) was "temporary, unannounced and unaccredited" – so it is unlikely that any local human residents would have noticed. "Like a field recording 'returned' or hacked into nature", the artist's catalogue reads, "or a cuckoo's egg laid in the nest of another species, the audio is mixed to seem as 'real' or 'natural' as possible" (Webb 2020: 85).[1]

Similar interventions by the artist have appeared in many different places over the last two decades: "Calls of non-migratory Nigerian birds broadcast from speakers concealed within the trees of Joubert Park, Johannesburg, South Africa" (2006); "Songs of a Jamaican Becard (*Pachyramphus niger*) broadcast from speakers concealed in a tree in the Royal Botanic Garden Edinburgh" (2021). Noting that bird calls are some of the most recorded sounds on the planet, Webb remarks that he soon became interested in "the very politics of the vocalisations": "What we might take as being melodic and musical, with received cultural associations of relaxation like a kind of natural Muzak, is in fact a series of mating calls, identity displays, and the staking of territory" (Webb 2017: 52).

The Cape Robin (the South African National Biodiversity Institute explains) is not really a robin; it is actually a chat. The misnomer dates from a colonial era when British naturalists named almost all red- or orange-breasted birds after their own robin redbreast, *Erithacus rubecula*. The robin-chat is now one of the most familiar birds in South Africa, with common names like *Setholo-moru* in SeSotho, *ugaga* in isiXhosa, *umBhekle/uGaga* in isiZulu. As birds mimic cars, so human language echoes the birds. The guttural alarm call (*WA-dur-dra*) gives the Afrikaans name "Jan Frederik", which matches the rhythm (*JAN-Fred'rick*). As with many other onomatopoeias where birds say their name – cuckoo, grackle, *guguubarra*, kiskadee, *kiewiet*, loon – here the signifier (the "sound-image") attempts to close the gap with its signified ("concept"), calling out across an interspecies boundary (Saussure 1959: 11).

Audio technology now enables a far more effective way of hacking into the sounds of the world's avifauna. Webb writes that in making these installations, he was also influenced "by wanting to warp and challenge the often frowned upon ornithological practice of sonic 'baiting' wherein an audio recording of a local birdcall is sounded in the vicinity where that

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species might hear it and respond, with the hope of it making its visual presence known" (2017: 52–3). This baiting now stretches from the benign to the deadly. Tourists in game parks use smartphone apps to coax shy species out of the bush; thousands of duck and quail are lured to their deaths by MP3 files broadcast by bird trappers in the migratory fly-ways of the Mediterranean.[2] To avoid this unwanted mimicry, Webb conducted research in each location to ensure that the foreign birdsong broadcast was in no way similar to the vocalisations of species living there: "This is a sonic trap for human audiences, not the local birds" (2017: 55).

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How to think with sound in the context of environmental history? The question elicits another, more fundamental one: how to think with sound in a world culture so dominated by the visual? "A concentration on vision as the primary mode of comprehending reality", writes Nigerian scholar Oyèrónkẹ́ Oyěwùmí, "promotes what can be seen over that which is not apparent to the eye; it misses the other levels and the nuances of existence" (2005: 14). In his introduction to *Hearing History*, Mark Smith suggests that an increased attention to sound might help "to redirect in some profoundly important ways" what is often a visually oriented discipline, one "replete with emphases on the search for 'perspective' and 'focus' through the 'lens' of evidence, one heavily, if often unthinkingly, indebted to the visualism of 'Enlightenment' thinking" (2004: ix).

To give a comprehensive account of how the sonic might figure – or, rather, resonate – within the field of environmental history is an impossible task. One would, after all, have to consider in totality not only one of the five fundamental human senses, but then also those forms of audition which fall above (ultrasonic) or below (infrasonic) the human range of hearing. For as Jonathan Sterne writes, the boundary between vibration that is sound and vibration that is not sound "is not derived from any quality of the vibration itself or the air that conveys the vibrations":

> Rather, the boundary between sound and not-sound is based on the understood possibilities of the faculty of hearing – whether we are talking about a person or a squirrel. Therefore, as people and squirrels change, so too will sound – by definition. Species have histories.
>
> *(Sterne 2012: 7)*

As do (one might add) glaciers, rivers, volcanoes, littoral zones, echoing escarpments, and prevailing winds. Nonetheless (or perhaps for this very reason), the question of *sounding* environments – where the word is held in mind as both adjective and verb – constitutes a fascinating and multidisciplinary enquiry. It is an invitation to listen across time, and across different kinds of scientific, intellectual, and cultural practice: from the empirical work of acoustic ecologists to the experimentalism of sound art, with detours via the extraordinary creative possibilities opened up by contemporary recording technology, audio software, and the digital.

Relocated birdcalls; the crack and pop of melting ice; spring biophonies and the insect "vibroscape"; drone artists in the tropical rainforest; underwater seismic blasting; the natural and cultural history of whale calls; the diesel combustion of container shipping; subsonic pulses at the bandwidth of the Anthropocene; increasing noise and gathering silence – in the course of this chapter, we listen across these different soundworlds, tracing the

entanglements of human and beyond-human history that they take us into, while also reflecting on what it means to transmute non-verbal soundscapes into the medium of human language. The ability of sound to pass through (and to behave differently in) different bodies, substrates, and environments makes it an intriguing and often surprising way to think through received categories and boundaries, whether "natural" or "cultural".

Throughout, we suggest that thinking acoustically represents one of the most powerful and destabilising ways of attending (to return to Oyěwùmí) to "other levels and nuances of existence". As she notes, if visually centric cultures might tend to produce specific forms of ontological and metaphysical hierarchies through the visual sorting of differences, then perhaps more a sonic or multisensory culture might produce – given the fuzzier nature of audio/ontological distinctions, and the omnidirectional properties of sound – what Eduardo Vivieros de Castro describes as a "cosmopolitics": a world in which many worlds can fit.[3] The sonic imagination, in other words, is one of the most provocative modes for thinking in some way beyond a human-centred world, and a human-dominated history. If our cultural and historical imagination "is mostly disengaged from the sonic tumult we create", then the act of listening more carefully confronts us with the difficult paradox at the heart of this sensory crisis: that our species as "is both an apogee of sonic creativity and the great destroyer of the world's acoustic riches" (Haskell 2022: 318).

*

To return to the first of our case studies, or listening sites: the out-of-place birdsong in *There's No Place Called Home*. How might this "sonic trap" suggest the possibilities (and complexities) of the acoustic when trying to extend a sense of environmental pasts, presents, and futures?

When speakers play "non-migratory" Nigerian birds in central Johannesburg, the sounds might evoke much louder questions of human movement and migration across the African continent: of demographic flows and border controls; of the social conflict and xenophobic violence that has often been the result in a "host" country like South Africa. (But only, of course, for the informed listener: for anyone else they would simply be background Muzak). When a Jamaican bird calls in the Botanic Gardens of Edinburgh – or when an Ōma'o (Hawaiian thrush) sings in the Company's Garden in Cape Town (within earshot of a statue of imperialist Cecil Rhodes) – then the sounds might call to other, trans-continental histories of dispossession, forced migration, enslavement, and diaspora.[4] These are some historical frames in which to hear the work.

But, as Sterne writes, species have histories – and other species have other histories. Encoded in the world's birdsong (as in all bioacoustic signatures) is also a much longer, pre-human story of organic variation, evolution, and dispersion. So if sounds are fleeting – "ephemeral and light, dissipating as soon as they are made" – they are also, the biologist George Haskell writes, "layered records of history" (2022: 190), even while they leave little or no stratigraphic trace. A soundscape of birdsong, he goes on, is "an accretion built over hundreds of millions of years": "Sound, made of breath and gone in an instant, can be older than stone" (2022: 190).

As Elizabeth Kolbert (2014) and other writers on "the Sixth Extinction" have showed, this vast natural history of speciation and biodiversity is now being altered or effaced even as it is pieced together and understood (see Chapter 13). What environmental historians call the "Columbian exchange" (the consequences of the Old World/New World collision) and the

onset of colonial and global modernity – these world historical processes result in a speeding up and running backwards of evolutionary time. The geographical separateness that produced speciation and variation (and sonic diversity) – all are collapsed back into a modern Pangea: the single, hyper-linked, super-continent of a 21st-century world. This too seems latent in Webb's globalised birdsong: the proliferation and dispersion of avian MP3 recordings seeming to stand in for the diminishment, absence, and homogeneity within actual bird populations. A conceptual artwork of the globalised present, the hidden speakers also invoke older, mythic ideas of bird calls as augury, omen, or warning. It was, after all, the prospect of a world without birdsong that Rachel Carson took as the central metaphor in her 1962 work on DDT and pesticides, *Silent Spring*.

*

It may seem speculative, or unverifiable, to hear so much in a single sound. But this is one of the challenges that those who attempt to listen to history – whether natural, human, environmental, or all at the same time – must grapple with. That is: the nature of sound as (on the one hand) charged, immediate, embodied, evocative, affective, dense with meaning; but (on the other hand) impermanent, diffuse, non-semantic, unfalsifiable, dissipating, often unarchived and traceless. Sound, writes one aural historian, "is at once the most forceful stimulus that human beings experience, and the most evanescent" (Smith 2004: 28).

In thinking through the suggestive but elusive, often non-referential nature of the sonic, François J. Bonnet (2016) theorises a tension between "the savage sonorous" (those sonic experiences capable of producing a rupture in our experience of the world) and "the domesticated audible" (all the ways in which we attempt to recuperate the ingression of novelty into established schemas and formulae). No matter how much we attempt to domesticate sound, he suggests, its dual nature remains. On the one hand, there are the sounds that leave a trace, or which are properly ontological and can be drawn into our systems of meaning; while on the other hand, all sonic experience contains within it a degree of inexplicability, a hauntological echo that is never quite fully present or, however, completely absent (2016: 3).

In thinking via the acoustic as method, evidence, and experiment, the remaining listening sites in this chapter try to hold this tension in mind, and to comprehend *sound* as both noun and verb: both physical property (a sound) and open-ended process (to sound or sound out, to enquire into or investigate).

*

Sound (noun) as something received, recorded, and studied – soundwaves as physical, measurable, passively received, quantifiable – informs scientific method in fields like acoustic ecology, bioacoustics, and soundscape studies. These emerge with audio technologies across the 20th century, from the first bird call recording (an Indian shama on an Edison wax cylinder in Frankfurt, 1889) to the instantaneous sound library of the internet (which now allows you to Google "cape robin").[5] As these technologies become increasingly powerful and portable, more and more of the biosphere's found sounds can be archived and studied as field recordings: indicators of ecosystem diversity, health, dynamics, and change. Acoustic ecology (as developed by sound engineers turned ecologists like Bernie Krause) conventionally divides the world's sounds into biophony (sounds made by living organisms), geophony (sounds made by non-biological natural categories: wind, volcanos, lakes, canyons,

snowfall) and anthropophony (sounds produced by human agency) – and then tries to understand the relations between them.

In 2022, Krause's touring exhibition "The Great Animal Orchestra" drew on 5000 hours of field recordings made over 50 years, including the sounds of over 15,000 terrestrial and marine species from around the world, many of them since lost or at risk. This is perhaps the most direct use of sound in environmental history, arts, and activism: as indicator of zoological splendour and decline (the aural analogue, perhaps, of the BBC or National Geographic documentary, with its conjoining of Edenic abundance and anthropogenic threat). The format of the exhibition – broadcast field recordings combined with large-scale spectrograms projected on the gallery walls – audiovisually enacts Krause's "Acoustic Niche Hypothesis" (1987). This suggests that in sites of great bioacoustic density (like the tropical rainforest), different animal vocalisations have evolved to occupy different frequencies (niches) on the sonic spectrum, allowing calls to be heard distinctly without overlap or sonic "masking" – much like the different sections of an orchestra.[6] The theory may be contested, but the work of Krause and other acoustic ecologists draws important attention to listening for the totality of sounds in a given environment, and trying to understand the relations between them: "What seems at first a smothering throng of sound contains within it a spatial structure, a microgeography of sound" (Haskell 2022: 111). Another benefit of using sound as data in this way, Krause suggests, is the rapidity of the method: a fairly short recording of an ecosystem can log a plethora of information, providing a rich archive for tracing biodiversity and how it changes over time (Krause 2018).

Acoustic ecology also posits a difference between hi-fi (high fidelity) and lo-fi (low fidelity) soundworlds, and so opens towards a more phenomenological sense of how human (and other) subjects experience aural "space" – and how the parameters of this space have altered through time and in the wake of industrial and economic revolutions.[7] In a hi-fi soundscape, individual sounds can be heard more distinctly by the human ear, whether in the "foreground" or "background", such that the "acoustic horizon" may extend far into the distance. In a lo-fi context, sounds overlap, mask, and cancel each other out, reducing the "aural space" of the listener. Where the masking means that an individual can no longer hear the reflected sounds of their own movement or speech, then "aural space has effectively shrunk to enclose the individual, isolating the listener from the environment" (Wrightson 1999: 11). "If the masking of reflected and direct sounds is so severe that an individual cannot hear his/her own footsteps – which is common on the streets of many cities" (Wrightson 1999: 11) – "one's aural space is reduced to less than that of human proportions" (Truax 1984: 20, as cited in Wrightson 1999).

This points to another dimension of sound research in the context of urban environments: how decibel levels and the encroachment of unwanted or inescapable noise into personal aural space map onto historical geographies of race and class. Cape Town (one of the cities where this chapter was written) presents a typical example of how those living within what urban planners call the "acoustic footsteps" of major highways and the airport are generally those residents who enjoy the least physical and social mobility.[8] The meeting of sound studies with the political sociology of urban environments is a body of work with many possibilities for environmental history and justice, in tracing what might be called the social geography of sound.

Extending the reach of acoustic ecology into the urban and built environment, soundscape ecology (popularised in the 1970s by the Canadian composer R. Murray Schafer) was premised on the idea that "the general acoustic environment of a society can be read as indicator

of social conditions which produce it" (1977: 7). Schafer's work can sometimes read as didactic and nostalgic, generally valuing pre-industrial soundscapes above the undifferentiated "noise pollution" of modernity: "It would seem that the world soundscape has reached an apex of vulgarity in our time" (1977: 4).[9] Nonetheless, as Smith remarks in *Hearing History*, his ideas of localised "keynote" sounds and "soundmarks" remain suggestive in their historical dimension: auditory textures which are the product of a particular combination of geography, flora, fauna, people, and technology at a certain moment (Smith 2004: xi).

In Japan, the "100 Soundscapes" project provides an example of how this kind of listening can also lead to environmental awareness, policy, and protection – and in a way that includes both pre- and post-industrial soundscapes as part of a national imaginary. In 1996, following a public call for submissions, the Japanese Ministry of the Environment designated 100 sounds as part of the nation's cultural heritage, in an effort to combat noise pollution and conserve important elements of the nation's acoustic identity.[10] Some entries from a list of the different soundscapes suggest how the auditory moves across worlds that are often kept apart by a nature/culture binary:

Drift ice in the Sea of Okhotsk	(オホーツク海の流氷)
Cicada chorus droning in Honda-no-Mori Forest	(本多の森の蝉時雨)
Wave sounds and ship whistles at the Kanmon-kaikyo Strait	(関門海峡の潮騒と汽笛)
Water scoop (hydropower) of Onta Sarayama	(小鹿田皿山の唐臼)
Isobue whistling of female divers in Ise-Shima area	(伊勢志摩の海女の磯笛)
Soughing of the wind through pine trees of Oka Castle remains	(岡城跡の松籟)
Bell of Peace in Hiroshima	(広島の平和の鐘)

*

Sound (verb) as perception and enquiry – soundwaves as actively made, listened back for, transformed, or transduced into various forms and formats of knowing – is an orientation to the world that stretches from the echolocation of bats and whales to the human sounding out of unseen or otherwise unreachable domains: "to sound the depth of an ocean, the inside of a body, and the furthest reaches of space" (Roosth 2009: 349).

Sound as method and experiment might include everything from offshore seismic blasting (the subject of the next case study, which considers oceanic noise) to the practice of artists and activists who use sound to resist exactly these extractive technologies. In doing so, they attempt to engage socio-environmental questions in ways that often go beyond the dominance (and over-familiarity) of the visual, working with "the combination of intensity and ephemerality" at the heart of listening experience (LaBelle 2010: xvi).

Moving beyond acoustic and soundscape ecology as just evidence gathering, a wider sense of human audition can then be imagined, with sound not only as data or measurable signal but also method, theory, and creative enquiry. As Louro et al. suggest in their survey of "A Sonic Anthropocene", such practices evoke useful methodologies "to environmentally sense ecosystems and register transient power relations … before they get inscribed into the

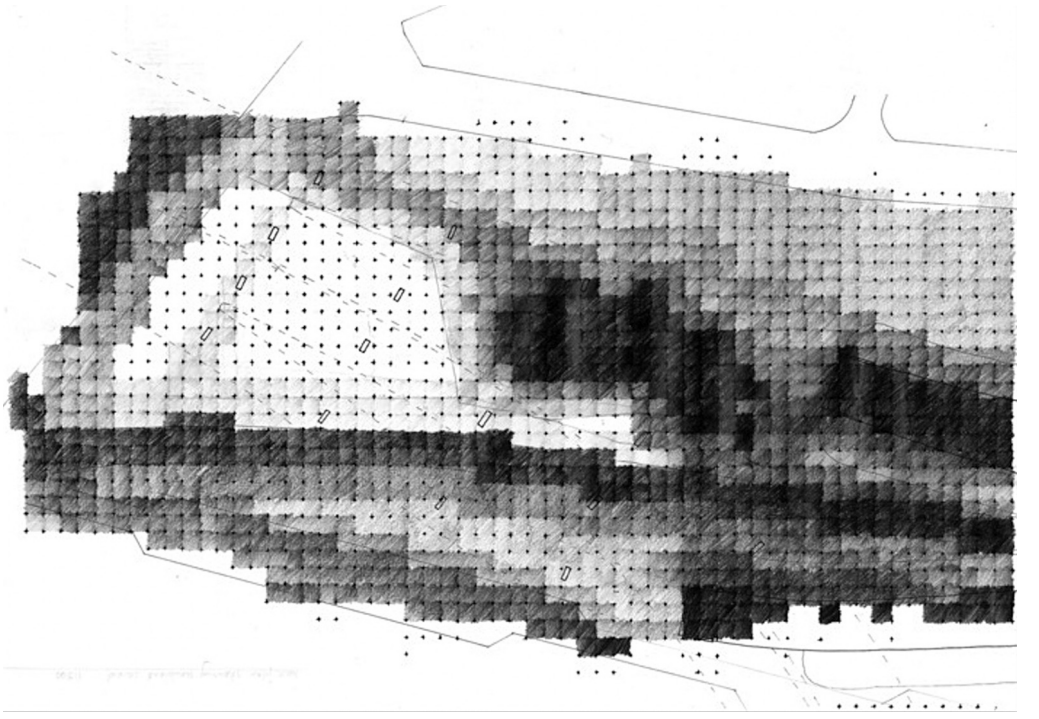


Figure 3.1 Sonic mapping of a site under the N2 highway, Cape Town Foreshore, tracing loudness and softness shaped by the architectural environment. Drawing by Meghan Ho-Tong.

geological strata", particularly in the context of the climate crisis: "Sound's omnidirectional quality trespasses all matter, leaving rippled traces, while destabilizing spatiotemporal causal effects and, as such, problematizes ideas of containment and jurisdiction" (2021: 1). Like water and CO_2, in other words, sound moves across the political or conceptual boundaries which often seek to contain and capture environmental thinking.

To give some examples of the sonic imagination in the work of environmental arts and activism: instead of the repeat photography pictures that are the usual (visual) language of retreating ice and climate change, Kalle Laar's *Call Me! +43 5254 30089* offers "direct telephone communication with a glacier": "A microphone on site transmits the sounds of nature directly and unprocessed to the caller. You can hear flowing water of varying intensities, the occasional cracking sound, and other sounds that a living glacier makes according to the seasons" (Laar n.d.). Other parts of the 15-year project (*Hotline*) provide direct lines to international energy companies, German nuclear power plants, or previously unknown pathogens: "The call gives each participant the opportunity to put themselves in a situation that normally remains unreachable and is neglected by the headlines in the daily press" (Laar n.d.).

As Jonathan Gilmurray writes of similar works that feature underwater recordings of glacial ice at the Arctic and Antarctic – for example, Douglas Quin's *FATHOM* (2010), Jana Winderen's *Spring Bloom in the Marginal Ice Zone* (2018), Daniel Blinkhorn's *frostbYte cycle* (2012–2015) – their "microsound aesthetic invites comparisons between the cracking and popping of the polar ice and the sonic palette of glitch music" (Gilmurray 2020: 450). One of the key aspects of all of these works, he goes on, is the way in which sound – which

requires attending to duration – renders the dynamics of glacial melting as ongoing process. Approached from a purely visual perspective, a glacier appears to be "frozen" in time; in contrast, "the sonic dimension of glacial melting facilitates our understanding of it as a dynamic process, happening ceaselessly and progressively" (Gilmurray 2020: 450). To listen to something, in other words, often requires a different, slower temporal frame than simply looking. And so the experiential, temporal duration of an audio work may resonate with the problem of representing the "slow violence" of environmental degradation and injustice (Nixon 2011) in a way that is different to the rapid consumption of images within an online ecosystem engineered for perpetual distraction.

*

While these works harness an immediacy and sense of physical connectedness – sound as a "direct line" – other, more conceptual approaches play with the disembodied nature of the aural: its ghostly, echoing, ventriloquised, voice-over or acousmatic potentials. Writing in the midst of the Great Acceleration – the post–World War II economic boom which positioned the United States as dominant world power – Schafer's ideology of the acoustic is constantly troubled by what he termed "schizophonia": the separation or "split between an original sound and its electroacoustical transmission or reproduction" (1977: 90). But it is just these kinds of splits and recontextualisations that other sound works draw on in trying to create new aural ambiences, atmospheres, and thought experiments.

"How honest can we be with each other?" asks a voice in James Webb's *A Series of Personal Questions Addressed to 5L of Nigerian Crude Oil* (2021). The oil is displayed in a glass case, with audio speaker installed above. Time is given between each question for the object to reply, "and for the audience to consider their own responses to the questions and the situation":

> How old are you?
> What was your original form?
> At what stage will we become like you?
> What have you been told about your value?
> Who died for you?
> How does this end?

In the work of ecologist and sound artist Francisco López, the acoustic is conceived not as data or indicator of a given reality; instead it becomes a way of opening up cognition to questions at a beyond-human scale, and to forms of audition not limited to the physical properties of the human ear. Much environmental sound art works to create listening experiences where the distinctions between biophony, geophony, and anthropophony are blurred, and in ways that release sonic thinking from a sometimes moralistic or limiting binary. "I don't see machines as oppressive", López remarks:

> Many of them produce beautiful sounds and a lot of true industrial "droney" sound environments are really fascinating. My work, however, is not concerned with making any judgements other than the purely sonic. And in this sense, I like machines as much as I like frogs.
>
> *(López 1999)*

Working with field recordings and found sound in a different way to acoustic ecology pioneers like Krause, López rejects the widespread tendency in nature recordings to try to reproduce the experience of "being in the place", arguing for something beyond sound as mere representation. The richness of this sound matter in the tropics is astonishing, writes López, but to appreciate it in depth, "we have to face the challenge of profound listening":

> We have to shift the focus of our attention and understanding from representation to being. … I have no interest in "representing" anything specific with my music. I actually have a strong commitment to do just the opposite; that is, to develop a sonic world that is so devoid of meaning and purpose that it can be completely open for individual experience. A blank phenomenological terrain where everyone is compelled to create and move through.
>
> *(López 1998)*

Here the idea of sound as related not simply to human hearing, but to physical vibration at all manner of different frequencies, might widen the ambit of environmental history, placing it in dialogue with the kinds of multi-species ethnography which seek to render human action as enmeshed with the histories of other beings, species, and agents (see Chapter 2, this volume). If the cochlea places us in "a perceptual box, a space much smaller than the diverse flows of energy in the world" (Haskell 2022: 32), then how to render energy flows beyond the threshold of human perception and understanding into some kind of apprehensible form? Again, here the sonic works less as evidence and more as invitation to widen cognition and orient historical awareness toward the beyond-human, and even the geopolitical.

"This is the history of a sound you cannot hear" – in her infrasonic history of the twentieth century, Roosth tunes into an environmental geopolitics at 19 hertz and under: frequencies below the threshold of human hearing, where our experience of soundwaves shifts from the audible to the palpable, liminal, vibratory, even illusory. Beginning with naturally occurring subsonic markers – from the 1883 eruption of Krakatoa to the Chelyabinsk meteor exploding above the Ural Mountains in February 2013 – she goes on to show how the infrasonic becomes entangled with nuclear and Cold War history. From the 1950s, the monitoring of very-low-frequency events (which travel much further than soundwaves through the earth's crust) became a way for the United States and the Soviet Union to know if nuclear tests had been conducted by their rivals (particularly after these moved underground in the wake of the 1963 Limited Test Ban Treaty).

Since the 1990s, these monitoring stations (and those established by the later Comprehensive Test Ban Treaty) have increasingly been retooled as instruments for predicting earthquakes, volcanic eruptions, and tsunamis, "refashioning the enemy not as political threat but environmental one" (Roosth 2018: 119). In this regard, she goes on, infrasound might be considered, following sound installation artist Raviv Ganchrow, to be "the bandwidth of the Anthropocene", because "environmental infrasound exhibits an intermingling of large-scale human industrialized activity with these other earth- and atmosphere-related frequencies" (Roosth 2018: 119; Ganchrow 2015: 194–5).

In the 21st century, the infrasonic remains tinged with an anxious, sometimes paranoiac imaginary. What ultra- or subsonic vibrations are we surrounded and affected by? What are the effects of these invisible/inaudible but ever-present by-products of global modernity? Hence, widespread anxieties about "vibroacoustic disease", or the insidious "hum" reported

by people across the world, or the contested illness termed "wind turbine syndrome" (West-Knights 2022). As "a liminal vibration propagating at the cusp of human audibility, ever so slightly below the threshold of human perception", the infrasonic "invites all-too-human anxieties about the limits of our own capacity to sense and know the environment in which we are embedded" (Roosth 2018: 119).

*

"I am not prepared to mourn my coastline" – in her director's statement for the 2018 sound and video work *Becoming Visible*, Janet Solomon discusses her attempt to represent the acoustic violence unleashed by seismic surveys off the southern African coastline. Launched by the South African government in 2014, Operation Phakisa (to "hurry up" in Sesotho) aims to "unlock the economic potential" of the country's maritime territories and to develop the "blue economy". With this comes, Solomon writes, "an escalating and unrelenting push for oil and gas development along the east coast of South Africa" (2018b). The KwaZulu-Natal coastline, she goes on, experienced its highest ever recording of whale strandings during and after a 2016 marine seismic survey looking for oil and gas reserves, a survey granted an extension into the whale migration season.

Working via multi-channel video and sound, *Becoming Visible* seeks to bring home the effects of towed airgun arrays that are used, in conjunction with multi-beam bathymetric sonar, to establish the topography of the sea floor. Such airguns can issue pulses of up to 240 decibels every ten seconds, for 24 hours a day (human eardrums typically burst at 160 decibels). The challenge presented by the work is its invitation for human listeners to comprehend the very different sonic environment of a watery, submarine space. Soundwaves behave differently below the ocean surface (where hydrophones pick up the same level of sound 12



Figure 3.2 Still from Janet Solomon (director) (2018a). *Becoming Visible* (film). Vanishing Present Productions. https://www.becomingvisible.africa/the-movie/

kilometres away from sources as from two kilometres away). They are faster, more far-reaching, and less avoidable for marine organisms (who often "hear" with their whole body) even while going (to human ears) largely unheard. How, then, can regulatory frameworks and environmental impact assessments be extended into worlds set apart from or beyond the human sensorium? Who is listening for, or to, our companion species in the oceans?

An intentionally disorienting and visceral work, *Becoming Visible* is best experienced as a multichannel installation: it harnesses our ability to hear many different sounds at the same time in a way that is difficult to replicate in the linear medium of writing. As with *Leviathan*, an experimental 2012 documentary on industrial fishing off the Massachusetts coast, the filmic soundtrack is not "a silent supporter of the image" (Doane 1985: 47), but rather a means of evoking "affective and epistemological confusion" that explores an "assemblage of human, animal and machinic existence" (Kara and Thain 2014: 187, 191). Yet at several points in *Becoming Visible*, those speaking attempt to transmute into language the extreme conditions created when sound as industrial, bathymetric barrage has come to override all sense of sound as communicative. Marine scientist Dr Simon Elwen turns repeatedly to terrestrial, urban metaphors of acoustic extremity in order to evoke the underwater world during a survey:

> You can, under extreme sound conditions, end up with gas bubbles in the tissue. It causes gas to vibrate, for want of a better word, out of muscle tissue, similar to shaking a can of Coke. And within the ear, it's similar to humans, you can get damage to the small cells and to the bones. More commonly you'll get things like permanent or temporary deafening: the classic nightclub example when your ears are ringing in the morning. Or it can be a much more subtle behavioural response, animals don't like the sound and move away from it, as you might with a jackhammer. And then masking is quite a big one because cetaceans are a very vocal species. They communicate hugely over quite vast distances with sound, and if that sound is being masked, that's when they have to vocalise louder or vocalise at a different frequency.
>
> *(Solomon 2018)*

"For want of a better word" – as an aside, it is worth considering how these deep-sea sonar pulses move across different mediums to arrive at this written text. From seismic blasts to soundwaves reflected off the ocean floor, picked up by hydrophones towed in kilometres-long "streamers" by ships, they are then mixed into the soundtrack of a documentary and reimagined via language in similes drawn from human experience – in this case the spoken voice of an interviewee, delivered by fibre-optic cabling and wi-fi to the author of this chapter, then transcribed and typed out for its reader. Working with an awareness of environmental sound constantly returns to these chains of transfer. The material irreducibility of sound coexists with the phase changes between different technological and symbolic mediums that are necessary to convey it and bring it into cultural significance. Perhaps it is the inescapable transduction (to use the technical term) involved in sound engineering, and sonic imagining, that makes the acoustic a compelling way to think experiences beyond the human boundary, and to extend historical awareness into domains beyond the human sensorium.[11]

Seismic blasting, the scientific literature shows, unleashes a cascade of effects on marine life, disrupting the nervous, hormonal, endocrine, and reproductive systems of organisms ranging from cetaceans, seals, turtles, and squid to invertebrates like crabs and molluscs. Yet these seismic spikes are only one aspect of a much larger phenomenon: the rapid and

ongoing increase of oceanic noise as a result of global shipping (perhaps the most dramatic historical change within the biosphere's soundscape across the 20th century). The engine noise of a large container ship is around 190 decibels (the equivalent of a thunderclap or jet taking off on land), which is combined with turbulence from hulls or sterns and the cavitation bubbles that form and implode at the tip of underwater propellers. "If there is an acoustic hell", writes Haskell, "it is in today's oceans" (2022: 292). And as he goes on to show, the encounter between whale "song" and anthropogenic "noise" in the oceans represents a charged and complex encounter between different currents of environmental sound history, one in which a biological enquiry into cetacean biology inevitably becomes entangled in a wider political and cultural history.

*

In 1979, the January edition of *National Geographic* magazine came with a page of "flexidisc" vinyl to be cut out and played. Narrated by zoologist Roger Payne, it contained excerpts from his million-copy-selling *Songs of the Humpback Whale*, released in 1970. The *National Geographic* disc reached ten million more listeners – the largest record pressing in history – and the humpback songs were also etched onto NASA's 1977 gold-plated LP, *Murmurs of Earth*, travelling with the *Voyager* probes into outer space.[12]

Yet even as these whale songs became the "call sign" for emergent environmental movements in North America (see Ritts 2017), their recording history points to a more complex relation between military, industrial, and oceanic listening. The recordings had first been made in 1950s Bermuda by the US Navy, where electronic engineers invented and installed hydrophones to monitor the Atlantic Ocean. Three kilometres offshore and 700 metres down, they hit the "deep sound channel", "the lens formed by pressure and temperature gradients that transmits sounds thousands of kilometres" (Haskell 2022: 292) – and allows whale vocalisations to travel across entire ocean basins. This underwater medium had previously been tapped by military technologies to detect the threat of icebergs and German U-boats; now it was being tuned into the frequencies of the Cold War.

Passed on to Payne, and then becoming some of the most influential non-human-recorded sounds of the 20th century, the humpback whale sounds occupy a cultural niche – or float in an ambient, New Age ether – that is sometimes removed from the history of their own production. If the album was in one sense a landmark of interspecies listening, it was also the product of sonar and echograph technologies which now reach an apotheosis in industrial "fish-finding" and the acoustic violence of seismic prospecting: sound as a means of probing and commodifying the furthest reaches of the biosphere. Listening to whale songs divorced from this context – as solo vocal tracks treated with woozy echo and reverb, isolated from (and perhaps ever working to conceal) the background "noise", in both historical and literal senses – this might risk making them "the aural equivalent of synthetic tranquilizers, manufactured anodynes for the senses" (Haskell 2022: 297).

Solomon's *Becoming Visible* draws attention to the extremity of sonar surveys, attempting to bring into human understanding a dimly perceived and insufficiently regulated aquatic "noise-scape" where industrial technology is making life unliveable within the oceans. But even when the seismic blasts fall silent, the "normal" level of anthropogenic ocean sound shows up an asymmetry, as the global supply chains of modern container shipping impinge remorselessly on worlds beyond human audition. "I have seldom seen or heard whales", Haskell remarks, seeking to make reciprocal links between suburban quiet and oceanic

uproar of container shipping: "But the whales hear me. They are immersed in the sounds of my purchases from over the horizon every day of their lives" (2022: 308).

*

In writing this chapter, we have tried to keep within earshot everything from the densely informational soundscapes of bioacoustics to the blank ambiences of drone music and environmental sound art.

Holding together these varied modes of sounding and listening can be challenging, but one helpful linking concept has been acoustemology. This approach, Steven Feld writes, "conjoins 'acoustics' and 'epistemology' to theorize sound as a way of knowing" and "enquires into what is knowable, and how it becomes known, through sounding and listening" (2015: 12). Feld goes on to emphasise how a sound-based practice can resonate with the kinds of relational, multi-species or beyond-human interdependencies which have proved generative for recent environmental thought, theory, and history:

> Acoustemology, then, is grounded in the basic assumption that life is shared with others-in-relation, with numerous sources of action (*actant* in Bruno Latour's terminology) that are variously human, nonhuman, living, non-living, organic, or technological. This relationality is both a routine condition of dwelling and one that produces consciousness of modes of acoustic attending, of ways of listening for and resounding to presence.
>
> *(2015: 15)*

To this, one might add: listening for and resounding to absence. In recent years, the dramatic reduction in human and industrial sound during the Covid-19 pandemic – the so-called "Anthropause" – afforded an opportunity for rethinking, or rehearing, the sound of a biosphere that is becoming both noisier and more silent. The unprecedented silence of a global lockdown – both eerie and liberating – permitted a kind of recalibrating of baseline environmental noise on land and in the oceans. For many, it was an invitation to think again about what cities could or should sound like, and how the acoustic textures of ecosystems in the 20th and 21st centuries have changed in ways that are both dramatic but also hard to represent or even remember.

Thinking within a context of declining insect populations, the sound artist Samuel Hertz writes about "hearing loss" (with the stress on the second word) as it relates to the auditory archive of personal and inter-generational memory:

> There is already a feeling associated with loss, however not always so clearly articulated through data. This pulse of feeling, however, has the cyclic span of a full generation – an adult's remembrance of a noisier time: the tactile unavoidability of this chattering and chirping biomass. If we cared to listen, we might hear (or might have heard) this slow disappearance as well – a creeping decrescendo of insect life, or an ever-so-gentle crossfade of biophony into anthrophony and technophony. Hearing absence is a funny thing; it is always harder to hear a hole than an intruder. And because of the longer scales of time involved in these disappearances, the body falls victim to 'shifting baseline syndrome' – the almost-too-casual adjustment of the ear to a consistently diminishing bed of sound.
>
> *(Hertz 2019)*

The challenge for a sound-based environmental history is to listen for such "crossfades" of sound and silence as they unfold in different socio-environmental contexts, and with different valences, blurring the conventional categories of biophony and anthropophony. And also, crucially, to think about how listening in one space be might be (invisibly) related to other sounds in very different places. It is an approach that could then consider – to adapt Jane Hutton's work (2020) – "reciprocal soundscapes". To understand, for example, the relation between the stillness of the suburbs and the tumult unfolding in other habitats, like the world's oceans. Or how the quiet hiss of electric bus transport in one city might be connected with the noise of two-stroke petrol engines in another.

While Rachel Carson's *Silent Spring* may have led to far-reaching policy changes within her own country, a corollary of this was that chemical pesticides no longer permitted in the United States were still manufactured domestically but then exported and traded globally. It is a pattern still at work today, with biocides ranging from atrazine to neonicotinoids – as well as the high-sulphur diesel often pressed on "developing" African countries with more lax environmental regulation – in a process termed "regulatory arbitrage".[13] And so the noise of the most polluting internal combustion engines increases in the Global South, even as automotive designers in richer nations engineer the future sound of electric vehicles, so "composing the soundscape of the 21st-century city" (De la Garza 2021). And vice versa: the silence that Carson warned of – a silence that haunts the modern environmental imagination – is then repressed only to reappear elsewhere as an externality: a silent spring exported or displaced to other, "unheard of" places.

We end, then, with the paradox of acoustic riches and diminishment with which we began. On the one hand, new audio technologies are unlocking previously unheard realities in the field of "digital bioacoustics".[14] On the other hand, human abilities to record and explore acoustic environments coexist with the gathering silence, or lo-fi drone, of anthropogenic action as sensory crisis. The complex and uneven acoustic geography that results – a biosphere where sound and silence are linked via the unevenness and inequities of the global economy – is surely something that any sound-based environmental history of the future would need to listen for.

Notes

1 The cape robin's repertoire is easily found online. It has a "song" comprised of a sliding down note ("a plaintive, descending *peeeeeuu*", says Wikipedia) intermixed with a chatty, fluting noises; and then an alarm "call" that is low and trisyllabic (*WA-dur-dra* or *TURR-da-da*). It can mimic all kinds of other birds and (as a species now well adapted to living in suburban gardens) has also been recorded impersonating the sound of hooting cars.

2 As the Mediterranean's waters "are fished clean by trawlers with sonar and efficient nets", Jonathan Franzen reported for *The New Yorker*, "its skies are vacuumed clean of migrants by the extremely effective technology of birdsong recordings" (2010). Sean O'Toole makes the link to Franzen's piece in his essay "The Sensory Complex: Hearing the Bird Calls and Auguries in James Webb's Work" (in Webb 2020: 107–17).

3 Throughout sound studies, there is a repeated claim that there is something "Western" (or a subtle preferencing of European modes of being and experience) inherent in the privileging of the visual. At the same time, Sterne cautions against drawing overly schematic boundaries and binaries between the visual and the audible, "a set of presumed and somewhat cliched attributes" that he terms "the audiovisual litany" (2012: 9), and which may work to reassert unhelpful oppositions between "modern" and "traditional" societies.

4 The cultures of nature imposed on sites around the world by European colonisation can be read directly off the landscape in a city like Cape Town; here they also infiltrate the soundscape. Rhodes's green imperialism of the late 19th century introduced foreign birds, like European common starlings, to the Cape, attempting to recreate the soundscape of English gardens and woodland. For an account of how bird vocalisations become entangled in questions of aesthetic value within the colonial context, see Low (2016). His work shows how (contra the diffusion model of European expansionism, so often mapped onto natural history), the evolutionary home of songbird species is the Australo-Pacific, a region now understood by biologists as "crucible and exporter to the world of songbird diversity" (Haskell 2022: 172).

5 The 1889 recording of a captive white-rumped shama (*Kittacincla malabarica*) was made by an eight-year old Ludwig Koch (who had been given an early Edison phonograph by his father) and is now preserved in the sound archives of the British Library. See Bevis (2019) for an account of the complex and often cumbersome methods of creating field recordings of birds in the early 20th century.

6 The metaphor of the "purely biological ambient sounds of our habitats" as something carefully "orchestrated" by evolution is explicit in the first articulation of Krause's theory in 1987 (14). It appeared illustrated by a musical stave, with "cicada" in place of a crossed-out "violin", "coyote" in place of "viola", "bullfrog" in place of "double bass", etc. (Krause 1987: 14).

7 Mark Smith's 2011 account of "Listening to Early American Industrialization" is an example of how much sound-based history has turned on tracking cultural and political responses to industrial revolutions, railroads, the machine age, and the internal combustion engine. See also Coates (2005).

8 See Twidle's account of Cape Town's N2 highway (2017) and Watkins's enquiry into "Sonic Apartheid: Ecoracism, Apartheid Geographies, and Noise Pollution in Cape Town's Blikkiesdorp" (2019), a research project which entailed residents keeping a Noise Pollution Diary.

9 As Timothy Morton points out in his argument for ecology without nature, sound history in the United States has often been linked with a place-based environmental politics, for example in the American West, where campaigns to ban military aircraft and snowmobiles from the national parks are "aided by accounts of what the Rockies sounded like a century before the internal combustion engine" (2007: 95). A certain version of sonic history can then be seen as a symptom of a radical loss of place, but an aestheticised version of place, "as the suffix 'scape warns us'": "A landscape is a painting. Soundscape has been framed": "It would be less seductive", he goes on, "to call the sound world a 'noise-scape'" (2007: 95).

10 "100 Soundscapes of Japan", Ministry of the Environment. Archived from the original on 2012-06-08. Retrieved 18 April 2011. See Wikipedia "100 Soundscapes of Japan" for the list in English: https://en.wikipedia.org/wiki/100_Soundscapes_of_Japan#cite_note-Hundred-1

11 See Helmreich, who quotes the *OED* definition*: "Transduce*: to alter the physical nature or medium (of a signal); to convert variations (in a medium) into corresponding variations in another medium" (2015: 222).

12 In its "100 Most Important Records Ever Made", *The Wire* magazine grudgingly affords *Songs of the Humpback Whales* a place on the list, explaining how it broke with existing ideas and formats of "nature recordings":

> Until the release of Roger Payne's now excruciatingly familiar recordings of Humpback whales, the format of sonic entertainment of an extra-human nature tended towards pseudo-science. As one's stylus tracked across the dark vinyl waste of a birdsong long player, the fauna would be caged off in separate bands, to be named and classified by sepulchral voices in weighty "objective" tones. Payne delivered up the first psychedelic bio-acoustic document. His intentions were prophetically conservationist and the project took off with remarkable force. Despite their limited range of sounds, whales continue to sing the call sign of the New Age and Green movements.
>
> (*The Wire* 1992)

13 See the *Public Eye* report by Gaberell and Viret (2020), which shows that in 2018, European nations exported 81,615 tonnes of 41 different pesticides banned for use in their region of production. On the international flows and arbitrage of "dirty diesel", see Gueniat et al. (2016) and Hecht (2019).

14 As Karen Bakker shows in *The Sounds of Life* (2022b), coral and fish larvae find their way back home by imprinting on the unique sounds made by the reef where they were born: "Moths have developed echolocation-jamming capabilities to hide themselves from bat sonar. Flowers and vines have evolved leaves to reflect echolocation back to bats, as if they were luring their pollinators with a bright acoustic flashlight" (2022b).

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4

GEOGRAPHIC INFORMATION SYSTEMS, REMOTE SENSING, AND SPATIAL DATA INFRASTRUCTURE

Marina Miraglia and Kairo da Silva Santos

Introduction

This chapter is organised in three parts: first, it offers a synthesis of environmental history as an interdisciplinary science and an analysis of geotechnological tools, in particular geographic information systems (GIS), the vector files, and remote sensing products. Second, it explores the use of historical GIS and explains the application of these new technological tools. Finally, it provides examples of their application in studies conducted on the dynamics of the historical landscape in Petrópolis (Rio de Janeiro State, Brazil) and historical cartography and toponymy in the Guarani Jesuit Missions (Argentina, Brazil, and Paraguay).

Introductory discussion on research in environmental history and GIS

Environmental history focuses on nature's role in human life (Worster 1991) and vice versa, making it possible to approach the description and analysis of how society and the environment affect each other. In this sense, this discipline is used as a conceptual, theoretical framework and, at the same time, as a methodological guide for carrying out the reconstruction, identification, and interpretation of the main political, social, and economic processes, as well as short-term environmental ones, the relationships between both dimensions, and the impact they generated on the space.

Leal, Soluri, and Pádua (2019) consider that the original topics of study by environmental historians of Latin America were forests and forest areas in general, degradation processes such as deforestation, and socio-economic changes. Other themes have been the agrarian or "rural" world, the history of conservation, protected areas, and the promotion of environmental justice, urban studies, water histories, and urban infrastructures (see Chapter 21, this volume).

Currently, environmental history is experiencing a boom in projects and general topics of study in Latin America, on both a geographical and a temporal scale. The themes are becoming broader and, concomitantly, the analysis tools, too. Marine ecosystems, agricultural ecosystems, war issues, gender, climate history, urban environmental history, and historical cultural traditions and traditional ecological knowledge of the original peoples of Latin

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America that influenced the perception of the environment by different societies are analysed. Thus, geotechnologies provide the necessary tools for the integration of historical sources in environmental analysis.

The intertwining between the field of environmental history and GIS points to promising paths in both new and old questions to be debated by researchers in the field. Worster (1991: 201–2) proposed that environmental history takes place at three levels of investigation, where three levels of questions apply knowledge from other areas, and at each level, "contributions from other disciplines and applying special methods of analysis" give us clues about the possibility of incorporating different approaches used in GIS environments. This is not only for the purpose of data integration, but also for analysis methods, where the main contribution of GIS to geography and related disciplines would reside (Longley et al. 2013).

The first level deals with the understanding of nature. In this sense, the focus of the environmental historian is how the past environments were organised in organic and inorganic aspects. Here the disciplines of history, ecology, and, instrumentally, historical documents and databases play a critical role. The location and spatialisation of this data set are fundamental steps in recreating the elements of past space(s) and time(s). The second level deals with the interaction between the socio-economic system and the environment, focusing on techniques used in the production of spaces, in work relations, in tools, and in the different ways that different peoples appropriate the environment. Each group has unique strategies and mechanisms, making the approach to these issues even more relevant. Modelling and dimensioning flows and interactions between societies and space is one of the greatest challenges for geography and related areas, since maps have traditionally always constituted fixed means of representation. The new representations in the digital environment have opened other possibilities to analyse and visualise these transformations. Finally, on the third level, Worster points out the world of meanings and culture, transcribed as follows:

> that more intangible and uniquely human type of interaction, purely mental or intellectual, in which perceptions, ethical values, laws, myths and other structures of meaning become part of an individual's or a group's dialogue with nature.
>
> *(Worster 1991: 202, free translation)*

Based on this perspective, we aim to bring together concepts and practices within the field of GIS and related areas as tools for environmental history. In the following section, the works of Santos, Antunes, and Fernandes (2019a) and Miraglia (2019) are offered as examples of applications and theoretical-methodological dialogues necessary to think about a fresh and fruitful approach for environmental historians.

The historical GIS: new tools and roads for environmental history

The diversification of the field of environmental history research in recent decades has presented not only a vast set of aspects of interactions between social and natural systems (Pádua 2010), but also the introduction of different methodologies. As in other fields of knowledge, from the middle 1990s onwards, the growth of geographic information systems boosted the use of complex analyses, integrating different systems and databases. This fact is not limited only to quantitative analyses; it also applies – more unexpectedly – to qualitative approaches. In the introduction to their book on historical GIS, Gregory and Ell (2007: 1) point out that

the arrival of GIS quickly generated an "increased awareness of GIS in historical research", given the possibility of GIS allowing "that geographic data be used in far more powerful ways than any other approach allows". It should be noted that the area of Historical GIS and environmental history are distinct fields, each with its theories and influences over the years. But given the nature of spatial analysis imbricated in both themes, they can prevail when their perspectives are incorporated in the search for the resolution of historical problems, arising from the interaction between human systems and natural systems.

This section explores two works that adopted an approach with the Historical GIS and allow different analyses in relation to changes that have occurred either in natural or social systems. They are not strictly environmental history, but they open doors to reflect on the possibilities of approaches for our discipline.

In a study on the landscape dynamics in the city of Petrópolis (Brazil, Río de Janeiro State), Santos, Antunes, and Fernandes (2019a) developed an analysis to identify and compare the changes that occurred in the three main rivers that flow through the genesis area of the city of Petrópolis, based on different historical records. Although the dynamics of the hydrographic basins of these rivers were not the central focus of the publication, it is possible to infer that human action directly impacted factors such as sinuosity, flow, and drainage capacity of the soil surrounding the riverbeds. Using a set of historical data, such as maps and other documents, as well as current satellite images – products of remote sensing – the authors mapped the changes carried out in the riverbeds (like decreases in the width of the rivers, changes in their course, and the percentage of change in vegetation cover in the study area). Another key facet added to the research were the recurrent floods that occurred in these hydrographic basins, which have been recorded in newspapers since the beginning of the 20th century. It was thus possible to conclude that the impact of human action, over more than a century of occupation of the city, led to the potential for events like these, especially in case of extreme events in periods of high rainfall.

To arrive at these initial answers, the main operational tools came from GIS. Satellite images as data, land cover classification as a method, and degradation detected as a result of analysis were fundamental, as:

> it [made] clear that the vegetated areas are concentrated in these slopes with wide slopes and in the valley bottoms the non-vegetation features spread, putting pressure on the fluvial channels, which had their courses altered to adapt to the industrial buildings that were becoming denser in Petrópolis, as well as the growing demand for residential buildings.
>
> *(Santos et al. 2019a: 12, free translation)*

The layering of different historical maps, based on the georeferencing of these documents, made it possible to compare the shifting courses of the rivers over more than 100 years. Considering the possible cartographic errors embedded in the different techniques that originated these documents, the alteration in the sinuosity and width of the main channels of the Rio Palatino, Quitandinha, and Piabanha was now measured with some precision. Thus, Santos, Antunes, and Fernandes (2019a) argue that there is evidence of a link between the alteration conducted in these channels, changes in land cover, and registered flood events.

Based on more recent propositions such as McEvoy (1986) and Worster (1991), one can contend that the methodology used by Santos, Antunes, and Fernandes (2019a) has the capacity to contribute to the first and second levels of Worster's proposal. Therefore, GIS

provides tools to identify the transformations of the biophysical world over time and to analyse both the socio-economic constitution of societies and their interrelation with certain geographic spaces.

In another important work, Miraglia (2019) introduces a theoretical-methodological discussion on the use of GIS for processing historical cartography and its integration with environmental history. The fundamental role of GIS is highlighted "in the incorporation and processing of historical and current secondary sources … geographic databases", as well as the power to "identify past socio-economic and environmental events and processes and their geographic location as an input for the spatial analysis of the historical development of the territory" (Miraglia 2019: 26–7).

Miraglia recognises that documentary, cartographic, and artistic sources are important secondary sources for research on socio-environmental issues in the past and present. In the case of the American continent, the cartographic and pictorial primary sources were the very first documents upon which the fantasy of the "American territory" was projected, based on the European imagination.

To this end, incorporating cartographic science concepts is essential, since maps, whether historical or not, convey covert concepts, methods, and biases that need to be investigated before their use in any research as a data source. Their scale, origin, and techniques may affect the accuracy and quality of the information contained. For environmental history, as well as other fields of knowledge, a cartographic representation needs to be interrogated through these methods before providing data to answer the questions posed.

Historical maps are of great importance because they usually contain information that cannot be found in any other written source (Miraglia 2019), in what can be called a true spatio-temporal testimony from the cartographer's point of view.

In recent years, there has been a growing interest in the application of GIS in various fields, including environmental history. GIS allows researchers to visualise and analyse data in a geospatial context, providing insights into the relationships between people, places, and the environment. With the ability to integrate various types of data from different sources, GIS has the potential to open up new avenues for research in environmental history. Figure 4.1 summarises one of the possibilities of GIS for environmental history.

The GIS Science interface and range of geotechnologies could thus be based on the integration of historical data and the modelling of social spatial patterns. In the first case, as discussed earlier, the integration of historical data allows one to reconstruct the environmental and socio-economic bases of the past, having different data sources as a basis for this.

The record found in historical maps, paintings, and texts are the main means to recreating past environments, and the integration, usually in a visual and digital model, can be carried out using different software. The second case examined by Miraglia (2019), dealing with the modelling of spatial patterns, uses material and immaterial (like place names) elements of human culture, in addition to their use in space, to understand past movements of social groups, historical artifacts, place names and the symbolic socio-political dimensions.

The practices of a modern agricultural culture and crop rotation, as in the case of different indigenous groups in the Americas, for example, go beyond a mere set of agricultural techniques. In many cases, they were part of distinct cultural and symbolic systems. The Mundukus, for example, used the labour of men and women, each with defined roles in the established system, and it is "important to highlight that the indigenous peoples had as their principles the division of labor by the sexes, as well as the discernment of the concept of

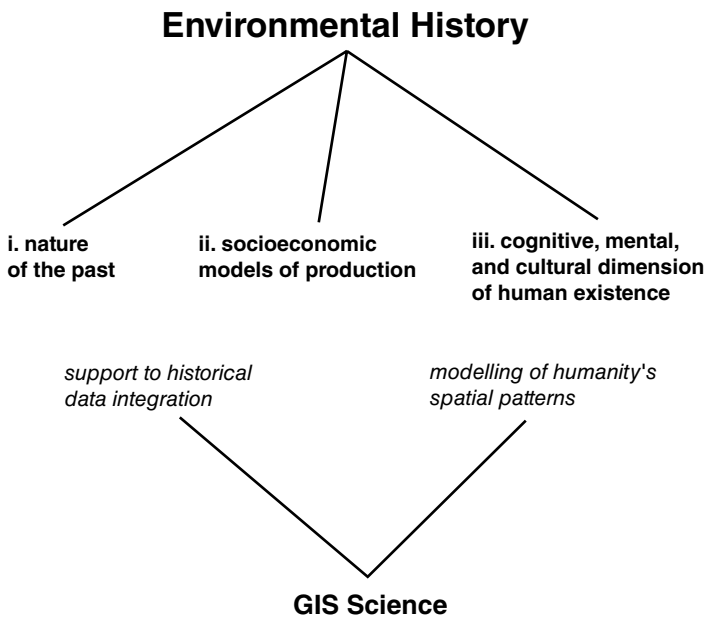


Figure 4.1 The synthesis of integration between environmental history and GIS Science. Authors' own elaboration, 2022.

properties" (Alves 2001: 10). Understanding this behaviour requires not only analysing the past and present records, but also reconstructing the environmental and cultural traces found. Thus, the multiplicity of possibilities of GIS Science with an interface to environmental history leads us to expand the application to rescue the past from the focus on cultural elements of social groups.

Environmental history and toponymy: a perspective from the integration of geotechnologies

The incorporation of geotechnologies in the field of environmental history is increasingly popular and innovative. Toponymy, studied in *La toponimia como herramienta para la identificación de geografías históricas: las misiones jesuiticas guaraníes de Argentina y Brasil* (Miraglia and Da Silva Santos 2021), was the object of study to understand the transformations that took place in the triple-border area between Argentina, Brazil, and Paraguay. However, as the only element, its focus was on the cultural dimensions of occupation and production of 'missionary spaces'. When analysing the research on the Jesuit Guarani Missions, there is an enormous potential for analysis, from the perspective of environmental history, to incorporate a set of geotechnologies.

Returning to the perspective already presented by Worster (1991), toponyms emerge as crucial elements to contribute to two dimensions of analysis of environmental history, allied to the use of different geotechnologies. About the nature of the past, place names can give clues about the past environment, as pointed out by Membrado-Tena and Iranzo-García (2017). The authors started from a diachronic perspective of the names of the places to virtually reconstruct different natural and cultural elements of the historical landscape of the

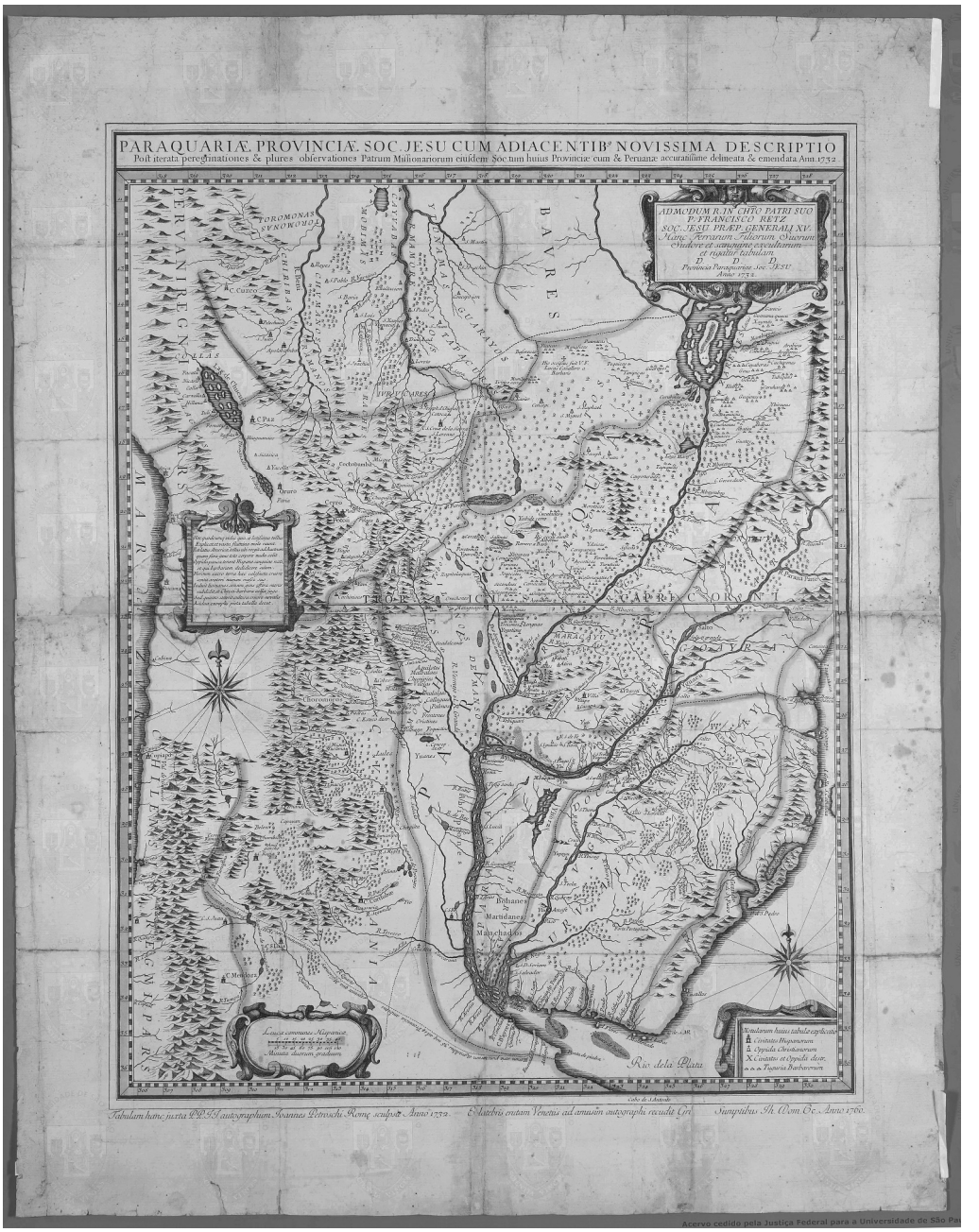


Figure 4.2 Victor Martin de Moussy. 1873. "Paraquariae Provinciae". Image no 0464003. David Rumsey Historical Map Collection (https://www.davidrumsey.com/luna/servlet/detail/RUMSEY~8~1~20532~510058:Paraquariae-Provinciae-?sort=pub_list_no_initialsort%2Cpub_date%2Cpub_list_no%2Cseries_no&qvq=q:paraquariae%20provinciae;sort:pub_list_no_initialsort%2Cpub_date%2Cpub_list_no%2Cseries_no;lc:RUMSEY~8~1&mi=0&trs=1).

region of Vinalopó. As carriers of symbolic power, the place names were useful as descriptors of natural and cultural characteristics.

In turn, from the perspective of the cultural dimension, the names of places can be seen not only as identifiers of elements in space, but as part of a system of meaning, understood from the perspective of spatial symbolic forms. Thus, as Corrêa (2018) argues, as symbolic spatial forms, names are fixed and flow, capable of integrating the dynamics of the movement of space production and transmitting different messages. As part of the cultural dimension, place names thus indicate the subjective dimension of connection between society, or groups present in a place, and their relationship with the environment. The dynamics of the territory's social relationship also point to the intrinsic values and memories.

Within this perspective, we return to the case of the *guaraníes* Jesuit missions. Many historical transformations characterised this region. The reports of travellers, explorers, and historians were important textual primary sources that gave account of these changes implemented by the Spanish and Portuguese monarchies in dominating the local indigenous peoples and building a settlement under the central monarchy.

The *guaraníes* came from the Amazon River basin in Brazil and formed part of the Tupi-Guaraní ethnic group (in the Plata basin region: southern Brazil, in the current states of Paraná, Río Grande, and Santa Catarina; north-eastern Argentina, in the provinces of Misiones, Corrientes, and eastern Paraguay, in the departments of the East of the homonymous river). The guidelines for locating the Spanish authorities included three aspects: the defence investigation, the evangelisation, and the extraction of riches such as gold and silver. The Jesuit missions were founded in the area in the studio in 1609 and were maintained for 159 years, until the Jesuit order was expelled from the South American territories in 1768.

With the founding process of the first reductions, cities, towns, and villages arose in the area that encompasses the territories administered by Brazil, Argentina, and Paraguay. These human settlements were contoured by local contexts, such as the displacement of previous occupations, the foundation of immigrant colonies, or even the colonial occupation of the indigenous territory. Most cities that had their origin in the old Jesuit settlements kept their names. However, the cities and towns established later had changes in their names or characteristics different from the original names. These differences arose when comparing the later changes with the nominations of the old reductions. GIS can contribute to integrating cartographic and textual documents to recreate relevant aspects of the area. This would help us to understand the environment and its geophysical transformation, initiated by this European occupation of native lands.

In the framework of the 10th Symposium of the Latin American and Caribbean Society of Environmental History (SOLCHA) organised by FLACSO Ecuador (Miraglia and Da Silva Santos 2021), the process of integrating historical and environmental data was highlighted in a geographic database and later in a spatial data infrastructure (SDI). The case study offered valuable historical insights that revealed a diverse range of situations analysed by researchers through the study of old maps. Since most of these are available in raster format,[1] it is necessary to carry out the vectorisation of the files to load their attributes in the standardised form required by the SDI. Spatial data infrastructure is important because it provides a framework for managing, sharing, and using spatial data. For example, SDI helps to reduce duplication of effort in data collection and maintenance and can improve the efficiency and effectiveness of managing data. By providing access to reliable and accurate geospatial data, SDI can help researchers and historians to understand how the natural environment has changed over time.

In the case of the Jesuit missions and the use of the toponymic extraction of all the maps and the standardisation of the bases, the areas could be identified that agglutinate or "clump together" the largest number of toponyms as a function of their concentration. The Kernel method[2] allowed one to both identify and aggregate these names in areas of concentration with reference to the "toponymic motivation" of each human occupation. Later, a file was generated to estimate the density of names with the same motivation. The newly created classes were linked to religion – Hagiotoponyms, Hierotoponyms; the cultural aspects – Anthropotoponyms, Axiotoponyms and Ethnotoponyms; and finally, the environmental aspects – Hydrotoponyms, Phytotoponyms, Zootoponyms and Geomorphotoponyms. Dick (1990) proposed these categories to classify toponyms based on the motivation behind their meaning. The words Hydro (related to water resources), Phyto (related to plant species), Zoo (related to animal species), and Geomorpho (related to landform shapes) are some of the classifications used to describe the physical-natural aspects that influence the naming process. The other terms (Hagiotoponyms, Hierotoponyms, Anthropotoponyms, Axiotoponyms and Ethnotoponyms) deal with the cultural aspects of the classification proposed by Dick.

The use of memories and values were linked to Catholicism, descriptive toponymy of the physical environment in general, in places without Jesuit occupation, identification of strategic resources in areas of interest (wetlands, fertile lands, cultivation sites, etc.).

The territorial organisation in the Jesuit missions precipitated a large number of geographic and environmental transformations, which were analysed using the geotechnologies applied to the process of historical cartography and toponymy. The identification of the Jesuit and Guaraní toponymy presented a challenge due to the integration and interpretation of their names and their cultural meanings. One of the main challenges in integrating cartographic and textual documents in research in environmental history lies in the difference in the level of detail presented in the data. This can result in a lack of information in some documents and the inability to cover certain study areas. Furthermore, the interpretation of these documents can be hindered by the need to search for the meaning of specific terms in dictionaries.

From the end of the 18th century, religious place names gained more weight through Catholic doctrine implemented by Spanish and Portuguese colonisers in America than by Jesuit policy. In analysing the symbolic spatial forms in the "cities", it is notable that, in the scope of the Jesuit missions, the names with environmental motivations began to appear with greater frequency only in the early 20th century. Before, especially during the periods (during the 16th to the 19th centuries) of Spanish and Portuguese colonisation in the region, few cities (like Corrientes, Yta, and Ytapua) had references related to the environment.

Conclusion

The processing of historical environmental information, using geotechnologies and their incorporation into standardised databases, such as spatial data infrastructures, enable the combination, comparison, and integration of data through the application of geographic concepts such as location, distribution, association, interaction, and temporal shifts. In this way, the data extracted from historical sources, such as maps, remote sensing products, censuses, geographic data, and written documents, can be added to the set of information already compiled, enabling the reconstruction and historical environmental analysis of past landscapes and territories.

The incorporation of geotechnologies and GIS promises to be a new research method in the field of environmental history, using existing historical data and aiding in the modelling of environmental patterns. This approach is accompanied by new theories and techniques, opening up possibilities for investigation and analysis. Thus, understanding historical processes and the context of the production of historical documents and texts is crucial for interpreting the data presented on past landscapes and spaces. For this reason, knowing the maps and other documentary sources is a precursor to any investigation, and, as discussed here, it remains vital to the field of environmental history.

Notes

1 In GIS Science, digital data models have two basic representations: vector and raster data. Vector data represents features as points, lines, and polygons, and it stores the coordinates of the vertices that make up these features. Raster data, on the other hand, represents the surface of the earth as a grid of cells, each of which contains a value that represents a specific attribute.

2 According to Smith, Goodchild, and Longley (2018: 34) "the term kernel in geospatial analysis refers to methods (e.g., density modeling, local grid analysis) that involve calculations using a well-defined local neighborhood (block of cells, radially symmetric function)".

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PART II

Non-Human Agencies


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5
THE TANGLED BANK

Harriet Ritvo and Rebecca Woods

> It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us.
>
> *Charles Darwin,* On the Origin of Species *(Darwin 1964 [1859]: 489)*

In 1859 Darwin began the final paragraph of *On the Origin of Species* with this ringing assertion of the interconnectedness and interdependence of organisms of all kinds. Although he made many changes in the text of subsequent editions, in 1876 he concluded the sixth, the final one on which he worked, in the same way. It is noticeable that the position of humans in this integrated system seems slightly ambiguous – we are clearly yet another "elaborately constructed form", and Darwin certainly did not mean to exclude us from the processes that he described in the *Origin* and elaborated in subsequent works. Nevertheless, he characterised the "laws" as "acting around us".

Perhaps, whether intentionally or not, Darwin was acknowledging the unusual relationship that humans have developed with other organisms. In some ways, we are, as we and our predecessors have always been, animals among other animals – sharing similar metabolic and reproductive functions, potential prey as well as deadly predators, equally vulnerable to bacteria and viruses. While Darwin mentioned only plants, bugs, worms, and birds as inhabitants of the entangled bank, later in the paragraph he described the "production of the higher animals" as "the most exalted object which we are capable of conceiving". But gradually we developed a complementary kind of entanglement, one that simultaneously places us a bit outside this system, as Darwin demonstrated when he used artificial selection as a kind of heuristic to explain and support his argument for evolution by natural selection. It also intensifies our connection with a radically reduced set of fellow organisms, specifically those that we have managed to domesticate and those others that have figured out how to piggyback on the agricultural, urban, and suburban environments that we have created.

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This chapter focuses on animals (all medium to large mammals, like ourselves) who exemplify the variety of possible entanglements. Even the apparently wildest turn out to be entangled with humans. Before their extinction, mammoths interacted with humans only as occasional prey, but as the targets of scientific resurrectors, they may end up as anthropogenic creations. The wolves that have transformed the ecosystem of Yellowstone National Park were intentionally introduced, to replace conspecifics that had been exterminated decades earlier. European attempts to replace the extinct aurochs with allegedly primitive breeds of cattle have been less successful, in part because of the absence of predators like wolves. Raccoons are both closer and more distant – occasionally pets or captives, but mostly just ubiquitous in their American homelands and, increasingly, in the far-flung territories to which they have been introduced.

Rewilding

The reintroduction of grey wolves into Yellowstone National Park has looked like a rewilding success story. Yellowstone's original wolf packs had disappeared by the mid-20th century, killed according to park policy, which, like most wildlife management in the late 19th and early 20th centuries, focused on protecting species that were considered desirable. Large predators did not fall into this category. The subsequent boom in elk population (the few remaining mountain lions and grizzlies could not make up for the lost wolves) ultimately contributed to the impoverishment of local fauna and flora. The grey wolf was listed as endangered in 1974, and 31 wolves from Canada were relocated to Yellowstone in 1995 and 1996. Wolf populations elsewhere also benefitted from the protection offered by the Endangered Species Act, and a year later, a few wolves from Montana were also introduced. After only a couple of decades, according to one National Park Service estimate, the wolf population had grown to more than 400. During the same period, the depleted population of beavers had rebounded, elk herds had diminished, and much of the vegetation that they had overbrowsed had begun to flourish again (Anon. 2022; Farquhar 2021; Kamin 2020). Ecosystems are complicated, and it is hard to attribute multiple changes to a single cause, but it seems likely that the wolves were responsible for the general reinvigoration.

But this success may turn out to be temporary. Wolf reintroduction was always controversial, which is one reason that it did not happen until two decades after the species was listed as endangered. Ranchers feared (without much reason, as it turned out) that wolves would decimate their sheep and cattle, and hunters just wanted to keep killing them. As the numbers of Yellowstone wolves increased, some of them roamed outside the park. As of 2017, wolves had been delisted (that is, they were no longer protected as endangered) in Montana, Idaho, and Wyoming, and subsequently, quotas that limited hunters to killing one wolf per season were removed in some areas that bordered the park. As of February 2022, the National Park Service listed the wolf population of Yellowstone as 89 (Anon. 2022; Devereaux 2022; Dore 2022).

These vicissitudes exemplify both the complex relationships among the animals and plants within any ecosystem and the particular complexities of the relationship between *Homo sapiens* and *Canis lupus*. Within less than a century, the policy of park wildlife managers had shifted from extreme persecution to extreme protection. In the areas surrounding the park, however, earlier attitudes have tended to prevail. This range or disjunction of policies is not unique to Yellowstone. Extirpation of rival predators was part of the European engagement with North America from the beginning – one reason that the current deer

population of the eastern seaboard is larger than the one encountered by settlers at Plymouth and Jamestown. Government policy in both the United States and Canada has traditionally encouraged elimination, and recent increases in wolf populations have inspired not only the repeal of local protections but even the local reinstitution of bounties. American antagonism reflected attitudes that had long prevailed in Europe, where wolves were demonised in folklore and hunted in the flesh. They became extinct in England during the 17th century (following the bear, beaver, and wild boar) and survived a little longer in Scotland (Harting 1880: 115–205). Their numbers in continental Europe also dwindled significantly, and in many places they disappeared; recent protection has led to an increase in both numbers and range, as well as to controversies like those sparked by the resurgent Yellowstone wolves.

Although the radical impact of humans on wolf numbers is relatively recent (at least in terms of millennia), the entanglement of our two species is much older. Wolves were the ancestors of dogs, the first animal species to be domesticated by many thousands of years. Experts disagree about the timing, since the fossil record is characteristically patchy and it is difficult to distinguish the earliest dogs from their immediate lupine forebears. But recent genetic analysis suggests that domestication dates from at least 23,000 years ago (Perri et al. 2021). Similarly, there are conflicting theories about the means by which the earliest domestication was accomplished. Did wolf the hunter decide to cooperate with man the hunter as they followed the same herds during the long pre-agricultural period? Or did wolf the scavenger decide to endure (and subsequently enjoy) the companionship of people in order to eat their garbage? (The second theory suggests that the domestication of the dog was similar to that of the cat.).

These ambiguities continue to influence canid taxonomy and nomenclature. According to the generally accepted definition, a species is "an interbreeding group of biological organisms that is isolated reproductively from all other organisms. … Most species cannot interbreed with others; a few can, but produce infertile offspring; a smaller number may actually produce fertile offspring" (Allaby 2009: 590). Among that small number of apparent exceptions are dogs and wolves, which interbreed unproblematically; hybrid puppies with varying percentages of wolf ancestry are readily available for purchase on the internet. It is possible, however, that instead of offering an exception to the conventional definition of species, this philoprogenetivity broaches an issue with wider taxonomic implications. Of the common domesticated animal species, only the pig and the rabbit share the same formal species name as their wild ancestors, even though, like the dog, all domesticated species can produce fertile offspring with their undomesticated relatives (if those relatives have not become extinct). This suggests that, in the view of taxonomists, the fact of domestication – the particular entanglement of domesticated animals with humans – is more significant than the physical and genetic similarities that connect them to their close relatives. And, of course, it is this distinction that allows the wolf to be protected as endangered. If *Canis familiaris* were reclassified as *Canis lupus*, wolves would become one of the commonest species, not one of the rarest.

Restoration

Like the innumerable breeds of dogs, all domesticated cattle reflect millennia of human manipulation; in Darwin's terms, they are products of artificial rather than natural selection. The ancestor of all domesticated cattle, including both those now found worldwide (*Bos taurus*) and the humped zebu cattle (*Bos indicus*) of South Asia and East Africa, was the

aurochs (*Bos primigenius*). No aurochs are now living (except in strictly cladistic terms), but they have not been extinct for long; the last one, a female, was killed in what is now Poland in 1627. In addition to bones and other material evidence, there is plenty of human testimony about them, beginning with the paintings on Pleistocene cave walls (Ritvo n.d.). They were hunted by the Romans, who made hunting horns out of their impressive horns, and they figured in bestiaries compiled by naturalists who might actually have seen them. Their original distribution was broad, stretching across Eurasia and North Africa, and it is likely that they have been domesticated more than once. Hunting doubtless contributed to their decline, but the primary and secondary effects of domestication were also important. The spread of agriculture transformed the aurochs' habitat, and once the process of domestication was underway, domesticators normally tried to eliminate the wild kin of their livestock, who might, along with less closely related animals, be perceived as potential competitors, threats, and general nuisances. (This inclination did not disappear after the early period of domestication. It was manifest in attempts of European settlers to protect their cattle from the rinderpest infection originally transmitted to indigenous African ungulates by their introduced livestock, and is currently manifest in kangaroo control policies in Australia.)

The removal of wild conspecifics was also necessary for reproductive isolation of domesticated populations, which made it easier to select for desirable traits. Most pressingly, with regard to a large well-armed animal like the aurochs, relatively mild temperament was highly desirable. Later, other attractive traits could be targeted, so that in recent centuries cattle breeds have been specialised for the dairy or the butcher, for quality or quantity, sometimes even to accommodate consumer preferences for more or less fatty meat. Beginning in the 18th century, this focused selection process was supported by the institutions of modern animal breeding, including stud books, breed societies, and competitive shows. More recently, it has been enhanced by such technologies as artificial insemination and genomic selection.

Of course, at least until relatively recently, reproductive isolation was not perfect. Like canines, bovines readily interbreed across species and even genera. For example, there is recent evidence that the European bison (*Bison bonasus*), listed as Near Threatened but increasing on the International Union for the Conservation of Nature's (IUCN) Red List, preserves traces of an ancient aurochs cross (Soubrier et al. 2016). Conversely, the genome of most American bison (*Bison bison*), the focus a century ago of one of the most successful attempts to rescue a species on the verge of extinction, includes some contribution from cattle. The most famous of these attempts focused on preserving such habitats as Yellowstone National Park, but there were also contemporary efforts at domestication. Some ranchers who owned both bison and cattle encouraged hybridisation, a practice which continues to produce the meat marketed as beefalo and advertised as leaner than beef. In addition, it is likely, as is certainly the case with the aurochs inheritance of European bison, that some of the mixture in herds that have always been wild reflects the animals' own decisions before the range was fenced in.

The aurochs has recently had a kind of revival among people attached to a nostalgic idea of old Europe (pure, strong, maybe barbaric). In the 1920s and 1930s, Heinz and Lutz Heck (brothers and directors of the zoos in Munich and Berlin, respectively) attempted to recreate the aurochs by "breeding back" from various European cattle breeds that had retained characteristics that they identified as primitive. The symbolism surrounding this allegedly primordial European animal was readily incorporated into Nazi ideology, and their efforts were appreciated by senior Nazi officials. Others have been more critical, not only on



Figure 5.1 TaurOs grazing in Croatia in lieu of unavailable aurochs. Photo credit: Harriet Ritvo.

political grounds, but also because both brothers concentrated on superficial characteristics such as colour and horn shape, and since neither kept careful records of his original stock or the pedigrees of his "aurochs". An attempt is underway to repeat the Hecks' attempt, but to do it better. According to the Taurus Foundation, which is based in the Netherlands, "The aurochs has always been at the very root of the whole idea of a continent called Europe. It is in fact our continent's defining animal" (Schepers and Goderie 2013). Using relatively recent (but not absolutely the most recent) technologies, they have developed a breed called the TaurOs, which is currently being introduced in rewilding locations in Portugal, Italy, Romania, and Croatia.

The TaurOs has not completely supplanted the Heck cattle, however. Although the reputation of the Heck brothers was greatly diminished after World War II, their cattle have continued to enjoy a kind of niche esteem. Herds are scattered across Europe, mostly in barns and paddocks like ordinary cattle, but in some places, they have been introduced as part of an attempt to recreate the pre-agricultural landscape, in which semi-open ecosystems, the home of many species that could not thrive in forests, were maintained by wild grazers (Vermeulen 2015: 3). The experience of Oostvaardersplassen, a nature reserve in the Netherlands, shows that such attempts are complicated. To some extent this is the consequence of absence, since rewilding in proximity to human populations necessarily excludes the predators who complete an ecosystem; indeed, the response to the reintroduced Yellowstone wolves suggests that humans are likely to resist such introductions even in sparsely settled areas. And to some extent it is the consequence of abundance, since without predators, the expanding populations of reintroduced ungulates may make them vulnerable to other threats. Overpopulation of ungulates (horses and deer as well as cattle) caused a reduction in the numbers of trees and wild birds, and in the harsh winter of 2017–18, many of them starved and others were shot before they starved. As a result, and partly in response to horrified public reaction, reserve managers abandoned their original policy of allowing

what they called "natural processes" to unfold; interventions currently include veterinary attention, winter feeding, and several methods of population control (Weston 2022).

Opportunism

Unlike dogs or domesticated cattle, raccoons do not reflect millennia of human manipulation. Their entanglements with human cultures, human worlds, and the broader ecologies of which they are a part are of a different nature. The common raccoon, whose current taxonomical designation is *Procyon lotor*, is endemic to the Americas. *P. lotor* belongs to the procyonid family, which evolved some 20 million years ago in South America, then expanded northward when the isthmus of Panama rose approximately 2.5 million years ago (Justice 2021: 24–5).

Raccoons expanded widely and into a diverse set of habitats.[1] Their current range extends from Panama almost to the southern shore of Hudson Bay in northern Ontario, with only a few intervening mountainous rocky ranges and deserts not providing habitat to *P. lotor* (American Museum of Natural History n.d.). Certain instincts and evolutionary features have helped raccoons range so extensively across such diverse climates and habitats. As omnivorous mesopredators, raccoons are highly adaptable "in the wild" and in an evolutionary sense, in part because they are neophilic: they are drawn to and display curiosity towards new objects, an uncommon trait among wild animals, most of which are, in contrast, neophobic (Justice 2021: 41).

This curiosity is somatic, not solely cognitive. Their relatively hairless and unusually long-fingered "hands" are in fact elongated, sensitive, and dexterous front paws (they lack the opposable thumbs of simians). Raccoons are adept at opening doors, lifting latches, and working (with little hindrance) supposedly raccoon-proof garbage and compost bins. Their scientific name (*P. lotor*) is a nod to their well-known habit of dipping things – especially their food, which in their preferred wooded habitat near streams, includes crayfish, molluscs, and other aquatic species – in water, and is a vestige of European naturalists' varied and conflicting efforts to classify the species in the 18th century. Without an analogous animal to which they could draw a comparison, Europeans struggled to understand what the animal was, describing it variously as like a bear (English), dog (Spanish), cat (French), fox, or monkey. Mark Catesby, author of *The Natural History of Carolina, Florida and the Bahama Islands* (1731), gave it the taxonomical name *Vulpi affinis Americana* ("American fox-kin"); while Carl Linnaeus, the Swedish taxonomist, settled on *Urus lotor* (washer bear) (Catesby 1771 [1731]: xxix; Holmgren 1990: 64–7). In 1780, the German naturalist Gottlieb Conrad Christian Storr weighed in on the side of canine resemblance, moving the animal from the Ursus genus to a new genus, Procyon, so called for the brightest star in *Canis Minor*, the "little dog" constellation, belying, it might be noted, the German vernacular for raccoon, which is *Waschbär* (Justice 2021: 21).

Raccoons thrive in liminal landscapes. Equally comfortable in forests and on the verges of human settlements and agriculture, raccoons undoubtedly profited from and expanded with the northward extension of Mesoamerican agricultural societies, occupying the ecologically disturbed spaces between forest, field, and conurbation. Long before the arrival of Europeans in the 15th century, raccoons – or *arakunem*, *esiban*, and *mapachitli* in Abenaki, Anishnaabe, and Nahuatl, respectively – figured prominently in the cosmologies of Indigenous North American societies (Justice 2021: 54; Robles 2023).[2] As liminal figures, they mediated between underworlds and overworlds in the pre-Columbian Mississippian cultural complex, and more

broadly figure in various Indigenous knowledge systems as tricksters and bandits (Justice 2021: 49–61). Raccoon stories, dances, clans, and ceremonies, as well as names, abound across First Nations and language groups, signalling what Daniel Heath Justice describes as "a long and diverse relational history" (Justice 2021: 62).

This long and diverse relational history was violently interrupted after the European invasion of the Americas in the 15th century that led to widespread societal collapse (due to violence, disease, trauma, enslavement, and war) at a scale that exceeds comprehension. Often called the Great Dying (an estimated 56 million people at least died by 1600), the collapse of these great agricultural societies across North, South, and Central America put an estimated 56 million hectares of formerly agricultural land out of cultivation (Koch et al. 2019). The forests that regrew cooled the earth's climate by an estimated 0.15° Celsius – enough to cause the global weather phenomenon known as the Little Ice Age, and to create the impression, for many Europeans arriving in the wake of the Great Dying, of the Americas as a bountiful primeval forest, the consequences of which for European settler societies' understandings of "nature" and "wilderness" (especially as it determines relations to "wild" animals) is well-trodden ground for environmental historians (Cronon 1995; Ritvo 2014).

What did this mean for raccoons? Even in the absence of estimates of the continental population before the late 19th century, it is safe to assume that the effects of these seismic shifts on raccoon populations varied locally, but that on the whole, raccoons, who are strongly associated with human settlement and known cross-culturally as crop-raiders, and who were kin with so many Indigenous societies, had to respond to the broad social, economic, and environmental changes that ensued. In particular, while the human communities that had sustained them became targets of genocide, raccoons became the target of European fur traders. Never as prized as beaver skins, raccoon skins were nevertheless dependable as a "resource" to be extracted (Justice 2021: 40). Their predilection for fringes of human habitation made them ubiquitous on the "frontier" of settlement, and they became strongly associated as symbols of that frontier, especially as hats, and later as coats for sophisticated American urbanites (Justice 2021: 94, 119).

It is partly in their fur-bearing capacity that raccoons have begun what might be an early stage of global takeover. Exported to establish fur farms in the 20th century, free-living populations of escaped raccoons now plague communities across the world, bringing with them their modern reputation as urban nuisances. In Toronto, Canada, which is believed to have the highest population – and highest concentration – of raccoons anywhere on the planet (an estimated 50,000), they are so firmly established as troublesome urban "trash pandas" as to have become an unofficial symbol of the city (Justice 2021: 184). Of course, raccoons have been interpreted as nuisances in other historical and geographical contexts as well. John Josselyn, an English sojourner in New England in the 1660s, wrote that "They feed upon mass [probably mast, a word for chestnut mash]; and do infest our Indian-corn very much" (Josselyn 1860 [1672]: 151–2). But in their entanglements with humans around the world today, raccoons are mostly understood as urban pests, nuisances, and bandits.

Much of what makes them a scourge, from the human perspective, also primes them to become something of a dark success story for the Anthropocene. Their boldness and curiosity, their propensity as nocturnal creatures to time-share human spaces and resources, emerging as most people go to bed to raid compost heaps and trash bins, and retreating to their dens (often co-located in human dwellings) as we wake; their preference for liminal ecologies and their ability to thrive in human-disturbed landscapes, have all contributed to a global population boom (Justice 2021: 26). As staggering numbers of other species face dwindling



Figure 5.2 A young raccoon in Toronto, 2022. Photo credit: Peter Friedman.

numbers and the spectre of extinction, racoons have rebounded from a global nadir in the 1930s, surpassing their previous population high-water mark while extending their geographical reach into Europe, Japan, Russia, and parts of the Middle East, where they are widely viewed as threats to the local ecology (and sometimes to architecture as well) (Justice 2021: 28). The IUCN rates them as a species of "least concern", their lowest – or best – rating (IUCN 2016). Almost alone among wild creatures, the future looks bright for raccoons.

Resurrection

The reverse is the case for mammoths, despite the efforts of a few eccentric scientists. From a common ancestor, the moeritherium, which evolved approximately 50 million years ago during the Eocene, to the Miocene era tuskers and the mammoths and mastodons of the Pliocene and Pleistocene, at the height of their collective planetary dominance, proboscideans could be found on every continent except Antarctica and Australia.[3] The mammoth genus, *Mammuthus*, evolved 5–6 million years ago, just before that of the Asian elephant (*Elephas*), and just after that of the African elephant (*Loxodonta*) diverged from their common ancestor, *Primelephas*. All three genera coexisted in Africa for millions of years, but only *Elephas* and *Mammuthus* wandered off the continent more than 3.5 million years ago, migrating through the Mediterranean and, in the case of *Mammuthus*, ultimately spreading far across the northern reaches of the globe. (*Elephas* migrated west across Asia, where it now remains in South Asia as *E. maximus*, the Asian elephant) (Lister 2014: 11–16).

Woolly mammoths proper, *Mammuthus primigenius*, evolved relatively recently, about 600,000–800,000 years ago in eastern Siberia, expanding with the spread of glaciation into Northern Europe, Beringia, and to the southern border of the Wisconsin ice shield in what is now the northern United States. At its maximum, around 20,000 years ago, a hugely expanded (by contemporary measures) polar ice cap extended into and across northern Eurasia and deep into the North American continent; the average global temperature was more than six degrees Celsius lower than at present (Lister 2014: 18, 21; Pielou 1991: 19). In the shadows of these masses of ice, grasslands flourished; forests were a thing of the south. Alongside bison, woolly rhinos, caribou, wild horses, muskoxen, and saiga antelopes, woolly mammoths roamed these steppes, grazing on the rich and varied grasses. A keystone species, they were crucial architects of the steppe environment that supported their own numbers and those of many other species. Like other species capable of dramatically altering their environments through their innate physiology and behavioural propensities (for example, elephants, beavers, and humans), mammoths are understood to have powerfully influenced the northern environment during the last glacial maximum. Their size and selective grazing made mammoths the architects of their own eponymous steppe – the "mammoth steppe" that dominated Beringia until the close of the Pleistocene era (Ukraintseva 2013).

While African and Asian elephants still persist in ever-contracting refugia and despite many anthropogenic predations, around 15,000 years ago, a series of climatic fluctuations trending towards warmer temperatures began to affect the steppe environment that supported woolly mammoths and other Ice Age megafauna. Pulses of warming, lasting around a thousand years each, culminated in a steady retreat of the glaciers around 11,000 years ago (Pielou 1991: 9). In its wake, the ice left behind cold, barren deserts, dynamic landscapes that slowly came to be occupied by the alpine species that mark the modern tundra. As southern forests crept northward, the mammoth's steppe contracted (Lister 2014: 100). Their habitat became more fragmented, their numbers fell, and by 2000 BCE, they were extinct. As woolly mammoths were made vulnerable by climate change, it is almost certain that another expanding and opportunistic species, *Homo sapiens*, helped sound their death knell (MacPhee 2019). The extent to which man the hunter may have caused the demise of the woolly mammoth has been the subject of decades of scientific debate, but current consensus holds that human depredation was surely a factor. The decline of the mammoths coincided, in evolutionary time, with the rise of *H. sapiens*: our species has expanded throughout a world that was once proboscidean, until humans can be found everywhere, and elephants, the last remaining descendants of the moeritherium, cling to the fringes of Africa and Asia, all that remains of their taxonomic family's once-extensive territory.

Their iconic status, the association of our own species with their decline, and their deep evolutionary (and imaginary) imbrication with extant endangered elephants make woolly mammoths extraordinarily powerful – and controversial – as proposed targets of de-extinction and rewilding efforts. Just as pandas and elephants grace the logos of wildlife conservation organisations, the silhouette of the woolly mammoth, with its recognisably shaggy outline and curving tusks, proclaims the mission of flagship de-extinction programmes, like Revive & Restore, run by the Silicon Valley technoprophet, Stuart Brand, and Colossal, Harvard geneticist George Church's de-extinction start-up. Fed by the emotional response that woolly mammoths elicit from contemporary humans, such proposals are based on a set of overlapping ecological and evolutionary relationships at the level of the organism – between *M. primigenius* and *E. maximus* – and between landscapes and organisms.

In practical terms, proposals to resurrect the woolly mammoth hinge on a suite of biotechnological methods that, in concert, are theoretically capable of recombining parts of the woolly mammoth's genome with that of the Asian elephant, often billed as its nearest living relative. Specialists in ancient DNA are able to extract preserved (although damaged) fragments of DNA from frozen mammoth remains, which allows them to sequence portions (but not all) of the *M. primigenius* genome (Shapiro 2020: 111). Key aspects of this genome – those bits of DNA that give the signature curve to its tusks, its woolly hide, small tail and ears, and generous layers of subcutaneous fat – inserted into the genetic code of an elephant followed by embryo transfer, would allow the latter to gestate a hybrid mammoth-elephant, with the cold-adapted phenotype of the former. Over time, Church and others promise, animals that look and function more like mammoths than elephants will emerge as subsequent generations of chimeras are mated one to another (Shapiro 2020: 121–4).

Such proposals conjure visions of resurrected woolly mammoths roaming the Arctic, promising a real-world Pleistocene version of Jurassic Park, generating both enthusiasm and scepticism. For both sides of the debate, it is the tangled tundra that is at stake. At a moment when fears over the state of the planet and the accelerating climate crisis dominate our collective consciousness, many have questioned this impulse to "bring back" the woolly mammoth. When so many extant species, from the very small to the very large, are threatened with anthropogenic extinction, the value in resurrecting one long dead, however exciting, is not always apparent. Critics contend that capital, resources, and efforts would be better placed working to ameliorate the condition of the more than 41,000 species listed as threatened by the IUCN (IUCN 2022).

For others, it is the mammoth's – or cold-adapted mammoth-elephant chimera's – role as keystone species and architect of a whole ecosystem that makes the project worth contemplating. The mammoth steppe, marked by wide expanses of grasses and shrubs, cultivated by the selective browsing of woolly mammoths, and by the tendency of these bulky beasts to trample saplings, provided ideal conditions for the formation and persistence of permafrost. According to Sergei Zimov, whose Pleistocene Park currently employs small bulldozers against saplings in lieu of resurrected mammoths, a re-engineered Pleistocene Arctic has the potential to preserve and rebuild permafrost, and halt global warming in the Arctic (Zimov 2005).

But more moderate enthusiasts such as de-extinction expert Beth Shapiro worry about the consequences of plucking creatures from the frozen sands of time and depositing them into a future shorn of their former ecological relations – between members of their own kind as well as other plants and animals. As Shapiro argues, de-extinction is worth the vast outlay of intellectual and capital resources only if the ecological relations and entanglements they produced and sustained can be brought back to the future with them. CRISP-R-ed elephants wearing the coats, teeth, and tusks of *M. primigenius* may resemble woolly mammoths in form and feature, but what proportion of the mammoth's genome must be spliced into that of the Asian elephant to ensure that these chimeras will co-produce their tangled tundra? (Shapiro 2020: 124).

Unravelling

Over the last several centuries, those attuned to the signs have witnessed a set of sad disentanglements on our shared planet. The cumulative effect of human action on a global scale has been not only the disengagement of our own species from most others, but knock-on effects unravelling many other ecological relationships. Species are disappearing

at rates not seen since the last great extinction; ecosystems are left poisoned, denuded, impoverished. Our species, it seems, is accomplishing a mass extinction comparable to the demise of the dinosaurs – without recourse to an asteroid – thereby undoing millions of years of mammalian evolution. The tangled bank of Darwin's imagination was already unravelling in 1859; how much more it has done so today is measurable in the more than 800 species that have gone extinct since 1500, almost certainly a gross underrepresentation of the true scale of biodiversity loss.

At the same time, certain forms of human entanglements are thriving, assuming a disproportionate prominence as so many others wither. Measured in biomass, domesticated poultry now represents 70% of avian life on the planet; cattle and pigs 60% of terrestrial mammal life. The remaining proportion is dominated by human beings, who account for 36% of the planet's mammals, leaving a paltry 4% for the wild (Bar-On et al. 2018). As ecological entanglement unspools across every corner of the globe, and as so many plants and animals lose their relations to one another, our ties to a meagre range of species take on unwieldy significance. As humans hone the planet's biota in service of fellow creatures that serve our own immediate needs, it is perhaps a cold comfort that we do so shadowed by the likes of the raccoons that manage to thrive in our wake.

Notes

1 For the current natural history of raccoons, see Zeveloff (2002).
2 All of these names translate to a comment on the species' propensity for digital manipulation.
3 See Lister (2014) for a detailed evolutionary history of the woolly mammoth.

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6

MULTISPECIES CULTURES AND ENVIRONMENTAL CHANGE

The animal (agency) turn

Diogo de Carvalho Cabral and Heta Lähdesmäki

Introduction

Writing at the start of the 21st century, Harriet Ritvo (2002: 404) observed that "Animals ordinarily have not been among the most prominent concerns of environmental historians, who have tended to focus on the roots of such modern issues as pollution", even though "the relationship of animals to these themes is clear". Not only had animals been overlooked as part of environmental change, but they had also been treated as mere victims when included. At best, their decimation reveals unrecognised agencies that were no more. For example, as examined by Richard White (1995), salmon stopped providing the inhabitants of the Columbia River basin with the services they were used to – including that of a meaning repository – by growing scarcer due to damming. Sharing broader societal commitments, historians usually fell into the trap of envisioning animals as mute, passive things. Even Ritvo herself, when studying the historical process leading to this objectifying mind frame, did not escape its dangerous grasp. In her otherwise groundbreaking *The Animal Estate*, she portrayed animals as "manifestly powerless", creatures allegedly incapable of shaping their material and semiotic relations with humans. "Animals", Ritvo (1987: 5) famously wrote, "never talk back", which supposedly put them in the helpless position of discursive objects, never subjects.

True, other foundational works in environmental history published in the 1970s, 1980s, and 1990s did foreground animals as ecological agents, especially in American colonial contexts. Alfred Crosby's (2003 [1972]) *The Columbian Exchange* portrayed Eurasian domesticates as prolific invasive species, which helped drive native plants, animals, and even human groups to extinction. Key among these invaders was the pig, which was also discussed by William Cronon in his study of colonial New England. Competing with the indigenes for seafood in coastal environments, pigs "became both the agents and the emblems for a European colonialism that was systematically reorganizing Indian ecological relationships" (Cronon 1983: 136). That grazing animals were "agents of empire", to use Timothy Weiskel's (1987) words, was Elinor Melville's (1994) central argument in *A Plague of Sheep*, which takes Crosby's cue to study a Mexican region in monographic detail.[1] However, one can object that the animal agentiality in these accounts is of a weak kind, one that is still

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very anthropocentric or somewhat dependent on "zoological givens", the ahistorical "constraints imposed by the animals' biological nature" (Ritvo 1987: 4–5).[2] This imperial world as shaped by horses, Swart (2010a: 252) observes, "is still too much the 'world the horses were *made* to make' (by humans) rather than the 'world they made'".

It was only late in the first decade of the 21st century, with the worsening of the planetary ecological crisis and under the influence of new philosophical and scientific frameworks, that environmental historians started to pay systematic attention to animal agency in an empirically and theoretically robust way. Paradoxically, the Anthropocene made salient that, even when initiated by humans, environmental change never fails to be co-shaped by non-human sentient, intelligent beings, even those kept in harsh captivity (Stoddard and Hovorka 2019). As part of the environment of these other animals, humans are interpreted, acted upon, and changed by them, which helps steer more-than-human trajectories. From ants to whales, animals have thus begun figuring as active, creative players in many environmental histories. This, we argue, is the agential component that thickens and consolidates the broader "animal turn" that Ritvo (2014: 493) identified in a later paper. This chapter aims to review this Animal (Agency) Turn, hereafter A(A)T, in environmental history by focusing on three specific themes that we deem especially representative of its broader trends: animal resignification of human-influenced environments, the role of wild predators in shaping their (human) symbolic representations, and the human-animal co-production of waterscapes. First, however, we briefly discuss the two concepts guiding the review, namely, environmental change and animal agency.

Animal agency, environmental change, and history

A good baseline definition of agency is the one by the anthropologist Marshall Sahlins (2004: 155), for whom "historical agency" designates those "interventions that affect the history of social collectivities". After more than 40 years of assemblage/actor-network writing, it seems clear by now that these "social collectivities" include much more than just humans and that these other beings (and things) are equally capable of making differences and helping steer the wheel of the larger and precarious conglomerations. From a certain perspective, non-human animals are especially agentive not only because they are "semiotic selves" (i.e., they interpret their surroundings, like all living beings), but also because most of them are locomotive, a characteristic that allows them to explore and tap into a wider range of environmental phenomena. This more active spatiality makes many animals "ecosystem engineers"; that is, organisms that transform the landscape, modulating the availability of resources for other species (Jones, Lawton, and Shachak 1994). Moreover, locomotion allows animals to be particularly inquisitive: they are constantly engaging with novel parts of their surroundings and playing with them, even in confining and/or unresponsive conditions. They do that to gather information and prepare themselves for unexpected situations and encounters (Spinka and Wemelsfelder 2011).

But how can one translate these capabilities into history writing? That animals do things to the world around them is obvious, but what needs to be changed so "historical agency" can be evoked? The answer is the environment, or, more precisely, *environments*. As "multidimensional places" (Drenthen 2021), environments connect the history of multiple species. In fact, a crucial part of environments is other living beings. All living organisms share the dual condition of having (and, therefore, changing) environments and, at the same time, being the environment of others (de Carvalho Cabral 2021a). Especially in the Anthropocene,

humans became the environment of innumerable other species. Ultimately, this is why there is no such thing as a "history of humans" apart from that of other animals. By expanding their settlements and changing landscapes, humans alter the habitats of other species, thus also the conditions under which they go about making "their" world – which is also, of course, human.

Unlike animal historians, who tend to focus on bilateral human-animal relations, environmental historians analyse the relations between animals, humans, and changing landscapes (Wöbse 2021). In an early succinct formulation of such an approach, Peter Boomgaard (2001: 4) described the central theme of his *Frontiers of Fear* as "the interaction between humans and tigers/leopards, with the natural environment serving as interface". He was interested in "how changes in the behavior of one party influenced the actions of the other, mediated by environmental change". Animals actively participate in the broader history of the biosphere by exploring, (re)signifying, and materially changing environmental features or processes in their reach, including human-made ones. Under this light, so-called "anthropogenic" environmental change is the process through which people negotiate the meaning of their place-making with the earth and its non-human animal inhabitants (de Carvalho Cabral, 2022). Even a zoo, the supposed apex of human control over other animals, is in reality a "hybrid space, an ecosystem in its own right" (Flack 2018: 155), fraught with more-than-human power struggles.

As already mentioned, here we address only three themes within A(A)T. As this movement became so pervasive in the environmental historiography, an exhaustive review would demand a much longer work, perhaps even a book-length one. Moreover, for conceptual consistency's sake, we excluded from our corpus those studies that approach animal agency outside of explicit environmental change contexts.[3] Even though these works may be considered environmental histories, we focus on straightforward environmental change analysis, one of the discipline's cornerstones since its inception. We have also excluded animal agency studies that, even though associated with environmental transformation, do not have a clear historical framework, meaning an explicit focus on the past or change over time.

Environmental resignification

Jakob von Uexküll (1982) showed long ago that animal species are inextricably coupled with specific arrays of external objects, both producing the perceptive organisms and being produced by them. As long as inhabited by living beings, any particular portion of the earth's surface – even the most human-transformed landscape – is an intersectional product of myriad different assessments (Drenthen 2021; Jørgensen 2017; van Dooren and Bird Rose 2012). As much as symbolic language makes Westerners feel isolated from other animals, the truth is that all living beings are inevitably immersed in a non-verbal communication field in which any bodily act always means something to someone. However, these meanings tend to be neglected, as they are not symbolic and depend on modes of sensory perception which are often totally alien to humans. Not surprisingly, this strand of the A(A)T has been predominantly concerned with animal taxa whose corporeality starkly contrasts with that of humans, namely insects and birds. Both insects' size and birds' ability to fly – to name only the most apparent differences – make them inhabit *umwelts* that we humans can barely imagine. The mismatch between our landscape assessments and theirs often leads to clashes over the meaning of our environmental interventions, thus setting key historical change processes in motion.

It is important to emphasise that although insects did get considerably more attention in the last two decades, since Chris Philo and Chris Wilbert (2000: 7) urged scholars to do more work on "insect geographies", their subjective worlds continue to be largely neglected. While conceding material agency to locusts, ants, caterpillars, and other creatures, recent studies on insects in colonial Latin America tend to externalise and massify these creatures by yielding to the biblical trope of "plague", which is, of course, omnipresent in the sources (Few 2013; Mulcahy and Schwartz 2018; Viruell 2019). This may also reflect some sort of "macrobocentrism", that is, the Western tendency – expressed in the languages themselves – to restrict other-than-human sentience to individual beings with body sizes comparable to ours (Dukas 2018; Philo and Wilbert 2000; Sealey 2018). Undifferentiated masses and clouds of tiny animals are little distinguished from abiotic phenomena like the weather. Such a de-subjectification turns insects into merely physical phenomena that hinder human agricultural transformation of landscapes. It might be argued that this limits the breadth of historical writing, as insects – like any other animal – can and should be accounted for in terms of perception, cognition, and learning (Dukas 2018). For example, while noting that "locust swarms" apparently tended "to follow royal roads and other roadways" in colonial Guatemala, Few (2013: 68) does not explore the underlying environmental interpretation. This likely had to do with the fact that roadbeds and roadsides were linear deforestation vectors that produced bare or sparsely covered soil, which female locusts cue for oviposition (Le Gall, Overson, and Cease 2019).

While present in Few's, Mulcahy and Schwartz's, and Viruell's works, the theme of insect "resistance" to colonial rule is made central by Rohan Deb Roy (2020). By focusing on termites' appetite for the paper and wood artefacts that the British mobilised in 19th- and early 20th-century India, he argues that the white ants, as they were often called at the time, helped shape imperialism. As an essential part of colonial bureaucracy, artefacts such as currencies, promissory notes, and tax and judicial records were objectified by termites in a totally different way. For example, the British had to deal with the termites' constant threat to destroy the written testimonies of colonial occupation of India, undermining their imperial narrative. Deb Roy comments on an article that appeared in the *Times of India* in 1874, which "lamented that documents related to Calcutta in the pre-1770 period had been 'swept away' by white ants" (416). Just as museums, archives, and administration offices, places whose infrastructure was heavily dependent on wood, like railways, ports, and vessels, were also severely threatened by termites. As these places were crucial to the colonial regime, their resignification by termites "provoked imperial officials to devise effective ways to govern" them (419), thus engendering the co-constitutive dynamics that Deb Roy dubs "entomo-politics".

Despite his declared emphasis on co-constitution, Deb Roy does not elaborate much on the termites' perspective, with the insects remaining, in a sense, external objects encountered by officials, naturalists, politicians, and other human actors. One of the first environmental histories to seriously consider the perceptive world of insects is John McNeill's (2010) *Mosquito Empires*. Although not primarily concerned with animal agency, McNeill does provide a detailed account of how *Aedes aegypti* mosquitoes interpreted the "creole ecologies" that emerged in the wake of 16th-century European colonisation of the Caribbean. True, sometimes the author somewhat "automatizes" this process, making it appear to be something of a mechanical necessity – as when he describes plantations and ports as "ideal incubators and larders for *A. aegypti*" (48). As Nigel Clark (2003: 165) has remarked, one must remain attentive to the "ability of living things to improvise in new settings, to compose

themselves into new rhythms and patterns and to recompose the milieus in which they dwell". For example, there was nothing pre-programmed about the mosquitoes using clay pots used for sugar crystallisation as breeding grounds. This was a semiotic coupling that required from the mosquitoes an iconic capacity, an ability to "forget to notice" (*sensu* Kohn 2013) the differences between the small water ponds where they had evolved to lay eggs and the clay pots coated with sugar, a configuration with which they had never been presented before. To use Thom van Dooren and Deborah Bird Rose's (2012) terminology, this is how the mosquitoes "storied" those water containers qua places. As a historical novelty, this non-human place-making helped produce the very possibility of the disease environments that are the basis for McNeill's argument about the low possibility of invasion of the Caribbean by Europeans (who lacked the immunisation that comes with an early childhood experience of diseases like malaria).

This more-than-human place-making is also a strong theme in Emily O'Gorman's (2021) analysis of the role of mosquitoes in the story of wetlands in Australia's Murray–Darling Basin in the 19th and 20th centuries. She highlights how certain human uses of swamps, including those aided by grazing animals, ended up producing "ideal breeding places for mosquitoes, 'as if for them'" (66). Borrowed from anthropologist Anna Tsing, the last part of this sentence ("as if for them") heightens a sense of paradox: even though not designed for mosquitoes, the places created as by-products of human/non-human activities did suit those insects almost to perfection. From an Uexküllian perspective, landscape features are "for" any creature who can signify them as part of their vital activities – including humans.[4] Further on in the book, O'Gorman engages with early 20th-century entomologists in pointing out that *Anopheles* females preferred to lay eggs in small water pools – like those created by grazing animals' treading – rather than in main water bodies because of the absence of predators such as fish (84–5). This shows that oviposition involves decision-making based on environmental assessment, which turns mosquitoes into full-fledged agents. The ecumenical nature of landscapes makes them highly refractive of narrowly speciest interventions, as other subject-object couplings might be disrupted inadvertently. In this connection, O'Gorman comments on entomologist Frank Taylor's recommendation of caution in "filling in" swamps as it could also reduce the number of small flies that bred in them, which would put in disarray their pollination services (93). O'Gorman is right in foregrounding the "feedback loops" that unsettle "modernist schemes" (66), referring to how the mosquitoes' domestication of human agricultural infrastructure made them transgress "the borderlands of nature and culture" (86).

One of this chapter's authors has taken a step further in developing Deb Roy's notion of entomo-politics by considering that it is not restricted to human language but encompasses the non-symbolic sign processes of the insects themselves. This is done by exploring the human-ant negotiated ecologies of agricultural deforestation in 19th-century Brazil (de Carvalho Cabral 2021b). It is argued that, while people thought of forest clearings using symbols such as "progress" and "civilisation", leaf-cutting ants interpreted them through iconic and indexical associations, like the ones allowing them to select the plant species to be harvested for their fungus gardens. The ants would engage with coffee groves according to their own parameters of usability and wholesomeness: having no genetic memory of *Coffea arabica*, the ants would experiment with it and, in some environmental circumstances, include it in their plant resource menu. Thus disrupting the major economic engine of the newly-emancipated country, the leafcutters triggered all sorts of social, economic, and political dynamics. Resonating earlier theoretical points made by environmental

historians on the imperfectability of the translation of ideas into actions (e.g. Buhs 2004), it is argued that non-symbolic assessments enacted by non-human others always divert human intentions.

A similar "multi-perspectival" approach was being used in previous years by researchers working on birds and other winged animals. Gregory Rosenthal (2012) wrote parallel and entangled histories of humans and birds inhabiting American-controlled guano islands in the Pacific during the 1850s and 1860s. Despite this cohabitation, these two groups "lived in radically different worlds" (751) due to their different bodily capabilities. For example, Rosenthal contrasts the human view of the sea-land binary with the birds' much more nuanced perspective of "an oceanic world where land, air, and water converge, act on each other, and make up separate yet combined components" (754). He also shows how the birds made sense of the novel multispecies landscape by applying old stratagems to new situations, such as frigatebirds lurking around waiting for boobies returning from the sea to get frightened by people and giving away their fish (the former were used to do the threatening themselves). Similarly, one of the chapters of Thom van Dooren's *Flight Ways: Life and Loss at the Edge of Extinction* addressed human-penguin conflicts over the meaning of Sydney Harbour's shores in the 20th and 21st centuries. Drawing heavily on ethology, van Dooren offers a rich portrait of how Little Penguins (*Eudyptula minor*) experience ever-denser urbanisation of what they see as their breeding places. The penguins' use of landscape features is not simply a layer superimposed on an existing world. Instead, van Dooren argues, their practices "emerge from and influence the way in which places and those that dwell in them come to be" (72). These dwellers include, of course, people, who feel uneasy about sharing their land properties and public spaces with the birds. Despite often being evicted – through seawalls, floor boarding-up, and other stratagems – the penguins stuck to their guns and kept stoically returning to their breeding places, thus imperilling their colony. Human exclusion of these birds impairs their "intergenerational gifting" of burrows, imposing various biophysical changes to shoreline sites due to the disappearance of practices such as breeding, hunting, and excreting.

Dolly Jørgensen took this approach even further by proposing a reinterpretation of the concept of domestication through an animal agency lens. Examining how birds and bats appropriate US cities' landscape features that might have been designed for them or not, Jørgensen (2018: 221) highlights how "wildness is present in the urban". She devotes the first part of her essay to human-swallow co-domestication, focusing on how birds autonomously interpret human-built birdhouses. In the second part of the essay, Jørgensen offers a lively analysis of free-tailed bats as "domesticating agents" in shaping Congress Avenue Bridge, built in Austin in 1910. In 1980 a renovation added two-centimetre-wide expansion joints that began to be carefully inspected by bats. Protected from predators and near abundant supplies of insects, as well as furnished with shapes suitable for their young to hang on, the bridge became a thriving nook in just a couple of years. After a brief period of controversy, Austinites started to wholeheartedly embrace the bat colony, as more and more urban activities would "hang together" with it, to use philosopher Theodore Schatzki's (2002) expression: artistic installations, cultural festivals, and even bat-watching cruises. In 2010, the free-tailed bat was proclaimed the "official animal" of Austin by the city council. But, as Jørgensen rightly argues, "This domestication of the bats has been a response to the bats' domestication of the bridge", as "animals choose whether or not to use human artefacts as homes based on their own needs, not ours" (230–1).

According to this logic, the very semantics humans use to classify landscapes are unsettled. In her analysis of human-duck conflicts in the Murrumbidgee Irrigation Area, O'Gorman (2021: 99) observes that "what has counted as a wetland for whom has had significant consequences". By objectifying the land differently, the ducks challenged human usage; more precisely, they challenged the very possibility of rice paddies. True, as O'Gorman shows, it is unlikely that the ducks were as seriously harmful to crops as the farmers would claim. In any event, it seems safe to say from her account that the birds did some damage to rice crops, even though poor farming practices apparently stimulated this. For example, inadequate sowing techniques often led to poor germination and thus to bare patches that ducks interpreted as good places to land and settle, subsequently "widen[ing] the opening by pushing down encircling plants" (114). What is important to retain here is that these contested meanings were historically productive, as they set in motion an array of human measures and initiatives such as the commissioning of those scientific studies that would eventually become O'Gorman's historical sources.

Environmental historians have been showing that the resourcefulness of animals in re-signifying human-shaped landscapes is a key aspect of their historical agency. As Martin Drenthen (2021: 435) reminds us, "We are not the only ones to define the meaning and significance of features in the cultural landscape". But wouldn't this necessarily lead to a reconstrual of culture itself as the interspecies negotiation about the meaning of what is "out there"? This negotiation produces history insofar as it forces humans and non-humans to compromise about the contours of reality. As one of us wrote elsewhere, "not everything can be everyone's because not everyone agrees on what everything is" (de Carvalho Cabral 2014: 238). Rather than mere human knowledge, behaviour, or codes, "culture" should be understood as the conversation through which different organisms strive to find common ground in a multi-meaningful world. Therefore, culture is not something humans do *to* or learn *about* other beings, but something they do and learn *with* other critters. After all, is Austin's annual Bat Fest featuring live music, arts, and crafts a "cultural event" not also shaped by, well, the bats themselves? Were not the coffee plantations in 19th-century Brazil also products of the leafcutters' perceptions and doings? What about Eastern Australians' discourses about swamps as dirty and unhealthy places? Were they not also constituted by the expansion of the marshes themselves brought about by animal grazing and insect breeding?

Wild predators and representational environments

Wild animals have often been perceived and portrayed as victims of human exploitation. Environmental historians have drawn attention to how humans have all over the world diminished or exterminated the populations of certain species and thus altered shared landscapes. Charismatic species such as the wolf and its demise have been studied abundantly. Historians such as Jon Coleman (2004) and Brett Walker (2005) have portrayed wolves as historical agents co-shaping their shared past with humans. Writing about the coexistence and extermination of Japan's wolves, Walker (2005: 10–11) emphasises the importance of treating wolves as creatures with historical agency, as well as experiences and stories of their own. Still, this is not always how wild animals are treated. In histories of extermination and conservation, the animals themselves can be left aside as silent scapegoats or symbols of interhuman conflicts. Looking at crocodiles and other "dangerous" animals in Australia,

Krista Maglen (2018: 190) has suggested that less sympathetic creatures tend to be disregarded as actors. Focusing on rattlesnakes, Whitney Barlow Robles (2021: 8) pointed out how oftentimes scholars tackling snake symbolism and figurativeness have overlooked the actual snakes and their material presence in everyday life.

Maglen (2018: 199–200) has argued that historians often restrict the agency of wild animals to the level of species or local population. Dangerous animals are an exception, as they become visible as individual actors because their actions are so momentous in the human realm. As Jennifer Adams Martin (2011: 452) puts it, large predators cannot be seen solely as victims of human power, since they "invert those traditional human-animal hierarchies when they convert human bodies into energy". Mahesh Rangarajan (2013) focuses on the century-long history of the lion–human interaction in India's Gir Forest, Gujarat State, and reminds us that Gir's lions rarely attack people. However, there are two specific phases of breakdown. This change in lions' behaviour tells Rangarajan that the lions, like humans, need to be seen as both products and actors of history. The Gir lions, like the tigers of Java discussed by Boomgaard, "are a historical entity, behaving differently today compared to a quarter, a half-century, or a century ago" (126). Even predators that do not kill humans can be easily interpreted as agents. Tuomas Räsänen (2017: 94), who looks into the white-tailed eagle as a catalyst for an ideational revolution in Finland, links agency to humans and "higher animals" who can modify their behaviour according to changing circumstances, choose between alternatives, and therefore can autonomously change entire social networks through their action. Also, to him, animals are important agents of change in human history.

The fact that predators can kill has shaped how humans have viewed them and the environments they live in. Due to their perceived or real danger to humans, sharks, as Martin (2011) writes, have influenced how many Americans have thought about nature and human–animal relationships). They also affect how people perceive the sea and the underwater world. Because sharks have the potential to threaten human life, their living environments can become a place of fear.

Animals living in captivity are also often linked to their "original" environments. Looking at the polar bears in the Bristol Zoo and how they influenced a debate on animal captivity, Andrew Flack (2016: 650–1) shows how people connected the captive polar bears to the Arctic landscape. In the late 1990s, icy worlds of the Arctic were seen as among the last pristine wildernesses of the world, "symbolising all that was threatening to move forever beyond our sight". The utopian view of the frozen North as a pristine wilderness encouraged people to demand that the Bristol Zoo's polar bears be returned to "freedom", to a place in which animals could live in "happy" isolation from the human world. Yet, as Flack puts it, the return of captive-bred animals to such native environments is deeply problematic because these habitats are disappearing, and we do not have efficient knowledge of the reintroduction of captive populations (642–3).

Rangarajan (2013: 115) draws attention to ecological patriotism. In India, lions were connected to the nation and became the national animal of the new Republic of India (about the Korean tiger as a symbol of the Korean people, see Seeley and Skabelund 2015). Still, some people described the lion as an alien species imported from Africa. This leads Rangarajan to ask how long an animal has to stay somewhere before it ceases to be alien. The question of biological belonging has been discussed by Peter Coates (2007) regarding immigrant and invasive species on American soil. Karin Dirke (2017: 166) writes about the biological belonging of carnivores. The idea that carnivores are part of the Swedish fauna

was new in the 19th century. She argues that earlier large carnivores were persecuted because they were seen as foreign, and Swedes linked wolves to the Sami people or Finns. Whereas, as one of us has shown elsewhere, wolf individuals who came to Finland from Russia were called intruders and Russian or foreign wolves by contemporary Finns (Lähdesmäki 2020: 38). These notions on animals' out-of-placeness show an anthropocentric way of looking at the shared environment, but they were also a reaction to animal agency, their movements beyond national borders and ways of perceiving space and creating places with their meanings.

Walker (2005: 20–1, 79) shows how wolves have also been linked to otherworldly environments: they were worshipped in the mountain traditions of both the ethnic Japanese and the Ainu of northern Japan as deities who lived in the otherworldly space of mountains and forests. They were also worshipped by grain farmers of the Japanese countryside who beseeched wolves to protect fields from hungry ungulates and wild boars. In a somewhat similar way, Jones (2019) shows how wolves in Yellowstone were seen as vital parts of the landscape. Jones argues that as wolves were returned to Yellowstone in the 1990s, they became a symbol for the environmentalists' mindset and the changing nature, "a carrier animal for Yellowstone's environmental memory, transporting with it the fates of other threatened species and the promise of an enlightened Ecological Age" (151).

When writing about the historical agency of wild predators, historians need to think more about the individuals who did not attack. For instance, Martin (2011) and Maglen (2018) ponder how we can access individuals who never harmed humans or entered historical records as actors in other ways. Maglen suggests an interdisciplinary approach: to "include elusive wild animals whose lifecycles never intersect with any great note with the lives of humans, we will need to stretch the scope and collaborative work of our discipline to include more natural and biological sciences" (206). When we write about the animals that did attack, Walker's (2005: 13) approach might be useful. According to him, including animal emotions can help historians to treat animals as historical agents and better understand why interspecific conflicts develop the way they do. Both humans' and wolves' emotions, alongside different factors in their societies and economies, brought these species into conflict with each other (177). In order to understand why it has been difficult for certain species to coexist, we need to consider these factors when writing historical narratives.

Animal shapings of waterscapes

Unlike predators, marine animals, from mammals to fish and birds, coexisting in the waterscapes alongside humans, have remained in the background in many historical narratives. Ryan T. Jones (2019: 186) observes how whales swim through histories of capitalism, science, diplomacy, Euroamerican imperialism, the Pacific, Indigenous revival, and environmentalism but rarely come into the full view of historians. Jones (2019: 185–6; 2013: 352) encourages historians to write oceanic histories where whales and other animals are more visible and consider animal cultures as important parts of human history. To do this, he suggests using both vast amounts of historical data and the latest biological claims on animal cultures. In a previously mentioned paper, Rosenthal (2012) goes further by arguing that it is important not just to highlight animal agency or animal visibility, but also to ponder about animals' point of view. In Rosenthal's analysis, the bird's-eye view is important since "examining the past from diverse perspectives reveals how different actors, both human and avian, frame their perceptions of the world according to differing scales of time and space"

(745–6). Similarly, in her environmental history of the Bering Strait, Bathsheba Demuth (2019: 324) uses (natural) science "to tell a history in which the songs of whales and the shapes of stones and all things in between" are integral parts of the plot.

Interviewing fishers and divers in South West Capes, Western Australia, Andrea Gaynor and Joy McCann (2019: 260) pointed out how oral narratives can – besides revealing marine environmental change and human perceptions of it – capture animal agency. They argue that "[w]hile oral histories of human-animal relationships cannot "let the animals speak", they play an important role in capturing "active engagement with animals in particular historical contexts, as well as showing how animals have related to us and how we have interpreted their subjectivities". As they point out, such a perspective is especially needed for the underwater world because it is alien and impenetrable to humans due to its differences from the terrestrial world (270). Also, Jennifer Daniels and Charles Mather (2017) highlight the benefits of oral history in tracing animal agency in waterscapes. They studied relations between humans and Atlantic salmon in Eastern Canada since the 1700s and recorded oral histories and personal testimonies of Newfoundland's Gander Bay region residents. From the oral histories, they detected a specific and situated animal-human entanglement to which they refer to with the concept of "wilful salmon". To catch an Atlantic salmon is a challenge, and a battle of wills between the fish and the angler affects them both. The salmon can escape, for instance, by breaking the line, but if it tires completely, the salmon will resign itself to the struggle and is reeled in by the angler. The angler kills the wilful salmon as quickly as possible because, for the angler, killing is kindness. Daniels and Mather describe this encounter as an attachment site "between intra-acting human and non-humans" and argue that the agency of the wilful salmon is revealed through its affective encounter with the angler" (209, 212).

The killing and eating of non-humans in the waterscapes are topics discussed widely by environmental historians. The acts of fishing, hunting, and eating non-human animals can easily be discussed in ways that highlight human agency and put animals in the background as passive and more or less powerless objects. Still, as Daniels and Mather (2017: 212) observe, the act of eating can be interpreted as an event where the subject and object are blurred. Food is essential, and the people living in previous centuries relying on animal protein were completely interdependent on the agency of non-human others. Also, it is important to note that in the waterscapes, animals were not easy prey. Jones (2019) writes how, by many accounts, right whales in New Zealand were extremely difficult to catch, and they could escape capture. Similarly, the "wilful salmon" described by Daniels and Mather is an example of animals putting up a fight. Animals and their agency become visible also when focusing on the ways fish, birds, and mammals have shaped human societies and cultures living in (or off) the waterscapes. Jones (2013: 357, 360) shows how migratory marine animals encouraged humans, both natives and colonisers, to adopt a migratory life, mirroring that of marine animals in the Pacific. He goes on to argue that European patterns of movement around the North Pacific depended more on animal migration than they did on imperial designs (377). Also, Demuth (2019) highlights how human life and whole industries were shaped by the existence and movements of whales, walruses, and other animals in Beringia. Even though she does not use the term "agency", Demuth writes about ecological networks or entanglements, where "[p]eople are only part of what shapes action" and emphasises, for instance, the walruses' ability to "concentrate rich seas in their bodies" and transform mussels into useful tissue and energy that humans in turn used.

As environmental historians have shown, humans have altered waterscapes in multiple ways. For instance, by overfishing and overhunting fish, seals, whales, and birds, humans have altered river, lake, sea, island, and wetland ecologies (Daniels and Mather 2017; Demuth 2019; Gaynor and McCann 2019; Jones 2013, 2019; O'Gorman 2021; Rosenthal 2012). Humans also altered their non-human neighbours' genetics (and vice versa, as for instance Haraway [2008] observed). Daniels and Mather (2017: 191) remark about how thousands of farmed salmon escape from aquaculture cages every year and breed with wild salmon, creating "hybrids". In addition to this, Atlantic salmon have interacted with other salmonid species introduced into Newfoundland rivers from the 1880s onward. Overwhelming evidence shows how these new salmonid species both influenced the gene pool of Atlantic salmon – to the point that one can argue that the Atlantic salmon is basically extinct (see Chapter 13) – and changed the ecology of rivers in Atlantic Canada (192). In this case, it is not easy to distinguish between the agency of humans and that of the introduced salmonid species.

Similar entangled agencies are visible in the case of the muskrat studied by Peter Coates (2020: 209), even though he is not primarily concerned with agency. Coates traces the history of the North American furbearer and semiaquatic animal introduced to Europe where it easily escaped confinement and had a brief presence in Britain during 1929–37. The British were afraid of the muskrat's ability to change the landscape by burrowing the embankments of rivers, canals, ponds, dams, roads, and railways. In continental Europe, muskrat was told to have caused railroad disruption, road subsidence, and other disturbances in human-altered landscapes (216). Like the insects and birds discussed in an earlier section, the muskrat re-signified human-shaped landscapes while making them their own living environments. O'Gorman (2021: 10) writes about how animals (and plants) have shaped their environments "both with and against other species".

During previous decades, historians have centred many of the previously silent players of the waterscapes and traced the historical agency of birds, mammals, insects, and fish by focusing on animal cultures and the changes that took place within them, or on the relational agency and intra-acting between human and non-human animal individuals. As shown here, animal agency can be found in the co-creations of landscapes, the creation of "hybrids", and the acts of eating and killing. One way to look at the waterscapes is to understand them as multispecies creations, similarly to O'Gorman (2021: 10), who describes wetlands as "multispecies achievements".

Cultural multispecies histories of environmental change

The early 21st century has seen such an entrenchment of the animal agency concept in certain areas of historical scholarship that it has even been considered *affaire résolue* by some (e.g., Benson 2011; Fudge 2017; Howell 2018). Many works other than those examined here deal with animal agency directly and indirectly, and a full appreciation of this incredibly diverse scholarship would require further research and reflection. In this chapter, we have restricted ourselves to examining a relatively small subsection of this literature. Although the differences should not be overstated, it is possible to argue that, unlike other students of human-animal relations, environmental historians are interested in how these interactions are mediated through, and further implicate, landscape transformations. In early environmental histories, animals were portrayed as landscape features, often not very distinct from non-living elements. Lately, various factors have led environmental historians

to grant world-knowing and world-making abilities to animals, thus complexifying their accounts of environmental change. Here we explored three strands of this new historiography: the conflicts arising from the multidimensionality of landscapes, the co-production of symbolic discourses about predators, and the animal cultures co-shaping waterscapes.

What emerges from examining these writings is a collective, not-yet-fully articulated push toward expanding the very notion of culture to encompass non-human animals. This includes considering not only "animal cultures" but also, and perhaps most fundamentally, how animals participate – with their own embodied ways of being and knowing – in co-creating "human" cultural systems. Tim Ingold (1993) argued long ago that humans make their lives not through disembodied observation and action but by attending to other beings with their own purposes and needs, the landscape being the intersectional, congealed form of these "taskscape" encounters. This view calls for a "dialogical kind of story that sees the land as a field of (product, outcome child/offspring of) *multiple interacting and collaborating agencies* which can include humans but is never exhausted by them" (Plumwood 2006: 125, emphasis in original). We would argue that A(A)T has been producing precisely these kinds of environmental histories. Even when addressing processes deeply seated in the "culturalist" imaginary, such as capitalism and racialisation, environmental historians have begun taking into account the participation of non-human animals, not only as resources like meat, pelts, feathers, and draft power, but also as builders, hunters, observers, and explorers. Like their human counterparts, these are actors whose agendas are often engulfed in emergent dynamics they cannot fully control – which we commonly call "History".

Notes

1 For an analysis of how indigenous peoples appropriated horses, as a sentient technology of imperialism, using it to fight back, see Swart (2010b).
2 This kind of framing goes back at least to George P. Marsh's (1965: 72) mid-nineteenth-century *Man and Nature* (see Chapter 12).
3 Reviews of animal agency studies in animal history can be found in Pearson (2017) and Howell (2018).
4 It is noteworthy that while humans, too, often benefit from other species' place-making – think of the fertile meadows in abandoned beaver dams used for grazing animals (Richards 2004: 470–1, 510) or the pollination services provided by bees visiting coffee plantations from nearby forest fragments (González-Chaves et al. 2020) – this seldom impresses scholars in the same way.

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7

ANIMAL AND VECTOR-BORNE DISEASES, ZOONOSES, AND ONE HEALTH

Lyle Fearnley and Melissa Salm

In 1934, Hans Zinsser (1878–1940) published *Rats, Lice and History*, a "biography" of the zoonotic and vector-borne disease typhus, written in the comic style of Laurence Sterne's *The Life and Opinions of Tristram Shandy*. The book, with its endless digressions and diversions (the topic of typhus is not reached until Chapter 13 out of 16) anticipated several approaches to the history of zoonoses and vector-borne diseases. A microbiologist, Zinsser was writing precisely in the moment when microbiological studies of pathogens were beginning to illuminate the links between animal and human disease, making visible the complex chains of infection across species from reservoir hosts to vectors. In the early part of the book, Zinsser defines the idea of a "new" disease (what would now be called an "emerging disease") and provides basic microbiological knowledge to the reader unfamiliar with the science. Drawing on this knowledge, he then develops two kinds of historical argument.

First, he draws on the current (for his time) microbiological knowledge about disease germs and infection chains to make speculative historical diagnoses of epidemics recorded in historical accounts of ancient, medieval, and early modern societies. "The specialist," he explains, "in studying the epidemiological data of former times, not infrequently finds observations and information which, in the light of modern knowledge, become valuable clues to unsolved problems" (Zinsser 1934: 282). Building on these diagnoses, he then presents accounts of major historical events (such as the Fall of Rome or the Crimean War), in which he claims that epidemics (and the germs that cause them) are critical historical actors. "Soldiers have rarely won wars," Zinsser declares, "They more often mop up after the barrage of epidemics."

Second, Zinsser also presents a historical account of changing perceptions and knowledge of diseases, including an intimate account of the emerging scientific understanding of typhus in his own period. In these discussions he is both open and attuned to the uncertainty of scientific knowledge. For example, he points out that in the late 19th century, typhus was thought to be a single disease affecting only humans. But microbiological studies on other animal hosts, and immunological studies on laboratory guinea pigs in the early 20th century, showed that there were in fact two types of typhus – one circulating in Europe and Asia, the other in the Americas. Zinsser speculates that this difference is related to a different ecology

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of disease transmission – whereas in Europe, the disease appeared to be spread continuously between humans by the louse vector, in the Americas typhus existed in a rat reservoir and periodically emerged into human population through bites from the rat flea.

Rats, Lice and History therefore clearly articulates a challenge that confronts historical studies of zoonoses. For on the one hand, Zinsser presents a history of changing scientific ideas about what diseases are, what causes disease, and how disease spreads in a population. But on the other hand, he also projects modern disease concepts onto causal explanations of disease events in the pre-modern past. Diagnosing and narrating past disease events through a conceptual and analytical vocabulary available only in the present is overlain, with some tension, on a historical understanding of disease events as they were lived and understood.

We suggest that this is an important methodological challenge that also confronts environmental history more broadly. Environmental historians grapple with the challenge of making the natural environment into a historical actor without presuming a historical continuity of what nature has meant to humans throughout different periods of history. Historians turn the natural environment into a historical actor by incorporating present-day scientific explanations of natural causes into their historical narratives. Yet such scientific understanding is anachronistic if applied to the world of the time, which did not share the same scientific knowledge and often drew on a broad range of agencies (Gods, ghosts, mental ideas, and so on) to explain the causality behind events. Approaching an environmental history of zoonotic and vector-borne disease through the lens of current biomedical science, then, may similarly risk trading a modernist reconstruction for an historically situated and culturally meaningful understanding of disease and the shifting roles it played in humans' relationships to the natural world.

The case of "zoonotic" and "vector-borne" diseases is a particularly compelling instance of this historical challenge because of the dramatic transformation in understanding of disease and the environment produced by the microbial germ theories of disease (Latour 1988; Worboys 2000). When microscopes and other laboratory devices made microbial pathogens visible, the laboratory also constructed new relationships between humans and non-human animals who shared – and exchanged – the same pathogens. One example is the medieval Black Death, now widely believed to have been an epidemic of bubonic plague. At the time, Europeans associated rat "plagues" with the human plague, but never considered this an etiological relationship – rather, both were seen as consequences of the same underlying "Biblical pestilence" (Cole 2010). Although it is possible and, indeed, compelling to utilise contemporary microbiology to reconstruct how rats transformed European history, such an account precludes understanding the historical and culturally shaped experience of both disease and the environments in which they lived at the time. A critical question for today's environmental historians, then, is how to narrate an environmental history of zoonotic and vector-borne diseases prior to the formal scientific understanding of diseases as properly "zoonotic" and "vector-borne" – disease concepts that did not emerge until the late 1800s' "laboratory revolution" in medicine (Cunningham and Williams 2002).

This chapter's approach to the environmental history of zoonoses, vector-borne diseases, and One Health starts from the premise that historically specific understandings of disease reveal different conceptualisations of nature, including its role in disease events and the human relationship to the environment. We emphasise that shifting epistemologies of disease, or, disease as an evolving object of human thought is, itself, an historical actor that has

played a formative role in human-environment relationships throughout every period of history. In what follows, we divide our chapter to address two different methodological approaches to the history of zoonotic and vector-borne diseases on their own, before exploring contemporary efforts at synthesis. The first approach, as we see it, narrates disease events as a consequence of changes in the human-environment relationship and the influence of disease events on human and environmental history through a conceptually modern understanding of disease. The second approach attends to shifting concepts of disease over time and how these reveal evolutions in thinking about the relationship between humans and the natural environment. Although these approaches are often kept separate, as Zinsser attempted to do in *Rats, Lice and History*, in our conclusion we suggest that drawing materialist and epistemological methods of writing history together can provide new insights into the dynamic relationships between human ideas about the environment and the anthropogenic transformations of the environment that drive the emergence of zoonotic diseases. We ask, moving from the premise of the historical relativity of "disease": how can we understand current human-environment contacts and their consequences for near future trajectories of disease emergence?

Zoonotic disease in history

Epidemics are an ideal topic for an environmental historian because they are clearly historical events, often richly documented, and clear cases where non-human forces play a role in shaping human history. While this is true of all epidemics, historians have drawn particular attention to the role of animal- and vector-borne diseases as sources of significant historical epidemics. In this section, we explore several foundational texts in the history of zoonotic disease to highlight a particular strategy central to histories of zoonoses: the use of microbiological sciences and theories to uncover the role of microbial pathogens as historical actors.

In *Plagues and Peoples* (1998), William H. McNeill describes the "breakthrough to history" (31) as a fundamentally epidemiological transition. As early humans shifted from mobile patterns of hunting and gathering to fixed settlements, and as domestication of plants and animals transformed human relationships to the environment, new epidemics of disease flourished. For one thing, "settling down to prolonged or permanent occupancy of a single village site involved new risks of parasitic invasion", particularly because increased contact with human faeces allowed a "wide variety of intestinal parasites to move safely from host to host" (McNeill 1998: 37). Equally important were the new, more intimate, and long-term relationships that humans formed with domesticated animals. As McNeill (1998) points out, "many of our common infectious diseases have recognizable affinities with one or another disease afflicting domesticated animals" (45), including measles, smallpox, and influenza.

In the decades since McNeill wrote his book, molecular biologists have provided additional evidence for the evolutionary links between pathogens that afflict domesticated animals and humans. Molecular analysis demonstrates that many of our common infectious diseases "evolved from similar epidemic diseases of our herd domestic animals with which we began to come into close contact 10,000 years ago" (Diamond 2002: 703). Collaborative work involving archaeologists and veterinary epidemiologists deployed archaeological data about goat populations in the Neolithic Fertile Crescent to build a model simulating the transmission of the livestock disease brucellosis from goats to humans, from which the authors concluded that early agricultural development enabled goats to become reservoirs

of the disease and transmit it periodically to humans (Fournié, Pfeiffer, and Bendrey 2017). Virologist Nathan Wolfe, Dunavan, and Diamond (2007) worked together to distinguish between infectious diseases that originated from domesticated animals (largely in temperate regions) and those that originated from wild animals (largely in tropical regions). By identifying these ecological differences in zoonotic pathogen emergence, Wolfe and Diamond argue that the impact of epidemic disease on human history was significant. For example, since 13 of the world's 14 major species of domestic mammalian livestock originated in the "Old World" (the Eurasian continent plus Africa), most major human infectious diseases also originated in the Old World. As a result, infectious diseases "facilitated the conquest of the New World" because "previously unexposed Native American populations had no immunity or resistance" to diseases like smallpox (282). Crucial to these accounts, as the collaboration between Diamond and Wolfe makes clear, is the support of microbiological sciences as a method for uncovering the role of the once-hidden, unassumed historical actors: the microbes (cf. Latour 1988).

Two historical events can be taken as key examples for exploring the impact of zoonotic disease on history: the plague in medieval Europe, and the encounter between Europeans and Native Americans in the period known as the "Columbian Exchange".

The historiography on plague in medieval Europe is enormous, but an important subset of this literature takes a long-term perspective to reveal how plague changed the course of European history. Although the impact of the plague varied across Europe, scholars estimate between one-third and one-half of populations died from the Black Death (McNeil 1998: 149). As a result, Europe entered a "new era of its history", responding differently in different areas, with labor shortages, famines, and transformations in class composition. In *Civilization and Capitalism*, Fernand Braudel identified the plague as one of the critical "structures of everyday life" that placed limits on the human and social development of Europe during the 15th to 18th centuries (Braudel and Reynolds 1985).

According to convention, the medieval Black Death likely spread to Europe during the Mongol invasions, a time that saw the building of new trade and transport connections – and therefore pathways for the transmission of disease – between Asia and Europe. McNeill argues that Mongol transformations of the Silk Road brought "wild rodents of the steppelands … into touch with new diseases, among them … *Pasturella pestis*" (the bacterial cause of the bubonic plague). The plague then moved gradually westward, infecting new rodent populations along the way, before finally reaching Europe, where populations of black rats – and their fleas – were ready to produce explosive outbreaks. McNeill's hypothesis is built not only upon historical documents of the Mongol period, but more importantly on 20th-century microbiological theories about plague aetiology that demonstrated the zoonotic link between rats, rat fleas, and human plague, and later identified the "focus" of plague in rodent reservoirs of Asia. As he explains, the "role (of burrowing rodents) in sheltering bubonic infection was discovered in 1921–24 by an international team of epidemiologists dispatched to investigate an outbreak of human plague in Manchuria" (134). McNeill provocatively rewrites our understanding of the impact of the Mongol Empire by tracing the pathways of rats, fleas, and microbes rather than people or commodities.

From a more general point of view, as Alfred Crosby (2003) points out, contact between previously unconnected regions has often led to the introduction of new diseases into populations without immunity, producing over the long term a "trend toward biological homogeneity" (46). In the short term, however, the resulting epidemics have themselves been historical "conjunctures" that shaped major historical events and trends. Perhaps the most

significant of these epidemiological contacts was the period described by Crosby as the Columbian Exchange. Beginning with the voyage of Christopher Columbus in 1492 and tracing the next several hundred years of "renewed contact between the Old and New Worlds" (40), Crosby (2003) shows that the "most important changes brought on by the Columbian voyages were biological in nature" (41). Crosby's scope is broad, addressing topics such as the transport of domestic livestock to the New World or the global spread of maize, but disease is perhaps the most compelling case of the Columbian Exchange. Most significantly, Crosby (2003) shows that accounting for infectious disease enables us to answer a key historical question: "Why were the Europeans able to conquer America so easily?" (95). Time and again, the arrival of Europeans brought pestilence – smallpox, typhus, influenza – that afflicted and decimated Native American populations, often before any battle was fought. Jared Diamond (1997) revisited this encounter as part of his controversial argument that differences in human environments – specifically, the early domestication of livestock in Europe and Central Asia – facilitated Western conquest and colonialism when infectious diseases decimated New World populations.

Many of these infectious diseases, including the most notorious – smallpox – were exclusively human infections. Though they may have originated in a zoonotic spillover in the ancient past, by the 15th century they were well-established endemic diseases among Europeans. However, several significant zoonotic or vector-borne diseases were also transmitted to the New World. Perhaps the most significant of these was yellow fever. Caused by a mosquito-borne virus, yellow fever causes short-term symptoms such as fever, muscle pain, and headache. In a small number of cases, more severe symptoms include jaundice (the yellow skin giving the disease its name), kidney and liver damage, and internal bleeding. Death occurs in up to half of those with severe disease symptoms.

Historical records, and more recent phylogenetic analyses of the virus, show that yellow fever originated in Africa around 1500 years ago (Gianchecchi et al. 2022). The virus probably first infected humans through a zoonotic spillover from non-human primates. Sometime during the early Columbian Exchange period, yellow fever was brought from Africa to the Americas, probably carried with the *Aedes aegypti* mosquito vector in the bilges of sailing vessels transporting African people to work as slaves on New World plantations. A major outbreak of yellow fever struck Barbados in 1647 and the Yucatan in 1648, and by the 18th century it had caused major outbreaks in northern American cities such as Philadelphia and New York. In 1793, the US government fled its then-capital, Philadelphia, when yellow fever caused thousands of deaths. By the 19th century, Europe was also affected (Coleman 1987). Once introduced to the Americas, yellow fever also spread to New World primates, establishing an ongoing non-human reservoir of the disease known as sylvan yellow fever. Today, yellow fever in the Americas exists primarily in the sylvatic form, and there have been no human-to-human transmitted cases since the 1930s. In Africa, by contrast, sylvan yellow fever regularly seeds urban outbreaks in which yellow fever is spread among human populations via the *Aedes aegypti* mosquito vector.

Zoonotic and vector-borne diseases have also been important objects of historical research in studies that explore the epidemiological impact of human transformations to the environment. Some of the most important studies explore mosquito-borne diseases, particularly malaria. In *The Making of a Tropical Disease: A Short History of Malaria*, Randall Packard (2011) discusses how the alteration of environments, primarily through agricultural endeavours, produced new habitats for disease vectors (*Anopheles* mosquitoes). In Southeast Asia, for example, colonial regimes opened vast, previously sparsely settled wetland areas

to agriculture in the lower reaches of the Mekong delta, the Red River delta (Vietnam), and the Irrawaddy River delta (Myanmar). Dams and drainage systems enabled production of staples such as rice to soar. However, they also created new interactions between humans, *Anopheles* mosquitoes, and the falciparum parasite that causes malaria disease. Packard (2011) emphasises that these ecological changes were often accompanied by sociological conditions, such as forced labor or low wages, that left human populations weak and less resistant to the parasite's infection. This interaction of ecological and sociological factors produced the devastating malaria epidemics of the 20th century in Southeast Asia. Tim Mitchell (2002) has explored similar interactions between ecological and sociological change in Egypt. Mitchell's goal is theoretical as well as empirical: he aims to reveal the agency of non-human forces such as mosquitoes and parasites. One of the most decisive factors in the outcome of Second World War battles and the failures of Egypt's development schemes, Mitchell (2002) argues, can be traced to the role of the *Anopheles* mosquito vector in spreading malaria.

All these studies adopt a similar epistemological approach: using current bioscientific and biomedical understanding of disease – or, as Crosby humbly put it, their own "amateur" approximation of it – to examine documents of the past, thereby revealing the role or agency played by zoonotic and vector-borne diseases in shaping human history. In doing so, they powerfully challenge anthropocentric accounts of human history by showing how historical events are transformed by the agency of non-human animals and their microbes.

However, historians attuned to the history of epistemology have raised serious questions about such anachronistic use of scientific concepts in historical explanation. Since historical actors did not share the same concepts of disease as we do, using current bioscientific knowledge to diagnose entities in the past may at times obscure rather than illuminate our understanding of the events and practices under historical investigation. Where historians like McNeill and Mitchell have aimed to show how a virus or parasite changed history unbeknownst to the human actors at the time, historical epistemology prompts us to attend more closely to what people *did* think about disease in history – the historical changes in human understanding of the aetiology, transmission, and ecology of diseases (cf. Delaporte 1986, 1991). It is to this *epistemological* history of zoonotic and vector-borne diseases that we now turn.

Concepts of disease in history

If environmental history is the study of humanity's changing relationship to nature over time, then disease history is a fundamental part of that history. So, too, is the intellectual history of disease, insofar as what humans have thought and believed about disease in different periods exerted a motive force on their interactions with the natural world. To understand the role(s) of disease in environmental history, we highlight how different concepts of disease have shaped humans' understandings of, attitudes towards, and interactions with the natural environment.

In *The Conception of Disease: Its History, Versions, and Its Nature*, the medical historian Walther Riese (1953) asserts that "various concepts of disease have always been overlapping, living side by side at each stage of human history". With this consideration in mind, it would not be possible to give an authoritative account or meta-narrative of the history of disease concepts as the unbroken line of human thought leading from past to present. It would be more appropriate to trace the *histories* of conceptualisations of disease, foregrounding how

ideas about humans, animals, and environments have been at the core of a variety of disease epistemologies, both before and after the concepts of "zoonotic" and "vector-borne" disease emerged.

Disease conceptualised as cosmological imbalance

Throughout antiquity, humans conceptualised disease as resulting from an imbalance in the body's four elemental humours, which the Greek physician Hippocrates (c. 460–370 BCE) identified as: blood, phlegm, yellow bile, and black bile (Conrad, et al. 1995). The Hippocratic humours were later adopted by the Roman physician Galen[1] (129–c. 217 CE), who identified them with the four basic temperamental types of persons – sanguine, phlegmatic, choleric, and melancholic – insofar as these character traits reflected an excess of one humour or another (Ball 2014). Galenic humoralism synthesised the writings of several Greek philosophers: Alcmaeon of Croton (floruit ca. 470 BCE), who described health as the proportionate blending of opposite qualities (hot and cold, wet and dry, sweet and sour, etc.); Hippocrates, who had combined Alcmaeon's pairs of opposites with the bodily fluids known as the four humours; and Plato (c. 424–348 BCE), who had aligned the four humours with the four elements – fire, earth, air, and water – from which everything on earth was created (Rooney 2012). Galen further related a correspondence between the four humours and the four seasons based on their mutual properties. Blood, as a humour, was considered hot and wet, which corresponded to spring. Yellow bile was considered hot and dry, which linked it to summer. Black bile was considered cold and dry, and thus related to autumn. Phlegm, cold and wet, was connected to winter (Jouanna 2012). By combining Hippocratic humoralism with Plato's humoro-cosmological conception of health, Galen maintained that disease (*dyscrasia*) resulted from a relation of disproportion between a body's humoral elements and the elements comprising the cosmos.[2]

The conception of health as balance between humans' internal bodily fluids and their external environment (*eucrasia*), therefore, reflected a particular understanding of the relation between the human body and the natural world, which mutually linked man and his humoral microcosm to the macrocosmic world of the elements. Importantly, because of the correspondence between a human body and its environmental context, disease causation could neither be explained solely with reference to internal bodily dysfunction nor solely as the result of environmental determinants.[3] Rather, it was understood as the result of an individual's humoral temperament *interacting with* external factors arising from the natural environment.

The cosmological conceptualisation of disease as a correspondence between the human body and the natural world was not unique to ancient Europe. In the final years of the Eastern Han dynasty, Cao Zhi (192–232) and Zhang Ji (150–219) characterised the cause of disease as the cosmic imbalance of yin and yang and their climatic correlates – Cold and Summer-Heat (Hanson 2012). In the Classical Chinese medical treatise, "Basic Questions" (*Suwen*), compiled between the first century BCE and 200 CE, it is written: "When in winter one is injured by Cold, in the spring there is certain to be a Warm disorder". The Cold Damage tradition emphasised latent *qi*, i.e. Cold *qi* that enters the body during the winter and hides below the surface of the skin until the heat of the spring or summer rouses it to action. When seasonal *qi* was excessive, a fever would become more severe with the rising heat of summer (Hanson 2012; 96–7). Despite geographically specific and culturally

nuanced differences in these two intellectual histories of disease, the principle of proportion between the environment and the human body can be seen to have guided understandings of health and disease for over two millennia.

Disease conceptualised as epidemic miasma

Cosmological conceptions of disease qua imbalance provided medieval physicians, early modern natural philosophers, as well as mid- and late-imperial Chinese physicians with a model for contemplating the impacts of the environment on human health.[4] In medieval Europe, miasmatic theories of disease, which attributed disease prevalence and spread to something in the air, were developed gradually over centuries and predominantly by Persian Islamic intermediaries who studied the texts of Hippocrates and Galen. In his celebrated text from the 10th century, the "Complete Book of the Medical Art", Ali ibn Abbas al-Maujsi (known as Haly Abbas in the West), describes how air could substantially decay into a "rotten vapor" capable of causing epidemic illnesses (Aberth 2012; 13). This happens when miasmata, referring to foul vapours or odorous "pollutions" in the atmosphere, arise from sources such as rotting organic matter, decomposing animal carcasses, and faeces in swamps, sewers, or drainage ditches. According to early miasma theories in Western medical thought, the rotten vapours mixed in with the air and altered its elemental composition; when humans breathed in this bad, "pestilential" air, they fell ill. In classical Chinese medical thought of the time, miasma theories posited malignant Winds as the source of epidemic diseases in agrarian societies, and zhangqi or "foul atmosphere/air" as endemic source of diseases "emanating from low-lying stagnant water reserves" (Sinha 2018; 61). From the 7th to the 10th centuries, northern Chinese medical accounts of zhang localised miasmic diseases to the subtropical waterways, marshlands, and mountains of the Far South, thus ushering in a new spatial understanding of epidemic emergence and spread, which transcended seasonal and elemental notions of miasma (Hanson 2012).

Amidst outbreaks of the Black Death throughout the 14th to the 17th centuries, miasma theories helped medieval European physicians to explain the inexplicable, that is, the apparent "contagiousness" of new, gruesome diseases in post-classical Europe – namely plague and syphilis, which did not fit easily into humoral theories of disease causation. Concepts, such as "poison" and "contagion", emerged, which reformulated classical humoral and miasmatic theories in new ways.[5] In *An Environmental History of the Middle Ages – The Crucible of Nature*, the medievalist John Aberth notes the numerous references to "poison" in plague tract literature from the late Middle Ages, arguing that the incorporation of a "poison thesis" into explanations of disease spread had wide-ranging repercussions "not only for the history of medicine but also for the history of human attitudes towards the environment" (Aberth 2012: 72). Concretely, the notion of poison provided miasma with a physical form, suggesting its existence as a causal agent distinct from the natural element of air itself. Challenging the idea that unhealthy odours were the cause of illness, Girolamo Fracastoro's theory of contagion also suggested that miasma possessed a material component, which he referred to as *seminaria contagiorum*, or small, invisible "seeds" of infection that were capable of flourishing in certain environments and of being conveyed from person to person through the air (Capua 2020). Insofar as beliefs in witchcraft and the magical ability to manipulate the natural elements for human purposes were on the rise, the environmental impacts of poisoned air gradually came to be understood as well as "something that

could fall under the sinister influence of man and that in turn could profoundly affect his health and well-being" (Aberth 2012: 76).

Implicit in miasmatic conceptions of disease were shifting ideas about the relation between the human and the environment, decreasingly understood as one of mutual correspondence and increasingly characterised as a deterministic relationship. On the one hand, disease could manifest when the environment acted on human bodies and populations, and, on the other hand, humans could both naturally or supernaturally act on the environment to influence states of human health and disease. In either scenario, the environment was reimagined as the medium of disease transmission.

In Europe, environmental understandings of disease prevailed for the greater part of the 19th century. To meet the etiological challenge posed by the cholera epidemic in 19th-century London, the "father of modern epidemiology" John Snow famously published his theory that cholera was spread not by inhalation of "bad air", but through a different environmental medium and means of transmission altogether, that is, by ingestion of contaminated water. Using maps to plot and examine the spatial patterns of disease distribution, he was able to link cholera to a specific source of water, a public water pump (Johnson 2006). This development suggested the environment as a spatial terrain that could align with localised sources of disease into which humans might be able to directly intervene (Anderson 2019).

Implicit in these renderings was a belief that both the environment and human-environment interactions could be modified in ways that were advantageous to human health. Correspondingly, public health efforts aimed at the dispersal of local miasmas – closed drainage and sewage systems, garbage collection, and housing – were pursued with great benefit to improving human health conditions (Rosen 2015).

Disease conceptualised as caused by germs

The germs – so to speak – of what would emerge in the second half of the 19th century as the germ theory of disease are already locatable in some miasmatic explanations of disease, particularly in the attention afforded to exogenous entities (e.g., poisons, seeds, contagious particles) found in the environment. Whereas those miasmas were presumed to be by-products of the environment and human interactions with the environment, germ theories of disease radically differed in that they afforded "germs" with an agency and animism whose mechanisms could be explained in accordance with internal causal principles of their own. This is to say, germs were understood to be alive. By the end of the 19th century, it was increasingly believed that discrete and identifiable microorganisms ("germs") were primarily, if not solely, responsible for the onset of specific diseases.

Historians most commonly give credit for the germ theory to Louis Pasteur and Robert Koch, two scientists who theoretically speculated and independently demonstrated that human diseases could be produced after certain microorganisms were introduced into the body (Lederberg 2000). By pioneering techniques for isolating, identifying, and growing microbial agents of disease in laboratory conditions, they laid the basis for developments in bacteriology, parasitology, and immunology, which in turn guided the discovery of new kinds of facts about disease and the connections between animals, humans, microbes, and environments. According to medical historian Myron Schultz, while Louis Pasteur, in France, was developing the new science of bacteriology, Rudolf Virchow, in Germany, was developing the new science of cellular pathology (Schultz and Schantz 2011). Virchow's theory that cells were the locus of disease in all organismal life, including humans, animals, and

vegetables alike, led him to establish laboratory-based medical facts about the links between diseases of humans and animals (Ancheta et al. 2021). By refashioning animals into points of comparison with humans, Virchow gathered insights into the biological mechanisms of cross-species infection and transmissibility, famously coining the term "zoonosis" to refer to infections in humans acquired by animals (Lerner 2013).

The historian Michael Worboys reminds us that there was not one germ theory but many, and that each was open to multiple interpretations leading to the formulation of many different explanations of disease causation and transmission (Worboys 2000). So, whereas Koch and Pasteur's contributions conceptually transformed disease into a biological relation between two organisms (the microbe and its host), Virchow's work marked an early instance of conceptualising infectious disease as an ecological relation between different species (humans and animals).

By locating infectious disease aetiology in pathogens that connected human and animal bodies, these theories contributed to what we now recognise today as modern epidemiological understandings of zoonotic and vector-borne diseases. Epidemiological theories and field studies from this period defined the importance of "carriers" (human hosts harbouring germs without themselves becoming ill) in the transmission of parasitic diseases, which promoted epidemiological studies of diseases borne by intermediate hosts or "vectors" (animal or insect hosts conveying germs from one host to another). In America's tropical colonies, for example, theories about vector-borne transmission were put to the test when, shortly after the Cuban epidemiologist Charles Finlay confirmed in 1901 that yellow fever was transmitted by the *Aedes aegypti* mosquito, US Army physician William Gorgas organised campaigns to control the transmission of yellow fever in Havana by isolating clinical cases from mosquitoes and eliminating mosquito breeding places. This resulted in the eradication of yellow fever in Havana within eight months and permitted the eventual completion of construction in the Panama Canal Zone (Delaporte 1991). The successes of these efforts were instrumental in elevating the strategies of insect elimination and pathogen eradication within North American public health work, particularly in campaigns against malaria.

The rise of germ theories in the late 19th century was a critical turning point in the history of medicine and public health, not because it undermined the miasma theory of disease, but because it marked the institutionalisation of a certain concept of the body in its relation to the environment. Linda Nash points out that, under the rubric of germ theory, "the healthy body was no longer a body in equilibrium with its environment, a body in balance, but a pure body, one that was free from germs and parasites" (Nash 2006: 89). At the same time, she notes that germ theories did not entirely disconnect the body from its environment. Environmental engineers, disease ecologists, and medical entomologists of the time would invoke germ theory as their rationale for more widespread efforts to reorganise environmental localities along "sanitary" lines, suggesting an awareness of the role of environment – and of the relation between humans, animals, and their environment – in processes of infectious disease otherwise attributed to transmissible organisms (84).

Disease conceptualised as ecological

Histories of medicine and public health once identified the rise of the germ theory of disease as a moment of modernist reduction, when the many interacting layers of atmospheres, environments, climates, and constitutions that had been understood to condition health and

disease were replaced by a single, specific cause of disease: the microbial pathogen (e.g., Rosen 2015 [1958]). However, more recent revisionist histories of the bacteriological revolution have stressed the multiplicity of germ *theories* of disease and the survival of concern about the health effects of environments on human bodies long after Pasteur and Koch. In the aftermath of the microbe, a minor history of "ecological vision" emerged and flourished (Anderson 2004). Most importantly, the discovery of the microbe enabled the visualisation of zoonotic infection. Since the same microbial pathogens could be isolated from animals and humans, the "zoonotic diagram" (Lynteris 2017) of infectious relations between animals and humans could be tracked for the first time.

Karl Friederich Meyer (1884–1974), who researched the ecology of pathogens and public health and was renowned as a "microbe hunter", traced microbes across species, revealing how non-human animals could play important roles as "reservoirs" of disease. Theobald Smith, MacFarlane Burnet, Frank Fenner, and others all tracked bacteria and viruses across species boundaries, revealing new ecologies of parasites and hosts (Anderson). Soon after the virus that causes human influenza was discovered in the 1930s, researchers identified the "same" virus in pigs, chickens, horses, and other animals, leading to new theories of the role of non-human animals in the emergence of flu pandemics (Fearnley 2020; Keck 2020). Even Zinsser, in his work on typhus, used the microbiological laboratory to imagine new infectious relationships between humans, rats, and lice. Although certain imaginaries of miasmatic environments and pathogenic filth were increasingly decentred, the discovery of the microbe enabled the constitution of new ecological visions of the environment as a dynamic space of contact and interface between species.

Eco-epidemiology emerged as a theoretical framework for conceptualising disease as the contingent outcome of multilevel determinants interacting dynamically with one another at molecular, organismal, and population levels of organisation (Susser and Susser 1996). Other ecological perspectives and models addressing the entanglement of biological, social, and physical environmental drivers of disease emergence and the inherent interdependence between humans, wildlife, and ecosystems continued to emerge, such as EcoHealth and One Health (Wilcox and Gubler 2005). What these ecological orientations to disease all share is that they direct attention away from any one level of observation, instead foregrounding *the relations* within and between vital phenomena at different scales of organisation and complexity. In other words, the conception of disease as "ecological" hinges on the idea that multiple causes act in various combinations relationally to produce different sufficient causes for a disease. Most of all, it reflects a particular understanding of the relation between the human and the natural world, one that situates humans in a wider biological and social ecosystem co-constituted by non-human animals, pathogens, and their shared environs.

Contemporary reconstructions (recent past and near future)

Since the turn of the 21st century, interest in zoonotic and vector-borne diseases has grown rapidly, in no small part due to a series of disease outbreaks and pandemics traced to animal reservoirs and vectors, including SARS (2003), MERS, avian flu, Zika, and Covid-19. Much of this interest in the relationship of animal to human diseases has been envisioned, studied, and popularised through the concept of "One Health" (OH) (Woods et al. 2018). As historian Angela Cassidy (2018) explains, the term One Health "first appeared in 2003, when it was

adopted by several groups working across human and animal health, and subsequently by policy-makers, clinicians, and researchers" (194). The Wildlife Conservation Society produced an early definition as part of their Manhattan Principles, suggesting that an "essential link between human, domestic animal and wildlife health" demanded new forms of multidisciplinary collaboration:

> Only by breaking down the barriers among agencies, individuals, specialties and sectors can we unleash the innovation and expertise needed to meet the many serious challenges to the health of people, domestic animals, and wildlife and to the integrity of ecosystems.

The term "One Health" was quickly adopted by many agencies and actors, becoming a centrepiece of global health programmes to control emerging diseases (Fearnley 2020; Salm 2020). Yet as Cassidy (2018) points out, One Health "is not a self-evidently beneficial phenomenon, nor the result of inevitable progress, but a contingent and context-bound activity that is actively and continually created through persuasive rhetoric and alliance-building" (196). Cassidy provides a detailed historical account that shows just how contingent and context-bound today's concept of One Health really is. But this leaves us with an important question: Given the historical relativity of concepts of disease such as One Health, how can we understand human-environment interactions today and their consequences for near future trajectories of disease emergence?

In this final section, we address this question by circling back to reconnect the two genealogies of environmental history that we have presented thus far: histories of how zoonotic diseases changed history; and histories of how the concepts of zoonotic and vector-borne diseases developed and changed through history. We now show how changing concepts of zoonotic and vector-borne disease have led to new interventions into the environment, changing ecosystems and human-animal relations in ways that have in turn created new (or different) risks of disease emergence. Whereas Zinsser, in his seminal *Rats, Lice and History*, attempted to separate the history of a vector-borne disease from the history of changing concepts of disease, we argue for an analysis through the lens of their mutual entanglement. These intersections offer key implications for environmental history because they show the recursivity of the environment as an idea and as a material surround: specifically, that ideas about the pathological features of the environment drive interventions into the environment, which ultimately produce new pathologies.

An exemplar for demonstrating this approach is the history of malaria and malaria control. As is well known, an intermittent fever known as *mal'aria* had, since Roman times, been associated with the "bad air" of low-lying swamps and marshes. Similarly, Chinese medical thought identified *zhangqi* or "foul atmosphere/air" as a source of diseases "emanating from low-lying stagnant water reserves" (Sinha 2018: 61). Such ideas gave rise to environmental engagements, including drainage schemes, and encouraged the avoidance of low-lying marshes. In a study of the California Central Valley from the late 19th century, environmental historian Linda Nash describes how physicians of the time advocated the massive importation and planting of eucalyptus trees in low-lying areas because it was thought that their strong aromas would neutralise the "noxious vapors" associated with malaria prevalence in the area, and thereby "render healthy otherwise 'uninhabitable districts'" (Nash 2006: 72). Ultimately, this transformation of the landscape did not decrease

malaria, but it did reflect an early modern belief that sickly environments could be restored to health, in turn, improving human health.

In 1880, French military doctor Alphonse Laveran took blood from malaria-infected soldiers and observed parasites under microscopy. However, as Ria Sinha (2018) points out, the discovery had little impact on control measures, perhaps only facilitating differential diagnosis from a range of other "fevers". Much more significant was the discovery, by Ronald Ross, that these parasites could also be found in mosquitoes that had taken blood meals from a malaria patient. As Sinha (2018) explains, "The malaria-mosquito connection heralded a global paradigmatic shift in the development of anti-malaria measures that moved the goalpost away from high-cost sanitary infrastructure projects to targeted and comparatively low-cost mosquito eradication" (64). After the development of insecticides such as DDT, military-style mass spraying campaigns drastically reduced the vector populations, leading to the elimination of malaria in many northern, temperate areas and its control elsewhere.[6] In 1955, the World Health Organization launched an ambitious programme to completely eradicate malaria from the globe, basing the eradication campaign almost entirely on vector elimination through DDT spraying (Packard 2011: 151).

However, success with vector control was short-lived, and the eradication programme soon deemed a failure. Randall Packard (2011) has identified a range of reasons why the eradication programme failed, including pesticide resistance; antiparasitic medicine resistance; the rigid, unilinear, and top-down structure of the programme; and financial shortfalls. What is clear is that the eradication programme, while not successfully eliminating malaria, *did* dramatically transform human–non-human ecosystems: including the elimination of certain vector species or other non-target insect species; the increasing resistance of target mosquito populations to insecticides; and other unintended health effects on both humans and non-humans from exposure to insecticides. As Nash (2006) has shown, the distinctive vision of disease and environment embodied in vector control and disease eradication programmes led to interventions, like pesticide spraying, that produced new contexts of health and disease, both for humans and mosquitoes.

The recursive dynamic of malaria control programmes can be followed further into the recent past and the near future of the contemporary (Rabinow 2008). With recent advances in molecular genomics, new forms of vector control have been developed to counter malaria through the application of biotechnological and genetic engineering strategies, such as mosquito gene drives. Unlike the application of insecticides, gene drives target the genetic modification, rather than elimination, of mosquito populations, causing them to inherit specific characteristics and disabling their capacity to carry and transmit the malaria parasite. At the same time, gene drives largely share a similar technoscientific developmental pattern with earlier insecticide campaigns. Like chemical control measures, methods of "biogenetic control" reinscribe a movement of new technologies from laboratories to field sites. There are obvious ways in which this targeted form of "biogenetic control" poses fewer direct threats to the health of humans as well as to non-target insect and plant species (i.e., chemical exposure). However, the technique has not yet been tested "in the field", in large part because uncertainty remains regarding how genes circulating in a population would change and how this would interact with environments or impact local ecosystems (O'Connor 2022). Based on the experience of insecticide campaigns, then, we can envision that the deployment of mosquito gene drives into field-based control operations may

produce unexpected changes in the dynamics of human-mosquito-parasite relations and zoonotic disease risk.

Another example of this recursivity can be taken from the controversies surrounding so-called "gain-of-function" research into zoonotic pathogens such as influenza or coronaviruses. Recently, new patterns of interaction between lab and field are also coming into view at the molecular scale of the gene. Under the umbrella of One Health, technology-driven innovations at the frontiers of bioengineering are increasingly channelled into the research of different zoonotic and vector-borne diseases. Laboratory scientists, for example, conduct experiments with newly discovered pathogens – purposely modify them – to characterise the potential risk they pose for zoonotic transmission into human populations. Relying on PCR and next-generation sequencing to study the pathogenicity of newly discovered viruses and to individuate the main characteristics that can cause viral transmission from animals to humans, experimental life scientists can isolate viral matter; and, if need be, they can synthesise viruses to see how they behave and replicate in a cellular host (Schmidt 2018). Commonly known as gain-of-function (GOF) research with potential pandemic pathogens (PPPs), this subsequent step in the research can take place only in laboratory facilities where special precautions are taken for reducing the risk of unintentional exposures to or the accidental release of a pathogen while conducting high-risk research.

Since the onset of the Covid-19 pandemic, the debate over GOF/PPP research has been reinvigorated, especially considering prevailing uncertainties – whether they be scholarly or conspiratorial – regarding the origins of the disease's causative agent (Relman 2020). On the one hand, proponents of GOF/PPP experiments have claimed that such research can help to delineate the principles of virus transmission between species. This indicates which high-risk pathogens should be prioritised for further research attention, and to strategically develop pre-emptive medical countermeasures against zoonotic outbreaks in the form of new diagnostics, antiviral medicines, and vaccines (Fauci, Nabel, and Collins 2011; Lakoff 2017; Morse et al. 2012). On the other hand, opponents of GOF/PPP research have argued that these practices present unacceptably high biosafety and biosecurity risks not only for experimenters handling dangerous viruses in the laboratories but for the global public health of humanity at large, should a pathogen with high human virulency "leak" from the lab on account of either unintentional human error or else malevolent misuse (Evans, Lipsitch, and Levinson 2015). From this precautionary vantage point, the potential benefits of purposefully modifying pathogen genomes do not outweigh the risks: although it may precipitate increased awareness and understanding of zoonotic risks before major outbreak events occur, evidence that GOF/PPP research translates directly into effective control strategies and broad-spectrum treatments is scant, and the probability of accidental release is high. In short, contemporary attempts to prevent the probability of future zoonotic disease events risk inadvertently creating (new, different) conditions for disease emergence.

One Health continues a long line of interventions into ecosystems and environments to control zoonotic disease risks. Despite its apparent move beyond anthropocentrism, however, One Health cannot avoid being itself a human driven engagement with non-human environments. As new concepts such as One Health drive new efforts to manage health risks from zoonotic and vector-borne diseases, it is worth considering how future environmental historians will trace the impact of these schemes on environments, as well as their potential for producing new risks, today still unforeseen.

Notes

1 Though the doctrine of humoralism is commonly equated with Galenism, historians suspect that the origins of humoral theory probably lie in Mesopotamia or Egypt (Porter 2009).
2 It is important to acknowledge the contingency of today's terms, especially with reference to concepts from the past. The Ancients, for example, had a very particular conceptualisation of the "cosmos" that differs from our modern conceptualisations of "nature" and "environment".
3 A remarkable feature of Hippocratic thinking is its appraisal of spatial and environmental factors as health determinants. In his book *On Airs, Waters and Places*, we read:

> Whoever wishes to investigate medicine properly, should proceed thus: in the first place to consider the seasons of the year, and what affects each of them produces for they are not at all alike, but differ much from themselves in regard to their changes. Then the winds, the hot and the cold, especially such as are common to all countries, and then such as are peculiar to each locality. We must also consider the qualities of the waters, for as they differ from one another in taste and weight, so also do they differ much in their qualities. In the same manner, when one comes into a city to which he is a stranger, he ought to consider its situation, how it lies as to the winds and the rising of the sun; for its influence is not the same whether it lies to the north or the south, to the rising or to the setting sun.
>
> *(Hippocrates, 400a BCE)*

4 Note how the cosmological concept of disease as imbalance is worked into miasma theories of disease. Chinese scholars of the 10th century described disease as the struggle between heteropathic *qi* entering the body from the outside and orthopathic *qi* defending the body from within (Hanson 2012: 29). The 17th-century Chinese physician Wu Youxing explained disease as the combined result of an internal *qi* imbalance and environmental factors, such as epidemic pestilential *qi* (*liqi*) and other local miasmas (*zhangqi*), which he claimed affected people differently because of their different predispositions; the strength of an individual's constitution could still ward off invasion by epidemic *qi*. Similarly, as explained by the 17th-century English physician Thomas Sydenham, to become infected by environmental miasmas, a person's humoral constitution had to be internally imbalanced in a way that made that person susceptible to the infection in the first place (Riese 1953; Susser and Stein 2009).
5 In European history, there are multiple miasma theories. Beginning with Hippocrates, miasma denoted a noxious exhalation, specifically those emanating from corpses and stagnant water. Much later, Girolamo Fracastoro gave miasma a more tangible form, believing that it was neither vapours given off by rot nor "corrupt air", but rather a poison that caused epidemic illness. His book in 1546 on "contagion" is a manual of infectious disease, in which he postulates three modes of contagion by inanimate particles: either by way of direct person-to-person contact, by fomites, or by inhalation of invisible airborne particles (Susser and Stein 2009: 75). Richard Mead (1673–1754) was similarly emphatic about the role of "contagion", claiming it could be spread by air, diseased persons, and goods from infected places (Susser and Stein 2009: 19).
6 To be sure, eradication campaigns of the mid-20th century were militaristic in nature – humans were the infantry in a war waged on vectors of disease. Its associated techniques, like pesticide spraying, were predicated on the idea that parasites were pathogenic to human health and thus the vectors that bore it ought to be removed from the environments in which humans lived.

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8

THE NON-HUMAN IN AGRICULTURE

Technologies of agriculture and non-human aspects of farming

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Introduction

In November 2019, a scientist detected a virus with pandemic potential possibly from an animal market at Wuhan, People's Republic of China. Within a few months, SARS-cov-19 spread to every continent, demanding answers to international governance in times of pandemics, the race for vaccines, economic challenges and civil rights versus lockdown politics, and, perhaps most terrifying to many, conspiracy theorists, "fake news", and denialism. Simultaneously, issues initially raised have been marginalised by the global debate, obliterated by the concerns of pandemic containment and the subsequent economic downturn. In the first months of the pandemic, scientists, activists, and governmental institutions critically discussed the world's food production chains, especially regarding industrial agribusiness. With the hypothesis that SARS-cov-19 would have emerged in a market of (purportedly) wild animals in the central region of Wuhan, it would be necessary to analyse how the relationship between humans and non-humans reached this climax of apocalyptic potential. In 2020, the United Nations Environment Program "Preventing the Next Pandemic: Zoonotic Diseases and How to Break the Chain of Transmission" (United Nations, 2020) urged the rethinking of the global food supply chain. This debate echoed across borders and continents. In early 2020, one of the largest content, technology and digital payment media companies in Brazil, UOL, published an article provocatively entitled "To Avoid Future Pandemics, the Global Food Chain Must Be Revised" (Veiga 2021), discussing experts' recommendations on decreasing meat consumption. For the Islamic world, Mohammed Faiz Bin Shaul Hamid wrote "A Call to Re-Think Agri-Food amid COVID-19 and the Looming Food Crisis" (Hamid 2020), discussing the impact of the pandemics in food security. There were plenty of such warnings about the urgent need to rearrange the global food chain. However, in the following months, global industrial agriculture representatives successfully pressured governments around the world to decrease Covid restrictions on the productive sector – such as industrial slaughterhouses, where the virus had spread particularly rapidly.[1]

The critique of industrial agriculture as well as their advocates' responses are ever-present in recent memory. In the mid-1990s, "mad cow disease" (Creutzfeldt-Jakob disease)

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crossed the borders of the United Kingdom; in 2005, the bird flu affected Southeast Asia; in 2009, H1N1 broke out in Mexico and reached at least 75 countries; and Ebola spread in 2014 in Guinea. Epidemics, entangled in industrial agriculture and the trend within NGOs, among public intellectuals, and in popular culture to rethink the animal-based food production chain have become embraced by animal rights activists, social movements, and institutions that had denounced the conditions of exploited (human) workers in this sector already for four decades. The new millennium deepened awareness of the ambiguities inherent in industrial agriculture, giving rise to a wide range of critical documentaries in first movie theatres and later streaming.[2] These films portray the logics of industrial livestock farming along the lines of horror movies. The fusion of horror and absurdity is to be found in the minutiae: Anita Krajnc, a Toronto resident, was charged with criminal mischief for giving water to pigs in a slaughter truck in Burlington in 2015.[3]

In short, industrial agriculture has become a major topic of global debate, with the focus on the interwoven exploitation of plants, animals, and humans. Agricultural animals have begun to attract attention in the field of modern historiography, and in studies of environmental history, agriculture, and science and technology (Blanchette 2020; Fleischman 2020; Haalboom 2020; Olmstead and Rhode 2015; Settele 2020; Specht 2019). Plants such as maize, wheat, and soybeans have recently played a relevant role in environmental historiography (Uekötter 2014), whereas soils and living organisms such as bacteria and viruses have hitherto only begun to attract attention, in works such as *The Dust Bowl* by Donald Worster; *Soils and Society*, edited by John R. McNeill and Verena Winiwarter; *The Grasslands of the United States: An Environmental History*, by James Sherow; and "Malignant Microbes" by Matthew Plishka. New fields of study such as animal studies (see Chapter 6, this volume) on the one hand focus on the contribution of individualistic animals to history and society (Holloway and Bear 2017: 215; Nimmo 2017: 118); on the other, the commodification of farm animals has become part of a history of capitalism (Curley 2021; Medrado 2021; Settele 2018). In sum, new readings of past environments seem to offer farmed animals, plants and seeds, soils, and other non-human elements, as well as greater agency and influence in the history of agriculture.

By exploring these influences, this chapter provides thoughts on how the non-human in industrialised agriculture can be addressed. Following this perspective, we concentrate on conceptual and empirical ideas for a globally connected environmental history of non-humans in agriculture since the late 19th century. In geographic terms, we will explore how processes of industrial agricultural diffused from one region to another. The chapter proceeds in three steps. We first present evidence on why the non-human beings in agriculture – animals, plants, bacteria, soil – supported technologies and products to travel beyond political borders. In a second step, we examine how the non-human and the human remained connected in an infinite and ouroboros-like circulation (plants–proteins–animals–humans). Finally, we will suggest a short research agenda of untangling the entangled environmental and agricultural history of the non-human.

The non-human has no borders: science, technology, and the striving for productivity

On the farm "Várzea da Onça", in an Atlantic Forest area located in the north-eastern state of Pernambuco, Brazil, pig farmers have undertaken an alternative process for raising their animals, believing that animal welfare directly affects the quality of the meat. According to

the farmers, sows of the breeding lines Landrasse, Large White, Duroc, Moura, and Piétrain are mated twice a year with "David Bowie", a Large White male. Their offspring are suckled for more than 45 days and reared freely in the woods, listening to music, being brushed and bathed, and fed on forage grasses or seasonal fruits such as banana, mango, jackfruit, and even cashews. Finally, depending on the time of year, the farmers slaughter some animals and sell the byproducts to regional and national markets (Pastre 2019). This alternative production method resembles at the beginning of the 21st century how peasant farmers used to raise pigs in the interior regions of the Americas before World War II. With abundant ecological resources, such as seasonal fruits and grasses, farmers on the continent would have raised their animals unconfined, without fences, since a herd of pigs (working in tandem with free-ranging chickens) would also fulfil the role of clearing large areas of unwanted weeds and fertilised the soil with their manure. The processes of urbanisation, marketisation, and capitalisation, as well as the adaption of new biotechnologies, fast-tracked the transformation of livestock farming globally into a capital-intensive industry since the end of World War II, making "David Bowie" a rare exception in the 2010s.

Industrialisation and the persistence of traditional faming technologies were a global phenomenon. Colonisation projects for Latin America, Asia, and Africa merged with the intentions of governments and corporations to integrate economical "frontier regions" – regions considered as having great potential for economic resources exploitation but that so far have not been used due to a lack of technical knowledge (Silva 2023). Consequently, existing extensive breeding grounds were now no longer intended for self-consumption, the exchange of surplus, or religious celebration in the community. Porcine drifts or droves began to be transported more than 100 miles to large slaughterhouses and later traded to other regions in the form of lard, salami, chops, or sausages (Silva 2006). From 2009–10 data, we found that traditional or backyard systems remained predominant over large-scale commercial systems in some countries such as Kenya – a farming style almost eradicated in other parts of the world, such as the United States or Europe. Out of a total Kenya population of 335,301, 187,073 were being raised in backyards, while 149,965 were associated with commercial systems (FAO 2012: 4). The persistence of traditional farming systems combined with foreign biotechnologies as it is applied in Tripura, a state in north-east India, proved itself helpful to food security of poor populations (Haldar et al. 2017: 472).

Not only did non-humans travel as "meat products", but they started to cross continents even before they came into existence in the second half of the 20th century, due to a new technology that allowed increased productivity in livestock farming. The introduction of artificial insemination (AI) has been an impetus for other technologies, such as cryopreservation, sexing of sperm, oestrus cycle regulation, and embryo harvesting (Foote 2002: 1), and thus a milestone in how humans expanded control over non-humans (Jungk 1952: 179–93). The implementation of AI in European and North American cattle breeding since the 1950s shows how a new technology simultaneously increased productivity of dairy cattle and pigs and the sphere of influence of this non-human product. In 1899, Soviet veterinarians had developed the technology of obtaining bull sperm before inserting it in the cow's uterus by human hand, closely tied to the same practice in horse breeding. Subsequently, artificial insemination travelled via Japan and Denmark to several countries of the Global North (Ivanoff 1922), unfolding a huge globalising effect in animal breeding techniques. In Denmark, the first dairy AI organisation at The Royal Veterinary College in Copenhagen was established in 1936, two years before such a cooperative opened in the United States (Lonergan 2018: 4). Ten years later, Milan held the first congress on "AI and

Animal Reproduction" in 1948 and from then on every four years (Foote 2002: 10). Technicians considered the new biotechnology to accelerate the improvement of reproduction and genetics of farm animals. The implementation of AI in cattle breeding in the Federal Republic of Germany and the German Democratic Republic was representative for the Global North, where at the beginning of the 21st century, approximately 80% of dairy cattle in Europe and North America, 90% of all breedable pigs, and 100% of turkeys were bred by AI (Morrell 2011: 1). In Asia and Africa, in contrast, AI saw fluctuations and remained limited to particular areas which resulted in a total of a fifth of the breedable female cattle population in the world being bred by AI in 2000 (Thibier and Wagner 2002).

The technology, however, had been established around the same time in the Global South. Kenya had been among the AI forerunners in the 1930s and 1940s. The Kenyan Veterinary Department supported the introduction of AI by European farmers in 1935 to stop venereal diseases. Only ten years later, by the end of the Second World War, Kenyan veterinaries praised themselves to be second only to the Soviet Union in the application of AI (Leonard 1991: 150 f.; Hopcraft 1976: 53). In 1946, the Veterinary Department under Ishmael Muriithi established the Central Artificial Insemination Station outside Nairobi at Kabete, where semen was collected, processed and stored. Kenya's AI Service, shaped by a Swedish aid agreement from 1966, quickly became efficient through use of management information systems, statistics, reliable vehicles, and deep-freezing facilities (Leonard 1991: 151). Although African managers of rural development and western development experts remained considerably interested in the biotechnology that promised the upgrading of traditional African Zebu stock as well as the introduction of already-optimised high-performance breeds, proliferation stagnated from the 1950s onwards. Charges financially not reasonable for single farmers thwarted the dream of fast and comprehensive genetic improvement. In the 2010s, 70% of the Kenyan cattle were reproduced through natural mating, 30% through AI (Kenya Market Trust 2014). A recent report on AI in Kenya revealed farmers being at the mercy of opaque pricing systems for AI service in addition to inadequate protection from malpractice as main reasons for the lower application rates of AI compared to those in Europe and North America (Kenya Market Trust 2014: 6f.). Kenyan history of AI in cattle breeding joined the ranks of sub-Saharan African development. Also in Tanzania, Ethiopia, and Uganda, infrastructural and technical challenges such as high costs and insufficient distance covered by the service provider have recently been researched as negatively influencing AI adoption (Mwanga et al. 2019).

The faith in progress awarded to the biotechnology of AI has not changed since the 1950s. Agricultural engineers, veterinaries, and agricultural planners have attributed decreasing prevalence of contagious decreases among animals and increased milk and meat consumption to enhanced AI adoption around the globe ever since (e.g., FAO 2020; World Trade Organization 2011). Government organisations provided, mostly in terms of public-private partnerships, economic resources for semen collection centres and semen banks, progeny test programs, and the application of quantitative genetics. The recurrent motivation at heart was that AI required only a fraction of the formerly needed bulls, which would render cattle farming cheaper as bulls' maintenance costs were high. It was for this reason that West German dairy farmers refused to return to the traditional mating method after the acute outbreaks of venereal diseases such as trichomonosis, vibriosis, and campylobacteriosis had been overcome in the 1950s, for which AI, as it has been the case in the United Kingdom, had been introduced as a temporal means (Hopf 1951: 713; Parkinson and Morrell 2019: 746). The offspring from artificial insemination, they had also learnt,

displayed higher milk yields, as the bulls were more carefully selected than before. The number of artificially inseminated West German cows rose annually and already at the end of the 1960s, technicians were impregnating more than half of all cows (Sell 1976: 110). In contrast to the Kenyan experience since the 1950s, in West Germany the motives of individual cattle farmers went hand in hand with the larger agricultural strategy of increasing overall productivity in livestock farming despite a shrinking workforce, increasing demand, and international competition.

In the GDR, as in other socialist countries tied to the Soviet Union, artificial insemination was introduced as a centralised government project to increase milk fat and milk yield. Although economically it was organised differently, AI there showed similar globalising effects. AI rendered genetic material into a traded commodity with constant growth expatiations up to the present (Veterinary Artificial Insemination Market 2022). Then it transformed cattle herds through cross-breeding between imported, mainly North American or European semen of Brown Swiss, Holstein-Friesian, or Jersey as it could be observed in India and Ethiopia (Duncan et al. 2013; Münster 2017: 25 f.). With its new ability to travel, bovine sperm caused political trouble in Cold War Europe. In December 1962, a breeding organisation in Schleswig-Holstein offered Nikita Khrushchev 200 portions of frozen sperm from its best bulls to increase the milkfat of Russian cows (German Federal Archive Koblenz, B 116/17922). Soviet presses rejoiced at the offer, and West German farmers were upset about the ingratiation of their fellow cattle breeder. In the end the controversial marketing strategy paid off. The breeding organisation that offered the sperm was among the first West German sperm exporters to Russia. Despite agriculture's accelerated loss of importance in national economies compared to the industrial and service sector from the 1950s onwards, new technologies of livestock farming provided for equally accelerated globalising effects in the very same time period.

AI became an impetus for scientists to develop further technologies, which facilitated global mobility of the non-human. Cryopreservation of the extracted cattle semen followed in the 1960s and displaced traditional boundaries of space and time. It became possible to mate cows with bulls who were geographically distant or who had even died years before, with their offspring first carefully evaluated before their genetic material was distributed on a large scale. Bulls – or more precisely, human technicians who applied their semen – could now create progeny simultaneously on different continents without a lack of resistance to local diseases (Parkinson and Morrell 2019: 747). In February 1960, the USSR started to build a central semen bank in Moscow, where sperm of the best bulls was stored and could be ordered from (German Federal Archive Berlin DK 1/7158 RGW). The Federal Republic of Germany became a major player in the trade of frozen sperm in the 1970s and of embryo transfer in the 1980s (Sell 1976: 250).

The impact of the non-human in cattle breeding did not decline, albeit AI made countless bulls and boars redundant. What the East German district veterinary Dr Riedel documented in November 1958 remained a risk until today (German Federal Archive Berlin, DK1/10954; FAO 1981; Maes et al. 2011). Riedel first recognised an unusual acute outbreak of a contagious herpes in the cattle herds around Erfurt. He soon determined that all of the infected cows had been inseminated with sperm coming from in the Erfurt station for artificial insemination. There, further inquiries revealed that 20 of the 36 bulls were also infected, because the phantom cow they mounted was not disinfected after each use. After the bull Questelino had mounted the phantom without quarantining after his arrival, his infection had spread first among his fellow bulls before veterinaries brought it to the numerous cows. The rapid

transmission of pathogens caused by AI led to disease outbreaks in many different herds, thereby showing how the non-human continued to challenge intensified livestock farming.

Economic and environmental historians focus on international trade as the main force to connect Western Europe and the United States to the agrarian frontiers of the Global South. In this argument, gradually, part of the capital generated in cattle frontier areas began to be invested in herd improvement, acclimatisation of new breeds to the tropics and subtropics, acquisition of specialised feed, and medicines. Reverse processes, livestock being imported from Africa or Asia to Europe, was complicated by protectionist import regulations on behalf of preventing the import of animal epidemics. After Europeans had introduced cattle to the Americas during the 16th century, countries like Argentina and Uruguay took the lead on a controversial modernisation process – i.e., through the creation of government authorities specialising in exchanging technical information, attracting experts, and adapting genetic material to the local environment – introducing new breeds in an old agrarian structure since the late 19th century. In both countries, the ranchers introduced prime breeds such as Shorthorns, Hereford, and Aberdeen-Angus (Argentina), while Creole breeds constituted 82% of their neighbours' herds in southern Brazil until the 1950s (Zarth 2016: 76). As a result, Argentina dominated the world beef export market until the 1930s, with Great Britain being the main importer. With the increase in supply to Great Britain and the consequent decrease in exports, the governments of Argentina, Uruguay, Paraguay, and Brazil intervened to increase internal consumption. In a complementary way, the emergence of outbreaks of foot and mouth disease and the closing of new markets in Europe, Africa, and Asia made Latin American governments concern themselves with the modernisation of herds and production conditions (Arceo 2017: 165). Taking Argentina and Uruguay as an inspiration, Brazilian government authorities and large landowners unleashed a process of modernisation of livestock farming, replacing the Creole cattle with European breeds, aiming at greater productivity and insertion into the global market for refrigerated meats (Zarth 2016: 72). The new breeds had environmental impacts and required a new production structure, based on the foundation of research and technical support institutions, experimental stations, ranchers' associations, and transportation structure. During the Cold War, Latin American countries under North American influence received financial and technical support. Both the US government and private institutions like the Ford Foundation provided technical cooperation and the introduction of Indian cattle breeds aiming at tropical acclimatisation and focusing on Zebu breeding. In the countries of the south of the American continent, the 1950s saw a tremendous expansion in the number of agronomists and veterinarians involved in lecturing on agricultural issues, such as cattle vaccination or tick and heartworm control (Silva 2015: 125).

Between the 1950s and the time of this writing, technological exchanges between distant regions of the planet, and industrialised or agricultural frontiers, have intensified dramatically: the technification of agriculture, generally represented through the concept of the Green Revolution, has deepened a process of diffusion, adoption, and adaptation of agricultural production techniques and structures previously localised to specific geographies. In terms of crop farming, both traditional slash-and-burn and classic plantation agriculture were replaced gradually by paradigms consistent with "modernity" – such as the use of chemical fertilisers, pesticides, hybrid seeds, and heavy machinery (Picado 2022). This knowledge transfer had intensified since the late 19th century in universities, research centres, and government institutions mostly in Western Europe and North America. In the meantime, the interpretation of scientific and technological progress has become an

imperative task to the agri-environmental historiography. However, many of these technological artefacts were produced in a disjointed way, through an agenda that would replace "trial and error" practices with rational, scientific, and neo-Malthusian planned precepts (Silva 2015). Although not in the same way everywhere, the colonialist imperative to produce plantations was giving way to the benevolent rhetoric of feeding a growing population, although through an environmentally destructive monoculture. Taking the Green Revolution as key, this process was embodied by the missionary action of US agronomist Norman Borlaug.[4] As part of a team of technicians, classic Green Revolution historiography attributes to Borlaug the development of varieties of wheat in Mexico during World War II. After that, this biotechnology travelled from Latin America to Asia, advancing over the territory of India and Pakistan and becoming a model for transactional actors such as the World Bank and the Rockefeller and Ford Foundations, which, in turn, propagated it back to the Americas and Africa in the 1970s (Silva 2015 and 2023). This wide-ranging program of exchanges between non-humans, techniques and technologies, agricultural experts, and the infrastructure supporting the new production patterns of industrial agriculture has gained dramatic momentum, especially in the Global South in the second half of the Cold War. While the technical knowledge of agronomists, biologists, soil scientists, or chemists expanded the scale of diffusion through conferences, workshops, and specialised publications, countless seeds, microbes, genes, or insects came to be perceived as native rather than exotic. An example of this is the African grasses that dominate central regions of South America, which are adapted to savannas and are subsequently reintroduced to African savannas or Australia as pastureland for cattle breeds. Moreover, since the end of World War II, new varieties of rice and wheat have travelled similar routes, replacing seeds introduced during colonialism. Farmers and scientists in what were considered isolated areas of the Americas were provided with the opportunity to order wheat or soybean seeds from all over the globe, but especially from the United States, China, and Japan. In turn, corn from the Americas, a product of traditional knowledge, was transformed into hybrid corn seed, developed by hybridising two or more strains, and reached all continents to be grown on a large or small scale by the late 1970s. Those technologies of industrial agriculture were travelling across borders and at the same time fostered monocultures with concomitant need for pesticide use, increased need for water, deforestation, and regular warnings about possible environmental collapses (United Nations 2020).

Since the end of the 19th century, agriculture has undergone several transformations produced by scientific and technological changes. Agricultural leaders were enthusiastic about those changes as they increased productivity and therewith food supply, balance of payment, content citizens, and national economic growth. Colonial science acclimated thousands of non-human species and sent them to other continents. In addition, the farm coexisted with the laboratory as a place for adaptation and transformation of non-human species; scientists and technicians began to overlay the farmers regarding knowledge production. Indeed, scientists and agricultural planners designed models to be adapted to other regions of the planet. Those "technological packages" indicate the tendency of agricultural research institutions to centralise and standardise information with the aim of offering simple solutions and homogenised recommendations (Okali et al. 1994: 299). In general, every agricultural development policy in South Asia, Latin America, and Africa followed this pattern between the late 1950s and 1980s, based on bank loans connected to the technicians' prescriptions on what kind of seed or amount of chemical fertiliser. In 1952, The Ford Foundation Annual Report celebrated the "new climate of international relations",

with the growth of technical cooperation programs from the United Nations, the United States, and private organisations (The Ford Foundation 1952: 19).

In geopolitics, lingering hierarchical and neo-colonialist scientific practices contoured technical assistance practices and, later, international technical cooperation. Scientific and industrial agriculture has become an instrument of foreign diplomacy: instead of using military armies to invade territories and establish governments as in Cuba and the Philippines – after the Spanish-American War (1898) – the idea of technical assistance has guaranteed to the United States new channels of dialogue and the opening of markets. Incorporating ethnocentric or even racist values arising from the approximation between agriculture, genetics, and eugenics since the beginning of the 20th century, the technical assistance programs originated in the United States and exported to the Global South gradually adapted to the new conceptual realities, especially after the collapse of Nazism (Silva 2022). This means that the replication of knowledge produced in US research institutions was later overshadowed by the notion of technical cooperation, an approach involving many players in development processes (Silva 2015 and 2023). Large areas previously considered unsuitable for industrial agriculture were seen as potential sites for agricultural production. During the Cold War, capitalism and socialism began to compete not only through nuclear weapons, but also through the transformation of internal and neocolonial territories through industrial agriculture and crops commerce. Non-human beings entered the political world scene. Nevertheless, the agricultural technical prescriptions did not advance on countries and areas of land collectivisation such as Laos and Vietnam until the fall of the USSR in 1990, as well as in the commons, since the Green Revolution and its contemporary technical programs have concentrated their efforts on the agricultural development of private lands (Williams and Cramb 2020).

More recently, historians have observed how, throughout the history of plant species adaptation, countries of the Global South have offered fundamental solutions to combat pests, asserting the need to relativise the role of the Global South as the "periphery" in scientific production (McCook 2019). The creation of laboratories, agricultural schools, and lab farms that involved experimentation, technical assistance, and technological exchanges formed true hybrid systems, adapted to local ecologies. Thus, scientific and technological practices in agriculture, as well as their diffusion or adaptation, became a platform for the advance of industrial agriculture. This reveals entangled relations of power and the enduring hierarchies of power between the human and the non-human, as well as between the Global North and the Global South. The historian and veterinarian Floor Haalboom analysed how the rise of intensive pig and chicken farming in the Global North correlated with a rise in fishmeal production in Peru, Chile, and Angola between the 1950s and the 1970s (Haalboom 2020). Animal feed produced and imported from elsewhere was the precondition for keeping Dutch pigs and chickens in large-scale "factory farms". The global supply of fishmeal as cheap feedstuff, originating from fishmeal production in the Global South, saw a boom with the industrialisation of pig and chicken farming from the 1950s onward. In 1962, Peru exported one-fifth of its anchovy fish animal feed to the Netherlands, Chile more than one-third, which was among the top three fishmeal importers internationally from 1954 to 1972 (Haalboom 2020: 572, 576, 582). Fishmeal became part of compound feed created by an emerging feed industry which blended grains, oil seed cakes, and meat and bone meal to offer a single product that fulfilled all nutritional needs of pigs and chickens. US marine expertise, investments by American industrialists and subsidiaries of US companies like Cargill and Ralston Purina helped to realise fishmeal plants in Peru (Haalbloom 2020: 582).

Driven by the industrialisation of livestock farming in north-western Europe and by profit expectations of the then-collapsed U.S. fishmeal industry as Californian stocks of sardines had been depleted, fishmeal was transformed from a by-product of fish canneries to a premium export article. The ports of Lima and Rotterdam connected the ecosystems of Peruvian fishmeal plants and Dutch farms. This connection, however, remained invisible; industrialised animal farming in the Global North became known as "landless". However, by focusing on the non-human in agriculture and tracing the resources that supported agricultural organisms, we can begin to see how these connections shaped ecosystems. Thirty years before the BSE crisis in the 1990s, debate about endangered food safety had arisen in the context of fishmeal contaminated with salmonella bacteria if not sterilised profoundly (Haalbloom 2020: 586). In addition, the rise and fall of the global fishmeal industry allowed the untangling of international power relations. Fishmeal production in the Global South became a topic of public health discussions in which fishmeal, especially from Africa, was imagined as particularly dangerous to European and North American diets (Haalbloom 2020: 588 f.). Social inequality between fishmeal industrialists and shareholders at stock exchanges speculating on fishmeal and the poorly paid workers in the fishmeal plants resulted in labour unrest during the 1960s in Peru and the 1980s in Chile (Haalbloom 2020: 590). In Peru, the centre-left military dictatorship in power since 1968 cut back the fishmeal industry in order to use fishing for human consumption instead of feeding someone else's animals. In 1973, after the Peruvian anchovy population in the Humboldt Current had collapsed and struck the fishmeal industry, the military government expropriated the entire industry into the national company Pesca Perú (Haalbloom 2020: 593).

The non-human in agriculture functions as a signifier of global and national power relations. The entangled history of fishmeal production and consumption reveals the changing assertiveness of the agroindustry, whose opponents have risen in the form of South American military governments and Western environmental movements, both arguing that meat production on fishmeal basis was a waste of proteins. From the 1980s onwards, fishmeal was increasingly replaced by meat and bone meal and soy as a vegetable source of protein in compound feed for pig and chicken farming. The scope of the non-human in agriculture is not limited to the last product in the production chain. Rather, the non-human reveals power relations in every step of farming.

Non-humans and humans in industrial agriculture: an infinite process of circulation

Immediate physical contact between most humans and animals decreased significantly during the process of the latter's industrialisation. Most citizens in Global North countries had no longer personal contact with cattle, sheep, hogs, or chicken apart from overtaking livestock transporters on the highway. Counter-intuitively however, even in those places, the human and the non-human continued to be closely tied to each other in loops of infinite circulation. An environmental history approach on the concentration of large herds at single production sites uncovers this sustained but hidden entanglement. In the Global South, the development was more ambiguous, as traditional farming methods continued parallel to the import of intensified agribusiness in crops and livestock.

In the 1980s, the area around Vechta and Cloppenburg in the West German state Lower Saxony became nicknamed "swine belt". Hog farming transformed the entire area. Between 1970 and 1986 the number of pigs in this area doubled from 832,011 to 1,644,205, the

large majority of them kept in all-year-indoor facilities. At the beginning, the growth of the pig population was no problem. Neighbouring farmers gratefully applied the free manure to their fields and boosted the harvest of the otherwise poor sand soil (Mose 1995: 28, 1989: 6). They started to plant corn and barley, plants not resenting much manure. Soon however, the symbiotic relationship collapsed. Even tolerant plants could no longer absorb the further increasing amounts of swine manure. Fodder, instead, could still be imported without limits and agricultural policies encouraged the setup of large pig farms, what led to a constant aggravation of the local manure surplus. Public dissatisfaction with the odours, and even more with the threat of soil and groundwater damage reached a first trough in 1983 and 1984. Public exposés denounced the uncontrolled manure application, whereupon regulations were tightened (Teherani-Krönner 1992: 366). Citizens worried about the manure's nitrogen that would oxidise to nitrate in the soil and further move into groundwater. From there, it could threaten health and even lives of babies, as nitrite, to what nitrate transformed within human bodies, hampered oxygen transport.

For this reason, the East German government provided families who had babies younger than six months with free "bottled baby-water" in the 1980s (Fleischman 2020: 93). Beyond that, however, the political elite of the GDR did not care much about the environmental side effects of industrialised pig farming. Without democratic feedback loops and channels of resistance available in democracies, the circulation of human and non-human forces unfolded an environmentally destructive potential. In Thuringia, near the town of Neustadt an der Orla, a gigantic pig plant with more than 180,000 animals was opened in 1978. Ammonia concentration in the air around the farm complex led to trees dying and forests turning into steppe (Buck 1999: 425). The sewage equalled that of a city the size of Leipzig, but there was not any strategy for manure treatment. Local authorities accepted the violation of limits and tried to keep the consequences secret (Schönfelder 2001: 22). The constant application of pig manure on fields, in streams, and in ponds outraged surrounding residents, who began to organise themselves in 1986. The protagonists of the Thuringian anti-manure movement, however, faced massive repressive measures by the SED regime. Only after the GDR had collapsed in late 1989 could the manure crisis be discussed openly. Although humans, pigs, manure, nitrogen, soil, and water influenced each other constantly, the negotiation of odour nuisance and nitrogen pollution in FRG and GDR emphasises the role of political context for the relationship of humans and non-humans in agriculture.

In the history of the industrialisation of livestock farming, contemporary sources offer robust evidence of how humans devaluated the influence of the non-human. Even large mammals were denied agency and leverage. Instead, animal farmers and scientists considered pigs and cows only as relevant agents if things did not work out as planned. In their contemporary perception, non-humans were able to cause trouble that only humans could fix, who were furthermore solely responsible for every successful process. When pigs increasingly showed behavioural disorders that threatened the expected return in the 1960s, farmers, veterinaries, and biologists turned to them with particular attention (Schliffer 1965: 18). After the introduction of slatted floors, which reduced the workforce needed to muck out the excrement, animals started to injure each other. Without straw on the floor to dig in with their snout, they started to nibble at their fellow animals, preferably at their curly tails. The wounds rapidly inflamed in the humid climate of a densely packed animal stall. Cannibalism became a serious problem in industrial pig farming as some animals had to be slaughtered before maturity because their sores could not be cured any more (Rieger 1966: 22–4). After a period of freestyle innovations by individual farmers who, for example,

constructed spiky metal clips they would attach to already-bitten tails to prevent pigs from continuously gnawing, those methods were discarded as too costly (Biß-Schutz für Schweine 1966: 14). Instead, pig farmers preventively began to cut off the tails of all piglets with hot knives (Hofmann 1976: 16; Grund 1973: 16). The bodies of the animals were violently adjusted to the time-saving and cost-reducing technology of slatted floors in the hog houses. Thus, historians of the industrialisation of farming can be useful in unmasking strategies of human exploitation and depreciation of the non-human. By doing this, they decode the network of human and non-human forces and map the diverse economic, political, social, and cultural contexts in which animals as well as humans are embedded (Specht 2014: 59).

The case of farming plants involves less contested perceptions than the way animals are exploited in industrial agriculture. First, the idea that cultivating plants does not involve similar animal-like suffering still prevails in the global food industry. Only recently works such as those by anthropologist Eduardo Kohn or philosopher Jane Bennett illuminated the possibilities of addressing the complex relationships established among plants themselves, whether in the form of competition or cooperation (Bennett 2009; Kohn 2013). This premise appeared in several religious or social prescriptions of the so-called traditional populations, indicating a holistic integration not only between plants, but between humans and non-humans in general: "a tree is almost an animal, and an animal is almost a human", the nomadic monk João Maria would have said in the wilderness of the southern region of Brazil. Although he left no written texts, social memory attributes to this monk certain practices of environmental care such as the maintenance of water sources, woodlands, and domesticated animals, preventing future shortages of supplies that would ensure the stability of human communities (Silva et al. 2020). Similarly, the emergence of the concept of *Buen Vivir* in recent decades characterises an alternative model of development, revaluing social and ecological practices of peoples like the Andean Quechua (Silva et al. 2020). The holistic experiences undertaken by traditional populations throughout their historical trajectory and adapted in the present day as programmatic contestation of capitalism are placed as an alternative to the image of environmental decline produced by monocultures. With the establishment of plantations and their advance, mainly from the processes of colonial domination exercised by Europeans in the last five centuries, the human impact on the ecological landscape was accentuated, aiming at a biological unification of the planet (Uekötter 2014). Gradually, polyculture or (currently called) agroforestry would yield larger spaces to the cultivation of a single plant in the 19th century; therefore, the monoculture system imposed itself over diverse planting systems, such as that of pre-colonial Mesoamerican techniques like the Milpa, which had consorted a taller plant such as corn, with shallowing plants benefitting from the shade produced by the taller one, such as corn and pumpkins (Silva et al. 2020). While polyculture favoured subsistence farming, industrial agriculture turned increasingly to producing surpluses for the market. As a result, since the 1970s, small farmers have been captured by governments and seed and chemical input companies in networks of assistance aiming at replacing crops dialoguing with the community diet by market-oriented plantations (Silva and De Majo 2022).

This new relationship has caused former producers of diversified food for their own consumption to become producers of a single grain, such as rice, beans, corn, or soybeans – and they have since started to purchase the food for their own diet from other sources, usually supermarkets (Silva and De Majo 2021). The new relationship with the market has intensified land use: previous crop rotation – in which, after three or four years, the place of

cultivation was changed to provide soil resting, regenerating the land based on nature's own dynamics – was replaced by industrial farming systems, intensifying land use without providing time for regeneration, and ensuring fertility from the introduction of chemical inputs instead. These modifications in land use involve, besides the already-mentioned soils and plants, an interplay of microbes, bacteria, climate, light, seeds, or even pests, if the classical literature on the history of agriculture approached this entanglement of relationships as a result of human ingenuity (Soth 1957). The example of soybean monoculture, however, demonstrates a dramatic complexity. Originating in Northeast China, soybeans were domesticated and dispersed across regions of the Korean peninsula, reaching other continents only in the historical context of the emergence of imperial science in 1739 (Silva and De Majo 2022). From a plant cultivated for "scientific curiosity" in European botanical gardens, soy was introduced in the United States at the end of the 18th century, being used as fodder. The interest in using the oil from the beans increased the amount of investment in laboratory and field research, promoting the circulation of seeds between the Americas at the end of the 19th century. At the same time, countries such as Germany, Austria, and Poland adapted seeds to local conditions and promoted laboratory research – such as that of soy lecithin in Germany (Silva and De Majo 2021). Already at the beginning of the 20th century, the United States and China controlled the seed market, introducing seeds of increasingly taller and more productive plants. Geographically, the cultivation of soybeans became restricted: because of its better growth characteristics in short days (long nights), soybean cultivation remained largely located at latitudes above 30°, where temperate climate conditions prevail. In the post–World War II period, however, research on cultivars adapted to the tropics promoted a boom in soybeans, considerably expanding to regions that previously had little or no productivity – savannah areas in South America and Africa with naturally acidic soils. The development of soy cultivars presupposes the crossing of characteristics benefitting humans, considering traits focused on high productivity, production stability, and wide agronomic adaptation to varied environments. In these cultivars, technicians seek to introduce characteristics of resistance to diseases, nematodes, and insects, and by introducing special agronomic characteristics for tolerance to limiting factors related to soil and climate, such as capacity for deep root penetration, adaptation to more acidic soils and lower fertility, and high physiological seed quality, qualities that allow the plant to tolerate the adverse factors that can compromise production. Aiming to adapt soy to the greater luminosity of the tropics, technicians have developed cultivars with high productivity in regions of the Cerrados in Brazil, in the Argentinean and Paraguayan Chaco, and recently in the llanos of Venezuela and in the Nacala corridor in Mozambique (Kiihl et al. 1983, 1985, 1989).

Finally, another turning point for soy that ensured the dramatic expansion of this crop in industrial agriculture was the biotechnology of transgenics. Transgenic plants, animals, and microorganisms have been produced on a commercial scale since the 1980s. In the case of plants, GMO approval in the United States came in 1994, when the Calgene company launched a tomato with high resistance to storage. A few years later, transgenic experiments resulted in Monsanto introducing the first GMO soybean in the United States. In the following years it reached Canada (1995), Argentina and Japan (1996), Uruguay (1997), Mexico and Brazil (1998), and South Africa (2001). Roundup Ready Soybean presents as its main characteristic the resistance to Glyphosate, a pesticide used to annihilate the so-called weeds – that did not spare the soybean itself. The gene that enables the biological continuity

of soybean was extracted from a soil bacterium (Agrobacterium) and patented by Monsanto under the name CP4-EPSPS. Structurally, it is very similar to the genes that make up the genome of a plant, and when inserted into the soybean genome, it made the plant resistant to herbicide application (Embrapa).

With these biotechnological innovations, soy has become one of the most commercialised commodities in the last decades, occupying almost 6% of the planet's surface. In a controversial way, soy is not a human food; the production of the bean, in general, results in soy cake and oil, which have a multitude of uses, ranging from cosmetics to the automobile industry (Silva and De Majo 2021). An important part of the production is transformed into animal feed, exported to China or the European Union, and converted into animal protein through consumption in large farms of mainly pigs. The controversies of soy lie mainly in the expansion of the cultivated area, causing the expropriation of Indigenous populations and peasants; also, the cultivation of large areas of soy requires high mechanisation and use of pesticides, resulting in the pollution of water resources and workers directly linked to the plantation.

Soy, therefore, has developed a fundamental role of interactions in the complex chain of industrial agriculture, mediating relationships between human and non-human actors on a planetary scale. The consequences of this relationship, however, are still ongoing, and it seems that human future scenarios increasingly indicate their interdependence with certain non-humans such as soy.

Conclusions: a research agenda on industrial agriculture and the non-human

In the past decade, including non-human forces has advanced to a major shift in paradigm in the humanities. Dichotomous concepts of nature vs. culture have become outdated. Agricultural spaces as "multispecies contact zones" par excellence have become a first-class research object (Wilson 2019: 712–3; Tsing 2013: 27–42). A historical approach to the interplay of human and non-human forces steps in at this point and at the same time moves the research paradigm further forward. Historical research does not stop at the decentring of humans as moving forces. Its explanandum is change over time. A historical perspective, thus, helps us to unravel the entanglements of human and non-human forces, whose relationship varies according to political, economic, and cultural circumstances. We see the history of capitalism and commodity frontiers as well as current political efforts of animal welfare activists and their success as promising research topics.

The research network Commodity Frontiers Initiative convincingly shows how dynamics of capitalist expansion have merged with ecological transformations on global and local scales.[5] The history of capitalism has long been written as either trade history or urban history of industrial production sites. Analysing commodity frontiers allows to integrate the ecological transformation of the global countryside in the history of capitalism. In those processes, non-human resources proved not only to fuel capitalist expansion, but also to shape its practices (Moore 2011). Moreover, issues that used to be unthinkable are now very important in the constitution of productive chains. This is because the concern of animal rights activists, for example, has generated significant changes in the industry and in veterinary schools, introducing the concept of animal welfare. Countries such as Brazil developed the National Humane Slaughter Program, recognised by the Ministry of Agriculture, Livestock and Supply (MAPA) and by the World Animal Protection (WAP). Another example

would be that the economic emergence of Middle Eastern countries has led Western slaughterhouses to adapt to Islamic Halal code.

The centrality of non-humans in the history of agriculture requires rethinking history in its theory, and not just more specific fields as we usually do through environmental history or animal studies. These studies can potentially help us write renewed histories about the unequal, hierarchical connections between ecosystems, countries, species, and continents. Unveiling the non-human in the history of agriculture automatically discloses power relations between nations, corporations, farmers, consumers, and species. As such, it contributes to a politically sensitive environmental history.

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Notes

1 On 26 April 2020, a letter from John H. Tyson, chairman of the board at Tyson Foods, "appeared as a full-page ad in *The New York Times*, *The Washington Post*, and the *Arkansas Democrat-Gazette*" pressuring the US government to keep meat-packing plants in operation. So, "two days after the publication of Tyson's letter, President Donald Trump issued an executive order that declared meatpacking plants to be 'critical infrastructure' under the Defense Production Act of 1950—and prohibited their closure by state health authorities. The order provided meatpacking companies with a legal defense from liability claims by their employees" (Schlosser 2020).

2 Documentaries such as *We Feed the World* (Austria 2005), *The World According to Monsanto* (France, Canada, and Germany 2007), *Food Inc*. (United States 2008), *Cowspiracy* (2014), non-English documentaries such as *À sombra de um delírio verde*" (*In the Shade of Green Delirium*; Argentina, Brazil, and Belgium 2012), *O veneno está à mesa* (*Poison Is on the Table*; Brazil 2014) and *Carne e Osso* (*Flesh and Bone*; Brazil 2014).

3 "In the conclusion to a trial that garnered global media attention and shined a spotlight on the treatment of farmed animals in Canada, on 4 May 2017, the Ontario Superior Court of Justice acquitted Toronto animal advocate Anita Krajnc of all charges for offering water to overheated pigs on a transport truck bound for slaughter. Krajnc's case inspired multiple petitions of support and the slogan "Compassion Is Not a Crime" (Pallota 2017).

4 The process known as the Green Revolution stemmed from the introduction of chemical inputs, the diffusion of genetically improved seeds, and the rise in agricultural mechanisation to the Third World during the second half of the 20th century. As a concept, the Green Revolution

> has had different meanings, ranging from geographically focused processes to conflicting chronologies. This polysemic character is evident as it encompasses agricultural modernization in Latin America, Africa, and Asia since World War II, or the agricultural growth in Southeast Asia during the 1960s and 1970s. It is also used in referring to specific processes such as the development of high-yielding varieties … in wheat and rice, as well as the American geopolitical strategy to confront communism in the Third World during the Cold War. Furthermore, sometimes the concept of Green Revolution is applied to scientific advances such as genetic improvement in plants, the use of chemical fertilizers, and mechanization in agriculture. Finally, there is disagreement in its timing: some scholars date the beginning of the Green Revolution in the 1960s, while for others it began in World War II or even before.
>
> *(Picado 2022: 2)*

5 https://commodityfrontiers.com/; the network publishes the biannual open access journal *Commodity Frontiers*.

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9

(INTER)NATIONAL AND (TRANS) REGIONAL AGENTS

The coastal sand dunes of Mozambique

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Introduction

The environmental humanities scholarship has long acknowledged that knowing, thinking, and feeling are not exclusive from humans. Dunes do not know, think, or feel. They are not beings, but things. Dunes have agency, though. Dunes result from a sensitive balance between multiple elements, processes, and forces, non-human and human; they cannot be taken as outcomes but must be seen as ongoing processes (Kreike 2013). Looking at their history, morphology, and ecology, one finds, as Isenberg (2014: 135) points out about grasslands, "not unidirectional trajectories of progress or decline, but dynamic environments that shift unpredictably and without regard for human purpose". Much has been written in line about rivers and forests; this literature is useful to reflect about dunes, which to this point have evaded humanities scholars' attention. Contrary to rivers and forests that were always main concerns for societies, dunes are less familiar. Geographically and socially peripheral, dunes are strange landmasses; they behave like water, moving, invading, permeating their surroundings like a flood, but are made of solid substances.

Dunes can influence human choices, activities, vulnerabilities, and futures, so they were chosen to be the main character of this collaborative chapter, whose authors have different expertise. An environmental historian, a social geographer, a forestry engineer/historian of science, and a coastal scientist looking at the same subject matter do not ask the same questions, do not use or interpret data the same way, and do not present their findings on an equivalent basis (Greer et al. 2018). By mixing and blurring their knowledge and skills, combining distinct terminologies and practices, the authors produced a multi-layered study, made of historical and scientific data, geographic information, and personal observations, that brings "heterogeneity as a key lens" (Tsing 2015: 161) to cast a light into dunes as agents of (inter)national and (trans)regional webs.

Dunes do not adhere to borders (conceived as land and power) (Soen et al. 2017). Even though they stand in a territory belonging to a state, in the fluid world of the drifting sands and flowing waters, there is no real division between land and sea, nor is it possible to establish an effective line between countries. Dunes don't respect other limits, either; set in

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motion, they silt rivers and lagoons and cover agricultural fields and houses. Even though dunes are attached to specific geographies, their association to particular socio-ecological processes and interactions – colonial networks, knowledge transfer, migrations, climate change, conservation concerns – spreads throughout a large spatial magnitude, making them borderless. Sand infiltrates the human sphere – local folk, administrations, experts, tourists – and bridges along and across the territorial edges of empires and states, and the social and cultural lines within groups and peoples. Sand even pervades the traditional disciplinary frontiers, as it hides, fades, pushes the bounds of what is geography, geomorphology, history or anthropology, by working as the cement of diverse ideas and materials, making no divide between them. This chapter is then dedicated to point out what makes dunes both unique and representative of the poly-vocal (inter)national and (trans)regional histories, taking place in the coasts of Mozambique, in the 20th and 21st centuries, and how these relate to the environmental issues at the cusp of global concern.

The coast of Mozambique

The Republic of Mozambique is a southern African country, formerly a Portuguese colony up to 1975, bordered by South Africa, Eswatini, Zimbabwe, Zambia, Malawi, Tanzania, and the Indian Ocean (Ministério da Educação 1986; Muchangos 1999). The climate is predominately humid tropical, with two seasons: from October to March, a wet summer, and from April to September, a dry winter. The average annual temperature varies along the coast, from 26°C in the North, to 23°C in the South. Generally, temperature increases with the distance from the coast and decreases with the latitude. Annual average precipitation ranges from 400 mm/year in the inland semiarid areas of the southern region to 1,010 mm/y and 1,780 mm/y in the northern and central provinces. The winds in the southern and central regions are mainly from the south-east (SE) and in the northern region from the north-east (in summer) and south-west (in winter) (Palalane et al. 2016). Due to its geographical location, Mozambique is one of the most hazard-prone countries in Africa, being highly exposed to extreme events, such as floods, cyclones, and droughts (Instituto Nacional de Gestão de Calamidades et al. 2003).

Mozambique has a high diversity of coastal ecosystems. Coral reefs are more abundant in the North, seagrass and mangroves occur along the entire coast but are more extensive in the country's central part. Parabolic dunes characterise the southern region, stretching in the Mozambican territory for about 850 km, from Bazaruto Island to Ponta do Ouro, in the border with South Africa, extending as the same ecological unit well beyond that political limit (Pereira et al. 2014). On the provinces of Gaza and Maputo, a sand coastal ridge runs almost parallel to the shore, backed by lakes and lagoons, forming barrier-lagoon systems. The Limpopo and Incomati Rivers are the main sediment suppliers to this region (Miguel and Castro 2018). The geomorphological evolution of the transgressive dune fields shows a high aeolian transport potential on the coast. The highest rates of dune migration landward are experienced during the dry season, from April to September (Miguel and Castro 2018; Miguel, Nehama, and Castro 2019). Miguel and Castro's (2018) study of the coast of Maputo and Gaza provinces reveals that sand mobility is connected to wind activity, rainfall, and vegetation cover. In the Maputo region, the vegetation cover is less than 30%, and the dunes are migrating at a rate of 23 m/year into the lacustrine system in the rear, contributing to the silting of lakes and lagoons, which have important socio-economic functions, such as subsistence farming, fishing, and salt production (Miguel and Castro 2018; Pereira et al. 2014).

The Gaza stretch, protected by a headland, located downdrift (littoral drift runs south to north in this area) and less exposed to wind action, is characterised by 70% of vegetated dunes that reach about 150 m height, having no considerable dune migration. Leeward of the lacustrine-lagoon systems, extend the paleodunes that result from changes in paleoenvironmental conditions from the last Holocene transgression. The inner paleodunes of both areas are vegetated and stable (Miguel and Castro 2018; Miguel, Castro, and Nehama 2017); as a more or less continuous cover of dune forest reaches out from Bazaruto to Ponta do Ouro (Massinga and Hatton 1997: 13).

Agents of poly-vocal histories

Peoples, empire, foresters, and dunes

In Mozambique, as in other African countries, the universe of local communities is not easy to grasp, especially for outsiders, particularly in the past. In a territory with plural ethical groups and more than 40 native languages, only 10% of the population speak Portuguese as the first language. Nevertheless, to acknowledge the locals' views of nature and the changes that have occurred in the Mozambican coast since the 16th century, Portuguese records are in most cases the only known written sources (Roque 2016). The peoples of Mozambique, stated Friar João dos Santos in 1609 from his experience at the Catholic mission of Sofala, did not read or write or have books, and all the stories and things they knew came from tradition (Santos 1891: 81). Orality for these communities up to the present is not just a way of preserving relevant knowledge, a form of collective wisdom; it is also a creative force, an action upon life. In Mozambique, there are many peoples, countless traditions, each telling their own stories, frequently connected to a worldview and to temporal and spatial dimensions that elude western comprehension (Garbinatto 2010; Guimarães, Barbosa, and Fonseca 2004: 490–1, 500–1). Knowing how these communities perceived the dunes is as hard as holding sand in one's hand; the grains keep trickling through the fingers. Furthermore, in many coastal areas, human settlement is quite recent and made of populations coming from inland rural areas. In these cases, there are no coastal or maritime cultures, and folk stories are connected to land experiences (Guimarães, Barbosa, and Fonseca 2004: 500). According to the historian Ana Roque, the continuous variability of the coastline, subject to marine erosion, sea flooding, storms, and cyclones, explains the existence of ways of life marked by such oscillations and settlement patterns characterised by temporary occupancy. This mobility, based in an ancestral wisdom about the region, was disturbed by the arrival of the Portuguese and the establishment of fixed outposts in the littoral (Roque 2016: 170). The newcomers aimed to make use of a pivotal space for exchanges between inland areas and the Indian Ocean trade routes, connecting Africa, Asia, and Europe and previously controlled by Muslim merchants (Roque 2017).

For the Portuguese, coastal zones were always key areas in the process of strengthening political dominance and economic development in Mozambique, but particularly from the 19th century onwards. After the Berlin Conference (1885), Portugal put a great effort to make its presence more effective in overseas territories while optimising their populations and resources. In line with the imperialist drive of the time, science, technology, and progress become the tools for the European states to achieve their interests in the colonies. Scientists, engineers, and other experts were crucial to the development of the main institutions of the empire, working to identify local resources, developing colonial agriculture, and

building railroads, ports, and telegraphs to facilitate the circulation of goods, people, and information (Diogo and Amaral 2012). Ports and rivers, as gateways to the mainland and connections to Europe, became priority issues. This is where dunes and forests come in.

Public debate about forestry issues in Portugal and its colonies was particularly active in the last decades of the 1800s. The lack of wood, soil erosion, and frequent floods in the metropolitan territory brought the matter to Parliament and other high-ranking intellectual institutions, like scientific societies and academies (Joanaz 2017). At the beginning of the 20th century, colonial agriculture and forestry training were taking their first steps, based on the teachings and knowledge developed at the Institute of Agriculture in Lisbon, where the course of Forestry was established in 1864 (Garcia-Pereda 2011). For the students, the first contact with the environmental conditions of Africa came through the colonial garden of Lisbon, created in 1906 (Nunes and Abelha 2014). After the First World War, the administration of Mozambique, directly dependent on the central state, put into practice the first forestry projects set by Portuguese trained in Lisbon. The first forester working for the colonial administration was Fernando Almeida Bello (1914), from 1920 to 1923. After his return to Portugal for health reasons, Bello was replaced by Raúl Silva Guardado, in 1926, who had previously worked for the Angola Department of Agriculture (Guardado 1926, 1929). Júlio Alfaro Cardoso succeeded Raúl Guardado in Mozambique. Cardoso had the time and the stability that his predecessors did not have. He worked in the colony for about 20 years, from 1932 to around 1954 (Cardoso 1954), having laid the foundations of systematic forestry in Mozambique, based in European methods and standards. These three men were the main responsible for coastal afforestation or the planting of dunes.

In Mozambique, forestry work started by fighting dune migration, in an attempt, to prevent the silting of rivers and the destruction of lighthouses, through the planting of protective woods. The initial experiments were made on the Limpopo River banks. On the Limpopo's mouth, sand was imperilling navigation, by the continual changing of the position of the bar. The sand was also obstructing the water flow, favouring the occurrence of floods that destroyed settlements on the river margins and in the adjacent Xai-Xai region (Cardoso 1939, 1954). The Forestry Service began its intervention in this area in 1920, driven by an agricultural colonisation scheme presented by the English engineer John Balfour to the provincial government. Balfour (1920) proposed the creation of a 20,000-hectare irrigated range in the valley of the Limpopo River. The territory had favourable conditions for the installation of European farmers, but the dunes at the river mouth had to be stabilised for the plan to work. The agricultural part of the project would start only two decades later; still, Fernando Bello, responsible for the afforestation, strived on the dunes matter, from his first months in Mozambique.

The works were based in the setting of foredunes in the river banks and on the beach, using fences to break the winds and propitiate sand accumulation. Protected by these structures, vegetation was planted to stabilise the sands. Exotic and local species, like *Ammophia arenaria*, *Ipomea biloba*, *Eragrostis sps*., and *Canavalia rosea* were used. Trees, such as the *Casuarina equisetifolia*, *Acacia melanoxylon*, *Eucalyptus diversicolor*, and *Pinus sps*., were planted. Since the *Casuarina equisetifolia* proved to be the more suitable to the climate of this African coast, growing fast and helping to create a soil layer with its leaves, it was adopted as the main tree species to colonise the dunes of Mozambique (Cardoso 1948, 1954). In 1926, around 33 ha near the Limpopo river were fixed. In the following years, Silva Guardado proceeded with the task, before being replaced by Alfaro Cardoso in 1932.

In 1939, almost 575 ha of dunes had been planted using more than half a million trees (Cardoso 1939). In 1948, a total of 1,026 ha were afforested (Cardoso 1948).

Another example of dune stabilisation in Mozambique using casuarinas were the attempts to protect the lighthouses erected along the coast and in rivers' mouths. Many of these infrastructures were built on the dunes, in high places exposed to strong wind and, therefore, vulnerable to the drifting sands. In 1917, for instance, the lighthouse of Inhaca needed new windows to prevent the sand from coming in; also, the house of the keeper was almost buried under the dunes (Sousa 1918). In other cases, the foundations of the buildings were in danger because of the instability of the sandy ground. These complaints compelled the colonial government to take measures. Between 1929 and 1948, the Forestry Service proceeded to stabilise the dunes near the lighthouses of Ponta do Ouro, Inhaca, Monte Belo, Boa Paz, Závora, Inhambane, Barra Falsa, Bazaruto, Timbué, Ponta Caldeira, and Uifundo (Cardoso 1948; see Figure 9.1).

In many African regions, local communities were often blamed for environmental degradation, accused of destroying forests and vegetation through agricultural and grazing practices. Repeatedly, colonial declensionist environmental narratives were used to justify the imperial appropriation of land and resources (Davis 2007). This is not the case with the dunes of Mozambique, as there are no references in the foresters' reports about a previous greener state of the dunes, ruined by human activities. According to Cardoso (1948), most of the dunes were vegetated and represented no danger. Some were mobile and often invaded marginal lands, but since those areas were uninhabited, uncultivated, or used, no damage was done. In certain places only, the drifting sands were causing problems. Problems connected to the Portuguese enterprises: the development of agricultural schemes, lighthouses, and river and maritime navigation. Therefore, using European techniques and African labor – recruited from neighbouring regions and brought to the coast – the dunes were stabilised and afforested to safeguard Portuguese settlement on the littoral. However, the afforestation with casuarinas did not end with the independence of Mozambique: the works proceeded in the 1970s and 1980s, finishing only in the 1990s due to the lack of financial and human resources (Ministério da Agricultura 2006).

Dunes, an international affair

The problems caused by the sand dunes agency were neither new nor specific to Mozambique. Invasions in nature are usually associated to biological threats, but other natural features can be invasive too, like the glaciers in the Alps during the Little Ice Age, or the oceans encroaching upon islands and shores nowadays. Due to their mobile character, sand drifts were (and are) a common hazard, menacing human activities and assets placed near the coast. The abundant writing on the topic, coupled with efforts of many governments and private citizens to immobilise the dunes, speak to the significance of the issue. There are plenty of historical sources, from different provenances, and literature telling the stories of villages, houses, and agricultural lands buried by the sands and silted streams and lagoons converted into swampy ill areas (Clarke and Rendell 2014). By the 1920s, when Mozambique's dunes were starting to be afforested, the battle against the moving dunes was an old one, so the planting methods used were fully known. They had been thoroughly developed by experimentation, in Portugal and other European and non-European countries, for more than a century. Stabilising the sands was then a task that required only the adaptation of the existing principal model to local environments.

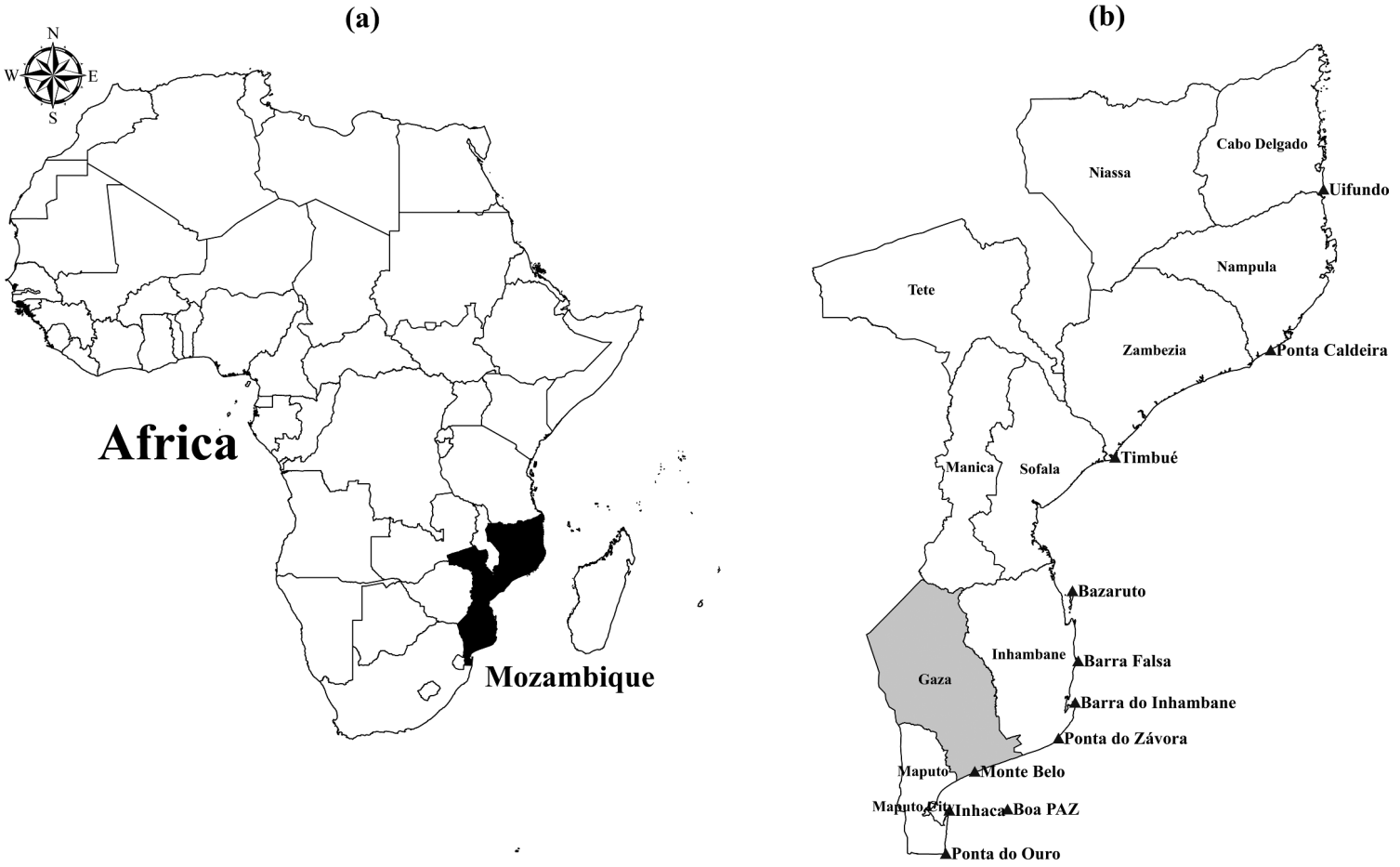


Figure 9.1 (a) Mozambique in the African continent. (b) The provinces of Mozambique, the lighthouses (the triangles) mentioned in the text, and the localisation of the Limpopo River mouth, including Xai-Xai area (the square).

The initial technique – the installation of sand-catching fences and planting of vegetation leeward of these structures to fix the sands with their roots – was based on the experiences of Nicolas Brémontier (1738–1809), engineer of the French *Ponts et Chaussées* Services in Gascony, since 1787. Brémontier did not invent the method, which was grounded on local traditional practices, also common to other regions of Europe, he simply managed to synthetise it, making it more efficient and, to have the support of the state to apply it at a large scale. After the success of the French Forestry Service in the afforestation of the dunes of Gascony, using Brémontier's technique, other nations promptly followed the example, transforming their sandy wastelands into pine forests. In the 19th century, dunes fixing was perceived as the final solution for many dune fields in Europe. The knowledge to do it was disseminated first by men of science and scientific societies, until it was adopted by technical schools, like the Forestry School of Nancy (France) and the Institute of Agriculture (Portugal). In these, a new generation of foresters was trained, before being incorporated in the recently created national (and colonial) Forestry Services, following a general tendency for the professionalisation of administration, in areas like surveying, agriculture, and forestry (Oosthoek 2018). These expertise and practices soon spread across the globe, as people, ideas, and organisms moved through the webs of the empires (Beattie 2011; Beattie, Melillo, and O'Gorman 2015).

At the beginning of the 19th century, dunes were said to be causing damages in Truro, Cape Cod (US), and, for that planted with beachgrass, by the descendants of the British settlers (Dwight 1828). In 1869, Golden Gate Park in San Francisco was created from barren sand, using the European afforestation methods. On the coast of Oregon, years later, experiments were made to find the right sand-biding plants to stop the dunes from drifting. In the 1930s, a major planting scheme, the Warrenton Dune Demonstration Project, was developed in Clatsop County, by the Soil Conservation Service, and thereafter replicated in other beaches of Oregon (Freitas 2022). In New Zealand, dune migration was being discussed by farmers and scholars as early as the 1870s, in newspapers and scientific societies. The reclamation of the sand wastes, using the French model, was promoted by erudite men and locally applied by privates and institutions (Sampath, Beattie, and Freitas 2021). In Australia, the situation was quite similar: in Newcastle and Perth, people requested the government's help for fencing and planting the moving dunes (Beattie 2011). According to Avis (1992), in the Western Cape (South Africa), problems of drifting sand arose in the mid-18th century, but it was not until 1845 that an organised stabilisation programme was initiated. From 1875, sand stabilisation become a function of the Cape Forestry Department. In Angola, the Portuguese also promoted the plantation of the dunes of Porto Alexandre, nowadays Tombwa, in 1928 (Moreira 1965).

At first glance, dunes are local things; they are connected to a specific beach-dune system, in a particular region. However, the sedimentary cells that feed them can be much broader and easily cross national borders. Littoral currents, waves, and rivers are not restrained by political frontiers. On a second look, it is possible to say that the agency of the dunes made them an international affair. The dynamic nature of dunes, by interfering with human business, ended up connecting them globally: the damages caused and the techniques adopted to stabilise the sands became a common concern and a shared solution. The history of the dunes of Mozambique must be perceived within a network of human and non-human agents and agencies, that connect local issues to multiple regions and nations, through the knowledge and practices used in the attempt to domesticate complex coastal systems. This is not, however, a linear history of Europeans as re-creators of colonial environments

(Kirchberger and Bennett 2020), at least intentionally. The examples provided about the United States, New Zealand, Australia, and South Africa can also be pointed as empirical case studies on how Europeans lost control over the new environments. What is striking from the narrative about the dunes of Mozambique are the provisional, ephemeral, and fleeting interconnections between different actors, agencies and processes (Beattie, Melillo, and O'Gorman 2015), that turn it into a poly-vocal history. There is no straight path where plurality rules, and in the search to find intelligible patterns to provide explanations, many other possible interpretations are lost.

Dunes, present-day challenges

The intricate web of agents and agencies shaping Mozambique's coast

In Mozambique, around 80% of the population needs forestry resources as a source of energy, food, medicine, building material, agricultural practices, culture, and tourism. Between 2003 and 2013, the biggest deforestation rates took place in the littoral, affecting the dunes forest cover. Population growth, urbanisation, food production, illegal cutting and mining are the biggest threats to the forests (Conselho de Ministros 2020). These factors also cause major disturbances to other ecosystems, including coastal areas.

In the Limpopo River area, satellite pictures from 1979, 1989, and 2001 show an extremely rapid growth of settlements and the clearing of the woodlands, which used to cover the dunes. The population of the coastal city Xai-Xai has tripled in the last three decades, due to the floods of 1997 and 2000 that resulted in the resettlement of the inhabitants from the Limpopo flooded valley in the higher and safer coastal dune area. To satisfy food demand, the entire dune sector was agriculturally developed (Brandt, Baumier, and Samimi 2009). The geographer Inês Raimundo made some fieldwork in the region, analysing the rural-urban migration to Xai-Xai, motivated by the civil war (1976–1992) and the great flood of 2000. She describes it as an inflow of people trying to survive the armed attacks and the destruction caused by the waters. These migrants, "poorly educated and unskilled, with a high dependence on agriculture for subsistence" (Raimundo 2005: 160), were pushed to marginal areas, like the dunes, because of land scarcity, due to the need of accommodating so many displaced people.

In other vicinities along the coast, local communities make use of the natural resources of dunes, planting coconuts (Tofo-Barra-Tofinho), grazing cattle (Bazaruto), and cutting the forest for charcoal production (Macaneta Beach). Prior to independence in 1975, but mostly after the war and in recent years, touristic infrastructure has increased along Mozambique's littoral, especially in the South: Ponta do Ouro, Ilha de Inhaca, Bilene-Xai-Xai-Chinguene, Tofo-Barra-Tofinho and Vilanculos, which are sensitive dune regions. The opening of access to the beach, through the dunes, by the locals to explore coastal and maritime resources, and vegetation clearance by touristic enterprises for the installation of camps, are disturbances that propitiate blowouts and changes in dunes topography, making them more vulnerable to other forcing mechanisms (e.g., winds and waves). The use of 4 × 4 off-road vehicles on the dunes is also believed to have major impacts on their vegetation, geomorphology, and biodiversity (Louro 2005; Massinga and Hatton 1997). Mega industrial projects, like the construction of ports within the Maputo Special Reserve and Ponta do Ouro Partial Marine Reserve, and titanium mining in the coastal sands of Moma, increase pressure on dunes and beaches (Pereira et al. 2014). The ASCLME (2012) report mentions that coastal

mining – the extraction of aluminium, coal, titanium, zircon, and rutile from sand dunes – is one of the fastest-growing sectors in Mozambique. The report also states that informal sand mining (mainly illegal) is done along the entire coastline. Port infrastructures, and dredging activities for improving navigation channels, groins, and seawalls, induce changes in the local sediment dynamics, causing negative effects in adjacent areas (Langa 2007; Palalane et al. 2016).

Anthropogenic factors, however, are not the only ones putting pressure on coastal ecosystems. Researchers from Eduardo Mondlane and Lund universities point to "waves, tides, tropical cyclones and depressions, fluctuations in the sea level, and long-and short-term climatic variations" (Palalane et al. 2016) as additional determining agents in the evolution of beaches and dunes. The strong wind and storm surges caused by the storms and cyclones that strike Mozambique's coast often produce massive destruction, causing significant coastal recession, especially affecting dunes not covered by vegetation. These are easily blown by strong wind and migrate inland silting the adjacent freshwater lagoons and agricultural areas, threatening the livelihood of the populations that depend on them (Gove 1997; Louro 2005; Palalane et al. 2016). Changes in the nearshore sediment dynamics, determined by these same natural and anthropogenic factors, are also responsible for increasing erosion rates in certain areas of Mozambique. Coastal erosion is a natural phenomenon that becomes a problem only when human infrastructures are built too close to the beach, since coastline retreat puts them at risk (Freitas and Dias 2017). In the 1970s, for example, part of the structure of the Hotel Tofo Mar, in Tofu Beach, Inhambane, collapsed due to severe coastal retreat (Palalane et al. 2016).

(Trans)regional solutions, (trans)national problems

A 2011 report from the Mozambican Ministry of Environment recognised the relevancy of dunes as natural barriers against the sea, habitats for biodiversity, freshwater reservoirs, tourism attractions, and the basis for the lighthouses. The report also stated that these ecosystems should be preserved so the next generations could benefit from dunes covered with vegetation, offering shelter from the sun, fruits, wood, charcoal, honey, and diverse fauna, providing groundwater and supporting ecotourism. To achieve this, the dune forests could not be cut down and had to be rehabilitated; paths could not be opened or infrastructures built (Balidy and Jacinta 2011).

In the 21st century, Decree 45/2006, on Protection of the Marine and Coastal Environments, acknowledged the dunes as fragile ecosystems, easily degraded and difficult to recover. Only basic infrastructures – water and power supply, telephone and sewage facilities – can be built on them. Access to the beach is a public right, yet paths cannot put the dunes at risk or potentiate erosion (Conselho de Ministros 2006). In spite of the protection conferred by regulation to primary dunes and beaches, including special licences to infrastructure development and the prohibition of driving on the beach, Pereira et al. (2014) assured that law enforcement and compliance were almost non-existent throughout Mozambique.

More recently, the National Forest Plan setting the strategy for 2019–35, promoted the rehabilitation of degraded areas, dune stabilisation, and urban afforestation as a goal to reinforce resilience to climate change and natural disasters. The Plan announced the purpose of stabilising 50,000 ha of coastal dunes in two decades (Mitader 2019). A year later, the 2020 Forest Policy, recognising the threat upon the Mozambican forests, approved

several measures to protect and rehabilitate them. Goal 2, connected to economic growth, sets the target of having, in a period of 6–12 years, new plantations with the purpose of mitigating the impacts of environmental degradation. This is to be achieved by stabilizing dunes and watersheds, restoring degraded areas and regions subject to erosion, promoting activities to reduce greenhouse gases, and minimising global warming. According to this policy, forests in areas of public and scientific interest – like the dunes – fall under state protection and management (Conselho de Ministros 2020).

These laws follow an international trend that recognises dunes as highly valuable ecosystems, for the multifunctioning services they provide related to nature conservation, recreation, freshwater catchment and coastal defence (Heslenfeld, Jungerius, and Klijn 2004). This is neither original nor specific to dunes; ideas and values regarding ecosystems and species change over times: the Caribbean climate went from deadly to healthy; oceans moved from dark void spaces to blue full-lived deeps; whales, the monsters of the past, are now iconic wonders. The characteristics of these environments or species are no different from what they used to be. The main modification occurred in societies, within "culture, ideology, economics, politics and social relations" (Carey 2011: 141). Moreover, even in the same period there are crucial variations. For instance, most European and American dunes were stabilised by afforestation programmes and/or have been lost progressively due to erosion and urban development in the 20th century. This is not the case in Mozambique, where the dunes are still in a relatively natural state. Coastal dunes in Europe and the United States have become open-air recreational spaces for walking, cycling, and enjoying nature. They are also used as protective barriers against sea flooding and, for that dune rehabilitation programmes (including sand beach nourishment) are being implemented. Stabilisation is applied only selectively, since mobile dunes are now considered as part of the natural successional landscape and should be allowed to function normally. Furthermore, western countries are available to pay for the high costs of dune management, which have been politically and socially accepted (der Meulen, Bakker, and Houston 2004; Heslenfeld, Jungerius, and Klijn 2004; Martínez, Maun, and Psuty 2004).

All these aspects point to a scenario that is very different from the reality in Mozambique, where coastal deforestation and dune resources use/destruction are linked to poverty, basic needs, abrupt population growth and displacement, small-scale agriculture, and the demand for firewood and charcoal. In fact, many of the people interviewed by Inês Raimundo in Xai-Xai were aware of the impact of overexploitation on their environment: "As far as I know, there is no rain because we cut trees for charcoal production". The reason why they keep doing it is simple and difficult to stomach: "We are involved in the charcoal business because we are hungry" (Raimundo 2021: 294). Too many hungry people around the world cause local and (trans)regional environmental problems, like cutting down trees and burning charcoal, to expand cumulatively and infiltrate the large (trans)national spheres, reaching planetary impacts.

Meanwhile, global connectivity opened Mozambique, and many other areas worldwide, to foreign investors interested in exploring forest and mining resources, as well as coastal tourism, activities that have major significance to the national gross domestic product and huge consequences to local shores. Recent laws and protection plans are important to restrain the predation of this fragile ecosystem. However, to effectively implement those measures, the country also has to overcome its economic and social constraints. Additionally, coastal dunes in Mozambique (like dunes everywhere) face escalating planetary-size variations: climate change, sea-level rise, alterations in moisture regimes, and sediment supply.

These multi-scale environmental and socio-economic settings menace the capacity of dunes to be responsive to change, adapt, and endure as self-sustaining systems.

This could be the end of the story, but it is not. Dunes have no life or emotions; they are masses of sand grains that come together or desegregate according to circumstances. Dunes will not be victims of human-driven environmental changes, since they are components of enduring coastal systems with their own agency to abide to the new conditions. The more certain sufferers will be the human and non-human populations, whose subsistence depends on the continued existence of present-day coastal environments and their life forms, and who will not be able to adapt as quickly as the situation will demand.

Final remarks

In this chapter, dunes are key elements; as long-lasting non-human agents within socio-historical contexts, dunes showcase the attempts of the Portuguese empire to control colonial environments, the pressure of poverty upon natural ecosystems, the present divide between exploring and preserving resources, and the local and global scales of problems and solutions. Each dune field is unique in its characteristics, its processes of change, and, in its relationship with other elements, its co-agents in the making of local worlds. Each have singular eco-socio-historical contexts, which are not reproducible or shared. Yet, dunes also transcend the regional and national frames, as part of eco-cultural networks of knowledge and practices linked to what humans think dunes should be and serve for. Moreover, within the conjuncture of the global anthropogenic pressures and environmental changes, dunes worldwide face common challenges and threats.

To do the history of dunes is to follow these manifold trajectories of change and those involved, over the long run. Historians can call up the dunes in the archives and use them as proxies to retrospectively see the natural and the social environments that produced them (the material dunes and the paper ones). However, historians do not have the skills to unfold the complete story, as they do not master the knowledge on all the beings, things, and phenomena that exist and thrive beyond human reach. In this chapter, distinct types of expertise came together to present a multi-perspective narrative that meshes the science of coastal dynamics and dune physical and biological features; the human geography of Mozambique, based on fieldwork observations of the consequences of the country's recent history on its people; the colonial setting, the role of experts, and knowledge transfer to solve some of the problems of the Portuguese settlement on the coast; and, the outlook of Mozambican dunes from a global angle, connecting past concerns on sand drifting and present anxieties about dunes conservation. This transdisciplinary collaboration activated other ways of thinking and perceiving the potential of the stored information, making possible to apprehend phenomena of largely different spectrums under the same critical examination, revealing many inconspicuous relations, disentangling the plural interconnected agencies that lie within and beyond the sand dunes.

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10

ACTOR-NETWORKS, CONSERVATION TREATIES, AND INTERNATIONAL ENVIRONMENTAL HISTORY

Re-assembling conventions

Raf De Bont and Simone Schleper

The past century has witnessed an increasing number of multilateral agreements and conventions that aim to conserve nature across the globe. The focus of these agreements and conventions concerns a great variety of topics – including the transnational protection of wetlands, migratory animals, biological diversity, and the global climate, as well as the cross-border control of wildlife trade, the spread of invasive species, the movement of hazardous waste, and the export of tropical timber (see Chapter 13, this volume). Historians and political scientists have not failed to notice this proliferation of agreements and conventions. By now, there is wide-ranging literature on their content, how they have been negotiated, and the extent to which they have successfully achieved their policy goals (Boardman 1981; Bsumek et al. 2013; Cioc 2009; Lausche 2008; Meyer 2010; Nagtzaam 2009). The study of international conservation conventions indeed has become a well-established field.

While diverse in their approaches, most studies on international environmental treaties and conventions share one thing. The great majority of them focus on human actors and the social institutions these actors represent – whether these institutions are states, NGOs, scientific associations, intergovernmental organisations, or corporate lobby groups. Therefore, stories about the making and policing of treaties are often stories about the interests of human individuals and the groups they speak for. While relevant, such stories also seem unidimensional. This chapter will use actor-network theory (ANT) to make the case for an approach that widens the view. We will argue that making conventions, and making conventions *work*, involves the mobilisation not just of humans and their institutions, but also of non-human organisms and things. Inspired by ANT, we will claim that treaties exert performative power only when embedded in hybrid networks – networks made up of relations between living and non-living entities. Overall, we will propose to write the history of treaties in terms of changing relations within such networks. By doing so, we build on the literature that deploys ANT to broaden our understanding of contemporary conservation practices (Bennett 2018; Jepson et al. 2011; van der Duim et al. 2014; Whatmore and Thorne 2000). Of course, ANT's focus on the interaction between human and non-human

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agents ties in with long-established interests in environmental history writ large. In this chapter, we particularly seek to extend historical scholarship in which environments are conceived "as fields of agency and power in which the human and nonhuman intermingle" (Sutter 2007: 729; see also Antonello 2019; Mitchell 2002: 19–53) in order to show how networks connect the paper world of environmental legislation to the material world of legislated environments.

After introducing the methodological outlines of ANT, we illustrate its potential for the study of international treaties by exploring two cases. First, we discuss the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the ways in which this convention made a difference for the functioning of zoological gardens. Second, we analyse the mobilising power of the African-Eurasian Migratory Waterbirds Agreement (AEWA). Both cases, we argue, illustrate that what treaty texts *do* (if they do anything at all) relies on networks that are varied, ever-changing, and often unstable. Environmental historians are obviously familiar with the important question of whether and to which extent legislation can stem environmental degradation. By taking a relational approach and broadening the number of living and non-living actors, we believe ANT can help in providing answers to that question.

Actors and networks

ANT is traced back mostly to the work of Michel Callon, Bruno Latour, and John Law (Callon 1986; Latour 1987, 1988, 2007; Law 1987), who, in the 1980s, developed new approaches to study science and technology "in action". Today, ANT has become hugely popular in the humanities and social sciences more generally, and scholars have used it to explain a broad range of phenomena. As is often the case with hugely popular approaches, opinions diverge on what exactly its main tenets are. Yet, a handbook summary usually stresses a few characteristics. The first is that ANT conceives of actors not as wilful agents, but as entities that in some way influence other entities. This explains why not just human beings, but also ships, scallops, or maps can figure as actors in ANT analyses. Secondly, and in line with the first point, ANT seeks to explain agency not by referring to the qualities of the actors themselves, but by the relations among them. This, then, leads ANT scholars to study how entities of various kinds assemble to form "actor-networks", "collectives", "associations", or "assemblages".

We believe an approach inspired by ANT is useful for our purposes because it can sensitise us to aspects of the history of international conservation treaties that so far have received little attention. The sociologist John Law (2016) highlighted four central "ingredients" of ANT, all of which we believe are helpful in understanding the cases at hand. The first is ANT's attention to the heterogeneity of relevant actors. As indicated, the existing scholarship on conservation treaties – even when it occasionally took inspiration from ANT (Bled 2010) – has focused on humans and their organisations rather than on non-human organisms and things. There is, thus, ample room to develop a more symmetrical approach, paying attention to the role of, for instance, technological and animal actors. Second, ANT scholars encourage us to think of both human and non-human actors in terms of "semiotic relationality". They do so by stressing that the entities in a network continuously "define and shape one another". In this line of reasoning, treaties are shaped by the people who write and negotiate them, but the treaties, in turn, also shape the negotiators. Furthermore, both the negotiators and their texts can be understood only in relation to a variety of other human

and non-human actors. Third, ANT alerts us to what Law refers to as "process" and "precariousness". While international treaties can be associated with a particular date of ratification, their meaning and influence *change* with the assemblages they are embedded in. Such assemblages, furthermore, might collapse as soon as one of its constituting actors stops playing its part (Law 2016: 146). Finally, ANT is attentive to issues of power, place, and scale. It has developed a particular interest in information flows and forms of standardisation that enable "centres of calculation" to act "at a distance" (Latour 1987). International treaties, of course, can be easily understood as tools that play a part in such long-distance acting. In brief, ANT can help us understand the performative power of international conservation treaties or the lack thereof.

CITES and the functioning of zoos

Our first exploration into the actor-networks of international treaties concerns CITES and how it has shaped zoo practice. Largely drafted by the International Union for the Conservation of Nature (IUCN) in the 1960s, CITES sought to regulate international trade in wildlife and wildlife products to assure the survival of threatened species in the wild. As zoo traffic made up only a relatively small part of that trade, it might not surprise that zoos were hardly involved in the early discussions about the convention. Once ratified, however, they were quickly drawn into CITES's expanding assemblage. In what follows, we will look into CITES's meaning for and power over zoos in two steps. First, we will analyse how various groups of human actors – in ANT, sometimes referred to as "social groups" (e.g., Latour 1988) – continuously renegotiated the treaty's significance, reach, and modalities. In a

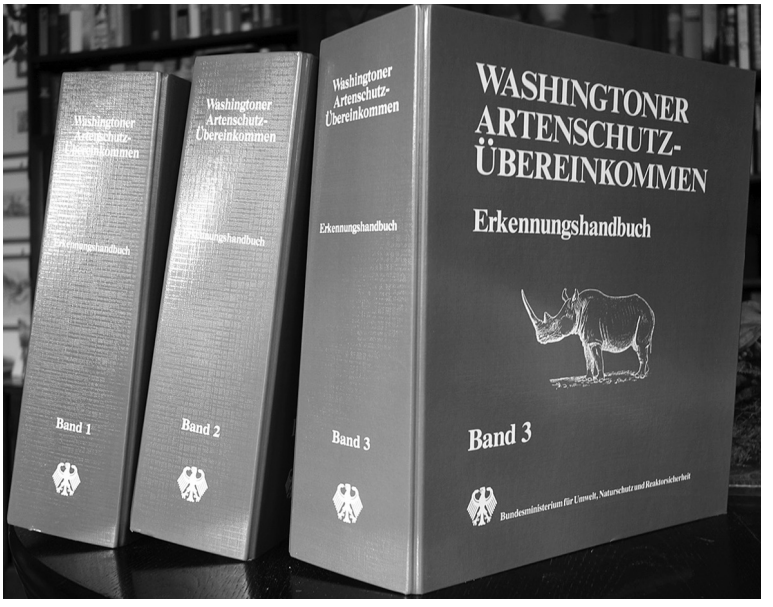


Figure 10.1 A CITES identification manual, showing pictures of the most smuggled species. Bundesministerium für Ernährung, Landwirtschaft und Forsten. 1985. Washingtoner Artenschutzübereinkommen, Erkennungshandbuch. Kunststoffordner, Band 1 bis 3 (Fauna). Collection G. & C. Franke. Wikimedia commons.

second step, we will show how non-human things and organisms, too, took part in this renegotiation process. Both types of agent, we believe, are crucial if we want to understand the material impact of CITES, and, thus, its significance for environmental history.

Initially, the preparation of CITES concerned only a small network of IUCN-related conservationists. By the mid-1960s, IUCN staff started to circulate draft texts to representatives of national governments. Some (such as the US government) largely supported IUCN's agenda, but "wildlife producer nations" in the Global South proved more sceptical. It was therefore only with a lot of effort that, in 1973, the negotiators reached a complicated compromise (Boardman 1981: 88–96; Hutton and Dickson 2005; Reeve 2002; Wyatt 2021). The compromise text sought to regulate trade through three appendices, which listed species in various states of endangerment. These lists served as the basis for a global system of import and export permits to control and limit the trade in endangered species. The convention entered into force after ten states had signed it – a number reached in 1975. From then onward, a Conference of the Parties convened every two and a half years to decide on amendments, which implied that the modalities of the treaty were continuously renegotiated from then onward (Boardman 1981: 88–96; Duffy 2013; Hutton and Dickson 2005).

Drawing zoological gardens into the CITES's actor-network proved difficult. In the 1960s, zoo organisations maintained only a loose relationship with IUCN, and some were taken aback by its initiative (Bayma 2012: 122). Initially, regional zoo associations exerted pressure on national authorities to weaken the convention's implications. In the United States, for instance, the American Association of Zoological Parks and Aquariums (AAZPA) lobbied Congress to keep trade restrictions to a minimum (Bayma 2012: 122). As one involved curator indicated, their goal was to stem "the torrent of recent adverse unwarranted animal-related legislation" and avoid zoos being "legislated out of business" (Todd 1975: 22). Simultaneously, however, CITES fed into ongoing initiatives of zoo reform. From the mid-20th century onward, regional and international zoo organisations actively tried to rebrand their member institutions as harbingers of science and conservation. Leading zoos increasingly dissociated themselves – at least rhetorically – from dealers who caught endangered animals in the wild, while starting to build bridges with conservation organisations. CITES sped up this rearrangement of networks as it stipulated that only animals "bred in captivity" could circulate between non-commercial zoos as long as there was evidence that they could be "maintained in a captive breeding situation for multiple generations" (Duplaix 2022). Zoo practitioners immediately realised this would limit "the availability of animals in international trade" (Farst 1979: 80, 82). By complicating access to rare wild-caught animals, CITES, thus, made collaborative breeding programs a survival strategy for zoos, while helping them to transform their public image from "consumers" to "saviors" of endangered species (Bayma 2012: 129–30; Hanson 2004: 166–8; Penn et al. 2012: 62–79; Pouillard 2019: 382–3).

The changing relation between governments, zoo organisations, and dealers (sped up by CITES) reshaped and redefined the activities of all these social groups. While animal dealers continued at least part of their work, they certainly became less visible in the activities of "scientific" zoos that presented conservation as crucial to their mission (Graham 1987: 646). Simultaneously, governmental control drove some trade of exotic animals underground. Yet, helped by the fact that initially only a limited number of nations ratified CITES, dealers could rearrange trade routes of endangered animals by diverting shipments between ratifying countries via non-complying nations, evading control (Duplaix and Grady 1980: 172). The introduction of CITES, furthermore, changed the

activities of custom officials. For some time, the latter struggled to acquire the taxonomic skill to recognise the various species of the (ever-changing) CITES appendices (Linhart et al. 2008). To mitigate the problem, the Conference of the Parties eventually developed "identification manuals" showing pictures of the most smuggled species (Wijnstekers 2001: 474). The actor-network constructed around CITES gradually expanded its scale, but it also continuously proved to be precarious. Inventiveness on the side of dealers, or lack of taxonomic skill on the side of custom officials, could make it all unstuck.

Apart from humans, material things were crucial for the functioning of the network. The aforementioned identification manual provides only one of the many examples. In fact, the manual could only "play its part" in relation to various other technologies of control. Many of those technologies involved paperwork, most notably of import and export permits. Those permits could, for instance, indicate that the transported animals were captive-bred, which then required proof through other (paper) certificates (Versteege 2021). Of course, this system of control was not static, but evolved over time. Gradually, it was streamlined, standardised, and digitised. Crucial in this process was that from 1980 onward, the United Nations Environmental Program (UNEP) World Conservation Monitoring Centre launched a CITES Trade database – thus starting to act as a center of calculation (*A Guide to Using the CITES Trade Database* 2013). For zoos, standardised record-keeping of ingoing and outgoing animals was certainly no longer a novelty at that point. After all, through their renewed focus on breeding, they had already been developing their own international inventory systems since the 1970s (Braverman 2013: 110–26; Flesness 2003). Over time, CITES increasingly mapped onto these existing technologies of bookkeeping and control. Today, the non-profit organisation Species360, which runs the most widely used database for zoo animals, explicitly advertises its software as "accepted and preferred by international regulatory bodies such as CITES" (Species360: Benefits of Membership n.d.). Technologies as databases, thus, clearly exerted agency, shaping the circulation of living animals and enabling particular forms of conservation practice.

To exert control over trade, CITES officials not only mobilised databases monitoring animals from afar, but also technologies close to the actual animal bodies themselves. To link individual animals with individual certificates, they looked into all kinds of markers ranging from tags to rings, bands, tattoos, photographs, and, from the 1990s onward, microchips. These markers, of which CITES would single out the closed feet-ring and the microchip as the most trustworthy ones, were crucial to the functioning of the network, but also came with new forms of precariousness. Individual governments in charge of enforcement differed in terms of the types of markings they allowed. Manufacturers, furthermore, added to the complexity by marketing different and incompatible technologies of microchips and scanners ("CITES, Eleventh meeting of the Conference of the Parties, Gigiri (Kenya)" 2000). Simultaneously, illegal traders found ways around the identification systems. In 1998, the CITES Animal Committee discussed how fraudsters re-programmed microchips (Summary Records, CITES Animals Committee, 14th Meeting 1998), and a 2007 report highlighted that some traders removed rings from dead birds, putting them around the legs of wild-caught chicks (Knapp and Affre 2007: 8). All this pushed CITES administrators towards continuous adaptation, further negotiation, and standardisation. This was crucial work. Purpose-made rings and microchips, after all, established important links in CITES's actor-network by tying individual animal bodies to bookkeeping technologies, and thus enhancing the long-distance power of the technologies' owners.

Interestingly, in developing animal markers, the members of the Conference of the Parties took into account not only the logic of governments, manufacturers, and fraudsters, but also the "physical or behavioural characteristics" of the animals themselves (Marking and Labelling n.d.). Microchipping and scanning microchips proved complicated with dangerous animals such as large carnivores. Moreover, heavily traded juvenile tortoises were for a long time seen as unsuited for marking by either rings or microchips, as were many small animals such as amphibians and invertebrates (Knapp and Affre 2007: 7, 22; Versteege 2021). When too small or aggressive, animals proved hard to be inscribed in CITES's assemblage.

Animal actors mattered in other respects, too. In their response to CITES, zoos might have foregrounded their mission to breed endangered animals, but not all species proved equally susceptible to such a vision. In the 1970s, the proportion of zoo-born animals within the overall population did rise significantly, but certainly not for all threatened species to the same extent. The Arabian oryx and golden lion tamarin were early successes, but gorillas – with their low birth rate – proved problematic (Duplaix and Grady 1980: 174–6). Overall, there are indications that, during the following decades, breeding difficulties in combination with CITES's legislation actually led to a decrease in species numbers in the average zoo (Brereton and Brereton 2020: 142). Animal procreation in captivity, thus, partially set the pace of post-CITES zoo trade.

Indeed, some animals almost seemed impossible to fit in the rationale of zoos as breeding institutions. African elephants offer a case in point. Breeding with the species in zoos is notoriously difficult, which is associated with the short oestrus of females, the limited access to males, and the lack of social structures of larger groups in a zoo context. Infant mortality is generally high and life expectancy low, with most zoos seemingly unable to provide the space and group size African elephants need for healthy lives (Hartley and Stanley 2016). Yet, with African elephants listed as Appendix II species in four southern African countries, CITES continued to allow for their export to "appropriate and acceptable destinations". Between 1990 and 2015, zoos (most of them in China and the United States) still imported 331 wild-caught African elephants (Challenges to CITES Regulation of the International Trade in Live, Wild-Caught African Elephants 2017: 8). Yet, after much debate, the CITES Conference of the Parties of 2019 voted a resolution stipulating that the only "appropriate and acceptable destinations" for African elephants are within their natural habitat ("Eighteenth Meeting of the Conference of the Parties Geneva (Switzerland)" 2019: 3). Of course, the lobby work of NGOs was crucial for this outcome, but equally so was the behaviour and physiology of African elephants that proved highly difficult to be integrated into the logic of captive breeding.

The recent resolution on trade in African elephants shows once again how the actor-network around CITES is dynamic and has mobilised shifting coalitions of agents. The convention's performative power in zoos was shaped by governments, zoo associations, dealers, custom officials, manuals, databases, microchips, and the physical and behavioural characteristics of golden lion tamarins and African elephants. The mutual relations between all these agents have continuously changed. New ratifications have shut (some) loopholes for traders. Identification manuals have provided custom officials with new instruments. Increasingly, small microchips enable use in more taxonomic groups, while biotechnological innovations alter possibilities of captive breeding. Laws, technologies and bodies are thus re-assembled in ever-new constellations. Consequently, CITES today is no longer what

it was in 1973. While initially only tying together a few negotiators in a boardroom, CITES ended up connecting a wide range of humans, things, and non-human organisms in a world-spanning yet unstable network.

AEWA and the protection of flyways

Our second case is the AEWA and the new types of alliances and relationships that ornithologists and conservationists forged during and after the introduction of the international agreement on migratory waterbirds. For the AEWA, too, we show that conventions are heterogeneous and at times precarious assemblages that depend on the enrolment and mobilisation of human and non-human allies. The AEWA falls under the Convention on Migratory Species (CMS) framework, first signed in 1979, which has its seat in Bonn, Germany, and is administered by the UNEP. Unlike CITES, the AEWA, which was ratified in 1985 and entered into force in 1999, is not concerned with the capture and transportation of animals by human actors. Rather, it focuses on birds that, in their annual migration, cover vast distances on their own. The AEWA tries to guarantee their protection from landscape development, hunting, and obstructions on their migratory routes. The agreement's geographical focus is on the Western Palearctic Flyway, the route taken by a vast number of birds breeding in Europe and Russia when migrating southward and westward during the European winter months. Similar to CITES, the protection of migratory waterbirds required the enrolment of a range of different actors, including policymakers and researchers in various range states as well as international organisations, and technologies for tracking and recording animal movement and endangerment. Again – as we will show – animal agents played a crucial role in the formation and practical implementation of the legal text.

Like all CMS agreements, the AEWA focuses on the protection of border-crossing species. Similar to CITES, both the CMS and the AEWA work with appendices that classify particular species under the convention as either "threatened" (Appendix I) or "with unfavourable conservation status", requiring additional international agreements for their protection (Appendix II) (Baldwin 2011: 539–40). This focus on species differentiates the CMS and the AWEA from other conservation conventions, such as the Ramsar Convention on Wetlands (1971), the European Birds Directive (1979), or the Habitats Directive (2000), which are traditionally concerned with the protection of habitats, marshes, and coastal regions in particular. Even within the framework of the CMS, the AEWA takes a special position. While most CMS daughter agreements are concerned with one or two species, the AEWA in theory covers all species of waterbirds migrating along the Western Palearctic Flyway. With more than 60 parties, it is one of the largest CMS agreements and is often considered an example of best practice. Like the CMS, the AEWA, although legally binding, has no strict monitoring or enforcement mechanisms, and the success of the agreement depends on the participating parties. Nevertheless, a commitment to the AEWA framework generally results in expectations and – if necessary – peer pressure for compliance (Lewis 2016; Remmelts 2021; Trouwborst 2012).

While the AEWA is a relatively recent instrument, calls to protect migratory waterbirds preceded the agreement by several decades. An emerging network for migratory bird protection first enrolled ornithologists concerned with the fate of charismatic European bird species, for instance white storks and large waterfowl. In the postwar decades, censuses on the breeding populations of white storks in several central European countries indicated that

European stork populations had drastically declined. Already during the 1950s and 1960s, at the so-called MAR conferences, international organisations such as the IUCN, the International Council for Bird Preservation (ICBP), and the International Waterfowl and Wetlands Research Bureau (IWRB) concerned themselves with the vulnerability of waterbirds and their dependency on networks of wetlands along their migratory routes (IUCN 1964). Later, the Ramsar Convention (which grew out of these concerns over declining waterbird numbers) also addressed the need for additional international cooperation, but its scope was limited to wetlands, and thus to particular sites, including in border regions (Lewis 2016). In the 1970s, leading bird conservationists such as the German ornithologist Eugeniusz Nowak demanded an extension of existing international cooperation in waterbird protection efforts (Nowak 1979). Despite these calls for international alliances beyond the European community, the early proposals for what would become the AEWA originated as a European initiative. In 1985, the CMS's first Conference of Parties of mainly European signatories published a resolution to protect four groups of animals: European bats; white storks; Western Palearctic Anatidae (ducks, geese, and swans), to a large extent breeding in Europe; and two types of European dolphins (Secretariat of the Convention 1985: 50). By 1994, resolutions on two of these groups, Anatidae and white storks, formed the basis for what would become the AEWA.

As in the case of CITES, the enrolment of relevant social groups in the process of drafting the AEWA required extended negotiations. This becomes clear when looking at the case of Palearctic Anatidae. In the 1980s, initiatives behind the second draft agreement were led by a Working Group on Ducks and Geese (WGDG) located in the Netherlands, at the time the country with the strictest hunting policies in Europe. Unsurprisingly, the WGDG focused on hunting regulations within Europe rather than on flyway protection. When facing resistance from hunting organisations in countries with blood sports traditions, such as Italy and France, the WGDG proposed a compromise by focusing on hunting methods and types of ammunition rather than quota (Boere 2010: 35–37). Forbidding the use of lead in birdshot, which waterbirds tend to ingest, it sought to prevent lead from entering into the ecosystem's food chain up to the level of human consumers. The ducks' feeding habits here helped to reshuffle the actor-network to include the powerful actors of the European hunting lobby. The feeding habits in question enabled a policy focus on "sustainable hunting" – excluding the use of lead, but allowing for a continued shooting of certain species if not endangered. In this way, the WGDG and later the AEWA could draw on the support of the European Federation for Hunting and Conservation (FACE) in educational campaigns and policy promotion (European Commission n.d.; UNEP/AEWA Secretariat 2009: 4).

With AEWA, as with CITES, a multitude of non-human, too, allies shaped the composition and branching out of the convention as a network. The geographical focus of early proposals resulted from the availability of data on Palearctic migrants breeding in European countries with strong ornithological traditions (Boere 2010: 10; IUCN 1983: 10). In the 1990s, Europe constituted the centre from which AEWA's actor-network would expand by following the migrating birds it sought to protect. The emerging scope of the network was influenced by developments in the European research landscape, including the appropriation of foreign scientific concepts and the use of new technologies. The concept of the flyway, for instance, had emerged in the 1930s as an approach to understand and protect American shorebirds (Wilson 2010). In the 1970s, the concept was gaining traction among European ornithologists, concerned, for instance, with the mapping of migratory routes of waders, which had previously been understood as annually variable (Morrison 1977).

The appropriation of the flyway concept was stimulated by advances in tracking technologies such as electronic telemetry and new ways of organising banding. While traditional research methods such as observation still play an important role in the fieldwork underlying the AEWA, advances in tracking technology and their promises of precision functioned as important instruments for control and accounting in the actor-network of AEWA.

In the 1970s, the establishment of a European database for ring data by the European Union for Bird Ringing (EURING) triggered the standardisation of ring records and created a new center of calculation. In 1977, an attempt was made to computerise historical data going back to the 1920s, and, in 1982, these efforts were further advanced with additional funding by the European Community (du Feu et al. 2016). EURING has hence played a key role in the compiling of bird migration atlases that support flyway protection as pursued under the AEWA (Baillie et al. 2018). The 1980s and 1990s, then, witnessed the rise of bird tracking by transmitter, from the ground, by truck or plane, and eventually by satellite. Transmitters had previously only been used in wildlife research on larger mammals. While manual marking with tags and rings allowed for a general apprehension of large-scale animal movements, electronic telemetry enabled a more detailed understanding of migratory routes, including individual and annual variations. The development of smaller and lighter tracking devices with stronger batteries in the 1980s and 1990s supported the continuous tracking of individual birds across continents, aiding research into the choice of particular stopover sites, relevant to an instrument such as the AEWA, which aims to respect the migration needs of 255 different species (Benson 2010; Nowak and Berthold 1987). In the 1980s and early 1990s, white stork research with transmitters in the framework of the CMS, coordinated by the EEG and ICBP, resulted in an extension of the emerging AEWA area to include the southern half of the African continent, which lay outside the scope of existing conventions on European birds and wetlands.

But not only did new tracking technology aid the understanding of different bird species' flyways and the perceived need for their protection. Conversely, the CMS's dynamic framework also shaped the part played by technologies of control within the emergent alliance. Ornithologists at the German Max Planck Institute for Ornithology, for instance, perceived proposals for bird migration studies in the context of the CMS and its daughter agreements



Figure 10.2 A northern gannet with transmitter. Up to today, larger, popular birds such as gannets and godwits are fitted with transmitters more often. Wald1siedel. 2015. Ringed Northern Gannet with GPS Transmitter, Helgoland, Cliff. Wikimedia commons. CC-BY-SA-4.0.

as an opportunity to modernise their technological equipment and to manifest their expert standing (Berthold 1987). New technologies resulted in the enrolment of additional actors. While the ornithological community largely controlled bird ringing, telemetry led to new relations with commercial actors, such as Collective Localisation Satellites (CLS), the international company controlling the environmental surveillance satellite system Argos (Benson 2012).

In the case of the AEWA, too, the role of technologies brings to light not only the changing nature of the alliance, but also the precariousness of the assemblage. Especially in the early years of the CMS, telemetry held many promises. The technology was considered more efficient and precise than traditional banding. Accumulating sufficient banding data for accurate flyway atlases and for the enlisting of relevant range states could take up to a decade, as it did in the case of the brant goose (Boere 2010). Yet, despite its perceived advantages, the development of electronic tracking was inhibited by high costs and delays in the launch of European research satellites, for instance, after the Challenger disaster of 1986 (Keller and Schiewe 1990). Transmitters, moreover, are work-intensive and less versatile. While banding is often done on nestlings, expensive electronic transmitters are fitted to older birds that have a higher survival rate. Older birds are, however, more difficult to catch and release. With small species, such as warblers or small ducks, transmitters remain too large to be used (Fast et al. 2011; Fiedler 2011). Overall, the migratory routes of larger waterbirds are most closely monitored, and protection efforts are most thoroughly based on scientific research. The migration of the black-tailed godwit, a popular shorebird in the Netherlands, is one example here (Remmelts 2021). Yet, for the study of most birds and their stays outside of Europe, banding data or simple ground observation with binoculars continue to play an important role in the composition of flyway atlases.

Next to technologies, and just like in the case of CITES, animals themselves mattered for the effectiveness of the AEWA. In this case, the migration habits of the birds, their abundance, and toleration of being caught and counted are key. To make it into the AEWA appendices, species must be threatened, yet not too difficult to locate, too rare, or too shy to ring or track. The latter is the case, for instance, for the endangered aquatic warbler, a small beige bird with a heavily striped back that breeds in wet sedge meadows in an area ranging from Eastern Germany to Romania. The bird, with its own Memorandum of Understanding under the CMS, used to be widespread all over Europe. Small, and difficult to spot and catch, the warbler's electronic tracking or systematic ringing is virtually impossible. With surveys relying on observations and recordings of bird songs, uncertainties about the numbers of breeding areas and the locations of stopover and wintering sites present a continuous problem (Remmelts 2021; Tanneberger et al. 2005; UNEP/AEWA Secretariat 2018).

In the future, it is expected that global heating-induced changes in bird behaviour and migration, paired with intensified land use in both breeding and "wintering" areas, will significantly affect the AEWA's scope and effectiveness once again. Changing migration behaviour will require further adaption of flyway maps, species lists, and – to some extent – working group composition, as most migratory birds will shift into new ranges. For several bird species, especially those migrating within the African tropic zone and those depending on Arctic breeding areas and some European stopover sites including the Wadden Sea, the AEWA might provide insufficient protection (Nagy et al. 2021; Remmelts 2022; Trouwborst 2012).

The development of the AEWA as a heterogeneous network shows that legal instruments such as conventions are effective only as dynamic constellations of social action, research

initiatives, technological devices, and animals themselves. The final formulation of the AEWA agreement and the continued flexibility of its lists and appendices depends on the use of tracking technologies and the availability of conservation data. At the same time, population sizes, (changing) migration routes, and research interests in particular species all play crucial roles in the continuous reconfiguration of the AEWA's assemblage. Its success indeed relies on such continuous reconfiguration.

Conclusion

In this chapter, we have approached two wildlife conventions from an actor-network approach. We have shown that this approach, which treats conventions as heterogeneous assemblages of meanings and materials, rather than as legal texts alone, is useful to understand what conventions do – allowing us to trace their performativity. This performativity is ever-changing. What conventions do, continues to change after they have been ratified. Their meaning and agency unfold through the changing, heterogeneous relationships between humans, organisations, technologies, and animals. It is here that the advantage of the actor-network approach becomes apparent. It shows how legal texts (for which such relational approaches have hardly been used) can exert influence beyond the world of paper to affect concrete animal bodies. Other case studies could, of course, extend the approach to regulations on local ecologies, regional infrastructures, or the global climate – highlighting the way in which legislation is networked with the natural and the material world.

The two conventions discussed in this chapter administer the long-distance movement of animals beyond political borders. The scope of the actor-networks of the two conventions partially maps onto the type of movement they aim to regulate. CITES, regulating the movement of wildlife, needed a network involving wildlife-producing nations, often in the Global South, and wildlife consuming nations, in the Global North. CITES's actor-network, however, not just mapped on to that of the wildlife trade but also redrew it. It was instrumental in establishing new connections between zoological gardens and (unintentionally) creating new smuggling routes through non-complying nations. The AEWA, concerned with creating safe passage for migratory waterbirds along the Western Palearctic Flyway, connected range states between European and Asian breeding areas and seasonal resting areas on the African continent. The flyways involved, and thus the relevant range states, changed, however, depending on the condition of a species and conservationists' ability to understand it.

The emerging and changing relationships underlying these long-distance connections and the scale of the conventions were not easily established. An actor-network approach helps to recognise the work that goes into the tracking, mapping, and monitoring of animal movements, as well as into the obstacles that need to be overcome. The approach, moreover, brings to light that the relationships within the network are often unequal. For both CITES and AEWA, the administration of animal movement was aided by emerging "centres of calculation" that helped control and discipline the movement of animals. In the cases at hand, these centres were located in the Global North, within the headquarters of international organisations, such as the IUCN, or financed by European funds, as in the case of EURING. Of course, discussions of power imbalances are not absent from conventional histories of environmental treaties. However, an actor-network approach allows us to understand power dynamics within assemblages as continuously negotiated and determined by a multitude of human and non-human actors.

In fact, despite regulatory attempts by dominant actors, animal movements, whether they concern migrations or trade, remain unruly. In addition to revealing power dynamics and persisting imbalances, analysing conventions as actor-networks makes visible the precariousness of conventions as assemblages, as in the case of non-complying dealers and uncommitted range states, incompatible chipping technologies and insufficient flyway data, non-reproductive elephants and shy warblers. Again, it becomes apparent how important it is to look beyond the world of legal texts and the human actors involved in drafting them.

Overall, the actor-network approach is well suited for studying wildlife conventions from an environmental history perspective. A central aim of much of the current discipline of environmental history and neighbouring fields in the environmental humanities is to highlight the (historical) agency of *more-than-human actors* (Haraway 2007; O'Gorman and Gaynor 2020). While it might be tempting to write about environmental conventions as primarily products of political negotiations between humans concerned with protecting other species and environments, ANT invites us to rethink such unidirectional narratives. ANT refocuses the attention on the dynamic and multiform relations between various entities, including lobby groups and laws, manuals and trackers, golden lion tamarins and geese. It is through these relations that treaties and environments are made and unmade. As such, the approach acknowledges the unruly texture of environmental jurisdiction as part of collective, co-created, and always precarious processes, depending on both humans and non-humans playing their part.

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11
HAZARDS AND DISASTERS
Locusts, earthquakes, volcanoes, floods, droughts

Katrin Kleemann and Admire Mseba

Introduction

For a long time, historians assumed nature, climate, and weather to be static (Cronon 1993). In our own time, we are becoming increasingly aware that our actions can have grave consequences; humans and non-humans alike are beginning to suffer the consequences of anthropogenic climate change. The idea that the environment deserved its own voice emerged only in the 20th century; environmental historians began to challenge the previous paradigm. Environmental historian John McNeill states that environmental historians "write history as if nature existed. And they recognize that the natural world is not merely the backdrop to human events but evolves in its own right, both of its own accord and in response to human action" (McNeill 2010: 346). Hazards and disasters make it very clear that the environment can precipitate significant events, turning order into chaos and affecting life on a local and international scale. A natural event becomes a disaster only when the previous order is severely disrupted, usually by a myriad of factors.

At first glance, earthquakes, volcanoes, droughts, floods, and large locust swarms may seem to have little in common, other than a certain apocalyptic or Biblical resonance. What is clear is that these phenomena can pose a serious threat to the prosperity and welfare of humans and non-humans alike: they have the potential to devastate. These threats are ancient and have followed us on our human journey since the beginning. Given this deep history, some societies have a long history of experience with them. An awareness of the potential recurrence interval of these events has led to the development of methods of coping with and adapting to them. Some societies, however, did not engage with such strategies and remained underprepared, innocent of their own histories. In this chapter, we explore environmental histories of "natural" hazards and disasters and point to their interconnections and shared characteristics, such as their unpredictability, economic impacts, transregionality, and their potential to compound each other. After introducing definitions of hazards and disasters as well as the sources environmental historians use to approach this topic, the chapter is structured along these four aforementioned shared characteristics.

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Definitions

Earthquakes, volcanoes, droughts, floods, and swarms of locusts can all be understood as hazards. The term *hazard* has its origin in the Arabic word *az-zahr*, literally meaning dice and figuratively meaning chance or luck. The term made it into the English language through the French *hasart*, "a game of dice". It relates to the probability and risk that a particular phenomenon will occur in a specific region. A hazard becomes a disaster only if it impacts a human settlement that is vulnerable to it (Juneja and Mauelshagen 2007: 2, 14; Kempe and Rohr 2013: 124). Put another way, every nature-induced disaster is based upon an extreme natural event; however, not every extreme natural event is considered a disaster. Recent scholarship in the field of disaster histories has moved away from the previous notion of "natural" disasters (Groh, Kempe, and Mauelshagen 2003: 15; Mauelshagen 2010: 19, 96, 117–18). It is not the natural event alone that causes devastation; many factors play a role. For instance, for socio-economic reasons, those with lower income may be able to afford accommodation only in the floodplain of their hometown's river; during a flood, this area will be the worst affected (McDermott 2022).

The word *disaster* originally meant "a corruption of the stars" or "ill-starred" because, for a long time, it was believed that astronomical signs could predict negative earthly phenomena (Rohr 2022: 133; Weber 2015: 11). Today, the term disaster is synonymous with catastrophe and calamity (Irwin and Smith 2020: 98–9). All reference the possible disadvantageous impacts of hazards on human and non-human populations. Historically, the five phenomena discussed in this chapter have often struck suddenly, unexpectedly, and forcefully, leaving in their wake a trail of destruction.

Archives of nature and archives of society

Understanding these phenomena, individually and collectively, requires scholars to cross disciplinary boundaries. Evidence from both the "archives of nature" and the "archives of society" is necessary when reconstructing these past events (Kleemann 2019; Pfister and Wanner 2021: 16–17; White et al. 2022). The archives of nature include, for instance, ice cores, tree rings, and sediment records. Ice core records from Greenland and Antarctica, for example, help scientists to find traces of tephra, ejected solid matter, from strong volcanic eruptions, and studies of tree rings can show cooling or the presence of volcanic gases (Edwards et al. 2022). For evidence of earthquakes, floods, and droughts, scholars examine marine and lake sediment records (for the reconstruction of volcanoes, see Sigl et al. 2015; for earthquakes, see Doig 1986; for floods, see Wilhelm et al. 2022; for droughts, see Nelson et al. 2011; for locusts, see Bauch 2017; Brázdil et al. 2014; Camuffo and Enzi 1991: 56; Fei and Zhou 2016: 115; Rohr 2009, 2020, 2022; Stoffel et al. 2022). Often scholars apply a multi-proxy approach. For instance, when investigating droughts, they can use lake sediment records in combination with tree ring records (Anderson 2016; Schoenemann et al. 2020). The archives of society are historical records, such as chronicles, weather diaries, newspapers, flood markers, and oral histories (Camenisch et al. 2019; Johnson 2019 [1989]). While the archives of nature offer an annual or seasonal resolution, historical records can identify the day or even the exact time that a given phenomenon occurred (Kleemann 2023).

Scientists have developed different scales to measure some of the phenomena discussed here. For earthquakes, these scales measure magnitude and intensity. For historical earthquakes that were not measured by seismometers, geologists rely on historical descriptions,

such as damage reports, to estimate their intensity; with these descriptions, they can then calculate the scale of the earthquake in accordance with the seismic intensity scale commonly used in their region. In the United States, this is the Modified Mercalli Intensity Scale (MMI). These scales indicate an earthquake's intensity in terms of the level of destruction, ranging from I ("not felt") to XII ("almost all structures destroyed"). The perceived intensity of an earthquake depends on the distance to the hypocentre, the depth at which the earthquake occurred, and the soil characteristics; on soft soil, the intensity can seem greater (Apsel, Hadley, and Hart 1983). Another important measurable aspect of an earthquake is its magnitude, which is given in Arabic numerals. Magnitude scales, such as Moment Magnitude (Mw), designate a number to an earthquake, which indicates how much energy it released (United States Geological Survey 1989). For the categorisation of volcanic eruptions, scientists have developed the Volcanic Explosivity Index (VEI). It is a logarithmic scale ranging from zero to eight. Apart from VEI 0 to 2, every number represents a tenfold increase in explosivity. Different criteria, such as the volume of erupted ejecta, the height of the eruption cloud, and other observations, influence the classification of volcanic eruptions. The VEI is not perfect, as all forms of output – ash, lava, lava bombs – are treated the same, and it does not consider sulphur dioxide emissions (Miles, Grainger, and Highwood 2003; Newhall and Self 1982). For temperature and precipitation, although not necessarily floods, environmental historians use the Pfister Indices. This system of classification was developed by Christian Pfister and has a range of +3 to −3; historians can convert their pre-instrumental and instrumental data values to a figure within this range (Pfister 1992; Pfister, Camenisch, and Dobrovolný 2018; for the worldwide applications of the Pfister Indices, see Nash et al. 2021). The aforementioned measurements and estimates give historians and natural scientists a sense of the hazards and risk levels that these phenomena pose to specific areas.

The environment and anthropogenic influences

Across cultures, nature-induced disasters were sometimes understood as "divine wrath" (Kempe and Rohr 2013: 124). For example, the Bible mentions the five phenomena discussed in this chapter several times. Revelation 6:12 mentions an earthquake, Revelation 9:2–3 mentions a volcanic eruption ("smoke") and locusts, and Job 12:15 talks of drought and flooding. In the Bible, drought often is associated with starvation and famine, one example being in Joel 1, where it is associated with locusts. The flood narrative (*diluvium*) is famously present in the Bible, such as in Genesis 7. Biblical allusions to the phenomena discussed here formed the interpretative template for their pre-modern Christian understanding as, understandably, contemporaries struggled to make sense of these bewildering events in their own time (Wozniak 2020: 68). Reports of these phenomena were often obviously coloured by the writer's interpretation of the Bible. Environmental historian Christian Rohr suggests that knowledge of the pertinent Biblical passage "enabled the author to outline the unspeakable nature of the catastrophe" (Rohr 2007: 89); they borrowed words from the Bible to explain what was happening around them in their own time. In pre-modern texts, given their linguistic and stylistic similarities with descriptions in Biblical passages, it is sometimes difficult to differentiate between the *topos*, a rhetorical convention or motif, and what *really* happened (Rohr 2007: 100; Wozniak 2020: 711–14). In the modern period from the 19th century onwards, scientists began to uncover the natural causes for these phenomena and increasingly were able to pinpoint where and when they might next occur. One such example is the theory of plate tectonics, for instance, which explains why

many earthquakes occur where they do. The theory, which the scientific community accepted in the 1960s, was based on the idea of "continental drift" formed in the early 20th century; it was proven once technological advances allowed scientists to study seafloor spreading along mid-oceanic ridges (Oreskes 2003).

Environmental historians regard earthquakes, volcanoes, droughts, floods, and locust plagues as physical *and* socio-cultural phenomena (Mauch 2009: 5). Or, to borrow from anthropologist Anthony Oliver-Smith, such "disasters occur at the intersection of nature and culture and illustrate, often dramatically, the mutuality of each in the constitution of the other" (Oliver-Smith 2002: 24). At the same time, it is important to avoid environmental determinism (Erdkamp 2019: 422; McCann 1999; Sołtysiak 2016). Human actions historically compound or mitigate their impacts.

The relationship between droughts, floods, locust infestations, and anthropogenic factors has been made clear in the parts of the Americas, Africa, and Asia. From the 16th century onwards, large parts of these continents were integrated into a world economic system increasingly dominated by Europe (Davis 2001; Miller 1982, 1988). European colonial expansion into Asia and Africa in the 19th century impacted these societies' abilities to manage the effects of droughts and floods. In Eastern Africa in the late precolonial period, some societies turned to political centralisation; leaders became patrons of their subjects and helped them through high-risk periods, preventing droughts from becoming famines. Colonial rule disrupted political centralisation and the safeguards it had provided against these hazards (Giblin 1992). Historian Mike Davis has demonstrated how this played out. Three late 19th-century droughts "of planetary magnitude" in 1876–9, 1889–91, and 1896–1902 were triggered by El Niño–Southern Oscillation (ENSO) and cumulatively killed an estimated 30 million people, as Davis notes. He further suggests that it was not just the drought that produced this staggering mortality (Davis 2001: 6–7). These millions, he reminds us, "died … in the very process of being forcibly incorporated into" the modern world system's "economic and political structures" (Davis 2001: 7). Many perished because famine relief was unevenly distributed: aid was directed towards urban areas, as they produced the commodities required for the metropolitan economy. Philosopher Amartya Sen writes of this happening during the Bengal Famine of 1943 (Sen 1981: 63). This funnelling of resources became routine in other parts of the European empires as the 20th century progressed. Several studies show the impact of the incorporation of Africans into colonial economies, which, in comparison to the pre-colonial period, undermined their ability to manage their environments, rendering them vulnerable to droughts and pestilence (Iliffe 1990; Vaughan 1987; Watts 1983). Portuguese cotton production in Mozambique in the mid-20th century, for example, resulted in increased poverty for the peasantry and exacerbated their vulnerability to cycles of droughts (Isaacman 1996), whereas before they had mixed and locally adapted crops that ensured greater resilience.

This intersection at the nexus of environmental and anthropogenic influences can produce disasters on a very localised scale, too. Changing social conditions, at times, could undermine communities' abilities to manage ecological stressors, including droughts and pestilences (Giblin 1992; McCann 2019 [1989]). Indeed, political instability could also worsen the impacts of droughts. In Sudan, in 1888, war resulted in the mass movement of people to the more central territories; the resulting disruption of trade and affairs associated with it, turned the drought of 1887–8 into a catastrophic famine (Pankhurst and Johnson 2019 [1989]: 58). Significantly, global forces, at times, undermined local attempts at ecological management and turned nature-induced disasters, such as droughts and locusts, into

catastrophic famines. This was the case in the parts of southern Africa that found themselves engulfed in the expanding slave trade and the colonial frontier (Cobbing 1988). These colonial forces exacerbated problems brought about by competition for resources (Eldridge 1987; Guy 1980). In parts of the former colonial world, actions or inaction of the states involved compounded the stress caused by droughts and locusts (Takuva 2022).

Sometimes disaster could be averted if a local population was aware of the hazards in its area, had local ecological knowledge on how to mitigate them, and had the socio-economic means to invest in disaster preparedness. This was the case during the 1973 Eldfell volcanic eruption on Heimaey in the Vestmannaeyjar Islands of Iceland. Icelanders have more than a millennium of experience with volcanic eruptions. They have had to learn to live with the 30 volcanic systems in their country and their diverse eruption styles (Thordarson and Larsen 2007). During the 20th century, Iceland overcame poverty and economic stagnation, first as a result of the mechanisation of its fishing industry, and then by taking advantage of its geopolitically critical location during the Cold War (Ingimundarson 2011; Karlsson 2000: 239–42, 287–91). The Icelandic State Civil Defence Organization had prepared for an eruption like the one on Heimaey and quickly evacuated almost all 5300 residents of the island within six hours (Williams and Moore 1988). Lessons learnt from previous eruptions allowed for a proactive approach. Icelanders even managed to slow the lava flow by pumping ocean water onto it, which prevented lava from consuming an entire town (Lacy 1998: 13). This example demonstrates perfectly how a society can learn from past disasters, arming themselves with the knowledge to mitigate the ill effects of current and future disasters. The Icelanders' continuous and thorough monitoring of the seismic activity of the country's 30 volcanic systems allows for the detection of eruptions minutes to days before they occur, reigning in, to some extent, the unpredictable nature of the landscape (Guðmundsson et al. 2008: 251–63).

Unpredictability

What these phenomena also have in common is their unpredictability. Consider earthquakes, for example. Even in regions where they frequently strike, their magnitudes vary wildly. Similarly, their recurrence period is also still somewhat mysterious even today. Here, it is important to remember that analyses of records from the archives of nature and the archives of society enable us to *estimate* recurrence periods, but nothing can be definite.

An awareness of local hazards can affect disaster preparedness. Some countries or regions – like California, Japan, and New Zealand – have significant earthquakes frequently – at least once or twice a generation. Their respective governments have the socio-economic means to prepare for future earthquakes; by adhering to new building codes, retrofitting buildings to withstand shaking, or creating and executing evacuation plans (Crowley and Elliott 2012).

Sometimes, the recurrence period of a given event is longer than a human life span. In these instances, disasters can be forgotten. A low level of preparedness can result in high levels of destruction. One example of an area prone to significant earthquakes with long recurrence periods is the Cascadia subduction zone in the Pacific Northwest; here, smaller continental plates, like the Juan de Fuca Plate, move under the larger North American Plate. The last significant earthquake in this region with an estimated magnitude of 8.7–9.2 took place on 26 January 1700 (Atwater 2016: 3). This is known because Japanese sources registered an "orphan tsunami" (one with an initially unknown source or "parent"). Additionally,

dendrochronological analysis of so-called "ghost forests" in the Pacific Northwest, remnants of trees that were buried abruptly by landslides of tsunami debris, confirm that the trees here had their last growing season in 1699 (Schulz 2015). Archaeological studies have also shown that villages in this area near the coast were affected by flooding around the same time (Ludwin et al. 2005). Twelve previous earthquakes of a large magnitude occurred in the Cascadia subduction zone in the past seven millennia, with recurrence periods ranging from a few hundred years to over a millennium. On average, the recurrence period is 570–590 years; this is, however, only a statistic and does not indicate precisely when the next one will occur (Witter, Kelsey, and Hemphill-Haley 2003). However, a future event of this magnitude will likely have devastating consequences for the populations in the north-western United States and British Columbia in Canada. A resulting tsunami could possibly cause devastation across the Pacific, too.

Droughts, too, can occur unexpectedly. During the Little Ice Age, an overall colder period lasting roughly from 1250 to 1850, a "black swan" event occurred. In 1540, a megadrought affected Europe; it was brought about by 11 months of hotter-than-usual conditions with little to no precipitation. A black swan event is "a low probability, high-impact event of an unimaginable magnitude", which is "an outlier outside the realm of normal expectations carrying an extreme impact" (Pfister 2018: 157). The impact of this drought could be felt from the Atlantic coast to Poland and from Italy to the North Sea. It led to soil desiccation, forest and city fires, extremely low water levels in rivers, and difficulties transporting goods on rivers, and it brought water-driven mills to a standstill. The lack of clean drinking water subsequently led to disease, such as dysentery (Pfister 2018: 156, 178, 182–7; Zwierlein 2021). Environmental historians Oliver Wetter and Christian Pfister argue that this year was warmer than the 2003 European heat wave, which led to drought, crop shortages, and a high death toll (Wetter and Pfister 2013; Wetter et al. 2014; for criticism, see Büntgen et al. 2015; for a response to the criticism, see Pfister et al. 2015).

Regarding locusts, in parts of eastern Africa in the 1940s, there was a devastating plague where swarms invaded and overtook large swathes of land. It was 70 years later before another comparable incident occurred. Overwhelmed government officials pleaded for help to combat this current outbreak; they conceded that their level of preparedness was deficient because they had not encountered such a problem in their working lives (OCHA 2020). This example shows us how unpredictability and unpreparedness are reinforced by the duration of time between events and generations.

Economic impacts of hazards and disasters

In addition to a loss of life, hazards and disasters can also have a significant economic impact. Replacing and repairing infrastructure, buildings, and crops lost to earthquakes, volcanoes, droughts, floods, or locusts can devastate a region's finances. The costs can be higher still when two or more disasters occur in close temporal or spatial proximity; locust infestations often follow on the heels of droughts and occasionally floods (Johnson 2019 [1989]: 184). The science behind this is still to be settled, but it appears that droughts provide the conditions under which locusts lay their eggs in large numbers. These are then hatched with the next rains. As the solitary locusts compete for food, they then turn towards swarming (Uvarov 1943).

Living in areas prone to hazards also means that risk assessments, monitoring, and resilience measures are necessary. Resilience measures can, for instance, include establishing

strict codes for new construction projects and retrofitting buildings to withstand earthquakes, maintaining dykes or barriers in flood-prone areas, and installing warning systems that prepare a population for an impending emergency. The Dutch and German North Sea coasts have experienced many storm surges in the last millennium, some of which led to deadly floods. The exact number of victims varied greatly in each case, but some particularly disastrous examples include the Second Marcellus Flood in 1362, the Burchardi Flood in 1634, and the Christmas Flood of 1717. Often these floods led to widespread destruction and damage to infrastructure and loss of agricultural land and livestock. As a proactive measure, the coastal dwellers learnt to build and maintain dykes, and to raise them if necessary; additional warning mechanisms were put in place, such as bellringing when rising waters threatened the dyke (Allemeyer 2006; Soens 2018). This was by no means a straightforward process; decades without fatal storm surges, changes in landownership, or the economic tolls of war often led to dyke maintenance falling by the wayside. This is understandable; unfortunately, it inevitably led to a future disaster (Jakubowski-Tiessen 1992). Documented storm surges provide another excellent example of the environment affecting both human and non-human populations; the coasts' inhabitants often fell victim to this almost unpredictable and devastating phenomenon.

Trans-regional or transnational scope

The appearance of an orphan tsunami in Japan that followed the earthquake in the Pacific Northwest in early 1700 is a stark reminder that earthquakes, like volcanoes, droughts, floods, and locust swarms, can have impacts that are trans-regional, transnational, or transcontinental in scale. After the immediate, localised impacts manifest themselves, eventually a more expansive legacy begins to materialise. For example, high-latitude volcanic eruptions or strong eruptions originating in the tropics can produce ashes and gases that can blanket the entire hemisphere or, in some cases, the entire globe (Sigl et al. 2015). Volcanic eruptions may also lead to "volcanic cooling", which comes about when volcanic products such as gases and tephra are injected into the stratosphere. Here, these gases can result in climate forcing that can last for up to a few years (Grattan and Pyatt 1999). In such cases, this volcanic ejecta can potentially produce an albedo effect, whereby the particles in the atmosphere reflect sunlight back into space, cooling the climate at surface level (Robock 2000: 191–3). This happened after the 1815 Tambora eruption in today's Indonesia, a super-colossal eruption which famously triggered a "year without a summer" in 1816 in many parts of the world, including Europe and North America; tales of summer snow and failed harvests abound for this year (Behringer 2019). Volcanic eruptions can trigger teleconnections, a concept that neatly explains why and how eruptions affect faraway parts of the globe, which at first seem unconnected. Understanding these connections has proved useful in the field of climate science; environmental historians have recently adopted this concept to study societal teleconnections (Bauch and Schenk 2020: 27–8).

Locusts originating from a particular locality can also cause infestations across territorial and continental boundaries. One significant occurrence of a locust infestation occurred in 873–4. This medieval plague was significant. Its significance is evidenced by the fact that it is mentioned in numerous sources. The summer of 872 was very dry and hot, which led to a huge increase in locusts in the Danube delta. In 873, these swarms travelled westward along the Danube towards today's Germany, France, and possibly the British Isles. South of the

Alps, the swarm swept over the Balkans and continued to the Adriatic Sea towards southern Italy. The resulting damage to crops led to widespread hunger (Thornton 1996; Wozniak 2020: 549–80). Another example of an almost continent-wide locust infestation took place in the mid-20th century, when a plague of locusts struck the whole of Africa south of the equator with the exception of the continent's southern-most tip (Dunn 1952: 264).

Efforts to deal with the effects of the five phenomena discussed in this chapter have, historically, required collaboration across local, national, and even continental boundaries. By the early 20th century, this was understood by policymakers across the world. One example is the Intercolonial Locust Bureau, which was initiated in 1906 when representatives from Britain's Southern African colonies came together (Report upon the Central Locust Bureau of South Africa, 20 April 1907, CEN 506/E254 Vol. II, NARSSA). Similar efforts were made in South America and from the 1920s and 1930s on a more international level (Buj 1995; Uvarov 1938: 586). The international efforts of the past in a way mirror our own international collaborative effort to tackle climate change.

Compound events

When two or more of these phenomena occur simultaneously, the effects can be devastating. Earth system scientist Jakob Zscheischler and his colleagues point out that the scale of destruction can be "well beyond that which any of these hazards would have caused in isolation" (Zscheischler et al. 2018: 469). Environmental historian Martin Bauch has used this framework for the summertime St Mary Magdalene's Flood of 1342, a once-in-a-millennium flooding event that affected an area from the Rhône in France to Hungary, and from the Alps to northern Germany. This flooding event was singular in the recorded history of central Europe (Bauch 2019: 275). The winter was rich in snow, with ice drifts affecting the rivers. This was followed by a dry spring and early summer, both characterised by city fires. Then in mid-July, heavy rainfall led to flooding, and in turn, erosion. This erosion was extreme and carried away agricultural soil, ruining that year's harvest and putting a halt to further cultivation. The flood was one reason among many environmental and anthropogenic factors that led to sharp increases in the price of food and, so, hunger (Bauch 2019: 284–9; Bork and Dotterweich 2007; Collet and Schuh 2017). Bauch has shown that this was a compound event that developed its destructive potential only by the simultaneity of several phenomena (Bauch 2019: 300).

Across eastern and southern Africa in the 1890s, the ill effects of droughts, locusts, and diseases compounded one another. Between 1888 and 1892, a deadly epidemic of rinderpest was followed soon after by severe drought and locust swarms, resulting in the Great Ethiopian famine of those years (Pankhurst and Johnson 2019 [1989]: 48). "The three above disasters," write historians Richard Pankhurst and Douglas H. Johnson (2019 [1989]: 51), "combined to produce an acute shortage of both meat and grain – the country's two staple foods. This," they elaborate, "led to soaring prices, which were further increased as a result of speculation by merchants." A few years later in 1895–6, the same forces, combined with colonial policies – the colonial state responded to the rinderpest outbreak by killing cattle suspected of being infected regardless of their condition and continued to levy taxes – gave rise to untold suffering and an uprising among Africans in Southern Rhodesia [today's Zimbabwe] (Mseba 2022: 200; Ranger 1967).

Another particularly revealing example of the interconnectedness of the phenomena discussed here is the 1783–4 Laki eruption in Iceland. This eruption released the largest



Figure 11.1 The Laki Fissure as seen from Mount Laki in Iceland, 2016. Photograph by Katrin Kleemann.

volume of lava of any volcanic eruption on planet Earth in the last millennium (Kleemann 2022b; Thordarson and Self 1993). It also produced large volumes of volcanic gases, including sulphur dioxide, which formed a dry fog that was visible from Labrador in North America to the Middle East, and from Europe to North Africa (Demarée, Ogilvie, and Zhang 1998; Kleemann 2022a, 2023; Stothers 1996). Recent scholarship has postulated that this eruption produced asymmetric cooling in the Northern Hemisphere, which created a southward shift of the Intertropical Convergence Zone. Thus, there was a decrease in precipitation in the tropics. The eruption occurred in June and influenced the monsoonal rains that would usually occur around that time of year. This subsequently triggered droughts in India and eastern Africa, and led to a low Nile River flow in 1783, resulting in famine in Egypt (Zambri et al. 2019: 6787; for connections between ENSO and the Nile floods, see Mikhail 2015; Oman et al. 2006; Ortlieb 2004). The following winter, 1783–4, was very cold throughout Europe and saw a lot of snowfall. In February 1784, an influx of warm air from the Mediterranean caused sudden thawing and increased water levels along several European rivers from Hungary to England, which led to flooding, debris flow, and ice drifts, blocking and destroying many bridges and infrastructure such as mills. The flooding also caused loss of life (Brázdil et al. 2010; Degroot et al. 2021: 546).

Conclusions

Studying these five phenomena individually or in combination from the perspective of environmental history is a meaningful endeavour – intellectually and practically. Returning to a point made by John McNeill, the environmental historian quoted at the beginning of this chapter: The environment "is not merely the backdrop to human events", but, in fact, the environment and the non-human world take place on their own terms and own timescales. An analysis of hazards and disasters offers the opportunity to study how individuals, a

community, or society at large react in extreme situations; often exposing existing strengths and weaknesses. Put in a nutshell, hazards and disasters help to reveal the agency of the non-human world in shaping (human) history. Coping strategies show to what extent a society was aware of the hazards posed by their surroundings and reminds us that a lack of awareness or preparedness often led to disaster. What disasters all have in common is that they are unpredictable and have impacts on the economy. They have the potential to affect areas on a transnational or transcontinental scale. In combination with other disasters, for instance, epizootics or conflict, they can be substantially more threatening. These instances are known as compound events. An analysis of what societies learnt from disasters is important; the non-human, here in the form of eruptions, earthquakes, floods, droughts, and locust swarms, strongly impact people, fauna, flora, and the environment they inhabit. As we navigate our way further along our human story, nature-induced disasters seem unavoidable. As we push against nature, so it pushes back. It is better to use our knowledge of the environment in our struggle against hazards. With adequate understanding, this struggle may instead feel like a kind of cooperation, and we can live with our environment, and not merely in it.

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PART III

Engaging with the Planetary and the Anthropocene


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12

PLANETARY BOUNDARIES, CLIMATE CHANGE, AND THE ANTHROPOCENE

Ruth A. Morgan and Cristián Simonetti

The concept of the Anthropocene – the age of humankind – was coined at the beginning of the new millennium (see Chapter 14, this volume). The term was proposed by atmospheric chemist Paul Crutzen and paleoecologist Eugene Stoermer (Crutzen and Stoermer 2000) for a new epoch that has succeeded the Holocene: the exceptionally stable climatic period that started at the end of the last ice age and in which civilisations flourished (Crutzen and Stoermer 2000). Originating in the Earth System Sciences (ESS), the term represents the collective planetary impact of the human species, such that humans have fundamentally altered the conditions of all life on Earth since the late 18th century (Crutzen and Stoermer 2000). Nearly a decade later, geoscientists advanced an associated and more expansive concept of "planetary boundaries" (Figure 12.1), whereby if one or more boundaries was transgressed, humanity would depart its "safe operating space" of the Holocene (Rockström et al. 2009: 472).

Historians Christophe Bonneuil and Jean-Baptiste Fressoz (2016) understand these concepts of the Anthropocene and planetary boundaries as responses to the question, "How did we get here?" In framing those responses, Earth System scientists have "proposed a history", Bonneuil and Fressoz argue, that is "an authorized narrative of the Earth, its past and its future shared with the human species, a narrative that makes the management of the Earth system a new object of knowledge and government" (2016: 47). Researchers in the environmental humanities and social sciences have not let what they interpret as a post-political ESS grand narrative go unchallenged (Lövbrand et al. 2015). In doing so, they have helped to cultivate the "Anthropo-scene", perhaps *the* "intellectual zeitgeist" (Castree 2015; Lorimer 2017: 118) of the past decade or so.

Broadly, their critiques centre on moral questions of human and structural culpability, epistemology and authority, and the disciplinary implications of its repudiation of the (Western) nature-culture divide. They have proposed a plethora of alternative "cenes", which, they argue, more accurately differentiate the "Anthropos", foreground those peoples and systems culpable for the Holocene's end, and offer alternative ontologies; these include the Capitalocene (Malm and Hornborg 2014; Moore 2015), Plantationocene (Haraway et al. 2016; cf. Davis et al. 2019), Technocene (Malm and Hornborg 2014), Eurocine (Grove 2017),

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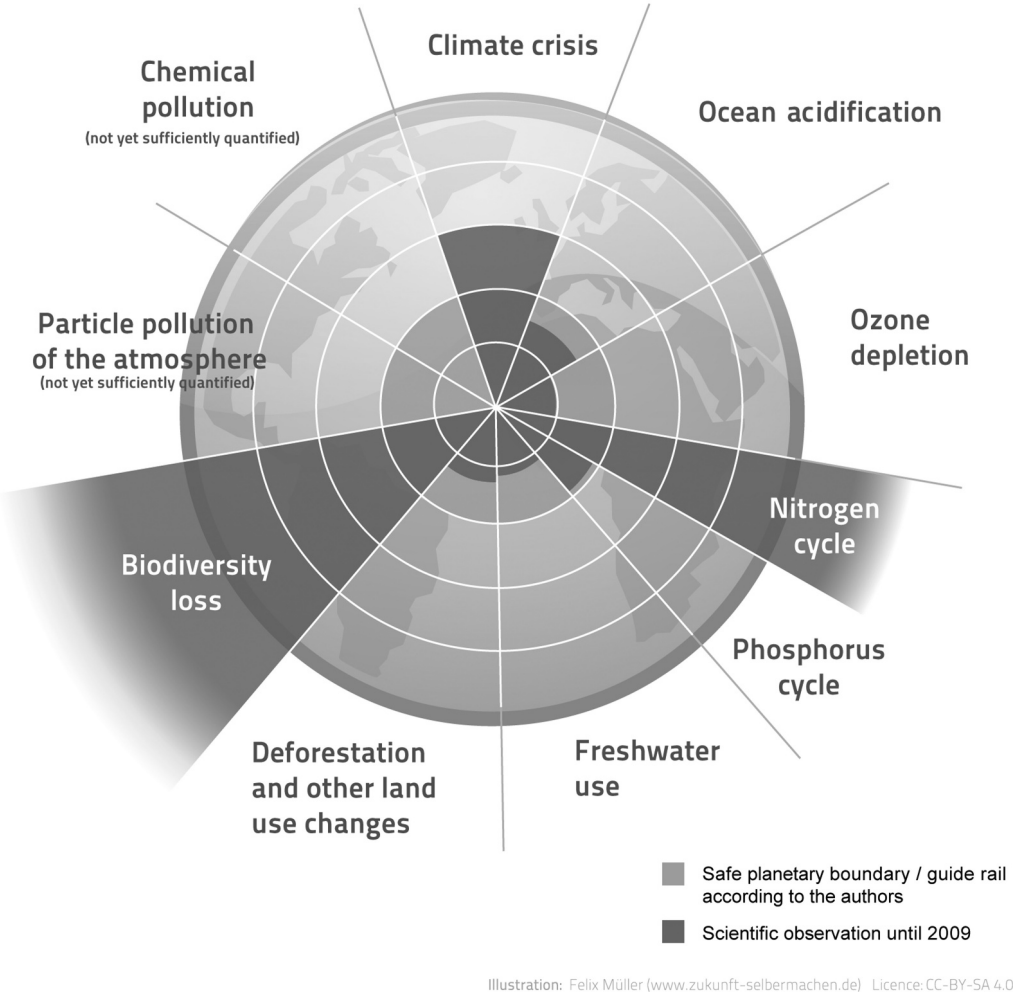


Figure 12.1 Planetary boundaries. From Rockström et al. (2009), available under Creative Commons licence, Attribution-ShareAlike 4.0 International (CC BY-SA 4.0), https://creativecommons.org/licenses/by-sa/4.0/

and Chthulucene (Haraway 2016), just to name a few. They and others question and problematise the disciplinary origins of the Anthropocene concept as a product of Western Earth System science that elides and subordinates other forms of knowledge and peoples in favour of northern technocratic expertise (e.g., Bonneuil and Fressoz 2016; Coen and Jonsson 2022; Yusoff 2018); a concept that can embolden ecomodernist technocratic fixes. Others ponder still the future of the humanities, particularly the historical discipline, beyond post-Enlightenment human-centrism (e.g., Chakrabarty 2016; Simon and Thomas 2022; Thomas 2022).

Through this vast and growing scholarship run the scalar threads of time and space. In this chapter we pull on these threads to draw out two different ways of seeing the Anthropocene: the view from nowhere, and the view from somewhere. Polarised as disembodied and situated forms of knowledge, these views or positions are often framed as epistemologically incompatible (Haraway 1988). But bringing the view from "nowhere" into the same frame as the view from "somewhere" foregrounds the visual iconography of a planetary consciousness from which the concepts of the Anthropocene and planetary boundaries are derived, while acknowledging the corporeally grounded encounter of feeling (Cosgrove 1994; Demos 2017; Jasanoff 2004; Lekan 2014). Following the paths laid by Mitman (2018), Clark and Szerszynski (2021), Thomas (2022), and Castree (2022), we suggest that our planetary predicament behoves us to attempt to reconcile these views not in a singular narrative of transformations to the Earth system, but instead in the plural voices of the planet's many places and peoples.

As a settler Australian environmental historian and a Chilean anthropologist, we join the Anthropo-scene from beyond the northern circles of the earth sciences. Our contribution aligns with those that highlight the dominance of male "northern voices" in planetary science circles (e.g., Carey et al. 2016; McGregor and Seymour 2017; Raworth 2014). Take the Anthropocene Working Group (AWG) in 2020, for instance. Established in 2009, the AWG was formed to advise the International Commission on Stratigraphy on the definition of the Anthropocene as a geological time unit. Of its 38 members, just 3 are based in countries outside the OECD (AWG 2022: 26–39). And of its 11 potential geological markers of the Anthropocene, just 2 lie south of the equator (Figure 12.2; AWG 2020: 5), excluding the entirety of Africa, Central and South America, and small island states. This selective objectivity of the geosciences affords the "view from nowhere" that we examine in this chapter's first section. We proceed then to a survey of "views from somewhere" that shed light on the planetary multitudes of the Anthropocene. Our focus on First Nations scholars and on the

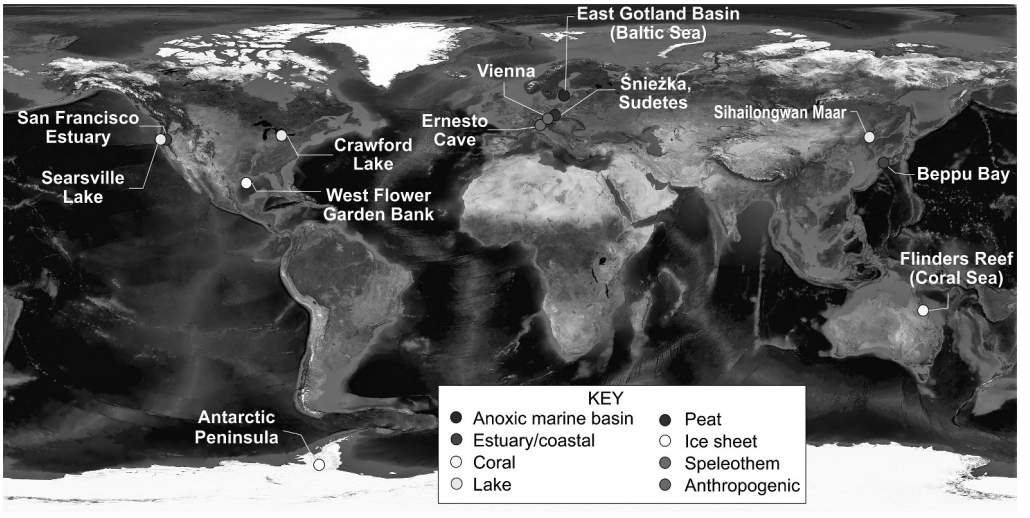


Figure 12.2 Location of candidate Global boundary Stratotype Section and Point (GSSP) sites under investigation, 2020. From Waters et al. (2023), Colin Waters, CC BY 4.0 https://creativecommons.org/licenses/by/4.0/

Global South foregrounds critiques that challenge a singular narrative of planetary change and reveals just some of the scalar complexities of provincialising the Anthropocene.

Planetary humanities and social sciences

A planetary concept has entered the imagination of social science and humanities scholars to mobilise what has been described as a new *planetary turn* (Chakrabarty 2019; Clark and Szerszynski 2021; Elias and Morary 2015; Spivak 2003). Paradoxically, this new concept is often defined in contrast to what lies traditionally at the heart of the social sciences and the humanities, namely the "human condition". According to historian Dipesh Chakrabarty, "to encounter the planetary is to encounter something that is the condition of human existence and yet profoundly indifferent to that existence" (2019: 4). The concept diverges from other related notions, such as *earth*, *world*, or *globe*, all categories that, one way or another, reference the human. In Chakrabarty's words "the category *planet* enters humanist thought, as a matter of human-existential concern, even as we come to realise that the planet does not address us in quite the same way as our older categories of *earth, world* and *globe*" (2019: 31).[1] The planetary concept, unlike earth, world, and globe, invites humanities scholars and social scientists to understand history and sociality without the human.

The particularities of the new planetary concept become distinctly evident, according to Chakrabarty, when concentrating on the contrast between the globes of globalisation and of global warming. The emergence of the second concept is related to the establishment of Earth System Science (ESS), a field born in the 1960s that conceives the planet as a holistic whole with different but interconnected systems. ESS, explains Chakrabarty, is undoubtedly related to the globe of globalisation. For instance, the establishment of ESS related partially to the global coordination of communication and transport technologies that compressed space, accelerated our modern sense of time, and led to the expansion of capitalism. The standardisation of time across nations on which such coordination depended was critical to the possibility of measuring atmospheric variations globally. Yet, ESS can offer a perspective on earth history that radically pulls us away from the human-centred imagination out of which histories of globalisation, not to mention world histories, have been written. Attempts to historicise the climate crisis through the lens of global capitalism are, according to Chakrabarty, surviving examples of this human-centred imagination (e.g., Malm 2016).

According to leading experts in the ESS field, such as Tim Lenton (2016), the planetary view offered by ESS grew out of an interest to locate life in other planets and coincides with the emergence of the Gaia hypothesis, according to which life on Earth and its non-living environment have interacted as a self-regulating system to make the planet habitable. James Lovelock, author of the theory, was employed by NASA as part of the Viking mission to Mars to work on how to detect the presence of life on the neighbouring planet. In doing so, he realised that life could be detected remotely, without travelling to Mars, noting how life on Earth alters the composition of the atmosphere, by introducing molecules that absorb radiation at particular wavelengths. Nearby, Carl Sagan worked at the Jet Propulsion Laboratory in Pasadena, California, on a different puzzle. Although the sun has burned steadily brighter since the Earth formed some 4.5 billion years ago, becoming about 30% more luminous, the Earth's atmosphere had remained habitable. When Lovelock discussed the puzzle with Sagan, he had an epiphany: if the atmosphere has remained stable for geological periods of time despite the variations in solar radiation, then perhaps life has been interacting with its surroundings to regulate the atmosphere and make it habitable.

Habitability, according to Chakrabarty (2019), is key to understanding the planetary view offered by ESS. He contrasts the notion with *sustainability*, a concept born out of the logic of globalisation and designed to address the continuity of human development amid the current environmental crisis. Habitability emerged from a comparative effort to understand the existence of life in different planets, from the simplest of forms, independently of human existence. Habitability, unlike sustainability, unlocks a register that Chakrabarty describes, in reference to the work of historian François Hartog (2017), as a *planetary regime of historicity*: a new ordering of historical time defined by post-humanism (see Chapter 14, this volume).

Posthumanism is not entirely new to the field of environmental history and its antecedents. For instance, Fernand Braudel's much-celebrated concept of *longue durée* referred, although in reference to shorter scales, to "secular trends" that gestured precisely away from "the grip of humanism" (2009: 171, 178). However, unlike the post-humanism of ESS's planetary view, the *long durée* of Braudel speaks of temporalities that are distinctively fixed. Defined in contrast to the instantaneity of human experience, Braudel's long durée referred to "slower temporalities, almost immobile ones", including those that unfold at a geological scale such as climate (2009: 181). To Braudel's eyes, "man is a prisoner for long centuries of climate" (2009: 179). Contrastingly, the climate of ESS is no longer a fixed backdrop to human activity. Implicit in the ESS conception of the atmosphere is the idea that life is the result of a precarious equilibrium with its surroundings that, at any point, can lead Earth in a path similar to Mars, a planet that, according to the established yet still unconfirmed hypothesis, had an atmosphere that once afforded the existence of life.

It is this fragility that sustains the notion of habitability, which is also at the basis of the *Anthropocene*, as suggested by ESS scholar Paul Crutzen (2002). Although centred on the human, the Anthropocene is an invitation to conceive human activity as an inhuman force capable of altering biophysical processes at a planetary scale. Collective human activity is now, for instance, responsible for a mass extinction of planetary proportions that risks not just its own existence, but also that of numerous other species, in a scale comparable to how, during the Cretaceous-Tertiary event, a meteorite led to the mass extinction of dinosaurs. Arguably, the same could be suggested regarding the notion of *planetary boundaries*, also established by members of the ESS community (Rockström et al. 2009). Although designed specifically to address the continuity of human life as we know it – therefore, in a regime of historicity that resonates with the concept of sustainability – the notion of planetary boundaries incorporates an awareness that the stable planet, in which human civilisations flourished during the Holocene, is the result of a precarious equilibrium on the verge of tipping. In the new planetary regime, planets such as Earth have an inherent potential for transformation and self-differentiation, to the point where it becomes impossible to tell in advance what a planet can do (Clark and Szerszynski 2021: 90).

To scholars in the humanities and social sciences, the planetary view introduced by ESS has invited them to expand sociality and history, perhaps in unprecedented ways, beyond the human and to conceive humans as indissociable from the heterogenous earthly becomings from which they belong and ultimately emerge. Adopting such a planetary lens to understand sociality and history has required, as Chakrabarty (2019) has argued, the dissolution of some basic categorial bifurcations that run through the modern Enlightenment up to the present. For instance, the new planetary regime has encouraged humanities scholars and social scientists to incorporate the category of *species* into their traditional understanding of history and sociality, blurring the gap between natural and social understandings of

what is to be human. Yet, as we hope to demonstrate in the next section, adopting a planetary lens can come at a great cost.

Planetary transcendence

A controversial aspect of Chakrabarty's analysis should be noted, namely an emphasis on the absence of moral imperatives in the new planetary mode of thinking. To derive any ethical or moral lessons from ESS is, according to Chakrabarty,

> to bring within the grasp of the global (the domain of forms and values and therefore of the political) the planetary that not only out-scales the human but also, as I have said, has nothing moral or ethical or normative about it.
>
> *(2019: 28)*

Clearly, the new planetary regime, as Chakrabarty describes it, cannot be navigated with global politics or institutions designed under an internationalist framework, such as the United Nations, bearing in mind the aforementioned difference between concepts such as globe and planet, which are centred respectively on human values and more-than-human planetary formation processes. The new planetary regime, Chakrabarty argues, requires a planetary politics led by new planetary institutions, capable of addressing a posthuman understanding of the place humans occupy in Earth's history. Yet, to imagine human institutions navigating these urgent times without any moral charts is truly problematic, knowing the risk of new totalitarianism; especially if the powers of individual and nation-states – defined by key principles that have historically advanced Western globalisation, such as freedom, democracy, and the rule of law – are eventually overruled to guarantee the habitability of human and non-human life.

The idea of scientific facts as transgressing moral values has a long pedigree in Western science that predates the arrival of ESS's planetary view. Palaeontologist Stephen Jay Gould, for instance, recounted this genealogy in reference to Sigmund Freud, the father of psychoanalysis. According to Freud, psychoanalysis had revolutionised the modern understanding of reason, as the sole commander of human progress, by conceiving it as drifting in a turbulent ocean of unconscious impulses and desires. Freud saw his psychoanalytical revolution as a progression from two former revolutions, where physics and astronomy relegated Earth to a corner of the universe, and biology lowered human status from a God-like figure to a walking ape. To these cosmic revolutions, Gould added the contribution of his own discipline, which he described as "geology's most frightening fact" namely an awareness that humans are only "the last inch in the cosmic mile, or the last second of the geological year" (1989: 44). "Our relationship with science", concluded Gould, "must be paradoxical because we are forced to pay an almost intolerable price for each major gain in knowledge and power – the psychological cost of progressive dethronement from the center of things, and increasing marginality in an *uncaring* universe" (1989: 44, emphasis added).

In correspondence with Chakrabarty's analysis, one might now add ESS's comparative planetology to the list of dethronements. Combining insights from astronomy, geology, and biology, ESS has made human existence the result of a whole self-regulating system that is ultimately indifferent to it. Implicit in Gould's "psychological cost" is also counter to psychological gain. Facing the reality of this "uncaring universe" creates some sort of mental

relief, similar to what psychoanalytic patients might experience when assimilating the involuntary influence of unconscious desires in their life. Indeed, a sense of relief emerges often when the circumstances of environmental crisis are zoomed out through a deep time lens. An unorthodox example comes from humour, particularly US comedian George Carlin, who gained his audience by suggesting that humans are unreasonably arrogant in caring for the extinction of other species, knowing that over 90% of the species that ever existed since the formation of Earth have become extinct regardless of humans; a line that was punched by the suggestion that, ultimately, caring for the planet makes little sense as the planet itself does not care for human existence.[2] Planetary thinking, in the face of an uncaring universe, affords eschatological visions that can come at the price of forgetting the numerous, unprivileged ones, human and other-than-human, who will suffer between now and the end of times.

Arguably, this narrative of how scientific facts transcend human values relates to a modern perspective on reality that the planetary concept analysed by Chakrabarty continues to share with global thinking (see also Massey 2005). To quote Lovelock, in relation to the developments in space research that led to the formulation of his Gaia theory:

> To my mind, the outstanding spin-off from space research is not new technology. The real bonus has been that for the first time in human history we have had a chance to look at the Earth from space, and the information gained from *seeing from the outside* our azure-green planet in all its global beauty has given rise to a whole set of questions and answers.
>
> *(1995: 7–8, emphasis added, in Chakrabarty 2019: 14)*

As philosopher Hannah Arendt (1958: 265) wrote at the time Sputnik, the first Soviet satellite, had been launched, a cosmological view from the outside, such as the one invoked by Lovelock, defined the trajectory of modern science and its emphasis on objectivity. This trajectory, according to Arendt, was intimately related to optics' capacity to afford a distant view on phenomena, and spanned from Galileo's invention of the telescope to the possibility of inspecting Earth remotely from outer space. This view was accomplished soon after by the god-like and masculine Apollo program, which in 1972 managed to take the first full photograph of Earth at some 27,000 nautical miles from the planet's surface (Cosgrove 1994; Simonetti 2020). Just like globalisation, planetary thinking resulted from space technology that grew out of the Cold War.

Undoubtedly, the globe and planet concepts can still be distinguished based on the different temporalities that they involve. Whereas global thinking seems locked in instantaneous time – defined by the ever-increasing speed of transport and communication technologies, and coordinated through mapping and clock time – the planetary navigates fast and slow temporal processes across the wide spectrum of Deep Time – a concept that contributed to reconceptualising human time as a glimpse in the vast history of the earth. Yet, in the new planetary regime of historicity, time also tends to be inspected optically, as stratigraphers subordinate, for instance, the existence of the Anthropocene to the possibility of locating a single isochronous marker in an absolute chronology mapped from afar and observed at a glance (Simonetti 2019b). Such a view relates to how humans tend to be understood in the new planetary regime as a single species, the presence of which predates the heterogenous diversification of cultures. As historian Christophe Bonneuil has suggested, the Anthropocene

"is a naturalistic grand narrative of an undifferentiated humanity uniformly concerned by and responsible for global climate change" (2015: 20). In the new planetary regime, the planet and the species driving its changes are still one, but the world and human society are not.[3]

The transcendence that characterises ESS's planetary view can be observed in some of its most basic concepts. Take, for instance, the concept of *climate*, which underlies research on anthropogenic global warming. According to the World Meteorological Organization's definition of the concept, on which the work of the Intergovernmental Panel on Climate Change rests, climate is beyond vernacular knowledge as it corresponds to an average of the daily variation of weather phenomena, measured over a period of 30 years. Correspondingly, no one *feels* climate change, not to mention global warming, at least not in the sense that one feels warm in the sun, drenched in rain, or cold in the wind. It rather unfolds in scales that are beyond human perception and memory. To follow feminist scholar Gayatri Chakravorty Spivak (2003) – from whom Chakrabarty draws inspiration and in whose footsteps a similar planetary turn has been advanced in the field of literature (Elias and Morary 2015) – the planetary contrasts with globalisation, in that the former is "inaccessible to human time" (Spivak 2003: 88).

Such a notion of climate, defined in contrast to weather, predates the arrival of ESS, since at least the Enlightenment, where an interest in domesticating weather phenomena emerged though measurement and recording (Golinski 2007). Mark Twain, for instance, famously contrasted weather and climate in the 19th century: "climate is what we expect, weather is what we get". Yet, Twain's notion of climate is in a different register to the climate of global warming, as it has not yet departed fully from vernacular knowledge (Simonetti 2019a). The climate of global warming transcends human time because it depends on a global distribution of atmospheric measurements and recordings assembled in a planetary view. Indeed, as Chakrabarty points out, "ESS produces a reconstituted planet, the Earth System, an entity no one ever encounters physically" (2019: 16).

However, encountering the planet has not been solely the result of a cosmological view from the outside, as Lovelock suggests, but has depended also on more immanent experiences, including a capacity to envision Deep Time in the human flesh. An example comes from biologist Lynn Margulis, co-author of the Gaia theory, when she suggests, in a collaboration with her son Dorian Sagan – son also of Carl Sagan – that "we [humans] are walking, talking minerals" (1995: 45). Transcendence in planetary thinking has also depended on immanence. This is partially what transpires in geographer Nigel Clark and sociologist Bronislaw Szerszynski's recent *Planetary Social Thought* (2021). According to them, the planet is not a single entity to be known from a god-like view. Finding inspiration in the influential work of feminist scholar Donna Haraway, they argue that the planet is a multiplicity to be known only through partial views: forms of situated knowledge that do not escape from moral commitments to the lives of others but – as Haraway (2016) has argued more recently in relation to the Anthropocene – simply extend them to other-than-human beings with whom humans co-habit this planet. It is such multispecies conviviality (Kirksey and Helmreich 2010) that modern narratives of progress have historically marginalised in their efforts to place humans above other species, science above vernacular knowledge, and reason above felt experience. To return to Arendt, efforts to transcend nature, tradition, and sensation relate to the trajectory of modern science and its ambition to objectively capture reality. We suggest that comparative planetology is nothing but a culmination of this historical trajectory; a rocketing transcendence that should not be let run loose.

Provincialising the planetary

In 1955 the Wenner-Gren Foundation for Anthropological Research convened a meeting at Princeton University in the United States, titled "Man's Role in Changing the Face of the Earth". This symposium was informed by what one contributor described as "a God's-eye view" of the airplane's "conquest of the air", thus marking a watershed in the intellectual genealogy of the Anthropocene (Gutkind 1956: 1; Lekan 2014; Steffen et al. 2011). The title of the symposium was a nod to the 1864 work of George Perkins Marsh. In *Man and Nature*, the US diplomat had confronted the comforting myth that humanity's environmental impact was positive at best, or negligible at worst. Understanding the Earth as a planetary body (Lowenthal 2015), Marsh decried the effects of human action in the "Old World" of Europe and the Mediterranean, where he had observed that "man has brought the face of the earth to a desolation almost as complete as that of the moon" (43).

Among the men of the Global North assembled at Princeton in 1955 was a lone woman, the Indian-born, US-trained geneticist and plant geographer E.K. Janaki Ammal. In her paper, "Introduction to the Subsistence Economy of India", she noted that "Independent India is making great strides to increase productivity of land already under cultivation: the first five-year plan made India self-sufficient in food supply" (332). Within 20 years, Indian Prime Minister Indira Gandhi spoke before the 1972 UN Environment Conference in Stockholm and reflected on her nation's great strides: "For the last quarter of a century, we have been engaged in an enterprise unparalleled in human history – the provision of basic needs to one-sixth of mankind within the span of one or two generations" (Gandhi 1972 [1992]: 12). Having followed the path of industrialised nations on that enterprise of economic growth and development, India, Prime Minister Gandhi observed, had already "encountered a bewildering collection of problems" (Gandhi 1972 [1992]: 13). These problems were not the result of an increasing population, she argued, nor a conflict between conservation and development, but rather the conflict "between environment and reckless exploitation of man and earth in the name of efficiency" (Gandhi 1972 [1992]: 15). Gesturing to the Western environmental movement, she wondered, "Will the growing awareness of 'one earth' and 'one environment' guide us to the concept of 'one humanity'?"

Two decades after the Stockholm meeting, Indian researchers Anil Agarwal and Sunita Narain argued that circumstances remained wanting. Critiquing a 1990 report of the World Resources Institute that had called for developing countries such as India and China to share the responsibility for global warming, they decried its findings as an example of "environmental colonialism" that "perpetuate[s] the current global inequality in the use of the earth's environment and its resources" (1991: 1). They concluded that since neither India nor China consumed the world's resources equivalent to their populations, then "surely these countries should be lauded for keeping the world in balance" (2). Although India has since become one of the world's highest emitters of greenhouse gases, the nation's economic growth since the early 1990s has often bypassed local peoples. As an Adivasi elder, whose village was slated for new coal mines, told sociologist Devleena Ghosh, "They are fooling us and filling their coffers in the name of our development. The development is of outsiders and foreigners, we are getting destroyed" (2020: 97).

These South Asian snapshots from across the Great Acceleration (since about 1945) speak to what contributors to a 2016 roundtable in the *Journal of Asian Studies* observed, of the framing of "Asia [as] victim, perpetrator, and redeeming agent all at once" (Thomas et al. 2016: 938). For Chakrabarty, meanwhile, the rapidly rising emissions of some Asian nations

such as China and India, render them "prospectively guilty", while the nations of the industrialised West are "retrospectively guilty" (2009: 218). These allusions to the "common but differentiated responsibility" of the developing and developed worlds, to a moral reckoning of past and future deeds, underscore the different kinds of affect and politics that arise from attending to history, place, and historical time. This "moral pull of world history", as Chakrabarty puts it (2018: 18), informs critiques of the Anthropocene within the environmental humanities and social sciences, which recast its planetarity in terms of different scales of time, place, and agency. Here we recast the planetarity of the ESS Anthropocene narrative in terms of what Clark and Szerszynski call the "manifold ways that human collectives negotiate with the varied temporalities of their physical worlds" (2021: 171–2). We do so by advocating the view from somewhere as a vital standpoint for the environmental humanities and social sciences that provincialises the ESS narrative of the Anthropocene.

"Provincializing" the Anthropocene, as archaeologist and anthropologist Kathleen D. Morrison advocates, is a necessary corrective to the concept's inherent Eurocentrism (2015; 2018). To her mind, the notion of the Anthropocene "represents an effort to expand (rather homogenized) European historical experiences, frameworks and chronologies onto the rest of the world" (2015: 75). Its planetary extrapolation of the impacts of European agriculture or industrialisation continues a longer Western tradition to periodising and naming the global past. Whether the Medieval or Palaeolithic periods, or the Medieval Warm Period and Little Ice Age, such historical and scientific chronological terms devised for Western European conditions "do not always capture local realities" (79). Drawing on her own research, Morrison points to South Asia's divergence from the Anthropocene narrative, while the deep human histories of Australia and southern Africa similarly challenge "the deep wheel ruts of northern hemisphere history", as historian Libby Robin puts it (2013: 332). Of the Anthropocene's wheel ruts, the rise of farming with the onset of the Holocene some 10,000 years ago has been an attractive origin date for northern scientists. For Australia's ecological history, however, the arrival of the first humans over 65,000 years ago represents a more decisive shift, leading to the extinction of the continent's megafauna long before the Pleistocene extinctions of Europe and North America (Robin 2013; Robin and Steffen 2007). By universalising the history of the British Isles and northern Europe, the Anthropocene concept represents, Morrison argues, "a disturbing extension of colonial discourse into a postcolonial world" (2017: 3) that perpetuates "existing 'Western' structures of thought and disciplinary practice [that] overdetermine modes of agency – human and natural" (2017: 4).

Although Morrison questions the utility of the concept of the Anthropocene, its proliferation across disciplines shows that many researchers have found it to be especially generative. Here we trace attempts to provincialise the Anthropocene by First Nations scholars in settler colonies, and by historians of India and Brazil, which together challenge the temporal and spatial framings of the singular ESS Anthropocene narrative. First Nations scholars have advocated for the significance of the "Orbis Spike" of 1610, from the Latin for "world", which acknowledges the human and environmental toll of the "collision of the Old and New Worlds" (Lewis and Maslin 2015: 174). Building on the work of Alfred Crosby (1972) and William Ruddiman (2003), UK-based scientists Simon Lewis and Mark Maslin (2015) proposed that, due to the resulting near-cessation of farming and reduction of fire use, the colonial genocide of Indigenous peoples in the Caribbean and Americas resulted in a decline in atmospheric carbon dioxide between 1570 and 1620 (see also Koch et al. 2019). Regardless of the extent of the Orbis Spike's planetary signature, their conclusions resonate with the interests of the Indigenous-led climate justice movement. For First Nations peoples

in the Americas, anthropogenic climate change has been understood since at least the 1990s as akin to the transformations and disruptions wrought by settler colonialism. As Potawatomi scholar Kyle Powys Whyte (2016) observes, a warming world represents "colonial déjà vu" for Native peoples (see also Whyte 2021). Explicitly attuned to the "political efficacy" of 1610 for elevating Indigenous voices and decolonising the Anthropocene concept, Métis anthropologist Zoe Todd and critic Heather Davis argue,

> The Anthropocene – or at least all of the anxiety produced around these realities (of climate change) for those in Euro-Western contexts – is really the arrival of the reverberations of that seismic shockwave into the nations who introduced colonial, capitalist processes across the globe in the last half-millennium in the first place.
>
> *(Davis and Todd 2017: 761, 774)*

These critiques have resonated with First Nations and non-Indigenous peoples in settler colonial societies beyond the Atlantic world. Geographers Meg Parsons, Karen Fisher, and Roa Petra Crease (who among their cultural identities, share Māori and Pākehā heritage) similarly understand the Anthropocene concept as the "deliberate consequence of the extension of colonial logics" (2021: 10). Foregrounding those logics and centring Indigenous Knowledges in Anthropocene scholarship, argues Aboriginal scholar and novelist Tony Birch, are part of the difficult conversations that are vital for "colonialism to unravel and climate justice and protection of country to become a reality" (2020: 269). Birch interprets proposals to date the advent of the Anthropocene to the dawn of the nuclear age as an attempt to side-step the spectre of colonialism that would wrongly imply shared collective responsibility for the "environmental poisoning" of Indigenous peoples and lands (2017: 201; see also Goodall 2021).

Others, however, read the extrapolation of global narratives from the dynamics of Atlantic colonialism as not entirely dissimilar from the universalisation of British industrialisation that Crutzen and Stoermer originally proposed. The world outside these temporal and regional examples, as historian Elizabeth Chatterjee observes of Asia, "often appears in these accounts as a passive receptacle in which universal logics play out their inevitable historical course" (2020: 3–4). In her view, the Capitalocene critique similarly falls short, particularly in the postcolonial period, as its focus on the rise of a planetary fossil economy "inadvertently replicate[s] an old, Eurocentric master narrative of modernity, albeit newly valorizing the supposed ecological innocence of the non-West" (2020: 6). Focusing on the electrification of post-colonial Asian states – aligning with the trajectory of the Great Acceleration – Chatterjee argues for the planetary significance of the diffuse and uneven nationalist project of fossil developmentalism, over fossil capitalism. As she points out, the Asia Pacific's proportion of global energy consumption has increased from less than one-sixth in the early 1970s to more than half in the 2020s, even though per capita emissions in many countries in that region remain low (20).

Brazil's industrialisation during the 20th century similarly confounds Anthropocene periodisations that centre European and North American imperialism. For historian Antoine Acker, "even if they shed light on how the environmental exploitation of the South underpinned the Anthropocene, these propositions are not adequate to understand the trajectory of large, technologically developed, middle-income states such as Brazil" (2020: 171). Like Chatterjee's postcolonial Asian states, fossil developmentalism similarly characterised Brazil's transformation into an oil producer and an oil-dependent country between 1930

and 1975 (see Chapter 15, this volume). The rise of petroleum, Acker argues, shaped "petro-ideals of emancipation" (173) through natural resource sovereignty, industrialisation, and modernisation. Although "the mansion of freedom stands on an ever-expanding base of fossil-fuel use" (Chakrabarty 2009: 208), the relationship between the fossil fuel economy, independence, and decolonisation in both postcolonial Asia and Brazil suggests fundamental (moral) differences in the kinds of freedom that fossil fuels have afforded. Compared to the democratisation of consumption and mobility of the West, in Acker's view, "[t]here is no reason, in retrospect, to condemn [Brazil's] carbon-based imaginary of freedom on the grounds of its planetary consequences" (2020: 210).

While gesturing to the multiplicity of Anthropocene narratives, these diverse experiences of the Anthropocene and the Great Acceleration underscore the challenges facing international climate diplomacy. Acker suggests that a more productive approach might lie in localised climate policies that reflect local models, expectations, and histories (2020: 211). This approach could suppose a greater awareness of national histories, which aligns with the pragmatic position of historian José Augusto Pádua to attend to the Anthropocene "in the context of existing different countries" (2016: 22). On the one hand, such an approach recognises that prevailing modes of environmental governance assume the primacy of the nation-state as an actor in the international arena. On the other, nation-states do not necessarily represent a single polity, and, at least in their high-modernist form, can simplify the complexities of peoples and places from the disembodied "view from nowhere" (Scott 1998). As historians Vinita Damodaran and Sangeeta Dasgupta argue, the stories of Adivasis in postcolonial India "point to the multiplicity of cultures and myriad ways of thinking that must be accommodated within the ambit of the nation, and yet offer the possibilities of different ways of living and being on this earth" (2022: 1354).

We suggest, rather, that the national might be just one scale of analysis among many for provincialising the Anthropocene. Drawing out the histories and experiences of particular places, peoples, and locales sheds light on the many somewheres of the Anthropocene that the ESS narrative alone overlooks. Echoing anthropologist Anna Lowenhaupt Tsing's support for focusing on landscapes as units of analysis (2017) and John R. McNeill's argument for "ground truthing" global history (in Corona et al. 2008: 236), Damodaran invites us to shift

> the focus to the locality and to the local effects of human-induced climate and environmental change in the periphery, and by looking at the local responses to the effects of global processes both in the historical period and more contemporaneously.
>
> *(2018: 22)*

Understanding the planetary in local terms requires relational thinking that recognises more-than-human entanglements across spatial and temporal scales (Pugh and Chandler 2021). Such multi-scalar work is familiar practice for environmental historians, as historian Tom Griffiths observes,

> Environmental history frequently makes more sense on a regional or global scale than it does on a national one. It uniquely bridges planetary and deeply local perspectives, staking a claim for histories that are bound intimately to place and also embrace the natural world, histories that are deeply attentive to human and biological parochialism.
>
> *(2002: 377–8)*

By provincialising the Anthropocene, scholars of the environmental humanities and social sciences can narrate pasts and presents (and futures), across multiple spatial and temporal scales, the measurements, representations, and diverse drivers, manifestations, and experiences of planetary change (see Coen 2016).

Views from nowhere and somewhere

It may be tempting to understand the Anthropocene as mere gloss or gimmick. After all, as some historians have observed, the "Anthropocene *is* the modern period" (Bashford 2013: 346) and "maps onto most standard stories of the modern age" (Mikhail 2016: 223). For other scholars in the environmental humanities and social sciences, the synoptic ESS concepts of the Anthropocene and, to a lesser extent its companion, planetary boundaries, have provoked a kaleidoscope of interventions. In these shimmering refractions, some prompt and probe their own disciplines to respond to the implications of these concepts, while others stake claims for *their* disciplines in understanding and tackling the environmental crises that impact the world so unevenly and unequally.

How our disciplines grapple with the scalar nature of these concepts has occupied us in this chapter. How do we know that humanity has affected planetary change? On what scales does the ESS narrative of planetary change depend, and at what expense? Are the scales of ESS and other disciplines reconcilable? As we attempt to show here, both the view from somewhere and the view from nowhere make the scale, causes, and nature of the Anthropocene mentally manageable in starkly different ways. The former accounts for heterogeneous experiences and narratives, while the latter can subsume these into a homogenous whole. Yet the very existence of the Anthropocene, in the sense that has become so familiar today, derives mostly from the planetary view of Earth Systems Science (ESS) that arose from the Cold War. Both the singular planetary view that ESS can offer, and the myriad situated views of the environmental humanities and social sciences, need each other precisely because they challenge the assumptions and outlooks of the other. In these productive tensions, we argue, we might more fully understand each other and the planet's multitudes. Can we afford not to?

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Notes

1 A similar argument has been made with regard to the *environment*. According to Warde, Robin, and Sörlin, "the concept of the environment was *always* about the human" (2018: 164).

2 George Carlin on the Environment, YouTube video, added by candidskeptic [Online], Available at https://www.youtube.com/watch?v=EjmtSkl53h4 (Accessed 7 December 2021).

3 A similar point was famously made by the United Nations' report *Our Common Future*, which in 1987 popularised the idea of "sustainable development". Noting the political difficulties of global governance of climate change, it stated that "earth is one, but the world is not" (Warde, Robin, and Sörlin 2018: 122).

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13

EXTINCTION IN ENVIRONMENTAL HISTORY

Historicising problems of classification and intentionality

Dolly Jørgensen and Miles Powell

In contemporary environmental discourse, extinction is often mentioned alongside climate change as one of the biggest environmental challenges of our time. Popular science books from David Quammen's *The Song of the Dodo* (1997) to Elizabeth Kolbert's *The Sixth Extinction* (2014) lament the rapidly escalating loss of biodiversity on Earth. In the eponymous film *David Attenborough: A Life on Our Planet* (2020), the beloved wildlife documentary commentator called extinction the "true tragedy" of our times. The International Union for the Conservation of Nature (IUCN) listed 902 species in the category *Extinct* as of 2022 (IUCN 2022). To classify a species as extinct, "there is no reasonable doubt that the last individual has died" (IUCN 2019). All 902 of these extinctions fall within the modern era, i.e. the animal or plant was known to be alive after 1500, and many thousands more are on the verge of extinction (IPBES 2019).

The word *extinction* is the noun of action for the Latin verb *extinguere*: to bring about extinction is to extinguish life (OED 2021c). The earliest uses of the word extinction in the 16th century meant to "quench" or "put out", particularly something burning or shining. Putting a living being out of existence, in the same manner as quenching a flame, was a logical extension of the word *extinction*. When whole families, kingdoms, or races (and later non-human human species) came to an end, they would be labelled as extinct (OED 2021a). It used to be that one could also write extinct as a verb, such that lineages could be *extincted* (OED 2021b). In contemporary usage the verb form of extinct is obsolete, meaning that we have to write around the action of extinction, typically relying on a passive formulation such as "the species became extinct" or employing other words such as "the species was extirpated". This linguistic impoverishment often turns extinction into a condition, rather than an action.

Humanities scholars have become increasingly interested in exploring extinction in our contemporary times. In 2017, Deborah Bird Rose, Thom van Dooren, and Matthew Chrulew proposed an interdisciplinary field called "Extinction Studies" that would examine how "extinction is experienced, resisted, measured, enunciated, performed, and narrated" (2017: 2–3). While this was called an interdisciplinary endeavour, the contributors to that volume are primarily philosophers, anthropologists, and cultural studies scholars, so the

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result was heavily skewed toward examining ongoing "processes of loss" and "the 'entangled significance' of extinction" (Rose, van Dooren, and Chrulew 2017: 3) rather than historicising extinction. This emphasis on loss and entanglement has become a through-line or connecting theme in environmental humanities scholarship on extinction – evinced, for example, in a collection of articles on "Geographies of Extinction" which featured titles such as "Geographies of Extinction: Exploring the Spatiotemporal Relations of Species Death" (Garlick and Symons 2020), "Nine Lives Down: Love, Loss, and Longing in Scottish Wildcat Conservation" (Wrigley 2020), and "Everyday Ecocide, Toxic Dwelling, and the Inability to Mourn" (Jones, Rigby, and Williams 2020).

No historians contributed to the definition of Extinction Studies as a line of academic inquiry in the titular book, yet environmental historians have had significant engagement with the issue of the extinction. Well before the Rose et al. book was published, historians were writing about understandings of extinction as a biological and cultural phenomenon, situating it historically in time and space. Extinction has its own history as an idea: how extinction has been conceptualised and the values inherent in those conceptions have to be historically situated (Jones 2014; Sepkoski 2020). Historians have analysed the causes of extinction or near extinction of specific species such as the American bison (Isenberg 2000), the Stellar sea cow and Pacific sea otters (Jones 2014), and the passenger pigeon (Price 1999). Others have focused on how extinction histories combined with the threat of future extinctions prompted conservation action (Alagona 2020; Barrow 2009). Historians have demonstrated that extinctions are historically bound to situated conceptualisations of race (Powell 2016b), to broader processes of colonialism and extraction, and to emotions (Jørgensen 2019). We know that extinction is brought about through a series of actions. Every extinction has a history – a cultural, economic, and political context that leads to the ultimate end of a type of living animal or plant.

Engagement by environmental historians with the issue of extinction is essential to unpacking how and why extinction happens. In this chapter, we take up two research directions within historically oriented extinction studies: the problem of classifying an organism as extinct, and the difficulties of intentional extinction. Both of these areas demonstrate the value of a historical approach to extinction.

Classification and extinction

Much of the discussion of extinction in the Anthropocene revolves around what is going extinct and when it has gone (or will go) extinct. Extinction within scientific literature is typically associated with *species*. In the IBPES 2019 report, for example, an international group of scientists determined that over one million species are threatened with extinction unless action is taken to reduce the intensity of biodiversity loss. Lists of extinct species, such as thylacine (*Thylacinus cynocephalus*), passenger pigeon (*Ectopistes migratorius*), and Carolina parakeet (*Conuropsis carolinensis*), appear in natural history galleries worldwide.

The binominal scientific names for species given in the previous paragraph are an inheritance of Carl Linnaeus, an 18th-century Swedish biologist. He proposed that all species be given a two-part name where the first part represents the genus, or type of species, and the second gives an epitaph specific to this species within the type. Most biological conservation measures are built on the species concept, often based on lists of threatened species such as the IUCN list, which started in 1963. National-level Red Lists and national-level laws such as India's Wild Life (Protection) Act of 1972, the US Endangered Species Act of

1973, and South Africa's Biodiversity Act 10 of 2004 enshrine the focus on species as conservation objects (see also Chapter 10, this volume).

Environmental historians have generally adopted the Linnean nomenclature for their non-human subjects without comment. Extinction histories of the Stellar sea cow, passenger pigeon, Carolina parakeet, and more assume that the organism under discussion is appropriately labelled with the common name and binominal given by Western scientists under the Linnean system. However, as Brett Walker (2008) has shown in the case of the Hokkaido wolves of Japan, species are created through complex scientific and cultural processes. Similarly, Sandra Swart (2015) has demonstrated that attempts to re-create extinct quaggas hinged on debates about whether the animal was a separate species or a subspecies of plains zebra. Species is not an ontological given.

What constitutes a species has a particular history. Within taxonomy, the number of species continues to grow, but often this expansion in the number of species is due not to finding new animals or plants, but rather to re-classifying known ones into separate species (Isaac, Mallet, and Mace 2004). For example, environmental historian Elizabeth Hennessy has shown that the concept of species as applied to tortoises in the Galápagos Islands has changed over time (Hennessy 2020). In the 19th and early 20th centuries, the Galápagos giant tortoises of Santa Cruz island were considered one species, which naturalist Walter Rothschild named *Testudo porteri* in 1903. This was not a stable identification: first the family name was changed to *Chelonoidis*, then scientists split off a new species called *Chelonoidis donfaustoi* from *C. porteri* based on genetic studies in the early 2000s. Hennessy places these shifts within biodiversity conservation's epistemological basis, from Darwin's notion of evolution to genetics. Classifications of species are not static.

Loss of biodiversity is also more than loss of species as defined by Latin binomials. While environmental threats have often been communicated in terms of species loss, this fails to capture other types of diversity such as ecosystem community composition and relations between species (Turnhout and Purvis 2020). Political ecologist Audra Mitchell has noted that contemporary extinction discourse focusing on the species level ignores "the profound entanglement of life forms" and "fluid relations of partial connection and division that defy the possibility of sovereign subjects" (Mitchell 2016: 34). The focus at the species level also renders invisible geographies of extinction because many presume that extinction happens only when the species as a whole is eradicated across all its geographies. As geographers Ben Garlick and Kate Symons have argued, this ignores "the cultural geographies of animals, their situated ways of living and the particular kinds of human-nonhuman formations that they enable" (Garlick and Symons 2020: 306). Animals have relationships with specific places which, as van Dooreen and Rose (2012) argue, is not interchangeable with other places. Because animal histories are bound up in place, it is possible for extinction to happen when a localised place becomes uninhabited by an organism even if the life form has not completely disappeared from the planet.

A case in point is the Hoàn Kiếm giant softshell turtle. Gitte Westergaard and Dolly Jørgensen (2021) discuss this particular type of turtle, which lived in Hoàn Kiếm Lake in the centre of Hanoi, Vietnam, and has an idiographic cultural history. According to the legends, after General Lê Lợi used a magical sword given to him by the Dragon King to free the land from Chinese Han rule in the 15th century, a giant golden turtle appeared to him in Hoàn Kiếm Lake and demanded that the sword be returned. Lê Lợi handed the sword over to the turtle, who took it away in its mouth. Because of Lê Lợi's reputation as a good king, the turtle of Hoàn Kiếm is a key element in the foundation myth of the State of Vietnam.



Figure 13.1 The last giant softshell turtle from Hoàn Kiếm Lake on display in the Ngoc Son Temple, Hanoi, Vietnam. Photograph by Dolly Jørgensen, 2019.

In 2016, the last giant softshell turtle living in Hoàn Kiếm Lake died. According to current scientific nomenclature, this was not the end of a species: this turtle is classified as the species *Rafetus swinhoe*, called Swinhoe's softshell turtle, and there were still a handful of them known to still be alive in Chinese zoos and a couple of wild examples in northern Vietnam. However, the assignment of the Hoàn Kiếm turtle to *Rafetus swinhoe* has been contested through the years, with teams of biologists identifying it as a distinct species on two occasions, named *Rafetus leloii* in 2000 and *Rafetus vietnamensis* in 2010 (Binh et al. 2010; Farkas and Webb 2003). These claims have been countered with arguments that the descriptive features and genetics do not warrant a separate species (Farkas, Le, and Nguyen 2011; Thanh et al. 2017).

While these taxonomic arguments have focused on morphology and genetics, they have failed to account for the entanglement of the turtle from this specific lake as a component of its distinctiveness. The lake's name Hoàn Kiếm literally means "returned sword", tangling the story of the turtle with the geography. The story of the Hoàn Kiếm turtle and the sword proliferates through contemporary Hanoi, with appearances in water puppet shows, statues, and temples. The giant soft-shelled turtle of Hoàn Kiếm has a distinctive cultural niche. The last two turtles from the lake are taxidermied and on display, not in a museum, but in the Temple of the Jade Mountain (Đền Ngọc Sến) on Hoàn Kiếm Lake, where they take on a sacred status (Westergaard and Jørgensen 2021). Having no more giant soft-shelled turtles

in Hoàn Kiếm Lake is an extinction, whether or not all individuals with its Latin binominal still exist. When the turtle died in 2016, it was presumed to be the last individual of its type in the lake. A dredging operation to clean up pollution in the lake sediments the next year confirmed that no other individuals were living there; thus the Hoàn Kiếm turtle was extinct.

But determining extinction is rarely so easy. Extinction as a concept is predicated on the absence of a species, i.e. that there are none left. Proving the absence of something is much more difficult than proving its presence. With presence, the thing in question only needs to be observed once in one place, but with absence, it needs to never be observed in any place (Jørgensen 2017). Because it is impossible to observe an entire area simultaneously to see that no individual is there except in a case like Hoàn Kiếm Lake, which is a very contained geography, there is always room for doubt that a given species is extinct.

Take the ivory-billed woodpecker (*Campephilus principalis*) as an example. The ivory-billed woodpecker was the largest woodpecker species in the United States at the time it was colonised by Europeans. Environmental historian Mikko Saikku has discussed how clearances in the south-eastern bottomland hardwood forest caused major declines of the woodpecker population in the 1800s. Because of their increasing rarity, the birds were then considered favourable targets for collectors (both lay and scientific) who wanted to ensure that the bird would be represented in their private or public collection (Saikku 1999). Ecologist James Tanner intensely studied the birds in the late 1930s and concluded that there were probably two dozen ivory-billed woodpeckers left. The last universally accepted sighting was in 1944 on the same tract that Tanner had worked in (Snyder, Brown, and Clark 2009). Yet there was always a lingering doubt about the woodpecker's extinction. Reports trickled in from the 1950s to the 1970s. Then in 2005, scientists associated with Cornell University's Laboratory of Ornithology announced that they had audio and visual evidence of ivory-billed woodpeckers in Arkansas (Fitzpatrick et al. 2005). A flurry of searches were carried out, but no definitive confirmation of the woodpecker's continued existence was found (Stokstad 2007). In September 2021, 77 years after the last definitive sighting, the US Fish and Wildlife Service proposed that the ivory-billed woodpecker should be classified as extinct rather than endangered, although there continue to be sightings and objections to the revised listing.

This kind of significant delay between last sighting and a declaration of extinction is not unusual. The last captive thylacine (*Thylacinus cynocephalus*) died in 1936, and although extensive searches were carried out from the 1930s to the 1980s with no conclusive evidence of living thylacines, the Tasmanian government did not recognise it was extinct until 1986, 50 years after the last one died – and reports of (unconfirmed) thylacine sightings still appear in newspapers and social media even in the 21st century (Jørgensen 2017). Similarly, the Caribbean monk seal (*Monachus tropicalis*), which had once been widespread in the Gulf of Mexico, was sighted only a handful of times in the first half of the 1900s, and extensive aerial surveys and interviews with fisherman from the 1950s to 1990s found no firm evidence of living monk seals, but it took the US Fish and Wildlife Service until 2008 to classify it as extinct (Jørgensen 2022b).

The delay between last sighting and extinction decision gives time to find remaining individuals. There have been species thought extinct which have been later found again, such as the Lord Howe Island stick insect (*Dryococelus australis*), which was believed extinct since 1930 but a colony in an isolated area was rediscovered in 2001 (Priddel et al. 2003), and the tentacled butterfly ray (*Gymnura tentaculata*), which was last documented in 1986 and listed as possibly extinct by the IUCN in 2017, but in 2019–20 scientists

discovered that these rays were being caught as by-catch in the Persian Gulf (Rezaie-Atagholipour et al. 2021). Caution is warranted when declaring extinction.

In the timelines just discussed, extinction is not a singular event, but rather a historical process. This process may even take twists and turns with a species being declared extinct and then being non-extinct, either because it was found again or because it was later re-created through backbreeding or genetic de-extinction (Jørgensen 2022a). Each extinction has a history even after the last animal has died. Extinction, as a classification in Western science with Linnean names and published in international scientific journals, requires scientific and political consensus, yet local and indigenous understandings of extinction do not necessarily occur along the same timelines with the same constraints. It is vital, therefore, that histories of extinction incorporate the contestations, questions, and negotiations that go into a declaration of extinction, while simultaneously acknowledging that listing a species as extinct is not the end of the story.

Intentionality and extinction

The issue of intentionality ranks among the most significant themes to emerge in historical writings on extinction. There is something unsettling about humans actively choosing to permanently remove an organism from the web of life. On the most basic level, historians have distinguished between *extermination* – in which human actors intentionally eliminate an organism deemed dangerous, detrimental to commercial or imperial agendas, or otherwise undesirable – and *extinction* – which includes the unintended loss of a species or subspecies through natural or anthropogenic causes. Some episodes, like predator eradication schemes, or the extirpation of wildlife to facilitate the conquest of indigenous peoples, fit reasonably neatly into the former category.

Beyond these straightforward cases of deliberate annihilation, however, the question of intentionality becomes more complicated, and herein lies exciting opportunities for further research. There are many instances in which historical actors have not sought extinction *per se*, but have decided that economic necessity justified the predictable elimination of a species or subspecies. Such choices represent a level of intentionality that, while perhaps not on a par with deliberate extirpation, still entail a weighing of outcomes and the determination to take actions that will result in the loss of an organism. Moving nearer to the present, ongoing efforts to restore or resurrect lost species represent another facet of extinction in which the issue of intentionality becomes muddied. As we choose to bring back some species, and not others, we are making deliberate choices about what organisms should persist in a given environment or on this planet.

Environmental historians have produced numerous excellent studies of predator extermination schemes. In these cases, historical actors deliberately eradicated carnivorous creatures because of the perceived risks they posed to humans, livestock, or commercially valuable wild animals. Some of the best research in this vein has addressed the extermination of wolves in North America. Jon T. Coleman (2004) has explored this theme in depth. Although US hunters never drove wolves to complete extinction within their national borders, as occurred in England, Scotland, Ireland, and multiple countries in continental Europe, by 1950 American hunters had eradicated wolves in every state outside of Alaska and parts of Minnesota and Michigan. In the early 20th century, as professional exterminators in the Bureau of Biological Survey studied wolf behaviour to eliminate them more efficiently, they developed a more sympathetic outlook towards these canines. But the hunters

persisted in their gloomy task on the grounds that it was necessary for national progress. The experience of killing a wolf perhaps most profoundly influenced the pathbreaking conservationist Aldo Leopold (Coleman 2004: 8, 191–4, 210–18). Leopold later recalled the experience of watching "a fierce green fire" dying in the wolf's eyes as a pivotal moment in his transition towards perceiving predator extermination as detrimental to the broader ecosystem (Young 2002: 207).

Although North America's wolves posed little danger to people despite tales to the contrary, big cats that British colonists encountered throughout their empire often represented a legitimate threat to human lives. Historians have written extensively about imperial efforts to exterminate these dreaded felines. Joseph Sramek (2006) describes how, in 19th-century India, both the East India Company and the British Raj attempted to eradicate tigers in the lands under their control by offering bounties. Peter Boomgaard (2001) relates how the British and other European colonialists established similar tiger bounties in Southeast Asia. In Singapore, this bounty system combined with landscape change to bring about the local extinction of Malayan tigers by 1930 (Powell 2016a).

Perhaps lesser known than the killing of wolves or big cats, extermination campaigns also emerged against birds of prey, and environmental historians have also produced admirable work on this topic. Mark V. Barrow has written extensively on this theme. Despite being a national symbol, the bald eagle (*Haliaeetus leucocephalus*) faced deliberate extermination campaigns in Alaska in the early 20th century. Deeming eagles a threat to commercially valuable livestock and wild salmon, the state provided bounties for eagle talons. In the 1920s and 1930s, though, conservationists adopted a more ecological outlook that acknowledged the importance of all creatures and looked unfavourably on anthropogenic extinction, especially intentional eradication. They secured passage of the Bald Eagle Protection Law of 1940, which brought an end to the bounty system (Barrow 2002, 2009). As noted by Barrow and historian Dyana Z. Furmansky (2009), women played a critical role in protecting predatory birds. For example, in the 1930s, conservationist Rosalie Edge convinced the National Audubon Society to denounce eagle bounties and to take up raptor preservation more generally.

In some instances, historical actors pursued the intentional extermination of an animal, not because they deemed it dangerous or detrimental, but because its eradication would undermine the subsistence or commercial practices of human groups perceived as enemies or rivals. In such instances, people were willing to permanently erase a branch of life in the pursuit of power over others. The best-known instance of this occurred when Euro-American settlers adopted an informal policy of exterminating American bison to weaken the resistance of Plains Indian peoples. Many historians have explored this subject. David D. Smits (1994) carefully weighs the evidence for and against this interpretation, and determines that, in the US frontier army, at least some soldiers, like General William Tecumseh Sherman, intentionally pursued the destruction of the buffalo to aid in the conquest of Indians. Dan Isenberg (2000) concurs that the US Army may have occasionally attempted to eliminate bison to subdue the Plains Indians, although he maintains that market forces played a larger role. Such eradication policies as people control were not confined to plains bison. Addressing a more obscure example, Jennifer Ott (2003) demonstrates that between 1823 and 1841 the Hudson's Bay Company (HBC) adopted a "fur desert policy" in the Snake River Basin of Oregon Country. Under this scheme, HBC trappers intentionally destroyed local beaver populations to discourage American settlers from entering the region and threatening British territorial claims.

In each of these instances, historical actors deliberately strove to eliminate a species from a given environment, or the planet more broadly. But intentionality was not always so clear-cut, and more nuanced variants of it allowed historical actors to absolve themselves of complicity in eradicating a being, even if the outcome was largely predictable. In many instances, people have not necessarily desired to eliminate a species or subspecies, but they have engaged in practices, such as deforestation or excess harvesting, that made local or complete extinctions all but inevitable. In such cases, historical actors made conscious choices that economic or imperial necessity justified the elimination of a life. Indeed, as English literature scholar Ashley Dawson (2016) notes, it is impossible to accurately discuss modern anthropogenic extinctions independent of the forces of capitalism, colonialism, and imperialism.

Historians have revealed numerous instances in which adherence to the logic of capitalist commerce resulted in extinction and species endangerment. In one of the first works by an environmental historian on the theme of extinction, Mikko Saikku examines the loss of the Carolina parakeet (*Conuropsis carolinensis*) following European colonisation in North America. While acknowledging multiple factors, Saikku suggests that deforestation resulting from the expansion of agriculture was a key contributor to the parakeet's passing. Driven by economic imperative, farmers persisted in this deforestation even after observers had recognised the bird's decline by the 1830s (Saikku 1990). Like Saikku, Jennifer Price (1999) finds multiple reasons for the decline of the passenger pigeon in the early 20th century: persistent hunting, farming, and logging for the market – even as evidence of declines emerged – played a critical role (also see Greenberg 2014). Robert B. Marks describes the deforestation that accompanied agricultural expansion in late-imperial South China as a form of "tigricide" (1998: 338). He suggests that cultural beliefs may have helped rationalise the destruction of tigers, but it was ultimately adherence to the directives of the market that predictably propelled the tigers' decline (Marks 1998). Examining the environmental history of arid Australia, Mike Letnic (2000) finds that historical actors recognised early on that agricultural expansion was propelling a diminishment of local native mammals. Prioritising economic benefit over biodiversity, settlers nonetheless persisted in this activity, leading to 26 species of mammals becoming endangered or extinct in the continent's arid zone following British colonisation.

Often intertwined with market forces, imperial ambitions propelled the loss of beings in expectable ways. Ryan Tucker Jones (2014) has examined how the expansion of Russia's empire in the North Pacific drove the extinction of the Steller's sea cow (*Hydrodamalis gigas*) and massive declines in other animal populations like fur seals and sea otters. As Jones relates, some naturalists denounced the ecological losses they witnessed in this far corner of empire, but other observers celebrated such mastery over nature and animals as a metaphor for imperial control. Although historians debate whether the United States' expansion into territories controlled by Indigenous peoples constituted imperialism, it did generate similar themes. As noted by Miles Powell (2016b), many historical onlookers expected both American wildlife and the Indigenous people who relied on them for survival to disappear. Yet commentators often justified such losses on the basis that they were essential to national progress. In each of these cases, extinction was not a desired end in and of itself, but it was an acknowledged corollary of choices made in pursuit of another goal (Anderson 2020; Qureshi 2013).

Moving nearer to the present, intentionality further blurs as we contemplate various means of restoring or reviving lost species. Since no one is advocating bringing back every vanished life form, these developments always entail decisions to allow some organisms to

remain locally or entirely extinct while we strive to recover others. Combining environmental history with the history of emotions, Dolly Jørgensen (2019) has pioneered the historical study of this topic. While acknowledging that scientific thinking has informed decisions about the appropriateness of adding an organism to a given environment, she reveals that emotions have often served as primary motivators. Emotions are complex, overlapping, and contradictory, but speaking broadly, she demonstrates that guilt propelled Swedish naturalists to reintroduce the beaver, hope convinced Norwegians to rewild their country by bringing back muskox after an absence of thousands of years, and grief has underpinned recent efforts to resurrect the passenger pigeon in North America (Jørgensen 2019). In these instances, intentionality is bound up with emotions, a situation that applies equally to organisms we choose to leave behind. For instance, researchers have recently reintroduced beavers to many parts of the United Kingdom with general public support, but UK scientists have yet to reintroduce wolves, and many remain wary of the idea. In such cases people may not have deliberately eradicated a species, but they have chosen to allow its absence – from a landscape it once occupied – to endure (Sherkow and Greely 2013). In many ways, this is the opposite of how Europeans have viewed wildlife in the Global South, where they have pushed for its conservation despite local inhabitant conflicts, such as with tiger conservation in India (Chakrabarti 2009) and the establishment of colonial wildlife parks in East Africa (Gissibl 2016).

Future extinctions are connected to losses resulting from economic choices, political ambitions, and emotion-based decision making (Warren 2011). Today, we have knowledge of a number of historical trends that make future extinctions highly probable, if not inevitable. The enormous number of extinctions likely to follow from anthropogenic climate change provide the clearest example of this phenomenon. A recent synthesis of the available literature concludes that if we persist in our current practices, humans may propel the extinction in the wild of one in six species on the planet (Urban 2015). This model suggests that the greater the rate of warming, the more rapid and extensive these losses will become. It is unlikely that many humans actively desire to see polar bears, penguins, or snow leopards vanish into oblivion. But for the vast majority of people residing in affluent nations, whose carbon footprints exceed what the planet can support, we are knowingly making choices that ensure these enduring absences (Urban 2015).

The forthcoming collapse of global shark populations is a salient example of a future extinction. The historical record amply demonstrates that sharks do not hold up well to prolonged harvests. In the early 20th century, Czech American entrepreneur Alfred Ehrenreich attempted to establish a global shark leather industry. He received government support and favourable press coverage, and established outposts as far abroad as Australia and South Africa. The trouble was that wherever fishers targeted sharks for leather, their populations imploded, rendering worthless any investments in factories or other infrastructure. During World War II, with access to Norwegian cod liver oil cut off by Nazi occupation, the Allies turned to shark liver oil as their primary source of vitamin A. The shark fishing bonanza endured until scientists artificially synthesised the vitamin in 1950, but by then fisheries researchers were warning that targeted shark stocks were collapsing. More recent food fisheries for dogfish and porbeagle sharks catering to European markets have seen similarly disastrous results.

Even as we have come to recognise the vulnerability of shark populations to overfishing, harvests have persisted. Australia and South Africa adopted strategies of culling sharks near popular swimming spots beginning in the 1930s and 1950s, respectively, in order to increase

safety and ensure tourism (Powell 2017). Influenced by the movie *Jaws*, sharks are still often framed as dangerous enemies (Jøn and Aich 2015). Researchers now recognise that most species of sharks produce few young and take years to reach sexual maturity, rendering them biologically ill-suited to rebound from population declines. Yet fishers continue to land enormous quantities of sharks, not only for the well-publicised shark fin trade, but also for their flesh (which has become an important source of protein in the Global South) and for sport. Numerous researchers have warned that global shark populations are in a state of collapse, with local extinctions already occurring (Barausse et al. 2014; Powell 2017, 2022; Verlecar et al. 2007).

Once again, we find ourselves peering over the brink into a chasm of biological loss, and once again we are choosing to persist in the activities propelling it. The majority of people likely do not desire to see sharks vanish from the world's oceans, and the fishers depleting shark numbers have an obvious economic incentive to maintain them. But harvesters persist in unsustainable practices, and the justifications they provide resonate with historical conversations surrounding other ostensibly inadvertent extinctions. They range from the need for sustenance, to commercial imperatives, to our limited knowledge of shark biology, and hence our inability to state with absolute certainty that populations are at risk of collapse. Whatever justification fishers might provide, though, they are engaging knowingly in activities that put global shark populations on the brink of extinction. While the destruction of sharks may not be the goal, it is yet another foreseeable biological erasure at our hands.

Environmental history approaches to extinction

All told, historical studies of extinction provide a number of important insights. For starters, as a discipline specialising in diachronic analysis, history can help us to conceive of extinction as a contested process, instead of an endpoint, that is historically specific in place and time. Extinction events often take place over several human generations, with multiple missed opportunities to halt the loss. Even ascertaining precisely when an organism has vanished is a contentious and imperfect science. As we begin to think of extinction as a historical process increasingly entangled with human economics, politics, emotions, and culture, we can also begin to appreciate the significance of local extinctions that do not necessarily take place on the species level. As the tale of the Hoàn Kiếm giant softshell turtle reveals, the loss of distinct population of animals in a particular place can have important cultural and ecological ramifications, even if scientists debate whether what vanished was a distinct species. For the human and ecological communities that shared that body of water, the Hoàn Kiếm turtle was an integral part of that place, and its loss has transformed the lake.

Historical studies of extinction can also complicate our understandings of the intentionality surrounding the loss of a being, and blur the line between extinction and extermination. In some instances, humans strove to eliminate a species or subspecies from a given locale, not because they perceived it as a menace in and of itself, but because they hoped destroying this being would weaken an enemy or competitor. Such episodes remind us that human interventions in the environment, including the extreme intervention of anthropogenic extinction, often result from the desire to exercise power over other people and other beings. Even in cases in which humans have not actively pursued the elimination of a species at all, it has often been a foreseeable consequence of activities justified on the basis of economic or imperial necessity. Actors have still made choices to knowingly erase a branch of life, even if they have opted not to see it in those terms. All of this leads to the question of

future extinctions. Whether we look at losses resulting from climate change, or at imploding global shark populations, when we repeat justifications from the past, we facilitate extinctions tomorrow. This is a lesson shaped by history.

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14

TEMPORALITY AND ENVIRONMENTAL HISTORY IN THE ANTHROPOCENE

Timing Climates, Modelling Futures

Emil Flatø and Erik Isberg

For every environmental problem, time is a resource as well as a constraint (Palonen 2008). Future time is the site where the consequences of environmental degradation become visible, but it is also where the efforts to mitigate these consequences will take place. The present environmental discourse is saturated with prognoses, models, projections, and scenarios. Time is at once running out, being budgeted, approaching tipping points, and shifting into new geologic epochs (Nordblad 2021). As human interventions alter the experience of a "natural" state, the planetary pasts legible in geological strata, layers of ice and deep-sea sedimentations become a crucial repository of knowledge against which to establish a baseline. These temporal characteristics of environmental problems are historical, appearing in different forms in different contexts, and realising modes of political, scientific, and social engagement with the environment.

Temporalities appear as a crucial yet understudied aspect of the broader conceptual history of making environments. Historical scholarship on the postwar breakthrough of environmental knowledge has explored the largely spatial relationship between science, societies, and their "surroundings" (Benson 2020). Excellent work has laid bare how concepts like the "biosphere", or simply, "the environment", acted as integrating concepts forcing interdisciplinary encounters, coordination, and consolidation, as well as new interfaces with governance (Aronowsky 2018; Warde et al. 2018). A narrative has formed about the knowledge-based governance regime dedicated to "planetary management", requiring networked infrastructures of data collection, monitoring, and modelling to understand and manage a global object of knowledge like the "climate system" (Elichirigoity 1999; Edwards 2010: 1–25).

On the margins of these accounts, however, matters of time often appear with equal urgency. Integrating knowledge of the climate system relied not only on "making global data and making data global" (Edwards 2010: xiv–xix), but also on "four-dimensional data assimilation": synchronising scattered sources of temporal data into unified representations of past, present, and future (Kasahara 1972). Across fields, scientists found it imperative to accurately measure and predict the rates of change of a wide set of environmental phenomena. As Antonello and Carey argue, environmental historians have not prioritised time and

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temporality as objects of inquiry, even though these categories have been fundamental for the postwar environmental sciences (2017: 186–7). When the environment concept took hold, the question was not only what the environment *was*, but also what its dynamics were, how it might change, and whose or what times it entangled (Antonello 2022; Sörlin 2022).

In this chapter, we argue that understanding and managing climate change was, in crucial ways, about understanding and managing time. Just as much as they were managing a "global problem", scientists and technocrats were reckoning with the multiple temporalities of human-induced changes in the climate. We circle in on the environmental sciences in the decades after World War II. During this time a particular epistemology of the planet as an integrated system took hold among primarily Western scientists and policymakers and set the stage for a "modeling paradigm" in climate governance (Heymann and Dahan Dalmedico 2019; Höhler, 2015). We identify two matters of time that were particularly salient in this period.

First, there is the emergence of climate archives, such as ice- and deep-sea cores, which could anchor coherent visions of planetary dynamics over vast periods of time. We will refer to this process as "planetary timekeeping". Secondly, experts set out to build knowledge of a future that depended on human impact on the climate, in a process we will call "modelling anthropogenic futures". By tracing how scientists and policymakers have produced environmental temporalities, we seek to explore how environmental history can give empirical depth to the temporal quandaries of the Anthropocene. This, we argue, can provide new perspectives on the scientific underpinnings of "the planetary turn" in the humanities.

Times, their histories, and planetary-scale environmental knowledge

Since the turn of the 21st century, the Anthropocene concept has permeated the humanities and social sciences and been accompanied by a surge in scholarly interest in matters of time (Swanson 2016; Chakrabarty 2018; Ginn et al. 2018; see also Chapter 12, this volume). Indeed, the Anthropocene, with its claim of human geological agency, is all but defined by temporal clashes: It appears as an uncanny form of event entangling planetary and human timescales (Bonneuil and Fressoz 2016; Tamm and Simon 2020). Even though the discussions the Anthropocene have sparked are relatively recent in the humanities and social sciences, the effort to reconcile human and more-than-human times of planetary change has been a salient feature of the environmental sciences since the postwar era (Sörlin and Isberg 2021). The efforts of postwar experts to temporalise the environment are important precursors of the current effort to relate the multiple times and histories of the Anthropocene (Sörlin 2022). While debates around the relationship between human and natural history had existed for centuries (Barnett 2019; Rudwick 2005), and temporalisation was an important feature of dynamic climatology as least as far back as the Habsburg Empire (Coen 2018), there were several peculiar aspects of how these questions were engaged in the postwar period. First of all, decades of rapidly rising fossil fuel consumption and industrial emissions gave new relevance to the question of human influences on the environment, and challenged the "nonanthropogenic orthodoxy" in the geosciences dating back to the middle of the 19th century, whereby human forces were considered negligible in planetary dynamics (Goossen 2020: 156–61; Locher and Fressoz 2012; Oreskes 2007: 93; Sörlin 2022: 78). Secondly, the booming development of a "knowledge infrastructure" for planetary and atmospheric monitoring, data collection, and processing could relate increasingly heterogenous sources of temporalised data, with growing (albeit uneven) coverage of the entire

planet, and a wider array of durations (remote paleoclimatological pasts, microdurations of cloud physics), in computer models with superhuman capacities for simulating futures on the basis of the big data repository (Edwards 2017; Flatø, forthcoming 2023). One of the implications of this postwar context is that scientific temporalities of climate were increasingly conceptualised with an eye to infrastructural compatibility: Hence, the emphasis on metrics, computer research strategies and modellable inputs in some of the period's most influential conceptions of climate temporalities.

Environmental history can benefit from a closer dialogue with the conceptual apparatus from the theory of history when approaching the history of environmental times. Especially the theory of multiple temporalities, which draws on Reinhart Koselleck to provide the analytical tools to help disentangle the temporal clashes of the Anthropocene (Jordheim 2022; Isberg 2020). This tradition is critical of classical historiographical moves such as periodisation, and the tendency in the history of temporality to declare universal "regimes of historicity" (Hartog and Brown 2015). Accordingly, expert temporalisations of the environment during the postwar era are not important because they allowed earth systems scientists to shape an "emergent regime of historicity" (Chakrabarty 2019: 1); they are merely specific practices creating "synchronizing" concepts out of ontologically multiple times (Jordheim 2014). If these synchronising concepts have become influential for politics and history writing, it was through specific avenues, such as their enfranchisement in global climate governance under the UN Framework on Climate Change Convention, and their role as an exemplar for other fields seeking broader influence (Borie et al. 2021). Environmental historians can challenge, qualify, and situate the claims to universality of the earth systems sciences by historicising its temporalisations and exploring origins in postwar networks of predominantly North Atlantic research communities, and the discourses, practices, and media of time they employed.

Planetary timekeeping

In the postwar era, a range of well-established scientific disciplines saw new subfields emerge with the prefix paleo- added to the name. Paleoclimatology, paleoecology and paleoceanography are all postwar products and highlight how the temporal scope of sciences concerned with the environment expanded radically in just a few decades (Charenko 2020; Heymann and Achermann 2018; Rosol 2015).

Just as "the environment", in the decades after World War II, enabled new connections between distant geographies (Gabrys 2016), a similar development can be said to have happened with time (Sörlin and Isberg 2021). Climate proxy records, such as ice and deep-sea cores, enabled a new kind of historically oriented gaze on climate, which in turn facilitated the elaborate work to reconcile, synchronise, and negotiate the boundaries between different planetary times (Isberg 2022). But contrary to the popular description of ice and deep-sea cores as "the Earth's own archive" or "natural time machines", the complex processes of translating sediments and ice into time were much more complicated and historically embedded (Alley 2002; Mayewski 2002).

The making of geochronological records – tracking changes in climate, land rise, sea levels, flora, and fauna – over long periods of time had existed well before the postwar era (Bergwik 2014; Sepkoski 2015). The professionalisation of several disciplines dealing with different aspects of Earth's past, such as archaeology, geology, palaeontology and evolutionary biology, in the 19th century, had rendered the study of *rates of change* a key objective in modern sciences (Sepkoski 2019).

By 1945, a well-established scientific infrastructure for dealing with the planetary past already existed and different fields had their own temporal orientations and delimitations. However, technologies for mapping past climatic conditions – ice cores, deep-sea sediment cores, dating of pollen and corals – emerged in spatially oriented sciences such as glaciology and oceanography (Summerhayes 2020). This temporal turn can be understood in the context of a vertical re-orientation during the early Cold War (Achermann 2020) as well as the emergence of isotope dating methods (Kern 2020). The interest in vertical space opened up possibilities for scientific ventures in remote, previously inaccessible, geographies.

One emblematic example of the turn to verticality is the landmark drilling of the first surface-to-bedrock ice core in Greenland in 1966. The drilling took place at the US Army base Camp Century, which had granted access to a group of Danish and American glaciologists after the decision had been made to abandon the base (Martin-Nielsen 2013). The Camp Century ice core would become an important contribution to the study of past climates and proof of the prospects and possibilities of ice core drilling (Dansgaard and Johnsen 1969). The core provided an uninterrupted timeline of the last 100,000 years of climate history. It could thereby offer a baseline against which the present climate could be measured. Similar interconnections between science and geopolitics are visible in the history of deep-sea core drilling, where new drilling technologies and military interests in the deep sea enabled large-scale scientific projects (Kullenberg and Fromm 1944; Oreskes 2021).

By the early 1970s, the global scope of paleoclimate records enabled an expansion of their disciplinary, epistemological, and temporal scope. Ice core drilling was, according to Willi Dansgaard, who worked on the Camp Century core, "reaching far beyond glaciology itself" (Dansgaard 1973). He pointed to how ice core data was being used by a broad group of disciplines, ranging from meteorology to solar physics and atmospheric chemistry (2–3). The ice core record could, in other words, speak to scientific issues well beyond the cryosphere and the glaciological community. Local ways of sensing and knowing ice was being replaced with a notion of ice as a proxy for the entire planet (Mulvin 2021). With the disciplinary expansion of ice core science, came a re-negotiation of expertise. Who could speak for the ice core data? On which temporal registers was it operating?

The publications of Dansgaard and his Copenhagen colleagues in the early 1970s are an indicative example of how the disciplinary expansion of ice core science made it possible for them to speak to new issues and other temporalities. If early ice core science had been temporally one-directed research, aimed towards the past, the future began to emerge as a possible domain to study through the ice cores. In a 1972 article, Dansgaard et al. elaborated on the prospects of using ice core data to predict future glaciations and distinguish factors that might cause them. Ice surges and volcanic activities were two phenomena that, they argued, could spark the next glaciation; but, they asked themselves, was "man's present activity … equivalent to such accidental events?" (1972).

In the years that followed, the intertwined relation between ice core timelines and human futures on the planet grew more explicit. Dansgaard became increasingly interested in the rapid collapse of the Norse settlement in Greenland in the 15th century. Even though this had already been the subject of debate among both historians and scientists (Utterström 1955), Dansgaard asserted that he, by assessing ice core data, could find evidence that changes in the climate made the living conditions too harsh for the settlers (Dansgaard et al. 1975). This was not only a historical matter: what happened to the settlers could, Dansgaard claimed, also happen to humanity in the future on a planetary scale. As Alessandro Antonello

and Mark Carey have argued, this perception of climate as an exterior force that determines the fate of civilisations tends to naturalise the political and ignore possible societal responses and mitigations in the event of changes in the climate (Antonello and Carey 2017).

In the article, Dansgaard also appealed to the climate modelling community. By using paleoclimate data in "diagnosing the processes that cause climatic changes, and for checking the validity of the models on all time scales between 10 and 10^6 yr" modellers could benefit from incorporating paleoclimate records into their work (Dansgaard 1973). Ice and other paleoclimate records could, in this mediated format, be translated from matter into datasets, further enabling the expansion of paleoclimatological data beyond the individual disciplines in which it first appeared (Isberg 2022). By the mid-1970s, paleoclimate data existed as a research object in its own right, detached from the materialities and practices that had enabled its emergence. The individual environmental times these records made visible became synchronised to a unified temporality of a new environmental object: anthropogenic climate change.

Between 1945 and 1975, new environmental times were gradually added to the scientific and political environmental framework, bringing the planetary past into the political present. These environmental times were a product of the scientific geographies of the early Cold War and rendered time visible in materials that had previously been inaccessible. But how these different times were configured and made speak to an abstract global level by a small group of scientists, contains a politics of its own. The "proxification" of, for example, ice and deep-sea sediments enabled planetary-scale temporalisations, but also obscured local difference and environmental phenomena that did not fit in the climate modelling framework (Heymann and Dahan Dalmedico 2019). The monolithic, linear temporalisation of climate change in the 1970s and onwards was not the self-evident translation of proxy records into environmental policy, but the outcome of a particular research program among Western postwar Earth sciences.

Modelling anthropogenic futures

It has been argued that questions about the environment in the postwar period were heavily oriented toward the future (Warde and Sörlin 2015). This observation may be contextualised within a broader postwar effort to structure expert approaches to the future, qualify levels of uncertainty, manage "risk" and integrate the long term in planning (Adam 2010; Andersson and Rindzevičiūtė 2015). In the earth and atmospheric sciences, the *prospective* temporal modality of anthropogenic climate change (in plain terms: the fact that climate change was decades away) presented an epistemological challenge, ultimately prompting new approaches to interdisciplinary research and forms of public evidence. As we have seen, paleoclimatological analogy was one of the innovations introduced by climate scientists to address the uncertainty of future climates that would be subject to anthropogenic influences. Another relied on computer modelling.

The rise of the modelling paradigm in climate science had a temporal component: It required a shift in attitudes to the temporality of climate. The shift was most clearly formulated in the climate modeller William Kellogg's rebuttals of Roger Revelle's famous comments from 1957 about a "vast geophysical experiment" (Revelle and Suess 1957). Revelle had originally depicted rising emissions from fossil fuel consumption as an inexorable force, and the scientific response would be to ensure proper documentation of this quasi-natural "experiment" (Howe 2014: 16–20). Writing at the end of the 1970s, Kellogg found this view

morally indefensible: climate scientists had to find ways of assessing the mode, timing, and variegated climatological consequences of changing anthropogenic inputs before "it will be too late to do much about it" (Kellogg 1978: 19). Kellogg offered the modelling of climate systemic responses to scenarios of future human impacts as a method ensuring that "we will not have to wait for the atmosphere to carry its own experiment to completion" (Kellogg 1980: 220).

Given the importance of computer modelling research design and encoding for producing evidence of future climate change, environmental historians may benefit from a closer dialogue with the history of scientific computing, cybernetics, and digital media studies. Effectively, the modelling paradigm made computers into a digital "laboratory" for experimentation with "unrealized" futures of climate before the event of anthropogenic change (Flatø 2022: 56–147; Galison 1996; Gramelsberger 2018). Historical scholarship has elucidated how computer simulations could accommodate a range of different epistemological approaches to the future climates: "heuristic" explorations of theorised connections in the climate system; "predictive" simulations seeking to provide more precise knowledge about such things as the scale and timing of temperature increases resulting from changing levels of anthropogenic forcing; managerial simulations aimed at integrating temporalities of decision and political action with models of the climate system; and simulations construing the atmosphere as an object of control, in order to explore possibilities for weather and climate "modification" – what is now known as geoengineering (Dahan Dalmedico 2001; Flatø 2022; Heymann and Hundebøl 2017; Rosol 2017; Schrickel 2017).

A promising direction of further inquiry for environmental history may be to ask how these virtual temporalities of climate operated as "environing media" – tools not only for understanding climate change, but also enabling historical interventions in the environment, be in the form of silver iodide cloud-seeding, banning DDTs or CFCs, or timelines of reducing trace gas emissions (Sörlin and Wormbs 2018; Wickberg and Gärdebo 2020). While these digital approaches to future environments were often presented as panaceas, their histories contain failures as well as legacies of environmental hazards, injustice, and oppression.

Computers did not deliver on either the promise of "infinite forecasts" or workable climate control simulations; climate scientists struggled to "motivate politicians for timely action" on the basis of modelled evidence, and the epistemological uncertainties around modelling were weaponised by climate denialists (Coen 2020; Edwards 2010: 139–86; Flatø 2022: 265–8; Franta 2022). They were entangled with efforts by the US military at inducing floods, as well as the construction of an "electronic battle ground", in the Vietnam War (Finkbeiner 2006: ch. 4; Furuhata 2019; Harper 2017: ch. 7). As the environmental media theorist John Durham Peters reminds us, "[d]igital media have not abolished bills, backaches, or crummy weather – to say nothing of rape, poverty, or scorn" (Peters 2015: 50). Political problems have a tendency to endure despite new technologies and the promises of experts, and environmental history is well positioned to elaborate the complex entanglements of computer simulations of climate futures and the socioecological histories they addressed.

For this reason, it is critical that climate scientists' work on the future of anthropogenic change be understood not only as an internalist history of science, but also against the history of risk and environmental "reflexivity" (Boudia and Jas 2007; Fressoz 2007; Locher and Fressoz 2012). Through modelling, past and future trajectories of the climate system and of "society" were synchronised through what is now known as "integrated assessment

modelling" and a conception of the "earth system" which incorporated "human activities" as a "factor" – alongside solar energy fluxes, ocean dynamics, soil, carbon dioxide flows, marine and terrestrial ecosystem, volcanic activity, etc. (Bretherton 1986: 19). In the 1970s, prior to the establishment of Earth systems science, climate scientists developed this highly specific understanding of "mankind" as a "factor" expressing itself as industrial particle releases, emissions from fossil fuels, patterns of land use (e.g., urbanisation, deforestation, agriculture), chlorofluoromethane and nitrous oxide emissions, and krypton-85 fallout from nuclear reactors (see table in Kellogg 1978: 19). Thinking about this human factoring as a matter of risk management as well as scientific inquiry brings attention to how these methods performed a radical flattening of the relatively small community of institutions and societies carrying disproportionate responsibility for inducing climate change (cf. with the role of global mean surface temperature in accounts of climate determinism, Paglia and Isberg 2022; see also Hulme 2011).

Moreover, the theory of risk teaches that no one social actor – not even scientists – have monopoly over knowledge about matters of common concern: These were inherently contested objects (Mythen 2004: ch. 3). The consolidation of climate science approaches to the future around integrated human-earth systems modelling in the 1970s and 1980s occurred in collaboration and competition with other communities of experts. Management science was particularly invested in the new futures and planning methodologies employed by climate science (Elichirigoity 1999; Flatø 2022: ch. 3–5; Jantsch 1967). Shell Corporation ran a successful scenario planning group under Pierre Wack's leadership, while economists and climate scientists were collaborating on model strategies at the International Institute of Applied Systems Sciences (Chermack 2018; Rindzevičiūtė 2017; Schrickel 2017). Even within the small community of climate modellers, practitioners could not agree on the lessons of *Limits to Growth* for modelling in climate science; some even participated in challenging climatological determinism, in presenting alternative notions of the earth as system, developing new forms of "crisis science" and "useful" expertise, and in foundational work in political ecology (Coen 2021; Coen and Jonsson 2022: 409–11; Flatø 2022: 275–89). Work on the future in climate science, then, has a chequered legacy: While the field developed a heavily institutionalised, standardised, and technical approach through integrated assessment modelling of human and earth systems, futures methods also opened a new interface with the complex knowledge economy that developed in the 1960s (Agar 2008), and they enfranchised other social actors such as the fossil fuel industry in the production of knowledge about anthropogenic change (Aronowsky 2021; Bonneuil et al. 2021).

Conclusion

Even though the postwar history of the environment has received much attention from historians in recent years, matters of time and temporality have remained in the background. This chapter aims to bring together environmental history and the theory of history to highlight how environmental temporalities have been configured, negotiated, and synchronised in the postwar era. Temporality was not a new concern in atmospheric science and climatology in the middle of the 20th century, but the prospect of climate change from fossil fuel emissions challenged the "nonanthropogenic orthodoxy" treating social influences as negligible to planetary dynamics, and prompted new investments with epistemics of change. We have brought forward two aspects of this history, which we call "planetary timekeeping"

and "modelling anthropogenic change" and traced their emergence in a range of scientific disciplines and epistemologies. These terms, respectively, speak to how scientists marshalled a growing array of temporal data sources – prominently, ice cores, pollen samples, tree rings, radioisotopes – to build more precise knowledge of long climatological durations. Additionally, they speak to how these new time series were integrated with a knowledge infrastructure relying on computer modelling to "assimilate" four dimensions of vastly heterogenous data which could be used to simulate trajectories of future human-earth systemic trends.

Our aim is to highlight the study of time and temporality as a relevant enterprise for environmental historians in a moment of rapid planetary change. As environmental historians, as well as scholars across the humanities and social sciences, continue to grapple with the predicaments of the Anthropocene, tracing the scientific underpinnings of the concept and of integrated human-planetary timescales appear as a pressing task.

Discussions about historical time in the Anthropocene in the theory of history have brought forward productive concepts and rich theoretical discussions, but they often lack empirical grounding in the history of environmental knowledge production. Environmental history, with its attention to how environments are shaped by technological, economic, and political circumstances, can play an important role in these deliberations. If the planet, as Dipesh Chakrabarty suggests, is emerging as a humanist category (2019), we should also pay attention to how the planet could emerge as an environmental object in the first place.

In the history we have outlined in the chapter, particular attention has been paid to a small group of Western scientists and institutions that came to shape how the planetary-scale environment acquired its temporal qualities in the decades after World War II. The claim that these institutions, practices, and technologies seized hegemonic status during a formative phase of planetary-scale environmental knowledge production, does not entail that they were the only ways of conceptualising environmental temporalities. While interdisciplinary climate science increasingly "synchronised" planetary and social times in an influential big science framework, the postwar rise of a more complex and public field of knowledge production undermined the epistemic monopoly of atmospheric and earth scientists.

There are more ways of knowing the Earth, as Deborah Coen and Fredrik Albritton Jonsson point out, than through the "geo-epistemology" of earth system science (408–9). The historicity of environmental temporalities is a far larger issue for environmental historians, we argue, than the particular history we have outlined in this chapter. Histories of environmental times do not have to lead to diagnoses of totalising, planetary-scale "regimes of historicity" (Chakrabarty 2019: 1; Hartog and Brown 2015). They can just as well anchor temporalisation – the conception of shared notions of time – as a social and scientific practice in a wide set of contexts, ranging from the planetary to the embodied experience. By revealing the histories and temporalities of environmental concepts, new avenues of inquiry may open for environmental history: What environmental politics emerged in dialogue with paleoclimatological analogy? Whose pasts and whose futures were highlighted in the diagrams, assessment reports, and clarion calls of earth system science? And more broadly: how did scientific engagements with temporality affect environmental knowledge and politics? What can environmental histories of time offer to theoretical debates about the planet as an emergent humanist category?

As the spatial metaphors of "globalisation" have given way to a proliferation of temporal concepts – visible in discourses of the green *transition*, climate *crisis*, and the need for *transformative* scholarship – environmental historians should elaborate the temporalities against

which earth system science and global environmental governance positions our polities: how they built synchronised concepts of the times of the planet, and how they came to model its anthropogenic futures. In these thick descriptions lie the keys to conceptualising these times in other ways.

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15

FOSSIL FUELS FROM EXTRACTION TO EMISSIONS

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Introduction

At the end of the Second Anglo-Burmese War, the East India Company dispatched a diplomatic envoy to re-establish peaceful trading relations with the Burmese King of Ava, Mindon Min. The king was eager to meet the "stone teacher", Irish geologist Thomas Oldham, from whom he thought might divine new deposits of rubies, long a source of the Burmese dynast's famed wealth (Yule 1858: 99). But Oldham's "geologizing", as he put it, was actually concerned with the coal formations running beneath the forests of the upper Irrawaddy. After all, the annexation of lower Burma by the East India Company in the preceding war was conducted by steamship, and Oldham's commission was thus to survey a future line of coaling depots for an expansionary network of imperial steam power. Mindon Min, who grew sceptical of Oldham's peaceful intentions, gradually barred the geologist from free passage throughout his kingdom. There was truly something amiss that a substance as unremarkable as coal might require the attention of a man capable of reading the history of the Earth.

The history of Burma's conquest by the East India Company is a history of the transformation of the world by fossil fuels. This history unfolded through the pathways of conquest and within the competitive market pressures unleashed by a cycle of globalisation dominated by imperial Europe. Figures like Mindon Min and places like Burma seldom figure as starting points for charting a history of fossil fuels. Instead, such histories tend to begin with figures like James Watt and his steam engine and offer a diffusionary narrative of carbon dependencies moving outward from north-western Europe or North America to encompass the world. This framing, however, obscures the irreducibly global scales through which fossil energy became a durable force in world affairs. There is no national origin story of energy outside of empire, just as there is no accounting for historical forms of carbon dependency that are not already global histories of connection, extraction, and planetary transformation.

This chapter is an effort to explore the prospects for writing a history of fossil fuels that takes these entangled global and imperial origins as a starting point. Such a history, we

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insist, has to move beyond historiographical investments in histories of mechanisation or comparative industrial development – which treat fossil fuels merely as inputs within socio-economic processes – and instead engage fossil energy through social, cultural, and scientific histories of the global environment. The advent of fossil economies fundamentally reconfigured relations between humanity and the natural world, while at the same time rescaling the collective capacities of human societies to transform global environments. However, the place that fossil fuels came to occupy was "neither natural nor inevitable" but the result of specific historical decisions (Jones 2014: 2). Our aim is thus to map what Dipesh Chakrabarty (2021) has called the "global" human histories that have produced fossil energy regimes, alongside the more-than-human or "planetary" transformations that have arisen from, and supersede, humanity's unsustainable relationship to the earth in human-dominated geological epoch scholars now refer to as the Anthropocene (Thomas 2014; see Chapter 12, this volume). Bringing these histories to bear on the present crisis allows us to re-examine fossil fuels and the extractive infrastructures that render them into "emissions" as a set of environmental and social relations ultimately subject to historical change. Against both a climate pessimism that views fossil dependency as an inevitable outgrowth of humanity's transhistorical appetite for "energy", as well as the technological fantasy of a future clean energy transition unmarked by contentious politics, this chapter sets forth an outline of energy history that looks to the past to understand the prospects for a post-carbon future.

The chapter itself is divided by the spatial metaphors of lithosphere, technosphere, and atmosphere. Just as these spheres form interlocking parts of the single Earth system, we view these spaces not as separate areas of historical concern, but as a sedimentary or structural formation that brings into view the dynamic interaction between humans and fossil natures on a planetary scale. We begin with the "Lithosphere", a geological term denoting the rigid outer layer of the Earth's crust, in order to explore the dispersed histories of energy extraction that rendered fossil fuels into global commodities. Our second section, "From Biosphere to Technosphere", foregrounds the remaking of the environment through new infrastructures of energy production and techno-managerial expertise. The final section, "Atmosphere", examines how the emergence of global energy systems gave rise to new understandings of the Earth as a biophysical totality, and the capacity of humans to disrupt the Earth system through the mass transformation of buried carbon into what we now call "emissions".

Lithosphere: extractive encounters

Fossil fuels are "interscalar vehicles", material objects and conceptual tools that allow us to navigate across spatial and temporal scales typically analysed separately. They link together the local with the planetary, and the more familiar temporality of human history with the deep history of the Earth. Through photosynthesis, plants trap solar energy to build organic compounds and produce oxygen – also crucial for combustion itself. As this organic matter and other organisms decay and decompose over long periods of time, often buried deep in the lithosphere, what we call fossil fuels are formed.

As the name "fuel" indicates, in modern societies these materials have been defined from an anthropocentric and utilitarian perspective as energy sources, able to convert their (mostly heat) energy into mechanical energy. Yet the geological conditions that produced the formation of fossil fuels lead to parameters that escape human intentionality. Such are fossil fuels' aleatory geographic location throughout the lithosphere, and their variable

density, volatility, and toxicity as liquid, solid, or gas. Thanks to their inflammability, millions of years of "fossilised sunlight" can be rapidly released again in the form of heat energy. At the same time, a portion of the carbon dioxide generated from fossil fuel combustion will remain in the atmosphere for at least 100,000 years. Through the extraction of coal, oil, and gas, the spatial and temporal zone of human activity is thus linked to the lithosphere below and the atmosphere above, and to distant futures and even more distant pasts.

A popular historiographical shorthand posits a binary separation between the older "organic" or "solar-agrarian" economy of muscle power, water, and wind and the later "mineral" or "fossil" economy.[1] Yet, on human timescales, the usage of fossils is not particularly new. Archaeological evidence suggests that the Chumash and Yokut peoples in what is now California were using bitumen, a semi-solid form of petroleum more commonly known as asphalt, up to 12,000 years ago (Connan 2012). Coal was being routinely burned in northwestern China as far back as 4,500 years ago, while in the region around modern Chongqing, bamboo tubing was already being used by the fourth century CE to store and channel natural gas for lighting (Dodson et al. 2014: 66–7).

Therefore, it was not the "discovery" of fossil fuels that distinguished the European imperial powers. The European colonisation of the New World both preceded and did not require fossil fuels, instead installing a newly intensified and commodified organic energy regime based on chattel slavery. Indeed, colonialists often appropriated pre-existing indigenous sites of energy extraction, as in the case of Spanish pits dug near known oil seepages in Peru (Barrett 1999). Closer to home, large-scale coal consumption did not spur industrialisation immediately. Already by 1620, coal may have outstripped woodburning in Britain and its energy density enabled large populations to cluster in rapidly expanding cities. However, the fuel's little-studied thermal uses were still more important than its later, and much more famous, kinetic uses within industry (Cavert 2016). Most of this coal at first went to domestic hearths rather than incipient factories – to *re*productive labour, rather than production – providing a consumer-centred alternative genealogy of the striking energy intensity of Western societies.[2]

It is nonetheless through the subsequent "great divergence" between the early industrialisers of western Europe (and the anglophone white settler colonies) and the rest of the world that the history of fossil fuels has been narrated conventionally (Jonsson 2012: 679–96). Several frameworks have been brought forth to discuss this linkage. The most influential, associated with E.A. Wrigley (1988) and Kenneth Pomeranz (2000), highlights the energy scarcity faced by Britain as its growing population faced the limits of the wood-based economy. With British coal deposits located within easy reach of industrial areas and the colonial "ghost acres" supplying resources, the conditions were set for the at-first-very-inefficient steam engine to develop. This enabled the laborious technological experimentation that would eventually harness the steam engine for the country's famous textile mills and railroads (Mouhot 2013; Parthasarathi 2011; Sieferle 2001).

In contrast, alternative frameworks focus on steam-based mechanisation in terms of the contentious politics that arose through the concentration of workers, fossil energy inputs, and machines under the precocious capitalist development of early-19th-century Britain. While Timothy Mitchell (2011) argues that British coal mines provided the infrastructural conditions for the emergence of mass democracy via the potential for labour sabotage, Andreas Malm (2016) insists that it was prior social struggles over this very transition that led to the adoption of steam-based mechanisation by factory owners seeking greater control over their workers (see Chapter 16, this volume).

While often framed as an epochal energy transition, nowhere did fossil fuels immediately displace older "organic" energy sources, especially wood. Much more often, the new energy source joined and *amplified* use of the old fuel within a society's energy portfolio in a process of addition and intensification (Fressoz 2013: 173–87). The rise of steam-powered machines and trains increased reliance on horses and camels in the medium term and led to an intensified regime of mass killing for whale oil (Barak 2020; Demuth 2019; Greene 2008).

It is a mistake, too, to take an "energy transitions in one country" approach. Once Britain's industrial take-off began – initiated by colonies and sustained by coal – it took on a momentum of its own, reshaping the world system within which later industrialisers would develop. Looking beyond western Europe and North America, there is no deterministic relationship between the availability of fossil fuels and the structural transformation of the economy: compare, for example, the rapid industrialisation of resource-poor but independent Sweden or Japan with coal-rich but colonised India (Chatterjee 2020). With the notable exception of white settler offshoots like the United States and Canada, most of Britain's colonies would be introduced to the logic of fossil fuel extraction without accompanying industrialisation (Ghosh 2016).

The 19th century was an era of unprecedented European imperial expansion. Building on older colonial projects of resource extraction such as silver, gold, rubber, or diamonds, the twinned dynamics of European mechanisation and imperial globalisation shaped new projects for the enclosure of global energy reserves and established networks of distribution (Brown 2012; Ross 2017). This dynamic was not limited to fossil energy alone, as attested to by the global search for guano as a nitrogen-rich fertiliser in the Indian and Pacific Oceans by European merchants (Melillo 2012).

However, 20th-century petroleum production would drastically change the scale of such extractive enterprises throughout the world, but particularly in the Global South. This ecological imperialism, a reordering of nature-society arrangements to facilitate extraction, would see local elites collaborate with such extractive enterprises to export resources to the Global North while espousing a technocratic ethos promising progress and civilisation. This not only legitimised the wholesale transformation – and at times destruction – of entire ecosystems to build the infrastructure of petroleum extraction, but also gave said infrastructure an aesthetic flair of modernity (Corey 2017: 203–36). Described by historian Myrna Santiago as an "ecology of oil", this transformation entails changes in land tenure patterns, landscape, and social dynamics. A crucial concept for this configuration is the "sacrifice zone", an area given up to the benefit of some idea of progress or development elsewhere (Santiago 2006). Though also a factor in the coal-rich areas of northern Britain and the eastern United States, it was particularly in the Global South where these fossil ghost acres, whole landscapes dedicated purely to the extraction of fossil fuels, were established, often in the form of wide-ranging enclaves granted as concessions to large oil companies, given free rein to use both landscape and labour as they pleased.

These enclave structures were particularly present in Latin America and the Middle East. Owing to their close relation to contemporary US political practices, they were initially highly segregated along racial lines in terms of division of labour and housing, usually featuring comfortable lodgings and facilities for well-paid white expatriate workers and managers, while native labourers lived in rough shantytowns and performed dangerous manual labour, exposed to the oil industry's toxicity (Mitchell 2011; Salas 2009; Vitalis 2007).

The establishment of such enclaves in often remote areas facilitated highly repressive control, exercised either by the local state's armed forces or sometimes, as in the case of the

Middle East, the imperial power's forces (Maugeri 2006; Serje 2004). Furthermore, the entire process of extraction and production could also be spatially separated to diminish the possible power of a labour force. Such was the case in early 20th-century Venezuela, where the refineries were established not on the mainland but on the Dutch island of Curaçao (Mitchell 2011: 5). It is a pattern that finds echoes in 21st-century practices of strategic offshoring in sub-Saharan Africa (Appel 2019).

While often located in the periphery, such enclaves were, due to the highly international nature of the oil industry, strongly globalised areas, gathering people and technology from all parts of the world. Yet it was also here where labourers from disparate parts of their respective countries came together for the first time to encounter a different notion of what it could mean to be Venezuelan, Persian, or Trinidadian. The daily encounter with a quasi-imperial project of oil extraction also facilitated the establishment of a new proletarian culture focused on anti-imperialism and nationalism in the sense of sovereignty over land, resources, and welfare (Salas 2009; Vega Cantor, Núñez Espinel, and Pereira Fernández 2009).

This was an especially strong current in Latin America, where the presence of foreign oil companies was an important driver for nationalist and anti-imperialist projects to emerge and consolidate. In 1922, Argentina established the world's first state petroleum company. (Gadano 2013). In 1938 Mexico was the first country in the world to nationalise all its oil and gas fields (Santiago 2006). In the wake of World War II, Venezuela also made a path-breaking move by imposing on multinational oil companies a 50–50 royalty deal that would soon become a global standard (Garavini 2019). Then, in 1953, the creation of Petrobras made Brazil the first nation ever to start to exploit petroleum under a state monopoly (Acker 2020). These ventures had been preceded by long-standing discussions on resource sovereignty. Crucially, as opposed to arguments brought forth by Mitchell that the oil industry hampered democratic development, in Latin America petroleum workers played a founding role in modern social and democratic movements (Dunning 2008).

In the Global South, primary export goods and particularly fossil fuels became instruments of economic decolonisation (Dietrich 2017; Acker 2020). Through nationalisation campaigns and through confrontations with global oil majors, they became emblematic of the struggle for resource sovereignty and more just terms of trade for the Global South. An expression of this new reality was the foundation of OPEC in 1960. A pioneer organisation in terms of South-South relations, OPEC briefly came to define a world in which sovereign producers managed oil production under a framework of conservation and development. However, though at first a powerful actor in Global South development, political rivalries and falling oil prices amidst a retrenchment of industrial countries led to the fracturing of OPEC on national lines, foregrounding extraction and expansion above unity (Garavini 2019). Furthermore, in many cases – perhaps most famously, Nigeria – fossil fuel-driven demonstrations of national pride only rode the wave of short-lived economic booms. They quickly gave place to the consolidation of neo-colonial or internal colonial patterns of unequal global exchange, the submission of local workers to degrading labour norms, and toxic contamination of waters and soils (Apter 2008; Osha 2006).

Even as the leading national drivers of transnational resource extraction have shifted towards East Asia, current dynamics point towards an increasing extension of the extractive frontier, reaching places that before were deemed inaccessible to fossil fuel extraction through the practice of "tough oil". This includes violent and capital-intensive techniques elaborated to find and extract the remaining oil and gas reserves such as fracking, offshoring,

and drilling in endangered tropical forests or – with dreadful irony – in the increasingly accessible Arctic due to the effects of global warming (LeMenager 2014; Yenikeyeff and Krysiek 2007). This retrenchment of extractive practices in full knowledge of the perils of global warming points to a continuity of historic violence within the oil industry. This can be described as "carbofascism", an ideology so enamoured with nostalgia for the golden age of fossil fuel extraction and its social configuration that it would see it continue despite all the cost in life and ecological damage, all to the continued benefit of an ever-shrinking minority (Acker 2021). So profound has the impact of energy extractivism become that it is directly affecting the lithosphere at a new scale: mining, drilling, and fracking have been linked to earthquakes, a dramatic illustration of the newfound geological agency of humans over the planet.

From biosphere to technosphere

The fossil fuel extractivism pioneered by European imperial powers marked a qualitatively new phase of technological intensification that produced vast infrastructural systems for resource transport, distribution, and use, increasingly detaching metropolitan consumers from the sacrifice zones where fossil fuels were extracted and combusted. Even as fossil fuels became fundamental to the industrial economy, they became increasingly invisible. By the 21st century, these infrastructures had become so planet-spanning and quasi-autonomous from human control that the geologist Peter Haff (2014) argues they form a distinct domain of their own, analogous to the biosphere where life exists – a domain he calls the *technosphere*.

The United Kingdom "was the Saudi Arabia of 1900", David Edgerton points out. British coal powered everything from Argentine grain elevators to Swedish ironworks and Bombay factories. Though production peaked in 1913, up to World War II British coal remained "the most important internationally traded form of energy" and overwhelmingly the country's greatest export by bulk (Edgerton 2018: 79–82). Coal's infrastructural expansion is a crucial and often-overlooked component of British dominance. Building up networks of coaling stations was central to the parallel expansion of both imperial power and fossil fuel usage around the world, from the Middle East to Central America and Japan's would-be empire. This double movement created new extractive frontiers with the help of railways, such as in the rich coalfields of Raniganj in West Bengal, and steamboats, as we have seen in Burma. Other imperial powers also deployed transport infrastructure to seek resources while expanding their territorial control of their colonies, as the French did in Yunnan and Indochina. The British coal example displays the critical link between energy sources and their transportation – canals, railways, and later pipelines, tankers, and trucks that link extraction, refining, and consumption locations (Jones 2014).

The expanding use of coal worldwide allowed for the substitution of wood in important economic activities. Countries therefore sought their own reserves, with important discoveries in the early 20th century such as in Poland, Russia, and Chile, that would eventually undermine British domination in that sector (Hémery, Debeir, and Déléage 2013: 221). Here, the Global South, both as produces and consumer, played a key role in shaping these global processes of carbonisation. The passage of British coal around the globe initiated unintended processes of urbanisation and interconnection, for example: some coaling stations became cosmopolitan boom towns, like Aden and Port Said, while the new infrastructures of circulation also remade

the *hajj* pilgrimage, and with it reinvented a sense of globe-spanning Islamic community (Barak 2020).

Fossil fuel-led technological intensification took on a whole new level as oil became the world's most important mineral commodity. Liquid oil's expansive and flexible supply remained concentrated in a handful of places, so growing consumption required a proliferation of planet-spanning infrastructures not only for extraction, but also storage, transportation, and transformation. Expanding networks of pipelines, refineries, super tankers, railway tank cars, trucks, and gas stations became central for petroleum distribution around the globe, allowing its trade to develop into a worldwide system.

The widespread sense that World War I was "won by oil" led to a race for oil deposits. As the United States and the United Kingdom, among others, looked to ensure the rights of their companies abroad, the need to control oil at its source became an issue with its own politics. In this process, new areas emerged as central for fossil fuel distribution, most notably the Persian Gulf. New technologies developed in parallel to follow these routes, such as the development of super tankers powered by diesel engines, set up to circumvent the Suez Canal after its closure (Khalili 2020).

As the locus of production gradually shifted away from the United States in the postwar decades, the links between state and oil were only reinforced, with countries such as Kuwait, Nigeria, Argentina, or Timor-Leste actively portraying themselves as parts of a petro-modernity, enabled materially and financially by oil and represented aesthetically by its infrastructures. These petro-modernities were fraught with contradictions and often failed to deliver the expected results or underwrote inegalitarian politics such as the South African apartheid state's oil-from-coal project, SASOL, a key site for the elaboration of the "apartheid modern" (Apter 2008; Bovensiepen and Nygaard-Christensen 2018; Hindelang 2021; Sparks 2012). Nevertheless, the idea of a modernity fuelled by fossils was central as more than rhetoric: the promises of development, industrialisation, and sovereignty were key elements in the construction of nation-states and underwrote world-making postcolonial aspirations, even if the promised future was never realised (Coronil 1997).

Crucial, too, in the turn from coal to oil was both the increased importance of processing infrastructures – which long remained dominated by the Global North – and the vast range of uses to which oil products could be put. The material properties of oil allowed it to be integrated in virtually all aspects of daily life, from food and plastics to industrial production, and its by-products to figure in all places on this Earth from the deep sea to the atmosphere and even outer space. The technologies that allowed for this integration, especially after World War II, transformed societies deeply, but not evenly. Roads built for vehicles changed cityscapes and connected far-flung regions, allowing the development of tourism and suburbanisation. They also opened up isolated places to new cycles of exploitation, as in the case of the Brazilian Amazon since the 1960s (Barber et al. 2014). While not all postwar oil-based consumption models followed the one espoused by the car-dependent suburban middle class in the United States, petroleum-fuelled infrastructure expanded globally. New industrialisation and electrification projects proliferated in the Global South, and petroleum refineries diversified into petrochemical production, becoming critical infrastructures of the Green Revolution in the form of fertilisers and pesticides (Pirani 2019).

Though many of these infrastructures bore resemblances across space, the entanglement of different places into the wider network of fossil dependence proceeded through political and economic dynamics and decisions happening at several levels, from local to global.

Nonetheless, initial choices created self-reinforcing and path-dependent logics. The construction and deployment of fossil-fuel infrastructures created "landscapes of intensification", creating a feedback loop between supply and demand: the availability of new energy sources led to new patterns of ever-growing energy consumption, which in turn drove further resource exploitation both in the Western world and in different political regimes such as China under Mao Zedong (Jones 2014; Seow 2021).

As infrastructures multiplied, so did their destructiveness. Oil tankers were and still are the main form of oil transportation, and they cause perhaps one-third of all oil pollution in the oceans, both from accidents and also in normal tanker operations (USA Congress OTA 1975). Although pipelines are the safest method to transport oil and gas, ageing pipelines are a hazard because of the increasing risk of rupture and leaks due to corrosion. Disasters in the Amazonian pipelines of Peru, Ecuador, and Colombia are a regular reminder of those risks and heavy consequences. Design and construction error, and incorrect operation conditions, are also frequent. Lately, pipeline sabotage has become a concern for security policies linked to terrorism, vandalism, or criminality concerns such as in Nigeria or in the Middle East.[3] These infrastructures also create dependencies both on an energy model and on their builders – private cartels, ex-colonial powers, foreign companies – since they are so expensive to put in place and too large to be torn down.

Atmosphere: from extractions to emissions

Fossil fuel combustion did not proceed in a spirit of ecological naiveté. Concerns about air pollution were visible as far back as 17th-century London, with (rather feeble) local laws to address this problem following throughout the 19th century across Britain and reaching India by the 1860s (Cavert 2016; Sharan 2020). Similarly, while early images of oil gushers reaching sky-high and occasionally catching fire were portrayed in media outlets as a symbol of an affluent future, this narrative, too, would soon shift to include the environmental harm caused by the sticky and toxic "black gold". Notorious was the 1908 "Dos Bocas" oil fire in Mexico, for a time the largest of petroleum-induced disasters (Morse 2012). Fossil fuels had manifold other discernible impacts: earthquakes, fires, on- and offshore oil spills (dramatised through copious images of dead birds), poisoning waterways and groundwaters and therefore soils. When industry left and oil dwindled, local populations had to deal with the environmental hazards of ruined water supplies, runoff soils, and spilled oil, such as in Sumatra, around Maracaibo Lake in Venezuela, or in the Nigerian region of Ogoniland (Ross 2017).

However, the toxic nature of petroleum remained ambiguous in 20th-century societies for a long time. Quite counterintuitively, contemporary minds even often perceived fossil fuels as potential remedies to environmental harm. This link manifested itself particularly in Latin America, where, due to the overdependence on the "organic energy economy" of wood, countries such as Mexico and Brazil faced an acute problem of deforestation. In Mexico's case, this prompted national elites to heavily promote the use of coal, and later oil, as "clean" fuels (Vergara 2020). In Brazil, where the formerly vast Atlantic rainforest had been severely depleted by the turn to the 20th century, oil was directly seized upon as a means to protect the natural environment (Acker 2020).

In many places in the Western world, too, the association of oil with toxicity arrived relatively late. In the United States, fossil-fuelled vehicles were rather associated with access to the aesthetic pleasure of an unpolluted landscape. In 1950s London, too, the industrial

conversion from coal to oil could only be welcomed, as it considerably reduced the deadly "pea soup" fogs that enveloped the city. By the mid-20th century, the increased use of gas and oil stoves was often a relief in urban homes, making the kitchen an "unpolluted space" by doing away with the heat, dirt, and odour of cooking with coal or firewood (Acker 2020; LeMenager 2014; McNeill and Engelke 2014).

Only in the following decades would oil become synonymous with atmospheric pollution, with the rapid population growth of metropoles and their congestion by gasoline-fuelled cars provoking respiratory diseases. By contrast, the link of fossil fuels with carbon dioxide, perhaps because of its colour- and odourless nature, remained hardly debated in the public space, despite its dramatic impact on local and global climates already having been posited by scientists since the 19th century. Most notably, the Swedish physical chemist Svante Arrhenius evaluated that CO_2 emissions from fossil fuels could potentially warm the global climate by 4 degrees Celsius. Yet, he welcomed this hypothesis as an opportunity to postpone the next ice age, benignly changing the course of natural history towards a direction friendlier to human life.

Paralleling the rise of fossil fuels, vast new infrastructures of knowledge would emerge, with new forms of aggregated expertise and institutions enabling planet-wide understandings of natural resources in the aftermath of World War II. American security strategists promoted the comprehensive study of the Earth system – an interest that reached even into space – as they surveyed the planetary availability of mineral resources that could meet the country's insatiable demand (Black 2018). Out of this Cold War context emerged computer systems capable of running complex simulations, critical in turning global observational data into models that enabled the understanding of the planet's climate system – and with it, climate change (Edwards 2010). While in the first half of the Cold War Soviet science broadly kept pace, it gradually started to lag behind due to the systematic lack of computer capacity, and to the scant and erratic political support granted for climate research (Jex 2017; Oldfield 2018).

We know now that fossil multinationals were among the first major players to take climate science seriously and that their internal experts knew about the link between their activities and the risk of global warming from around 1970 (Bonneuil, Choquet, and Franta 2021; Supran and Oreskes 2017). Yet they nevertheless embraced a strategy of fostering "climate doubt" in alliance with conservative politicians and media outlets, especially as a reaction to global climate policy conferences such as in Tokyo (1997) and The Hague (2000) (Leggett 2001). This discourse of denial, particularly strong in the United States, the world's major consumer of fossil fuels in the 20th century, paradoxically intensified in the 2010s at the same time as the proliferation of hurricanes, flooding, heat waves, and droughts made global warming a concrete reality to populations worldwide. It culminated in the presidency of Donald Trump, which also fostered a cultural rehabilitation of fossil fuels in the form of a toxic petro-masculinity, which tapped into the historic association of fossil fuels with values such as strength, masculinity, and patriotism (Daggett 2018). Slogans such as "Trump Digs Coal" appealed to a sense of pride among coal workers of the American Midwest, vaguely reminiscent of a tradition of solidarity in mining communities (Acker 2021). This coal nostalgia is also strong in the history of social struggles in western Europe and even national emancipation episodes such as the Solidarność Movement in 1980s Poland. At the same time, positive discourses about coal mining tend to silence the history of accidental deaths, lung diseases, child labour, and repression of unionism that has characterised coal extraction worldwide since the 19th century (Gomez 2020).

The way positive representations of fossil fuels have been used as part of a strategy to divert attention from global warming underlines the importance of historical narratives in our current climate crisis. In that spirit, a historical inquiry that encompasses the entire life cycle of fossil fuels in the Anthropocene can unveil the dynamics of dependency and domination that have shaped processes of extraction, production, and consumption, and were reshaped by these processes in turn. It is our task as historians to connect the social and environmental toxicity of fossil fuels, in all their changing forms, to the ejection of CO_2 into the atmosphere. From a historical perspective, the problem is not the physical relation between greenhouse gases and atmospheric temperature per se, an intricate planetary carbon cycle which obviously long predates the use of fossilised matter for the production of energy by humans. Rather, what concerns us is how our intensifying dependency on fossil fuels made atmospheric change systematic, exponential, and uncontrollable, to the point of becoming a structural driver of the Earth's ecological trajectory. Historians can investigate the building of social and political structures that provoked this dependency over time, and which start(ed) to take shape in the moment we decide(d) to take fossil fuels out of the ground. This is about helping to unveil what lies behind the "Keeling curve" – that is, the daily rise of the CO_2 concentration in terrestrial atmosphere measured since 1958 from the Mauna Loa Observatory in Hawaii, originally under supervision of the American scientist Charles David Keeling. As Joshua Howe (2014: 9) notes, an important part of humanity's failure to mitigate climate change is due to the fact that "there has been much more debate about what the Keeling curve means than there has been real change in the social and political factors that determine its slopes".

In understanding such developments from a long-term perspective, scholars have started to draw interesting hypotheses such as the connections between energy transitions and the politics of labour control discussed earlier. Other hypotheses go deeper into the past, focusing on early modern Atlantic colonisation and the global commodification of "natural" resources that it spurred (Moore 2015). Some even suggest that the slave trade and New World plantation systems paved the way for the intensification of energy dependence in global trade and markets; the energy demand met by slave labour was later replaced and intensified by fossil fuels after slavery was abolished (Mouhot 2013). In general, important works in international environmental history have drawn attention towards the ecological impact of global trends in the past five centuries such as colonisation, the building of modern empires and nation-states, world wars, neoliberalism, and the creation of global consumption standards (Crosby 2006; McNeill and Engelke 2014; Ross 2017: 199–230). All of these trends have contributed to an acceleration of the use and atmospheric impact of fossil fuels through an upscaling of the exploitation of natural resources, consumption, and energy use.

Interestingly, while many professional historians are still wary of drawing explicit links between these *longue durée* developments and the more recent uptick in atmospheric temperatures, this connection is already circulating in climate diplomacy and activism. One of the authors of this chapter recently spotted graffiti in the streets of Philadelphia describing the 19th-century industrial revolution as the cause for the planet's degradation. The sign "CO_2lONIALISM" has become a classic of climate demonstrations since the Copenhagen international climate conference in 2009, and the link between global environmental issues and the history of capitalism was explicitly made by Latin American socialist leaders like Hugo Chavez and Evo Moralez (Chavez 2013). Government leaders also invoke this past to allocate blame for climate change. The words of the Indian environment minister Prakash Javadekar at the beginning of the Paris climate summit in December 2015, referring to a

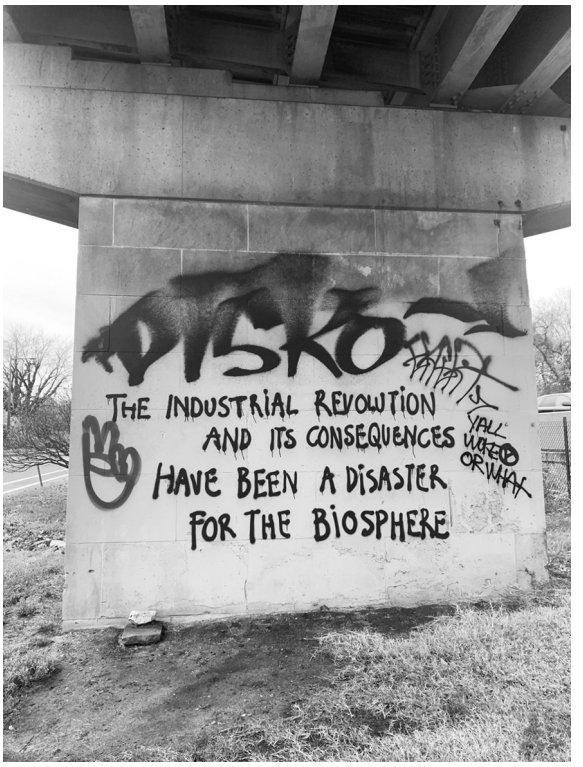


Figure 15.1 Graffiti near Belmont Plateau, Philadelphia, 6 December 2021. Photograph by Melissa Hornor.

record flood that killed 400 people in the city of Chennai, are a case in point. "What is happening in Chennai", he said then,

> is the result of what has been happening for 150 years in the developed world. That is what has caused 0.8 degrees Celsius temperature rise … Historically, for the last 150 years, they have reaped the benefits of growth and now they can't say that past is past. *(Malm 2016: 247)*

In current debates, fossil fuels can hardly be conceived without a mental association to CO_2 emissions and climate issues. This explicit link with the atmosphere is now part of economic calculations and technological programs embedding fossil fuels in global markets, such as carbon taxes, carbon credits, and geoengineering. The latter comprehends a series of plans and experiments, involving scientific organisations, governments, and multinational firms, to capture the CO_2 circulating in the atmosphere and sequester carbon in soils, oceans, or even underground – thus making it return to the lithosphere (Hamilton 2013). The dangerous downsides of such plans have been thoroughly discussed by scientists; some versions of them could even contribute to worsen global warming through the creation of negative feedback loops that reverberate throughout the Earth system. Ironically, while signifying a further peak in human control over the planet, they also aim to return fossil fuels to what they were before their human use: simple fossils. With this, they could resume their natural

climatic function not as sources of carbon, but rather as carbon sinks. Yet, from a historical perspective, the sounder option would be to leave remaining reserves of oil, coal, and natural gas underground. This is because, as we have shown, CO_2-induced atmospheric change is inseparable from cycles of pollution and human exploitation that begin in the phase of extraction or even surveying and continue over the entire life cycle of these energy sources.

Conclusion

While fossil fuels have become embedded within all aspects of modern societies and the spheres that form the interlocking parts of the single Earth system, we have strived to show that there is nothing essentialist nor inevitable about the role they have assumed within societies, nor is there a universal trajectory to this changing relationship. Far from the usual narrative of technological adoption, where the "Rest followed the West", our current situation vis-à-vis fossil fuels is the result of a variety of historical processes, decisions, and technological, power, and knowledge systems. Therefore, to understand the place of these energy sources within human history, the story of fossil fuels needs to be globalised and analysed from a different point of view from that of mere technological determinism.

Throughout history, fossil fuels were acted upon and used within different regimes of social relations – but, just as important, they were and are also actors themselves in the sense highlighted by Bruno Latour, in that they shaped and remade a nominal "human" agency through the assemblages of nature, technology, and culture (Latour 2005). The logic instituted by their extraction, production, and use, and the fateful consequences now felt from their emissions, have fundamentally changed how human societies understand their relationship to the more-than-human world. The techno-optimistic fantasies of mastery over nature are now confronted with a new future of planetary ecologies remade by human action, and the growing recognition that climate change represents an irreversible repatterning of the earth's climatological systems.

Reading the history of fossil fuels becomes ever more pressing in the current moment. While humanity embarks on exiting the fossil fuel era, its legacy seems likely to haunt us for a long time. While the foundations of the immense explosion of human economic activity, population, wealth, production, and consumption often referred to as the "Great Acceleration", and all its accompanying side effects, were made possible by fossil fuels, the consumption and living patterns it engendered will not just disappear along with them (McNeill and Engelke 2014). To take just one example, the veins of Latin America are still very much open when it comes to large-scale and often destructive lithium mining, powering the same lifestyle brought on by fossil fuels (Farthing and Fabricant 2018). Even in a post-fossil age, therefore, we might still follow the logic laid out by the economic system we might call fossil developmentalism. Tracking back the entire life of fossil fuels from extraction to emission, and how this more-than-human agency intertwines with human life, might be one way to emancipate ourselves from this legacy and from the imaginaries of fossil fuels.

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Notes

1 For organic/mineral, see Wrigley (1988). For somatic/fossil (or "exosomatic"), McNeill (2014: 7–63). For solar-agrarian/fossil:; Jones (2014: 1–21); Sieferle (2001).
2 As of this writing, Fredrik Albritton Jonsson is preparing an important book-length study of this alternative genealogy.
3 Pipeline sabotage, however infrequent, is the cause of most casualties (Biezma et al. 2020). Pipeline sabotage is also used in the action repertoire of climate and Indigenous movements, but with a concern for avoiding spills and human injuries.

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PART IV

Power, Flows, and Knowledges


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16

GLOBAL HISTORIES OF ENVIRONMENT AND LABOUR IN ASIA AND AFRICA

Mattin Biglari and Olisa Godson Muojama

To an outside observer, the connection between labour and environment in the study of history may seem tenuous. Yet as existing surveys exploring this intersection attest, these two categories were co-constitutive through humans' alienation from the means of their own subsistence. Indeed, they often begin by invoking Marx's idea of social metabolism and capitalism's twin commodification of both labour and environment. Hence, despite the distinct origins and separate trajectories of labour and environmental history as sub-fields, since the 1990s historians have endeavoured to bridge these through several rich studies, which previous surveys have already comprehensively covered (Andrews 2014; Barca 2014; Chomsky 2016; Peck 2006; Soluri 2014).

Yet traditionally, the geographical scope of scholarship exploring this intersection was limited. Most of these histories are related to North America, Europe, and, to a lesser extent, Latin America. The 2010s, however, have seen a proliferation of studies at this juncture focusing on Asia and Africa, for which there is no existing overview historiographical survey (see Chapter 15, this volume). Thus, this chapter will examine these works to illuminate the current state of the field and its new directions. On the one hand, it highlights similarities with the main themes outlined in existing surveys of the Global North, especially between settler colonial and colonial contexts. On the other hand, it points to idiographic divergences because of the specific nature and timing of colonialism and postcolonial development. It also questions the "universal" applicability of certain concepts that originated in a Euro-Atlantic context, such as "environmental justice", "environment", "energy", and even "labour". Instead, it foregrounds the languages and epistemologies of these regions as a warning against universalist assumptions and a way to deepen our understanding of the unique histories of these regions (see also Chapter 1, this volume).

First, the chapter offers a review of how colonialism and colonial modernity has shaped the relationship between labour and environment across Asia and Africa, explained through several key themes including alienation, knowledge, health, subjectivity and resistance. Next, the chapter explores how energy history is a particularly productive space to think how labour and environment have been imbricated. It shows how they are put to work in systems of colonialism and global capitalism, but are simultaneously separated in effect.

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We show how this was achieved through divergence between the Global North and South – through localised violence in Asia and Africa – thereby requiring multiscalar analysis. The final section offers a detailed case study to illustrate the aforementioned themes – connecting labour, environment, and energy – in the history of the Nigerian oil industry.

Histories of labour and environment in Asia and Africa

Given scholars' original interest in social metabolism, it is unsurprising that one of the major themes arising from histories of labour and environment in Asia and Africa has been the co-constitution of these categories and their separation through colonialism or colonial modernity. This is especially pronounced in the modern history of the river Nile. For instance, Alan Mikhail shows how political and economic power in Egypt transformed in the late 18th century through the interface of labour and environment. Land became increasingly concentrated in the hands of wealthy landowners who sought to manipulate environments through large infrastructural projects to increase agricultural yields. These projects required hundreds more workers now removed from their home villages, sometimes even forcibly, and river management relied less on local environmental knowledge and ethical obligations than labour expended in the abstract – a process that accelerated with larger-scale projects in the 19th century involving hundreds of thousands of workers, and that consequently resulted in environmental degradation (Mikhail 2011, 2014).[1] Mikhail's work is important in showing how transformations that helped separate labour and environment were already underway before the arrival of European colonialism.

As Jennifer Derr shows, Egypt's later colonial economy would also rely on the ecological change wrought by labour. Although scholars have long noted how Egypt's expansive cash crop production relied on augmenting the Nile over the course of the 19th century, especially through irrigation, Derr centres labouring bodies in this process as "agents and sites of ecological change" (Derr 2018: 196; cf. Derr 2019). In particular, river management schemes that achieved perennial irrigation (as opposed to the previous system of seasonal irrigation that channelled waters of the annual flood) enabled increased yields of summer crops such as cotton, which was Egypt's main export and quickly came to dominate agricultural production.

Perennially irrigated agriculture had both ecological and biological effects. The proliferation of canals allowed freshwater snails carrying the parasitic diseases bilharzia (schistosomiasis) and hookworm to flourish, and labourers were now exposed to these for longer periods of the year (Derr 2018: 200–2). Likewise, perennially irrigated soils were sandier and moister, providing ideal conditions for hookworm to thrive. Workers also increasingly encountered hookworm through mud, which they used to line irrigation canals (Derr 2018: 205). Agricultural workers experienced the temporality of perennial irrigation especially through their embodied experiences of schistosomiasis and hookworm, both of which caused incremental damage over several years. The former, for instance, not only caused fatigue, aching, and fever but also left gradual layers of scars and lesions in tissues and inhibited organ function. Through the colonial economy, then, subjectivitities of agricultural workers were defined not against the environment, but through "the enmeshment of laboring bodies within the ecologies of perennial irrigation" (Derr 2018: 207).[2]

Plantations best exemplify how labouring bodies were imbricated within ecological transformations across Asia and Africa. A number of scholars have shown that plantations especially provided ideal conditions for the spread of disease in the first decades of the 20th

century. First, they were all extremely labour-intensive, requiring large numbers of workers living on site in packed barracks without adequate sanitation and water supply, which were conditions conducive to the transmission of diseases like hookworm (Kaur 2012). Second, the clearing of large tracts of forest for plantations left large pools of stagnant water or limpid streams, which were ideal breeding grounds for malarial mosquitos, giving rise to high rates of malaria in Malaya and Vietnam during the 1920s and 1930s (Aso 2018; Kaur 2012; Ross 2017: 117). Similarly, the waterways serving Firestone's plantations in Liberia, shaded and wind-broken by monoculture rubber forests, became infested with black flies that carried parasites causing river blindness (Mitman 2021: 206). Third, malnutrition made workers susceptible to beriberi due to vitamin B deficiency, and the arduous nature of work compromised their ability to fight off all diseases more generally. Finally, chemicals such as ammonia and herbicides increasingly became part of plantation agriculture, which could cause immediate bodily harm and had longer-term carcinogenic effects on those exposed (Mitman 2021: 206–7).

Ecological transformations similarly facilitated the rapid spread of disease in tea plantations in Assam, India, during the period of British colonial rule. The proliferation of mosquitoes in plantations combined with the malnutrition of labourers to cause high mortality rates among plantation workforces. At the same time, this made plantations ideal sites to produce scientific knowledge about tropical diseases; although this was nominally undertaken for the mitigation of disease, the exigencies of profit often prevailed (Aso 2018; Bhattacharya 2012; Dey 2018). For instance, planters evaded quarantine and vaccination programmes, in addition to labour laws, for fear these might temporarily decrease the number of available workers, preferring instead to employ a diseased workforce. As Arnab Dey argues, paying attention to ecology allows us to examine how "worker exploitation in Assam went far beyond methods of bodily regulation and structures of recruitment", experienced in the often-invisible forms of embodiment (Dey 2018: 13).

The embeddedness of labouring bodies in their environments also brings into focus the impact of pollution and toxicity in industrialised settings. Whereas works at the intersection of labour and environmental history in North America and Europe initially flourished in relation to industrial hazards and disease in urban settings, relatively little has been written about labour, pollution, and toxicity in urban spaces of the Global South. One notable exception is Brett Walker's *Toxic Archipelago*, which shows how pollution and toxicity have impacted human bodies through the engineering of landscapes in modern Japan. From the late 19th century, industrialisation created hybrid environments that allowed the easier spread of toxins through seamlessly connecting ecosystems, technological systems, and bodies. For example, oxidised metals from the Ashio and Kamioka mining complexes were carried along rivers and irrigation channels before being deposited in rice paddies and entering food chains (Walker 2010). Drawing on Linda Nash, Walker argues that it is the most industrialised landscapes – supposedly emblematic of human alienation from Nature – that we are most reminded of the human body's embeddedness in surrounding environments (Nash 2006).

Much less has been written on toxicity and labour with reference to the Global South. Walker aside, some other notable exceptions perhaps indicate why: epistemic erasure in the archive. Both Gabrielle Hecht and Iva Peša show how occupational exposure was rendered invisible in the extractive industries across different parts of Africa. For example, Hecht (2012) demonstrates how radiation exposure in uranium mines in the second half of the twentieth century was obfuscated. In some contexts, this was through the deliberate work of

mining companies to conceal exposure, as in South Africa; and in others, like Gabon, it was partially because of workers were mostly unaware of exposure, much like some anthropological studies about the "slow violence" of chemical exposure show (Nixon 2011). But, drawing on Michelle Murphy's concept of "regimes of perceptibility", Hecht (2012) argues that common across all these sites was the lack of technical instruments to make radiation legible to established transnational science.

Peša (2022) similarly brings attention to the invisibility of pollution in corporate archives relating to the Zambian and Congolese Copperbelt during the same period, despite companies being aware of their polluting effects. This was through a combination of corporate denial and medical findings either complicitly denying ill health or not being made public when they challenged corporate interests. However, through oral histories, Peša shows how it was also because even when workers were aware of pollution, they learned to live with it rather than make it a subject of political contention, especially because of its perceived inevitability and the economic benefits that came with the copper industry. Together with recent anthropological studies on inaction and "unnoticing" on pollution and toxicity in Global South contexts, this cautions environmental historians against filling silences in the archive with normative concepts of environmental justice, and forces careful consideration about its translatability from its specific origin in the United States to the rest of the world (Lou 2022).

The universality of concepts is further challenged by Tamara Fernando's (2022) study of the Mannar pearl fishery (off the west coast of Ceylon) in the 19th and early 20th centuries. Fernando shows how labour, as an embodied "mode of knowing nature", clashed with the efforts of the colonial state to rationalise, standardise, and centralise both Nature and labouring bodies according to the principles of scientific management. This was not pre-given: in the mid-19th century, the colonial state relied on divers' embodied expertise to find pearls underwater, especially where "the sea remained inaccessible" (Fernando 2022: 141) This gave labourers some power: throughout the remainder of the century, colonial administrators sought to increase yields not by supplanting the labouring body by new technological instruments but by disciplining and maximising its productivity. A colonial police force was present on shore and at sea, which compelled divers to work and inspected their activities. Nevertheless, divers used their privileged underwater authority in strategies of resistance, for instance by refusing to work after the sighting of a shark. Ultimately, by the 1920s, colonial administrators ceased their efforts to apply scientific methods to the fisheries in the quest to maximise profits: these were complex undersea ecologies "of which humans were one part", existing beyond capital, abstraction, and any universalising tendencies. By implication, then, the very categories of "labour" and "environment" were abstractions that assumed a separation conforming to colonial exigencies, but which failed to correspond to relations on the ground.

In other colonial contexts, labour subjectivity could be formed in opposition to environment. Aso shows how during the First Indochina War, many plantation workers in Vietnam framed rubber trees as symbols of French colonialism. Although plantations were designed to discipline both environments and bodies, anti-colonial cadres and official Viet Minh publications agitated that the French valued trees more than human bodies, and even that the former had been "fertilised" by the latter. Moreover, rubber was a profitable commodity for the colonial economy, such that the Viet Minh called for the outright destruction of rubber trees, and plantations became key battlegrounds in 1945–6 as many plantation workers destroyed thousands of rubber trees (Aso 2018: 172–3). The ecological transformations wrought by colonial (and pre-colonial) violence often produced fundamentally new environments and

subjectivities to what had existed before, sometimes bringing these in opposition to one another. To understand these transformations, then, it is necessary to adopt a case-by-case analysis about the place of environment in labour subjectivity on a micro level, which necessarily also means foregrounding contextually specific (non-Western) epistemologies and languages.

Environment and labour in energy history

Energy is a productive area to think about the intersection of labour and environment because it is a concept that originated in mid-19th-century European thermodynamics to put "the world to work" in pursuit of profit (Daggett 2019). This has entailed the utilisation of raw materials, especially fossil fuels, and the human bodies needed for their extraction, processing, transportation, and consumption. Nevertheless, energy is also emblematic of the obfuscation of labour in the commodification of "Nature", and of the apparent separation of labour from environment. Through a survey of works in this field focusing on Asia and Africa, this section shows how this connection and apparent separation is intricately linked to histories of colonialism, global capitalism, and postcolonial development, further alerting us to the geographical unevenness of the Anthropocene (see Chapter 12, this volume).

This is best exemplified by Timothy Mitchell in *Carbon Democracy*, in which he shows how oil figured in key political developments of the 20th century (Mitchell 2011). Perhaps the most insightful section of Mitchell's work is when he explains how oil could limit workers' agency and thereby alter the form of mass democratic politics: the natural properties of oil allowed governments in the West to find alternative sources of energy to coal, thereby being less vulnerable to mass strike action and workers' resistance. For example, oil's liquid and relatively light nature enabled it to be transported by pipelines and oil tankers in contrast to coal's transportation on railways, which could be more easily shut down through general strikes (Mitchell 2011: 36–8). The energy required for economic growth in the West, especially in Europe, was dependent on limiting labour activism in the Middle East, where most of the world's oil was produced by the mid-20th century. Even when oil workers did engage in mobilisations and sabotage to halt the flow of oil, Western intervention worked to maintain energy security, exemplified by the 1953 coup in Iran to oust Prime Minister Mohammad Mosaddeq. In all, Mitchell's work enhances our understanding about the global unevenness of the Anthropocene by highlighting how capitalist modernity in the Global North depended on the twin exploitation of labour and natural resources in the Global South.

This point is extended by On Barak's *Powering Empire*, which shows how industrialisation of Europe was enabled by the proliferation of British coaling stations in the Middle East and the western Indian Ocean (Barak 2020). In the process, coal-fuelled infrastructures such as irrigation pumps and desalination plants – and the new populations they supported in the arid environments of the region – transformed local ecologies. For instance, they contributed to the Lessepsian migration of marine life between the Indian Ocean and the Mediterranean Sea. Far from replacing human labour (and that of animals), these infrastructures each increased and intensified the demand for labour in the extraction (miners) and transportation (heavers and stokers) of coal. This labour was performed along lines of racial difference: Adenis and Somalis disproportionately worked in steamship engine rooms because ship owners believed they were naturally better suited to extreme heat, calling them "human salamanders" (Barak 2020: 94). This labour could also be gendered as it extended to work in the home, although less has been written about this in Asian and African contexts.

Coal supported not only colonialism, but also the formation of nation-states in the Global South. In *Carbon Technocracy*, Victor Seow argues that the coal mine exemplified industrial modernity in its taming of nature through technology, its disciplining of labour, and its productivism (Seow 2022: 9). All of these characteristics could be observed at the Fushun coal mine in Manchuria across the 20th century, from the period of Japanese occupation to that of the communist government. Whereas Mitchell finds coal had initially facilitated the rise of democratic politics in 19th-century Europe, Seow shows that the exploitation of coal at Fushun went hand-in-hand with technocratic efforts to maximise productivity through controlling labour, in line with increasingly statist preoccupations. As such, the carbon economy and the modern Chinese state were co-constitutive.

Similar processes were at play through the extraction of oil. In *Machineries of Oil*, Shafiee (2018) shows how the Iranian state and the transnational oil company (specifically the Anglo-Iranian Oil Company, which later became BP) were co-constitutive. On the one hand, oil concessions allowed the oil company to establish a socio-technical assemblage in south-west Iran, serving as a laboratory to establish security and for producing knowledge that could be used to manage political outcomes in its favour. For example, the company translated its racialised division of labour into technical calculations to prevent more democratic structures of oil production to emerge: it refused to promote Iranians to senior positions based on the claim that they lacked the necessary technical knowledge (Shafiee 2018). On the other hand, the company's corporate sovereignty and reconfiguration of property relations, turning lands customarily used by pastoral nomads into "state" property, laid foundations for the enactment of state power on the ground once nationalisation of oil operations took place in 1951.

Yet energy was not only a site for the production of power, but also one of resistance. As argued in a recent landmark volume, despite the oil industry seemingly affording workers less capacity for disruption compared to coal workers, this has not stopped oil workers from engaging in various forms of activism, ranging from large-scale mobilisations to acts of everyday resistance (Atabaki, Bini, and Ehsani 2018). This is especially so in the history of the Iranian oil industry, with oil workers in Khuzestan having been consistently engaged in labour activism throughout the 20th century, most notably playing a central role in the 1978–9 Iranian revolution (Jafari 2018). For this reason, as illuminated in several social histories of the Iranian oil industry, oil companies and the Iranian government devoted so much attention to controlling labour through methods of social engineering, racial segregation, and welfare paternalism. Nor is this particular to Iran, as several studies of the global oil industry show (Santiago 2006; Tinker Salas 2009; Vitalis 2007).

Nevertheless, if energy history illuminates how environment and labour are both put to work in practice, it also offers the opportunity to examine how this work is made invisible in effect. Energy erases "the circumstances of its production" so that it appears as an abstract universal force (Barak 2020: 29). This means that, in contrast to the hypervisibility of the labouring body in the plantation, the presence of humans in the production of energy has often been rendered invisible. For example, visual representations of the oil industry made by corporations and states have often occluded the presence of workers and the various forms of violence inflicted on them, creating the effect of an automated infrastructural system (Biglari, forthcoming 2024). This is perhaps why historians have only recently turned attention to labour in the history of the oil industry, despite histories of mining having been foundational to labour history as a field.

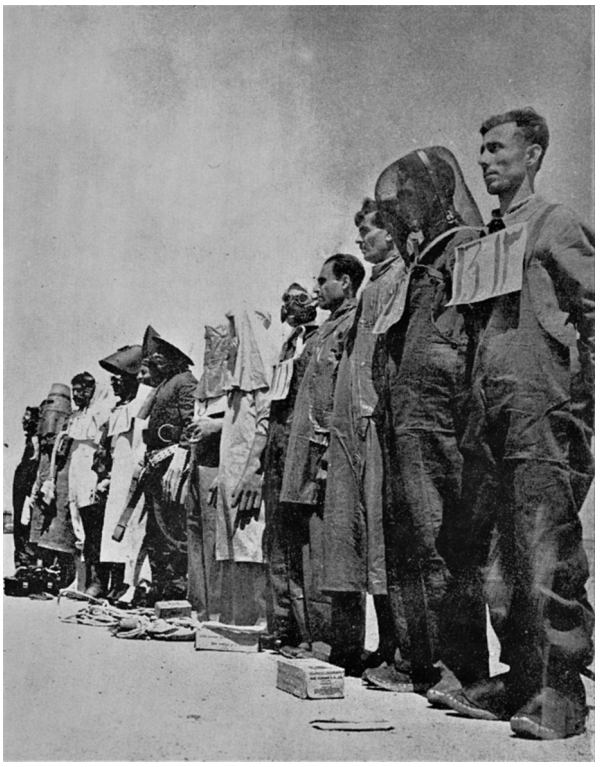


Figure 16.1 Safety training of Iranian oil workers, late 1940s. ARC 100033, BP Archive, Warwick, UK. © BP plc.

Labour in Nigeria's oil industry and its environmental consequences

The survey of the previous two sections has necessarily been brief in order to cover the breadth of studies that have flourished in the 2010s, yet it is also important to illuminate the complexities at the intersection of labour and environment through a more detailed example. This final section selectively examines the history of the Nigerian oil industry – bringing together labour, environment, and energy – as a means of demonstrating and complicating the themes outlined earlier (for a more thorough historiographical review of the Nigerian oil industry, see Genova and Falola 2003).

Besides agriculture, extractive industries have existed in West Africa since pre-colonial times. Gold in Ghana and tin in Nigeria were the major mineral resources extracted in what later became British West Africa. While the existing mining industries were expanded by the colonial authorities upon their incursion into the sub-region in the late 19th century, exploration for new ones was inaugurated. The most notable of the multinational corporations that dominated this sector were Ashanti Goldfields Corporation (AGC), which operated a gold mine in Obuasi (in Ghana) with its head office in London; and the British-owned Amalgamated Tin Mines (Nigeria) Ltd, incorporated in 1939 (Decker 2018: 696; Onimode 1978: 211).

In 1956, four years to the end of colonial rule in Nigeria, crude oil was discovered in Oloibiri in the Niger Delta by Royal Dutch Shell (then operating as Shell D'Arcy). Both Shell and Gulf Oil were producing by 1965, with the former doing so from East Coast onshore concessions and the latter from an offshore location in the Midwest. The petroleum and oil sector accounted for about 90% of Nigeria's foreign exchange earnings and about 95% of state revenues by 1976, when Nigeria was the world's fifth-largest exporter of oil. The oil sector has remained the major income earner for Nigeria, with numerous impacts on Nigeria's political economy, as well as labour and environment, the exploration of which will be the focus of this section.

The rise of the oil industry precipitated various changes and impacted not only the environment, but also labour regimes. Above all, it led to the proletarianisation, alienation, and marginalisation of labour, thus engendering a separation between labour and nature/environment. The character of oil production differed markedly from the production of the agricultural and mining industries already developed in Nigeria before the exploitation of oil. For instance, before the discovery of oil, colonial Nigeria was integrated into the orbit of global capitalism through the expansion of peasant commodity production in agricultural and mining products. Groundnuts and cotton, ginger and cocoa, oil palm, and sesame cultivation were all integrated into the peasant economy. Tin mining and gold mining were extremely labour-intensive activities relying on the same chain of labour contractors who controlled the lower rungs of the Nigerian labour market. The production of crude oil, by contrast, is notoriously capital-intensive. Only a few thousand workers are required to produce the millions of barrels of oil annually exported from Nigeria. Thus, the impact of oil had very little direct effect on the mass of Nigerians; it was the vast sums that suddenly accrued to the Nigerian government which has been decisive (Freund 1978: 93).

This effect of the oil industry on labour was compounded by the decline of agriculture and craft, occasioned by inflation, commoditisation, and urbanisation (Turner 1986: 33). Before the discovery of oil, agriculture was the main income earner for Nigeria. About 78% of the population was employed in agriculture, while the sector contributed 78.2% of the nation's revenue by 1962, and crude oil contributed 13.3%. Following the overdependence on oil, the equation changed such that the contribution of agriculture to the national revenue dropped drastically to 1.1% in 1977, while the oil sector's contribution rose to 98.9% (Olusakin 2006: 6). The rise of the oil sector and the concentration of investment around it at the expense of agriculture, combined with the dispossession caused by oil-funded state development projects, resulted in rapid proletarianisation of peasants, traders, and petty commodity producers (Turner 1985).

Similarly, the Nigerian oil industry impacted labour on the ideological front. Before the discovery of oil, national struggle revolved around colonialism and its impact such as exploitation, alienation, and concomitant racism. However, the exploitation of oil in commercial quantity was a postcolonial enterprise. Thus, subsequent labour and national struggle became framed around the oil industry. Sudden decline in the quality of life following the 1973–81 oil boom spurred popular protest, especially when elements in key economic positions expected improvement (Turner 1986). About 30,000 oil workers were employed prior to the 1983–6 retrenchment drive, with about 10,000 of them employed by the public sector, another 10,000 by private oil multinationals, and the remaining 10,000 by domestic and international service companies that perform contract work for the oil industry. By 1987, over half of this last category had seen layoffs. The Nigerian National Petroleum Corporation (NNPC) in the public sector had seen less job loss than the private oil corporations.

Thus, the oil bust brought local labour and foreign capital into a type of direct conflict that was hitherto unprecedented. This was manifested in the rejection, in late 1985, of an International Monetary Fund loan. Following the Structural Adjustment Programme that ensued, private foreign capital gained, while ordinary Nigerians were pushed further into more or less desperate strategies to avoid destitution and death. The oil recession of the 1980s and crash in prices at the end of 1985 coincided with the emergence of new alignments and developments among Nigerian oil workers. Retrenchment reduced their numbers, and repression weakened their unions (Turner 1986: 34–5). The dwindling fortune in the living condition of the oil workers and reaction to it is encapsulated in the Nigerian oil workers song as captured by Terisa Turner (Turner 1986, 33):

Oil Job is not good
Who can make soup with oil?
Who can drink oil?
Impossible!
The white man's trouble is more than oil.
They want us to work hard
But they don't want to pay us well
The rich eat while the poor work.

Added to these is the division and polarisation within the rank and file of labour. Oil workers are the most powerful and best paid of Nigeria's national and international corporate employees. In the rank and file of the labour movement, the oil sector also caused division and polarisation. Two employee groups – Petroleum and Natural Gas Senior Employees Association of Nigeria (PENGASSAN) for senior staff and National Union of Petroleum and Natural Gas Workers (NUPENG) for junior staff – codified the senior and junior staff status distinction in the oil industry. In July 1994 the latter went on what was until then perhaps the longest strike in the global oil industry since the 1978–9 Iranian revolution (Turner 1997).

The development of the oil and gas industry, especially in the Niger Delta region, has come with significant cost to the environment and health of the Indigenous communities (Ugochukwu and Ertel 2008). Nigeria is the second-largest gas-flaring nation in the world after Russia. In 2002, it was estimated that 108 billion cubic metres (bmc) of natural gas was flared globally, and that in 2010, 15 bmc was flared in Nigeria alone. There were over 100 flare sites in the Niger Delta, most of which are located close to human habitations (Ejiogu 2013: 983–4). Gas flaring releases over 250 identified toxins, including carcinogens such as benzopyrene, benzene, carbon-di-sulphide (CS2), carbonylsulphide (CoS), and toluene. Exposure to such toxins is known to have more directly impacted the health of workers and local residents by causing symptoms such as chills, fever, myalgia, respiratory irritation, nausea, vomiting and headaches, renal failure, central nervous system depression, cardiovascular failure, and altered neurobehavioral function, among others (Ejiogu 2013: 987).

Apart from gas flaring, oil spills have caused widespread environmental degradation. Since oil was first extracted in Nigeria, there have been over 6,000 oil spills documented, amounting to an average of 150 spills annually. Between 1976 and 1996, there were a total of 4,647 oil leak occurrences. A total of 127,467.96 barrels of oil were leaked between 2006 and 2012 alone.[3] Oil spills often pollute the soil and water that local inhabitants rely on for their livelihoods and subsistence (Ahmadu and Egbodion 2013; Bayode, Adewunmi, and Odunwole 2011).



Figure 16.2 Gas flare in Nembe Creek, Nigeria, 1993. Photographer: Sara Leigh Davis, Creative Commons Attribution-Share Alike 4.0 (https://creativecommons.org/licenses/by-sa/4.0/deed.en).

This situation has resulted in a series of protests over pollution and land use. Some of these have involved workers and local communities: for example, about 400 Bonny Island inhabitants, including oil employees, shut down Africa's largest oil export terminal in March 1986, stating that the operator, Shell, had disturbed their lives and made no positive contributions. A hundred women occupied the Shell helipad to block any helicopters from landing at the base of the tank field. They held signs that read, "Shell's 28 years in Finima is a curse to us", "Shell has destroyed our means of livelihood", and "No light, no water for us after 28 years of Shell". In Imo State, villagers demonstrated in opposition to the police killing of an oil worker in front of the military governor's office. Over 40 Shell employees were held hostage at the British company's headquarters premises for two days in April 1986 by the more than 5,000 residents of Egbema in Imo State. The occupation was a protest against the company's disregard for the neighbourhood when it first arrived in 1958 (Turner 1986: 44).

However, most protests have been led by local communities not employed by the oil industry. For example, in January 1993, 300,000 people marched throughout Ogoniland in protest of 30 years of pollution caused by Shell and its joint venture partners, led by Ken Saro-Wiwa (an Ogoni author and recipient of the alternative Nobel Prize and President of the

Movement for the Survival of Ogoni People, or MOSOP) (Sara-Wiwa and Saro-Wiwa 1995; cf. Watts 2004). From the late 1990s, a militant insurgency was mounted by the Niger Delta people against the oil industry to demand compensation for the destruction of flora and fauna. Conspicuously absent from most protest movements have been oil workers. Indeed, even as oil workers expressed solidarity with MOSOP in the 1994 general strike, among their demands they did not list any environmental issues, or even health issues relating to pollution (Turner 1997: 81–2). Evidently, then labour subjectivity in the oil industry was detached from the environmentalism of groups living in the Niger Delta region (Aborisade 2010).

In the case of the Nigerian oil industry, then, we observe many of the major themes outlined in histories of labour and environment across Asia and Africa: alienation; proleterianisation; labour subjectivity and resistance; environmental degradation; pollution and toxicity. Like other contexts previously outlined in histories of energy, this history shows how labour and environment were both exploited at the same time that they appeared increasingly separate. Moreover, it illustrates how this separation was necessary for the production of the former – labour itself – by alienating peasants from their land. Indeed, given that the oil industry's impact in the Niger Delta is perhaps most emblematic of the environmental degradation wrought by the global oil industry, it is instructive that none of the works on the Nigerian oil industry have approached this subject explicitly through the intersection of labour and environmental history.

Above all, the Nigerian oil industry brought about several transformations rooted in the exigencies of the colonial economy and its afterlives, which have continued to shape the nature of the industry to the present day. Ultimately, the extraction of Nigerian oil by multinationals has reproduced colonial relations of resource extraction, commodifying labour and environment for consumption mostly taking place elsewhere. The violence attending such transformations in Asia and Africa across the colonial and postcolonial periods – linked to the conjuncture of infrastructural capacity, energy supply, and the rise of the modern state – makes the intersection of labour and environment of special relevance to histories of these regions, and distinct from histories of Europe and the Americas. Yet it is also important to examine the pre-colonial period to examine how processes were already underway that alienated humans from their more-than-human environments, as illustrated in the case of Ottoman Egypt.

At the same time, the relationship between labour and environment should not be treated uniformly. If we are moving past unilinear narratives that posit a singular history of capitalism, we should also be aware of historically specific circumstances in which labour and environment are commodified and relate to each other in Asian and African contexts, which is especially pertinent when exploring how environment forms part of labour subjectivity. As outlined here, in some cases, like in the Nigerian oil industry and the rubber plantations of Vietnam, labour could be defined against or in isolation to environment. In others, like the Mannar pearl fishery or Nile delta, the experience of labour and environment could not be separated, and environment could even be a source of labour resistance. This means we should be cautious about the universality of certain concepts derived in Western contexts, such as "environmental justice", to avoid flattening the specific relationships and conditions of possibility for how people conceptualised their environments across the Global South. Even the categories of "labour" and "environment", and the separation this assumes, should be historically accounted for, or perhaps even provincialised. As such, we contend that not only is there ample room for more research focusing on labour and environment in Asia and

Africa, but that there is an even greater need for micro-historical studies across these regions in the years ahead.

Therefore, while histories of labour and environment in these regions may be relatively new compared to those of Europe and the Americas, they are not necessarily derivative in recounting a history we already know. Rather, by centring languages and epistemologies of these regions, there is great scope to change our existing knowledge of how labouring bodies relate to the world.

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Notes

1 On the colonial economy's reliance on labour for the maintenance of natural water sources in South India during the 19th century, see Ramesh (2019).
2 The formation of subjectivity through environment in labour history is elaborated through the concept of "workscapes", which "treats people as laboring beings who have changed and been changed in turn by a natural world that remains always under construction" (Andrews 2010: 125).
3 Federal Office of Statistics. Volume of oil spilled annually from 2006–2012. Unpublished statistics. FOS, Lagos, 2012.

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17

TOXICITY, RACIAL CAPITALISM, AND COLONIAL MINING

Lessons from Cyanide and Gold Mining in Zimbabwe (Southern Rhodesia)

Elijah Doro and Marco Armiero

Introduction

In 2000, a dam of tailings at a gold mine in Romania burst, releasing a deluge of toxic cyanide water into the tributaries of the Tisza River and exterminating aquatic life in downstream Hungary and Slovakia. This precipitated what has been dubbed "the worst chemical disaster after Chernobyl" (Cunningham 2005; Kovac 2000). Eleven years later, a global report on the use of cyanide in mining noted that 25 major accidents involving cyanide had happened between 1976 and 2011 (Justice and the Environment 2011). During the mid-1980s and 1990s, cyanide leach ponds in Nevada, California, and Arizona fatally poisoned an estimated 9,500 mammals, reptiles, and amphibians (Eisler 1991; Henry, Hallock, and Hill 1994). In 1982, cyanide effluent from a gold mine in Canada killed more than 20,000 steelhead. (Leduc et al. 1982). In April 1998, a Canadian gold mining company spilled 1.7 tonnes of potassium cyanide into a river in Kyrgyzstan. Thousands were poisoned and got sick, 2,000 were disabled, and several died (Pannier 2020). Between 2010 and 2013, more than 200 elephants were poisoned to death by cyanide in the Hwange National Park in Zimbabwe (Muboko et al. 2014).

These and other ecological considerations prompted a movement towards "green gold" and cyanide bans within the last two decades. However, while there are significant scientific conversations on the impact of cyanide and other toxic chemicals such as mercury on contemporary landscapes and human bodies, the historical toxic narratives of these poisons and their intersection with labour, race, and capital in colonial Africa gold mining remain understudied (see Chapter 16, this volume). This neglect marginalises the potential input of environmental history to illuminate and complement other facets of colonial research such as political economy, race, labour, and capitalism. Also, despite the proliferation of colonial mining research in recent years, the role of cyanide in the chemicalisation of landscapes and racialised chemical violence has not been much interrogated. This chapter uses the case study of cyanide and gold mining in colonial Zimbabwe to join the broader environmental history scholarship on toxicities, mining, capitalism, race, and labour (Barca 2021; LeCain

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2009, 2017; McNeill and Vrtis 2017; Merchant 1998; Pesa 2022; Rae 2001; Ross 2017; Ulmer 2020). From a theoretical point of view, this approach frees environmental history from a Cartesian dichotomy separating "nature" from the rest and places the human body at the centre of environmental history (Nash 2007: 8). Linda Nash argued in her foundational volume *Inescapable Ecologies*: *A History of Environment, Disease and Knowledge* that human bodies and nature are not discrete social or cultural constructions, but are co-constituted hybrid entities, enmeshed and embedded into power dynamics. Our case study clarifies that the focus on bodies does not flatten or obliterate power structures embedded in the environment such as class, gender, and racial inequalities. Our history does not speak of the relationships between human bodies and workspaces, but of racialised bodies organised by the capitalist colonial mining complex. The exposure to toxic contamination was part of the capitalist organisation of colonial workspace. In particular, we will present the case of cyanide contamination in gold mining in colonial Zimbabwe, employing archival fragments to illuminate the intersection of toxicity, race, capitalism, and labour within colonial mining practices.

Gold mining wastes landscapes and human bodies within embodied stratigraphy of power and toxicity (Armiero 2021). Chemical violence is inscribed on bodies and landscapes to produce wasted people, wasted landscapes, and toxic ecologies; in other words, what Marco Armiero calls the *Wasteocene*. The Wasteocene denotes toxic waste produced by humans, but it also connotes the wasting relationships that produce wasted people and wasted ecosystems within power hierarchies and structures that impose toxic regimes. These disposable bodies and wasted landscapes generated by toxic regimes are almost invisible in hegemonic narratives that praise capitalism and technological enterprise. Therefore, environmental historians must unravel the obscured regimes of toxicities submerged within historical institutions of racial capitalism and colonialism. This scholarly quest is more urgent in Africa, where the lucre of extraction for export-based capitalist settler economies motivated the colonial enterprise. The extractive encounters with colonial capitalism inscribed historical legacies of toxicity, disease, and death on the continent. The debris of these encounters was durable and survived the formal end of empire as toxic afterlives bearing on the material environment and spaces in which people live (Stoler 2016: 339). In South Africa, the colonial gold mining industry purveyed an insidious silicosis and tuberculosis (TB) epidemic that festered for over a century and tenaciously grips contemporary communities and human bodies (Ledwaba and Sadiki 2017; Marks 2006; McCulloch 2012, 2013). Toxic residues from historical and abandoned gold mines are the single largest source of waste pollution in South Africa, contaminating water supplies and endangering the lives of poor black communities along the gold mining belt (Chetty, Pillay, and Humphries 2021; Durand 2012; Oralde 2015). In colonial Zimbabwe, a brutal and coercive labour regime based on an avaricious model of "cost minimisation" and profit maximisation claimed the lives of an estimated 30,000 African miners to diseases between 1900 and 1948 (Van Onselen 1976). Chemical waste from gold extraction polluted rivers and creeks and poisoned plant and animal life. Toxic gases and fumes emitted during gold processing exposed African labour to chronic and transgenerational poisoning. Poisons from gold mines were further displaced into domestic zones and social spheres where new scales and repertoires of toxicities were constructed. Employing gold mining as a case study, this chapter contributes to the wider discussion on toxicity, racial capitalism, and its legacy in the making of wasted human and non-human ecologies.

Gold production and cyanide process in Southern Rhodesia: an overview

In 1974, the president of the South African Chamber of Mines, A.W.S. Schumann, remarked with a tone of irony:

> The mine dumps of the Witwatersrand are beautiful. We think of them with nostalgia, and when we are away, we return to them with joy. When told that some think them ugly, we are offended and then ponder on the thought that if our predecessors had refused to let mine dumps spoil the austere highveld horizon, then the gold mining industry would indeed be still born and none of us would have been here to express our concern about the environment. In the past industry in general has been guilty of many crimes against the environment, ranging from pollution to unadulterated ugliness and many of these crimes have been attributed to economic necessity when in fact they arose from thoughtlessness or outright incompetence.
>
> *(Schuman 1974: 17–24)*

This remorseful but belated introspection close to a century after the establishment of the colonial gold mining industry in southern Africa was an admission of culpability and impunity of colonial mining capital in polluting and defiling landscapes and human bodies. Today, these mine dumps continue to contaminate surface and underground water supplies with toxic metals such as arsenic and cadmium (Lecain 2017: 65). The toxic silhouettes of gold mining and its contemporary writ on communities and landscapes are cumulative legacies of colonial capitalist profligacy, technological innovations, and colonial racial politics. The discovery of alluvial gold in colonial territories in Africa and the Americas extracted by cheap native labour generated a boom in global gold production during the mid-19th century (Romero 2018). However, by the late 19th century, this trajectory subsided, as surface gold deposits were exhausted and traditional technologies were inefficient to extract gold from much complex ores found deeper underground. Recessions crept into the colonial gold mining sector, and by 1889 the Witwatersrand goldfields in the Transvaal were confronted with intractable geological nightmares as alluvial ores were exhausted and miners encountered pyritic rock and refractory ores (Phimister 1974). Subsequently, the fortunes of speculative mining in the Transvaal collapsed, and the market value of colonial gold mining capital fell by 70 % (Pogue 2009: 81).

As *les enfants terribles* of colonial gold mining capital, refractory ores had a unique geological identity. Unlike alluvial ores that were oxidised by natural geological processes, refractory ores occurred deeper underground, unoxidised and shackled with other chemical elements such as arsenic, and thus immunising them from extraction through mercury amalgamation.[1] Although amalgamation could remove 75–80% of the gold from oxidised ores, it could at best only extract 50% of gold in refractory ores (Adamson 1972: 88). This technological quagmire was eventually solved by the MacArthur-Forrester process (or cyanidation) patented in Great Britain in 1887 and in the United States in 1889. It involved the treatment of refractory and pyritic ores with dilute solutions of potassium of cyanide or sodium of cyanide to dissolve the gold and deposit it within extractor boxes (Blyth 1937). The toxic liquid waste was then discharged into slime dams. Cyanidation opened the geological frontier for deep level mining and exploitation of colonial gold deposits on an unprecedented scale. Mining companies could raise the yield of gold in refractory ores from 50% to over 95% (Gray and McLachlan 1933). They could also profitably treat waste and

tailings to recover at least an ounce of gold per tonne. Within months of its introduction, the total weight of gold produced in the Witwatersrand more than doubled, from 40,000 ounces/month in 1890 to 100,000 ounces/month in 1892 (Gray and McLachlan 1933). The battered prospects of colonial gold mining capital were restored into a profitable enterprise, and by 1893 cyanidation accounted for more than a quarter of gold production in the Transvaal.

This technological revolution had far-reaching effects in southern Africa, where gold mining capital carried the banner of imperial ambitions. The acme of cyanidation technology coincided with the annexation of the colony of Southern Rhodesia by Cecil John Rhodes and the British South African Company (BSAC). Rhodes had made his fortune in mining ventures in the Transvaal and Kimberley and formed a chartered company in 1889 to expand the British Empire in southern Africa. Phimister (1974) reckons that Rhodes's imperial adventure would have been abandoned in 1892 had it not been for the cyanide process. This technological revolution increased profits for colonial mining capital and provided guarantees for profitable financial returns from goldfields in Mashonaland. Rhodes was eventually able to annex Mashonaland and Southern Rhodesia and to invest in a colonial gold mining venture subscribed by large mining companies funded with capital raised on European stock markets. However, after extensive prospecting work, it became apparent that there were no rich gold reefs, and the extraction of gold in the colony required heavy expenditure before profitable production could begin (*Bulawayo Chronicle* 16 August 1897). Recession and depression crept into the mining sector, and the share value of top companies fell by between 50% and 90% (*Rhodesia Herald* 30 May 1898). In 1899, gold mining companies in Southern Rhodesia declared a paltry £26,000 dividend, and in 1900 even that miserly figure had whittled into nothing (Phimister 1976a).

The perennial pitfalls of gold mining capital in Southern Rhodesia evoked the chastening reality that the bane of gold extraction had been overcapitalisation on scattered low-grade quartzite reefs containing refractory non-oxidised ores (Phimister 1976a). Efficient and effective extractive methods were desperately needed. The first cyanide plant in Southern Rhodesia was installed in 1900 at Rezende gold mine in Penhalonga (*Rhodesia Herald* 24 May 1909). At a time when mining capital was focussed on limiting cost, the cyanide process was praised for its simplicity and economy, as it was estimated by colonial mining experts that an additional 8 dwts (pennyweight) of the gold originally contained in the ore could be recovered with an efficiency of 90% (*Rhodesia Herald* 9 August 1898). The returns from the cyanide plants were considered the difference between loss or profit to Rhodesian gold mining enterprises. It was estimated by mining experts that without the cyanide process, a few miners could have been profitable, as nearly 90% of the profits came through this agency (*Rhodesia Herald* 19 November 1901).

Cyanide and toxic gold mining landscapes in colonial Zimbabwe, 1908–1940s

The growth of colonial mining capital in Southern Rhodesia had preceded the establishment of white settler agriculture. The Company administration premised much of its hopes of colonial development on mining capital, and settler mining interests received much priority and preference. In 1895, the Company government passed the Mines and Minerals Ordinance that granted unfettered rights for mining capital to access water, timber, and grazing lands within the Gold Belt (Msindo, Madimu, and Swart 2018). Under this legislation, gold miners could peg claims on land expropriated for agriculture from indigenous

Africans and graze draught animals, cut indigenous timber, use water freely, erect temporary buildings, and conduct their mining operations. However, conflicts soon ensued in the Gold Belt between white settler farmers and miners over control of land, water, and forestry resources, as farmers complained about the nuisance of mining activities on their agricultural lands (Kwashirayi 2006; Msindo, Madimu, and Swart 2018; Musemwa 2009). These conflicts mirror similar contestations in California, United States, between farmers and gold miners during the late 19th century over the devastating impact of hydraulic mining technology on downstream farms in the Sacramento Valley (Merchant 1998: 113–35; Romero 2018) This was resolved by the 1884 landmark verdict that illegalised the dumping of mining waste in waterways (Kelley 1998: 120–5). However, in Southern Rhodesia, gold mining companies received little legal reprimand, and cyanide residue dumps and toxic tailing dams proliferated within the Gold Belt as peripatetic miners ravaged the countryside in search of gold. Concurrently, in the Transvaal, the disposal of toxic cyanide residue threatened the safety and lives of people in the vicinity of gold mining operations and cyanide leaks from gold mines poisoned streams of water (*Rand Daily Mail* 10 April 1908, 27 November 1906).

By 1908, the accumulation of toxic cyanide dumps within the Gold Belt had begun to elicit raucous responses from settler farmers over concerns on livestock poisoning. The Mines and Minerals Ordinance obligated gold miners to secure poisonous water and protect their cyanide tanks from cattle and humans by fencing and to inoculate cyanide waste before disposal as well as to warn the public against use of such water (NAZ S1681/22). However, infractions were so common that the Secretary of Mines often rebuked gold miners for ignoring to secure cyanide tanks (NAZ M3/11/8). In 1908, 30 cattle succumbed to cyanide poisoning after eating grass contaminated with uninoculated cyanide water that was being discharged from a nearby gold mine in Mazowe (*Rhodesia Herald* 22 May 1908). Cyanide tanks and slime dams on most gold mines were unprotected and a cause for "great public danger". Farmers constantly sought an audience with the mining officials over the insecure fencing on many cyanide tanks. In 1916, a Farmers' Association requested much stricter enforcement of fencing around cyanide tanks, as the matter was "a serious one" and "quite many livestock" had been poisoned (NAZ M3/11/8). They proposed provisions for extra fencing to ensure strong posts, barbed wire, and pig netting to effectively restrain small stock. However, mining officials insisted that existing precautions were adequate to secure water residues containing cyanide. Unfortunately, these unprotected cyanide tanks and tailing dams became "death zones" not only for cattle, but for African labourers who were not informed of the toxic risks embedded within the gold mining landscapes.

In 1909, an African labourer employed at Etna gold mine died after drinking cyanide water from an unprotected cyanide tank (*Rhodesia Herald* 12 November 1909). The manager of the mine, Joseph Edmundson Parker, was charged with culpable homicide for not securing two tanks containing potassium cyanide and not warning the public of the danger. The trial was a mere farce, and the manager was acquitted on the ridiculous technicality that although the tanks were not fenced, they were surrounded by various natural obstructions. This poisoning incident revealed that most African labourers were ignorant of the embedded toxicities within the mining landscapes and much prone to racialised chemical exposure and death. This ignorance was convenient for colonial mining capital to recruit labour for dangerous tasks, as Africans were seen as disposable bodies. The incident also showed that regulations on securing toxic cyanide water and waste were legislative formalities, as in most cases violators walked away free and in rare cases they only paid small fines and got

lukewarm admonitions from the mining inspectors. Tailing dams would occasionally burst, discharging cyanide water into the veld and pastures causing massive chemical pollution. In 1916, a manager at a gold mine in Gatooma was fined only £20 after failing to ensure the fencing of a dam that contained water impregnated with cyanide and fatally poisoning several cattle (*The Bulawayo Chronicle* 5 August 1916). In 1921, a complaint was raised against Mr Jones, a gold miner by Mr Rogers of Aadrick farm to the effect that he was allowing his slimes to run into and poison streams of water. Resultantly, cattle died, and cyanide slimes were found within the bellies of the carcasses (NAZ S1681/22).

The gold miners wantonly dumped their cyanide solutions into rivers, creeks, and other public sources of water supplies, polluting and endangering river ecosystems. The Odzi River in Umtali was severely contaminated by cyanide solutions and tailings. The ghastly riverine chemicalisation prompted the police to file a complaint to the Mining Commissioner expressing concerns over a heavy sediment of slimes in the Odzi River and directly opposite the Odzi gold mine. The police described the spectacle as "unsightly", as it was obstructing the flow of the river (NAZ S2721/6). The police indicated that they had spoken to the owners of the mine, who had admitted the source of pollution to be their gold mine but had not done anything to stop it. The Sambi River was also so heavily chemicalised by waste from gold mining that the water was described by the Mining Commissioner as "dirty and unfit for domestic use". The levels of chemical contamination were so rife that the Mining Commissioner observed with grave regret and despair that while his sympathies were with the gold mining community, he did not see "the necessity of destroying all the clean water in the country".

It is quite a herculean task to ascertain the ecological toll from the huge volumes of toxic waste dumped by settler gold miners into the environment during this period. The difficulty emanates from the conundrum that official colonial toxic narratives were much racialised and focused on white settler farmers and miners' power relations. Subsequently, colonial toxicities in African landscapes can be gazed only through the prism of white settler capital and power interests. Colonial toxic politics privileged entities that had value to settler economic power and obscured the other victims of chemical violence within gold mining landscapes. So, in these toxic landscapes, white settler cattle are more visible. This is not because cattle were the only victims of poisoning. Indeed, other species, plants, soil microbiology, fish, water life, birds, amphibians, mammals, and insects were poisoned in larger numbers on cyanide plants (Romero 2018). However, in the matrix of colonial capitalism, these were disposable bodies and species (Gargallo 2009; Mavhunga 2011).

Gold mining toxicities, race, and labour in colonial Zimbabwe, 1905–1930

The chemical poisoning and death of humans within occupational and domestic zones was commonplace during the early history of gold mining and cyanide use in colonial Zimbabwe. The toxic hazards on cyanide plants were acknowledged in 1905 by the Chemical and Metallurgical Society of South Africa after extensive investigations on the risks of chemical exposure to mine labourers (*Rand Daily Mail* 21 October 1905). Subsequently, the society drafted resolutions requesting the framing of regulations on compulsory cyanide poisoning and gassing antidotes for mine labourers. Concurrently, a series of fatal accidents on cyanide plants were being reported in the Witwatersrand gold mines. In 1907, a Chinese labourer fell into a cyanide tank and was suffocated to death (*Rand Daily Mail* 25 September 1907). At the Kleinfontein mine in Boksberg, three African labourers died of asphyxiation

from gas fumes while cleaning up a cyanide tank (*Rand Daily Mail* 22 April 1908). Poisoning incidences on cyanide plants prompted legislation to include cyanide rash, mercury poisoning, and arsenic poisoning as compensable occupational diseases in South Africa in 1917 (Myers 1989).

Cyanide plants had a racially hierarchised labour regime. White mine workers took the supervisory roles such as cyanide managers, cyanide shifts men, and cyanide foremen. These jobs distanced them from the intimacy of exposure to chemical hazards during the cyanidation of gold ores. Although constituting only 4% of the workforce in the mining industry in Southern Rhodesia, white workers had a monopoly on the supervisory and skilled jobs that came with much higher wages than their African counterparts (Phimister 1977). Africans working at cyanide plants exclusively occupied the drudgery-filled and dangerous roles as "cyanide boys" whose tasks involved roasting the gold ores, stirring the cyanide and gold ore slimes, and cleaning the cyanide tanks and zinc extractor boxes. The *Mines Circular* published in 1914 acknowledged the toxic risks associated with these tasks. The *Circular* noted that during the treatment of gold slimes with cyanide, there was the effervescence of toxic fumes from cyanide of zinc producing arseniuretted hydrogen – "the deadliest of all the compounds of arsenic" (*Rhodesia Herald* 14 May 1914). The *Circular* observed that much of the effects of such exposure were chronic, and labourers who had been exposed to the toxic fumes were unaware of the danger and only complained of headaches and nausea, which in some cases had proved fatal. Interestingly, although African cyanide boys were more exposed and vulnerable to poisoning from inhalation of the toxic fumes, colonial officials in Southern Rhodesia only became concerned about the dangers after the death of two white cyanide managers in 1914. Mr Wyndham Jones, a white cyanide manager at a Que-Que gold mine, succumbed to chronic arsenical poisoning arising from his system being "saturated with poison through inhaling the fumes during the course of his work" (*Rhodesia Herald* 19 March 1914). In Matabeleland, a white cyanide manager and an African cyanide boy were fatally poisoned while cleaning cyanide tanks (*Rhodesia Herald* 14 May 1914). The white cyanide manager was helping the cyanide boy to clean the tank. These two white cyanide supervisors' deaths prompted calls for new regulations to enable proper ventilation and escape of gases into the air on cyanide plants, as most were constricted and diminutive (*Rand Daily Mail* 20 September 1909).

The subsequent safety regulations emphasised that vessels used for the treatment of slimes during cyanidation had to be compulsorily fitted with mechanical agitators (NAZ M3/11/8). Furthermore, these vessels were supposed to be so conveniently situated so that all toxic gases generated had to be safely disposed to the external air to prevent persons from inhaling the fumes. When these safety proposals were circulated in a draft bill, they were vigorously opposed by certain sections of the gold miners, who felt they would subsequently incur huge operational costs. The Bulawayo Chamber of Mines berated the new regulations as constituting "a great financial hardship" to small workers who would have to bear heavy expenditure to install additional equipment. Instead, they proposed that wooden paddles with longer handles that operated on the windward side of the cyanide vats could more cheaply and more efficiently deal with toxic fumes. Indeed, many of the gold miners in Southern Rhodesia invariably operated on the principle of cost minimisation by keeping wages low while employing the crudest and most unsuitable methods of mining (Phimister 1976b). Although the bill was eventually passed, most gold miners were disinclined to expend costs on mechanical agitators or protective clothing such as gloves, overalls, and masks for cyanide boys who used wooden paddles to stir slimes in the vats. Thus, chemical

exposure of African labour in cyanide plants continued unabated. In 1927, two African labourers working on the cyanide plant at Shamva gold mine were taken ill after being overcome with fumes while stirring the slimes in the acid vats (NAZ S1713/2). One of them, Aliki Sinoia, rapidly deteriorated and died from arsenious hydrogen poisoning. The Mining Inspector's report was blunt and unapologetic on the sordid criminal negligence exercised by the mine owners. The report established that the deceased cyanide boy was newly recruited and not accustomed to working on cyanide plants. Furthermore, no warning had been given to him about the dangerous nature of his work. The report also observed that the cyanide plant was constricted and stirring was done by cyanide boys using shorter wooden paddles in a poorly aerated space, directly exposing them to effervescing gas fumes. Such incidences and occurrences of poisonings were widespread and pervasive in gold mines. In 1927, complaints about exposure to arsenic poisoning precipitated strikes amongst African workers at Hydra and Shamva mines (Hooker 1964). However, while the death toll in gold mines from diseases such as pneumonia and scurvy have been quantified (Phimister 1975), the toxic footprint of poisoning is much less visible in quantitative numbers. But what can be gleaned from sporadic archival records suggest wanton chemical exposure in unrestrained conditions of impunity on a disposable pool of African labourers. Also, most of the sources focus on acute poisoning, while slow chemical violence and chronic transgenerational poisoning remain obscured and difficult to quantify (Nixon 2011).

Despite the miniscule regulations stimulated by the 1914 poisonings, there was little enthusiasm from colonial officials in Southern Rhodesia thereafter to enact laws to protect labourers on cyanide plants. In 1921, the Compensation Ordinance Bill surprisingly omitted cyanide poisoning, arsenical poisoning, and mercury poisoning from the list of mining occupational hazards. Proposals by some progressive legislators to include them were met with trenchant objections from conservative gold mining constituencies (*Rhodesia Herald* 2 June 1922). Cyanide poisoning and arsenical poisoning were dismissed as conditions of "no serious character". Progressive legislators argued that there was the actual danger of cyanide and arsenic poisoning during the processing of sulphide ores and emphasised that most African workers who had been poisoned had to relinquish cyanide work and suffered a great deal of poor health. However, members from gold mining constituencies insisted that there was no reason for their inclusion, as the mining industry had not asked for such regulations. Despite this denial, later medical studies during the late 1950s and 1960s attributed the prevalence of carcinoma bronchitis and hyperkeratosis amongst African workers at gold mines to arsenic poisoning (Osburn 1957: 1969). These studies also revealed that most African patients suffering from these conditions had long histories of working on gold mines. Figure 17.1 shows the wasted palms and feet of an African gold mine labourer suffering from chronic arsenic poisoning in medical studies conducted between 1948 and 1956 (Osburn 1957).

Another aspect on the chemicalisation of landscapes and human bodies by colonial gold mining that requires historical attention is how toxicities crossed the frontiers of mining landscapes and became embedded within domestic and social spheres. We would choose to label this the "socialisation of toxicities" – that is, the process of displacement and acculturation of poisons from agro-industrial landscapes into domestic spheres where they acquire new meanings, new symbolisms, and new identities and serve purposes other than their intended use. Cyanide used on colonial gold mines crossed the confines of its active extractive lixiviant utility and embedded in the social and domestic rituals of murder, intrigue, suicide, criminality, and housekeeping. This was made much smoother because of

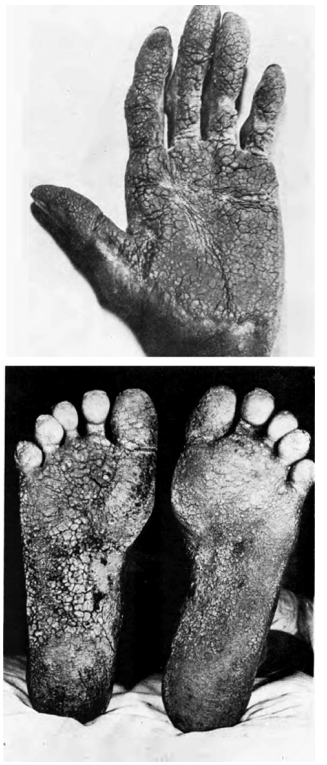


Figure 17.1 Feet and hand of an African patient with a 23-year gold mining history suffering from lung cancer and hyperkeratosis (1956). Osburn (1957: 219, 220).

the easy availability accessorised by its extensive mining use. In 1908, the Transvaal Pharmacy Board noted with concern the "indifference and carelessness" with which cyanide was stored on many gold mining properties and the respective frequency at which it was used for the destruction of life (*Rand Daily Mail* 5 September 1908). Suicides rates by cyanide poisoning were incidentally high. In 1909, there were concerns over what was described as "an epidemic of suicide" that was "passing over the Rand" goldfields in the Transvaal (*Rand Daily Mail* 22 February 1909). In Southern Rhodesia, cases of suicide by cyanide poisoning were common. In one of the cases, a mine owner, Mr F. Corfield, committed suicide by ingesting cyanide and left a note bemoaning the ruination of his mining venture which had run into insolvency with "no boys, no water, no fuel, no meal" (*Rhodesia Herald* 17 November 1911).

Within domestic spheres, potassium of cyanide was also used for the control of household pests and bugs. This practice although common, was roundly condemned by experts as injurious to health and reported to have resulted in many "sickly headaches and worst ailments" (*Rand Daily Mail* 25 July 1910). One fatal mishap was the death of Mr Jacobus Nicholas de Jongh, who was president of the Transvaal Chamber of Mines, from inhalation of cyanide after fumigating his residences (*Rhodesia Herald* 15 September 1911). Cyanide was also conscripted into the hunting rituals by Africa mine labourers to supplement their scant and rationed protein diet. In 1918, a "native" employed as a herd boy at St Louis gold

mine put a quantity of cyanide in a pool of drinking water for the purpose of catching birds, resulting in the fatal poisoning of cattle belonging to a white settler (*Bulawayo Chronicle* 27 September 1918). Cyanide was also appropriated as an accessory for criminal activities. In 1917, two African labourers at the Glencairn gold mine in Gatooma were found guilty of attempted murder after poisoning some meat prepared for another African labourer (*Rhodesia Herald* 3 August 1917). Another African mine worker was sentenced to five years' hard labour for attempted murder after supplying potassium of cyanide to a "native" woman at Queen's mine with the intention of poisoning her husband (*Bulawayo Chronicle* 24 November 1916).

The potassium cyanide from gold mines in South Africa and Southern Rhodesia also crossed boundaries in southern Africa because of labour migrations creating a regional network of socialised toxicities. In 1912, the colonial government in Nyasaland was concerned about an influx of poisons from South African and Southern Rhodesian gold mines (*Nyasaland Times* 27 June 1912). African migrants coming back from South African and Southern Rhodesia gold mines were bringing deadly poisons such as potassium of cyanide which they were using to commit crimes. In 1911, the governor of Nyasaland, Sir William Manning, despatched a letter to the administrator of Southern Rhodesia expressing grave concern over the importation of poisons by "natives" returning to Nyasaland from Southern Rhodesian gold mines (NAZ A3/12/24). In 1915, an African mine worker who had returned from Shamva mine in Southern Rhodesia was arrested in Nyasaland for possession of cyanide of potassium which he vouched he had obtained from a dump outside the mine. In one of the deadly acts, cyanide of potassium was used to pay off a grudge against a village, culminating in the death of seven people in Nyasaland (*Nyasaland Times* 27 June 1912).

Conclusion

In this chapter we have attempted to answer the question: how does environmental history look like when seen from a gold mine in the colonies, from the workers' bodies, from the rivers contaminated by toxic pollutants? For sure, it does not look like the familiar history of wilderness and its conservation. It does not reproduce a Cartesian dichotomy separating the social and the environmental. It does not support mainstream narratives that imagine a world divided between environmentalist elites and masses of poor uninterested in the environment. Building upon Stefania Barca's contribution on the relationship between work and the environment, we have shown the potentialities of an environmental history that places work and power relationships at the core of its analysis. Indeed, such historical narratives are useful conceptual tools to explore and analyse the intersectionality of race, capitalism, colonialism, and labour. We have shown how the racialised power relations in chemicalised and toxic mining landscapes mediated vulnerability to toxic exposure and visibility within settler-centric narratives that focused on white bodies and white capital. African bodies and vernacular landscapes were disposable entities much invisibilised within the wasted and toxic relationships of colonial capitalism that produced wasted people and wasted places. Therefore, writing environmental histories that integrate bodies and nature illuminates much more profoundly the link between the environment and other historical themes such as gender, race, class, and subaltern studies and provokes us to think critically about the colonial project, racial capitalism, and the construction of scientific knowledge about health and contamination. After all, as one of us has argued: the "environment" is not a separate realm; it blends human, technological, economic, and political power to produce toxic waste and

wasting relationships in the age of waste – the Wasteocene. By excavating the subaltern bodies in toxic landscapes and the concomitant power structures, we cross the disciplinary boundaries of environmental history to engage with colonial racism, labour studies, and postcolonial theories.

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Note

1 Amalgamation involved passing crushed ore through copper plates covered in mercury and heating the decanted mercury and gold mixture to vaporise mercury and leave the gold.

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18

LOCAL FISHERMEN KNOWLEDGE AND SCIENTIFIC EXPERTISE IN EASTERN EUROPE AND WEST AFRICA

Assessing the Unseen

Stefan Dorondel, Veronica Mitroi-Tisseyre, and Youssoupha Tall

"We know more [about the ecology of the delta] than what is written down on paper. If we act according to what is written on paper, then we will end up eating fish that is drawn on paper" (Bell et al. 2001: 14). These words, which may seem presumptuous, belong to a fisher from the Romanian Danube Delta who was criticising the way scientific experts and state bureaucrats assess the stock of fish population and respectively release fishing quotas accordingly. One may wonder why the disdain for scientific knowledge is so clear in the words of the fisherman. Is it only because ichthyologists' estimations are usually used in order to define fishing rights (and so the restrictions) and often blame local fishing practices for the degradation of fish populations? (Dorondel and Mitroi 2017; Mitroi 2013). Or is this a deeper distrust of experts' capabilities to estimate the number of fish without being fishers? Many scholars have documented this tension – if not outright conflict – between two types of *knowing* the fish as a resource (Bell, Hampshire, and Topalidou 2007; Johannes, Freeman, and Hamilton 2008; Scott 1998). These enduring controversies around estimations of fishing resources are rooted in two different ways of understanding nature and the way humans are interrelated with other species and ecosystems. On one hand, local fishers' assessment of the fish population is based on a direct experience with the fish, their feeding ecology and preferences, and a detailed knowledge of the local ecosystem. This body of knowledge – referred to by social scientists as "local ecological knowledge" (LEK) – covers many aspects of the natural world and has been passed down from one generation to another, sometimes for hundreds of years. LEK is essential to successfully catching fish and making ends meet (Berkes 1999; Gaup Eira et al. 2018; Law and Joks 2017; Shebitz 2005). On the other hand, the experts base their knowledge on scientifically rigorous observations, recorded and stored by research institutes, universities, and commercial firms (McCain and Kampourakis 2020). Research is carried out via state-of-the-art technologies such as teledetection (see for instance Andrade et al. 2007), is supported by the state, and is often wielded against fishers through top-down public policies. Even when not overtly opposed to each other, these two categories of knowledge developed as two different ways of seeing the world that engage

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different tools to assess it. It is also worth noting that both these categories are not homogenous; they have a great variety within them (Antonello 2022; Aswani, Lemahieu, and Sauer 2018).[1]

In the environmental history literature, these two ways of knowing are often represented in sheer opposition and separation. In this chapter, we rethink this dichotomy by attending to various actors and their relations. Despite the fact that these two ways of knowing the natural world are based on different epistemologies and on disbalanced power relations, they are not totally distinct and separated. Through a series of ethnographic vignettes, in two different settings – the Danube Delta (Romania, Eastern Europe) and Lake Guiers (Senegal, Africa) – we document the clash between these two ways of knowing but also reveal their intricacies and entanglements. We disentangle the power relations between experts, states, NGOs, and fishers, showing the way all these parties communicate. We document the role of the state in enforcing formal rules for fishing rights based on experts' assessment of the fish population. We show that whereas one body of knowledge – the local one – is disavowed by scientific experts and by state bureaucrats, the expert knowledge is in fact overconfident in its assessment of reality. The state – be it postsocialist, as in Romania, or postcolonial, as in Senegal – organises the politics of knowledge and imposes its experts' visions onto nature and the place of fishers within larger socio-ecological and production systems. This conflict is often seen as a purely dualistic "state protects fish stocks; fishermen overfish" relationship. But this is a profound oversimplification. Other elements such as ichthyophage birds, invasive species, and pollution – all socio-economic and ecological realities that cannot be blamed on fishers alone – have a great impact on fish stocks and should be included in any analysis. Whereas fishers include all these elements in their explanations for the scarcity of fish, states, experts, and scientists rarely do.

The chapter unfolds as follows. We first briefly mention the main concepts we use: fisher communities, LEK, scientific knowledge, and bureaucratic expertise. For reasons of space, we will not problematise these concepts or explore inconsistencies or contradictions, but rather attend to the tensions between them. The following two sections explore fishing practices in the Danube Delta and Lake Guiers areas and document the clash between LEK and scientific expertise and the adjacent problems that impinge on this tense relationship. We conclude by outlining some lessons gleaned from this study: although the two parties have very different epistemologies, they are surprisingly entangled and interdependent at the level of practices.

LEK, expertise, and the fish

A wide definition of LEK is the unwritten corpus of knowledge of the natural environment which includes local fauna and flora, soil, and waters (see, for instance, Casi, Guttorm, and Virtanen 2021; Law and Joks 2017). This knowledge is close to James C. Scott's *mētis*, a "knowledge embedded in local experience" (Scott 1998: 311). It is based on the direct observation of local ecologies and transmitted orally from one generation to another. LEK is a corpus of beliefs, principles, and social attitudes derived from daily practice of a community (Berkes 1999). We prefer to use "local ecological knowledge" instead of "indigenous ecological knowledge" as some authors prefer (see, for instance, Nelson and Shilling 2018), because while the word "indigenous" is appropriate for non-European populations that inhabited a territory before the arrival of European colonists, it is more difficult to use it in European context. Although there were, for instance, countries and places in Eastern Europe

that were colonised by the USSR, the word "indigenous" does not seem suitable for any European population.[2] Regardless, different communities on the Danube Delta have long lived from fishing and thus developed a specific knowledge of different species of Danube fish. These communities rely on fish for their socio-economic needs (Clay and Olson 2008), and thus they have to understand the ecology of different species, their behaviour and preferences, and the best tools to use in order to catch them.

It has been argued that there is a difference between local knowledge and scientific knowledge (Nazarea 1999; Scott 1998). The former is a situated knowledge (Berkes 1999; Casi, Guttorm, and Virtanen 2021), whereas the latter is formal, accumulated through institutions and publications, and, more importantly, backed up by the state. Scientific knowledge relies on scientific jargon that is difficult for laypeople to understand and that is validated by diplomas, offices, and social recognitions (Carr 2010). Scientific experts attempt to solve both theoretical and practical problems (Dostalík 2017), and they use their authority to impose their solutions (Vandendriessche, Peeters, and Wils 2016). Scientific knowledge is seen as universal, and its principles are debated in international networks; while LEK is local and specific. Fishers of a river or lake do not know the ecology of all species of fish, only the local species they catch. Other differences refer to relational aspects of LEK (Nazarea 1999; Nelson and Shilling 2018): villagers have an intimate relationship with their natural environment, whereas the scientific knowledge tends to separate humans from nature (Stiegler 2019).

In the last few decades this separation has become less pronounced, as the scientific world now tends to accept what has been termed as "citizen science". Defined as the involvement of citizens in collecting scientific data in collaboration with or under supervision of professional scientists and institutions (for more, see Eitzel et al. 2017; Irwin 1995), citizen science has gained more traction. It is now seen as a way to co-produce knowledge (Smederevac-Lalic et al. 2020). The collaboration between laypeople and experts in this type of hybrid knowing is also used in participatory monitoring of natural resources (including fish). This collaboration is not only a way of obtaining more data, but also a way of involving fishermen in the process of defining fishing quotas. The collaborative aspect is supposed to reduce conflicts in fishing management, by producing shared knowledge and expertise. However, as we will show, the participatory monitoring was not observed in the two areas that we studied.

Fish, landscape, birds, and people in the Danube Delta

Since the 1990s, various fishing rights systems have been experimented within the Danube Delta Biosphere Reserve (DDBR) in order to orient natural resource exploitation towards the conservation of biodiversity. In this largest and best-conserved wetland of Europe, fishing represents not only a very important income source, but also an important cultural element for local identity. With the creation of the DDBR in 1991, "overfishing" became the mantra of the Administration of the Reserve (ARBDD) and was seen as one of the main threats to biodiversity in the area (Gâştescu 2009).

After 45 years of intensive communist exploitation of the region by state companies (building massive agriculture polders and fishing farms and controlling the quasi-totality of fish catches and commercialisation), fishing enterprises started to be privatised after 1990. Between 1990 and 1997, fishing companies worked in the absence of clear regulations, the activity being ruled only by biological regulations (minimum size of catch, establishing a

fishing prohibition period) and the license system issued by the state. Witnessing the havoc produced by the unregulated exploitation of the delta resources, in early 2000 fishers denounced the privatisation of the former state fishing infrastructure and the mass dismissal of most fishers. Each fisher became self-employed and found themselves in a hard clash with the ARBDD's protective measures.

A new fishing law in 1997 introduced new rules for the exploitation of natural resources in the DDBR, especially a fishing rights system based on expert assessment of the stock. In the following years, expert estimations predicted a catastrophe in the fish stock that justified various fishing rights regulations (reductions of fishing licenses, maximum sustainable yield, fishing quotas, and authorised fishing gear). Significantly, the estimation of the existing fish stock was based mainly on fish catches. This raises several issues.

First, the scientific knowledge involved in defining the management of the Reserve's natural resources is based not only on standardised methods meant to objectively estimate fish stocks, but also on capture declarations made by fishers themselves (whereas technologies such as teledetection are used in industrial marine fisheries). Thus, captures determine estimations, and vice versa. But captures depend not only on existing fish stocks, but also on many other socio-economic and ecological entanglements. The economic capital of the fishers, the social differentiation among them, and the power relations within fishers' communities all play a role – along with ecological factors within the Danube Delta for which fishes cannot be blamed: fish-eating birds, eutrophication, and pollution due to agriculture.

Second, state offices blamed fishermen for widespread poaching. Experts rarely introduce into their critique the difference between traditional fishing communities and poachers, who engage in many unlawful acts. Local fishermen define poachers in precise terms: those who use forbidden tools to fish indiscriminately (such as dynamite or electricity, which kills everything in a large area, including spawn, or sonar and powerful-engine boats), that fish outside the established perimeters, or that fish during prohibition periods.[3] They also point out that poachers receive higher political protection. State and experts define poaching more loosely as an "act that intentionally contravenes the laws and regulations established to protect wild, renewable resources, such as plants, mammals, birds, insects, reptiles, amphibians, fish and shellfish" (Muth and Bowe 1998: 11). According to the state view, locals were turned from honest fishers into poachers practically overnight (Dorondel and Mitroi 2017). As one fisherman from Sfântu Gheorghe village put it to Veronica Mitroi in 2009:

> Fishing has become too expensive for us. Being a fisherman is a risky investment. I used to fish with a net with a 15-cm mesh, but the ARBDD now prohibits fishing with nets with mesh less than 20 cm. Each change in the law brings us closer to the status of poachers. Yes, yes, here the law makes poachers, like on an assembly line. You go out in the morning as a fisherman and come home at noon as a poacher, because they passed a law in the meantime of which you know nothing. All of a sudden, you are no longer in good standing, you are missing a piece of paper or you don't have the right one, or your tools are no longer in order, and here comes the poacher.

In many places of the world, anti-poaching laws are often used by states, NGOs, and private authorities imposing their vision and agendas on the living environment by criminalising local people and their practices (e.g., Jacoby 2001; Neumann 1998; Thompson 1975).

As a widespread global phenomenon, this is political at its core and reflects an unbalanced power relation between locals and an economic elite with access to local and global markets.

The struggle between the two parties – fishermen on the one hand, and experts and the state on the other[4] – turns around conflicting narratives (Campbell and Abbott 2009) around the meaning and causes of "fish population degradation" and the mechanisms via which overfishing can be stopped. Scientific experts emphasise the role of fishermen and their proclivity for overfishing. The overexploitation of fish has become a major concern for the ARBDD and declared a major threat to biodiversity. Consequently, fishing quotas dropped from 6.5 tons in 1997 to 3.5 tons in 2007, but this was not totally justified by the reduction of the fishing catches. If fishing catches did indeed diminish, the annual fishing quotas have rarely been exceeded (Figure 18.1).

It has been estimated that "the catches are not recorded nor reported in an accurate way", and that "the black market absorbs 50–60% of the real catches" (Iordache 2005: 172). Uncertainties about the degradation of fish populations are therefore not strictly ecological, but also social, economic, and political. Even if it is very difficult to obtain accurate data about fish stock evolution, the ARBDD has decided to base the fish regulation on expert indicators:

> With the quota system, it can be difficult to assess the maximum sustainable quotas using virtual population analysis or other methods. The thriving of black market, the lack of statistics on fishing effort and natural variations in the size of the fish population can lead to errors in estimating the maximum sustainable yield and reduce the effectiveness of management. Despite criticism of this kind, the fishery administration of the Danube Delta is still based on this strategy.
>
> *(Navodaru, Staras, and Cernisencu 2008: 327)*

In spite of the 2008 creation of fishing associations willing to get involved in fish conservation measures and promote traditional fishing as a way of life in the Danube Delta, the mistrust between ARBDD and local fishers led to an increase in restrictions in the following years. For instance, the ARBDD instituted a ten-year prohibition for an endangered iconic fish species (sturgeon) and prohibited some traditional fishing tools considered to be insufficiently selective. The entire delta population was accused of poaching in reports published in the regional and national mass media, while one of the ARBDD governors declared his determination to "finish with fishing in the Delta forever", considering a predatory activity for natural environments (Dorondel and Mitroi 2017). The very existence of fishing – on which local economies and identities are based – is threatened in the years to come by restrictions in fishing rights.

Our work in several villages of the Danube Delta shows that controversies between local fishermen and the state managers of the ARBDD are basically on the definition of fish. The ARBDD and ecological NGOs claim that fish are a natural resource that should be protected by non-interventionist means: that is, limiting human intervention on the environment. The fishing quota system should be understood as a way of protecting the biodiversity and ecology of the wetland. The delta inhabitants consider fish as a social resource that should be cared for, by assuring good growth conditions (Mitroi 2013). Local fishermen repeatedly expressed their regret that the socialist practice of fish farming and fish restocking

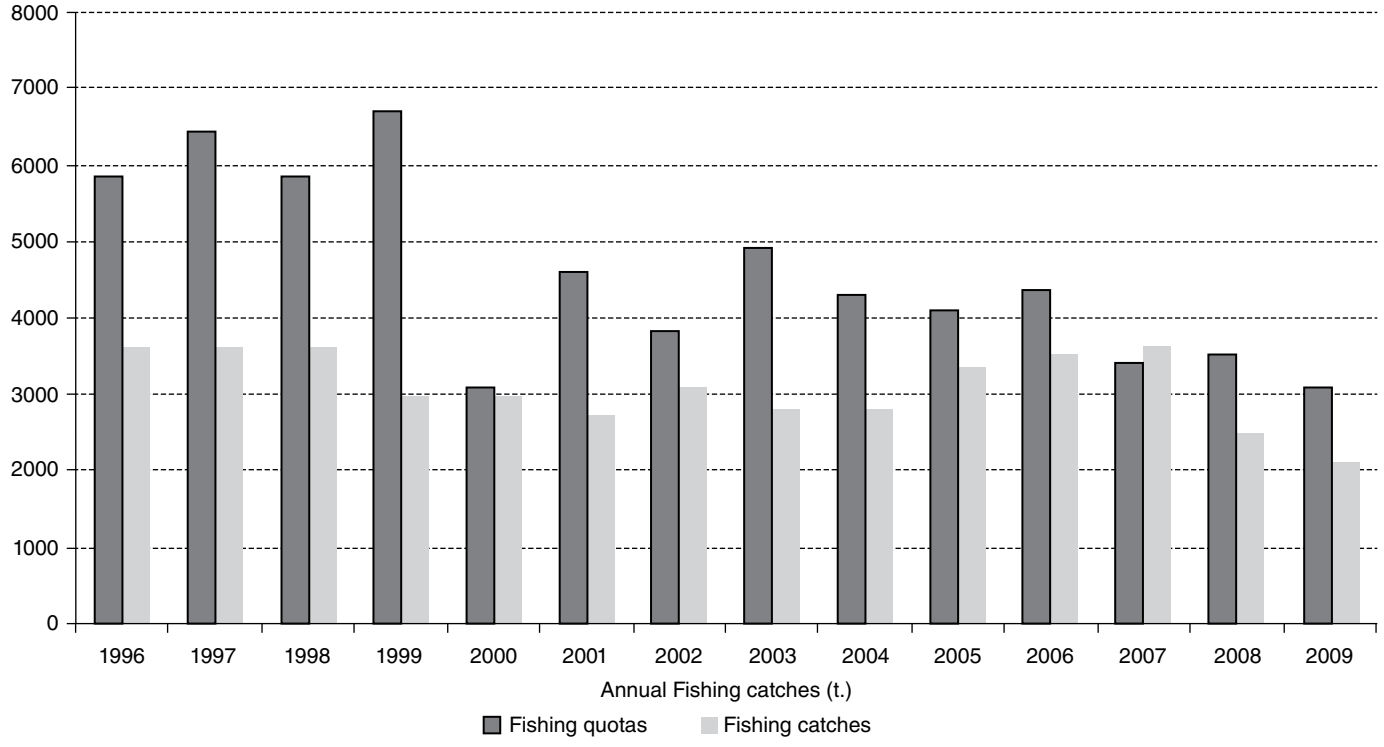


Figure 18.1 Evolution of fishing quotas and fishing catches in DDBR.

was stopped, and consider that this could help to maintain satisfactory fishing stocks in the Razim-Sinoe big lakes complex on the Reserve territory.[5] The ARBDD insists on intervening by controlling the rates of extraction and imposing prohibition measures. Conversely, an association of Razim fishers called the Group of Fish Producers of Razim (GFPR) highlights a need for the ARBDD to engage more directly in the productivity of ecosystems, in particular through repopulating different fish species. ARBDD do repopulate, but only endangered species such as sturgeon. As the president of the GFPR put it in an interview with Mitroi:

> Compared to 2005, the fish has dropped by 60%. Next year is going to be even worse, until there are none left! Before, it was good, we repopulated with fry and eggs. Now nobody does that. We take out all the fish and put nothing in its place. Without outside intervention, it will take years for the fish to regenerate.

This interventionist logic – proposed mainly by fishers and technicians nostalgic for the period of socialist high production of the delta – is not widely supported by state offices or by experts who would rather see less fishing in the delta than repopulation attempts.

Not only do definitions of fish separate fishers from the state bureaucrats and experts, but also management practices. Most (but not all) experts support non-intervention in the delta; they think the ecosystem must be undisturbed by human intervention if it is to thrive. In contrast, fishers believe that the clogging or closing of certain channels is one of the main natural factors degrading the fish population. Traditionally, they intervened by removing weeds that invade the canals and by setting fires – methods repudiated by the ARBDD. The clogging of canals influences the quality of fishing places, reducing water level and obstructing the circulation of water and fish. If the water circulation is slowed down, "it is not good, neither for the fish or for the fisherman. Fish don't like low water levels, they either die or go somewhere else", a fisher said:

> Just like a house, the delta must be cleaned constantly. If you let weeds grow around your house, you're not a good man, and the house will gradually be destroyed. The delta is the same: if we let nature take its course, the vegetation grows and gradually gains ground on the water.
>
> *(VM interview 2008, fisherman from Sfântu Gheorghe village)*

Another fisherman said: "It is not that we are more environmentalists than environmentalists, but fishermen respect nature in their own way". Close to the "dwelling perspective" developed by Ingold (2005), local fishermen consider the delta their living habitat and themselves as caregivers for the fish. They advocate for intervening actively in the landscape in order to create good ecological conditions for fishing.

Locals challenge the way experts of the ARBDD designated strictly protected areas where human presence is totally banned. According to the fishermen, the protected areas do not perfectly overlap with the places preferred by fish for reproduction. These zones were drawn according to criteria of ecological richness and "naturalness", or of a lack of human presence, and do not necessarily contribute to the improvement of the fish population. Fishers show the same mistrust in the ecological protection of fish-eating birds such as pelicans and cormorants. Designated as the number one enemy by most (if not all) fishermen we talked to, these birds are important, as they are part of the experts' calculation of sustainable fishing quotas. The estimated fish consumption of the birds (1.5 kg per day for each pelican) is included in

the total sustainable extraction quota (i.e. quantity of fish that can be extracted from the ecosystem without disturbing the ability to renew stocks). In the Danube Delta, the quantity of fish reserved for birds is more or less the same as (though some years more than) the fishing quota. Traditionally, delta locals would destroy a significant number of pelicans' nests and eggs in the spring in order to control their proliferation. This practice (encouraged also during the communist regime by the authorities) is totally forbidden today on the Reserve (which adopted the pelican as its symbol). Fishers criticise the protective measures, which they describe as "excessive"; they say that the ecological creed of "letting nature take its course" in fact leads to a reduction of fish. Fishers believe nature's course is not always favourable to fish, and so they advocate not only reducing birds' catch, but also keeping the lakes "open" and securing a permanent communication with the Danube River by de-clogging the water canals.

The stewardship of the delta as suggested by fishers is pretty similar to what Indigenous populations in other parts of the world do: for centuries before the Western ideology of "don't touch protected areas", locals acted as agents who shaped the landscape. Newly protected areas have seen the bureaucratic-scientific nexus evict local people from their ancient territory, which was for centuries the ground for hunting, grazing, logging, or fishing. The bureaucratic-scientific nexus projects modern ideas about how nature should look and what it is good for. The distinction between natural reserves or parks and areas where hunting, grazing, or fishing is allowed reinforces the divide between nature and culture and between the natural world and human activity. In other words, the state "creates wilderness" by segregating certain areas designated as national parks and protected areas from human activity (Kupper 2014; Neumann 1998).

Environmental concerns create victims not only in the delta, but also among fishing communities along the Lower Danube. Fishermen from Tutrakan, a small town laying on the Danube bank in northern Bulgaria, were banned from fishing close to a wetland on the bank of the Danube that was recently the subject of an ecological restoration project (Brashlen-Kalimok Natural Park).[6] Fishing is forbidden within 200 metres of the riverbank. Yet, as several fishermen of Tutrakan told Dorondel in summer 2021, banning fishing closer to the bank means that certain fish species simply cannot be fished anymore. The catfish (*Silurus glanis*), for instance, which likes deep mud holes close to the steep banks, and the Danube carp (*Cyprinus carpio*) both live not far from the bank and are the most two economically attractive species. Fishing at 200 metres away, fishermen can catch only mackerel (*Alosa immaculata*) and silver carp (*Hypophthalmichthys molitrix*), which lowers fishers' incomes.

So far, we have shown that there is an alliance between experts, NGOs, and the state that uses powerful tools to impose its definition of fish, assess ecological well-being, establish no-go zones of protection, define who are poachers, and impose management practices that control the territory of the Reserve. At the same time, there is also a continuum between LEK and scientific expertise that informs governmental decisions on fishing quotas. Scientific expertise is based mostly on fish-catching reports. This evaluation-catches-estimations-regulations equation is a circular relationship which ignores other factors that should be involved, such as technological state interventions, the noninterventionist policy, the existence of other creatures, and so on. The following section examines external causes of fish stock degradation, including invasive species, pollution, and climate change. All these disturbances should be linked to state offices' (lack of) activity rather than to fishers' practices.

Typha, fish, and fishers along the Senegal River

Freshwater fishing has a long tradition among the communities living on the banks of the Senegal River. Yet, in the last decades, fishers encountered several challenges. Waves of drought in the 1970s and changes in the river ecosystem produced by a high modernist policy – building large hydraulic, agricultural, and industrial infrastructures (Kamara 2013) – made the life of Senegalese fishers harder. According to Géraud Magrin and Sidy Mohamed Seck (2009), three main factors affected the river ecosystem. Firstly, the successive waves of drought affected the aquatic fauna. Secondly, building dams has contributed to the reduction of river currents and the consequent scarcity of marine species that used to enter Lake Guiers. Thirdly, intensive agriculture based on irrigation and agricultural fertilisers have caused the eutrophication of the lake and a quick development of aquatic vegetation, particularly *Typha australis*. These modifications of the natural ecosystem of the lake have changed the hydrological flows and ecological living conditions for most fish species. The decline of fish captures on Lake Guiers can be explained partially by this hydrological and ecological modification of the river ecology.[7]

The increase of invasive aquatic plants is a critical issue for fishers of the Senegal River and Lake Guiers. It is a consequence of a wider problem of water quality degradation, which is linked to agricultural activity in the Senegal river basin (Mboup 2014). *Typha australis*, an aquatic perennial freshwater herb, poses great problems to fishermen and constituted the subject of a fierce debate between experts from the state offices such as Water and Forests, Inland Fisheries, the Ministry of Environment, and local fishers. Typha is a plant that grows fast, easily reaching three metres high and thriving in shallow waters under different ecological conditions (Dia, Diagne, and Goudiaby 2020). Typha borders most of the banks of the Senegal River (see Figure 18.2). The mechanical and chemical measures to control Typha have failed so far. For scientific experts, this weed is beneficial. Typha favours the regeneration of the fish, offers sanctuary for fry, and provides a feeding source (of larvae, insects, and plankton) for fish (Magrin and Seck 2009). The plant, they claim, forces fishers to respect the maturation period of fish and limits the use of unregulated fine-mesh nets to catch fry. However, the fast-growing plant turns rapidly into a green wall that hinders the advancement of pirogues (small boats) and impedes fishing (Magrin and Seck 2009). Thus, for locals, the plant is a sign of the continuing degradation of the lake. Where once was fishing ground is now a field of Typha. As one fisher put it:

> Before [the emergence of Typha] the water was deeper, up to your chest, and you could park your boat. Sometimes, you could fish by just putting your knees in the water. There were times when the water was only a little above your ankles and you could still easily catch fish.

After Typha started to spread, fishermen's mobility in the water became utterly impeded. The plant also invades the piers, making access to water more difficult. The same fisherman continues his lament: "the entrance to the lake where you could catch fish is now blocked by Typha". Often, nets remain stuck in the bushes of Typha. Another fisherman says:

> Sometimes I go with my canoe for a swim. And I see a lot of nets stuck in the Typha bushes. It is not very motivating economically when you launch your net and it gets stuck in the thick vegetation. This is capital you lose as you can't get your fishing net back.

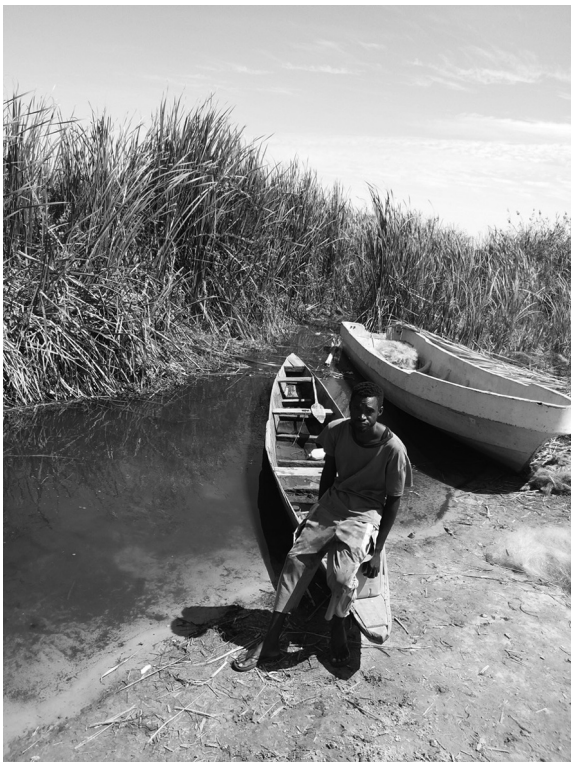


Figure 18.2 Fisherman preparing to board his pirogue on the Typha-lined lake. Picture credit: Tall et al., 2021.

For fishers, Typha is an enemy that worsens their life and pushes them to change fishing practices. For instance, as Magrin and Seck (2009) note, large boats with multiple engines – which were used to catch big fish – are no longer used; instead, they use pirogues. However, those who have no pirogue are excluded from this business. Those who have such a boat are forced to catch smaller fish, which encourages, the two authors suggest, the use of illegal smaller-mesh nets.

State experts emphasise the importance of this plant for the environment all the more, as there is a competition between different fishing groups for catching fry. Fishermen from the neighbouring country of Mali target the fry, as there is a growing local and regional market for it. Fishers smoke the fry on site before sending it in refrigerated trucks to Bamako and other towns in Mali. Malians have the right to fish in the Senegal River due to state agreements signed by the riparian states of Guinee, Mali, Mauritania, and Senegal.[8] The Malian fishers whose affluence increased after 2000 have different fishing techniques and tools compared to Senegalese fishers (Diouf et al. 2016). They use monofilament and large-mesh standing nets. Using monofilament nets means that they harvest fry in large quantities, which impacts maturation and thus stock levels. Furthermore, they leave their nets overnight to trap more fish. However, when other pirogues with engines go through the area, their propellers can rip the nets. The ripped nets remain for decades on the river's bed, trapping more fish that will end up dead. They also fish by using pots and traps. Malian fishers fit

propeller engines on their pirogues, which is forbidden by fishing regulations and constitutes a source of tension with their Senegalese peers. Thus, Senegalese fishers see the Malian ones as poachers and bad fishermen.

As fish become scarcer, or at least more difficult to catch due to Typha, locals attempt to weed the invasive plant by hand. This practice is harmful to the ecosystem and ironically leads to the weed's more rapid spread (Mboup 2014). This is the reason fishers consider the rapid growing of Typha as a degradation of the lake's resources. They link the lake degradation to practices of agro-industries and the irrigated agricultural perimeters, which use large quantities of agricultural fertilisers. Furthermore, local fishers claim that the fertilisers used by both agro-industrial large firms and small farmers pour into the water. Fish consume these residues and thus their flesh is "half-rotten":

> Sometimes you catch fish that are half-rotten or have horrible liquids pouring from their mouths. Then, you don't even touch the damn things, you don't even know what the hell is wrong with them. You only want to rip your net and let them back into the water. We started to fish this kind of fish only after the dam was built. If you swim into the lake for five minutes or you go into the water to look for your nets, you come out scratching your body for days or even weeks.

"Look at my hands!" the fisherman exclaimed to prove his point; they were covered with lesions. When fishers find such "abnormalities" – or "fertilizer-fish", as they call them – in their nets, they throw the fish back (if they are in the middle of the lake) or bury them in the sand (if they are closer to the banks). But they do not know if such fish are contagious and could poison other fish or contaminate the soil.

The authorities label these accusations as mere folklore and point to the fishers themselves as those who constantly overfish. In the authorities' eyes, overfishing is the main problem in the Senegal River. They plead for more sustainable fishing practices and for the acceptance of these aquatic plants that allow fish to move safely and thrive.

The West African examples reveal external factors that affect fish stocks, which are not part of the assessments that establish quotas for fishing. These external factors are not imputable to fishers. The state is to be blamed for dramatic changes in the fishing environments rather than the fishers' activities.

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The ethnographic vignettes from two quite different settings located on two different continents show dramatic similarities regarding the conflict between LEK and the state. Although the ecological, social, and economic situations are very different, some patterns emerge. In both cases, there is a local knowledge of fish ecology and behaviour that was developed over centuries. Both fishing communities possess a deep understanding of local ecosystems, which the state experts and bureaucrats constantly ignore and dismiss. In many parts of the world, fresh and marine water management is designed without local people having a say.[9] As R. E. Johannes et al. (2008) show (via examples of the clash between Solomon Island fishermen and biologists from the Australian Center for International Agricultural Research), when scientific knowledge ignores fishermen's local knowledge of annual, seasonal, or monthly variations in the behaviour of marine life, incomplete or inaccurate scientific data are produced. This dependency is not new. Richard Hoffmann and Verena Winiwarter

(2010) show how in the medieval age, the scientific written expertise of monks benefitted from peasants' direct experience of working the land.

The persistent controverses between expert knowledge and LEK is particularly evident with regards to complex interactions between human practices and ecosystems. As Tall et al. (2021) show, states are inclined to either overlook or overstate various activities that impact the fish population. Often, state policies regarding the protection of fish as a resource emphasise overfishing but disregard the strong ecological impact of pollution, agriculture, or built infrastructure. State experts emphasise fishermen's proclivities for overfishing and fishing outside the established perimeters, during prohibition periods, or with damaging tools. Experts rarely introduce into their critique the difference between traditional fisher communities and poachers who engage in these unlawful acts. In fact, as many authors have pointed out, poaching laws are often used by states, NGOs, and private authorities to impose their agendas on the living environment by criminalising local people and practices (e.g., Jacoby 2001; Neumann 1998; Thompson 1975).

This is not to say that scientific expertise is always wrong or that LEK is always correct. The desire of Senegalese fishers for a Typha-free lake and the Danube Delta fishermen's hate of ichthyophagous birds is understandable, but that does not mean their wishes would be positive for biodiversity. The state visions for pristine natural spaces void of human activity are counterbalanced by fishers' visions for environments free of natural competitors. Both visions are too radical and not beneficial for ecosystems and biodiversity. States and experts are wrong when they try to impose the image of an untouched natural environment. Since the Homo genus started to wander planet Earth, very few – if any – places have remained untouched by human intervention (Cronon 1996; Roebroeks et al. 2021). Humans living for generations on the banks of rivers and lakes should not suddenly be banned from their way of life. But fishermen facing material difficulties tend to overlook the importance of biodiversity. Using fire to remove weeds can be beneficial for the environment, but, left unattended, those fires can produce ecological catastrophes.

Local fishermen resist scientific and expert impositions by displaying their own knowledge of the landscape and fish. The fisher's words of disdain for scientific knowledge that opened this chapter should be read, in our opinion, as an attempt to resist the state power that repeatedly imposed economic and political regulations that created injustice for local people. States, be they European or African, often impose radical changes on waterscapes by building large infrastructure and reclaiming agricultural land, which massively affects the natural world. Some of the fishermen's practices may be unsustainable, but they are a response to state and private initiatives to control nature and people.

Conclusions

Compared with a natural resource such as a forest (where trees are visible and countable), fish are a resource that is relatively hard to see. This fact makes the central concept of "overfishing" disputed and contested by both sides. There are also differences in the ways of assessing the health of the fish population: narrowly, by looking only at fishers' practices (as favoured by the state), or more widely, by taking into account other non-human elements such as fish-eating birds, agricultural pollution, and infrastructural works (as favoured by fishers). Instead of looking at fishing as a socio-natural entanglement between fish, plants, birds, water quality, humans, and institutions, the state reduces the relationship to the fish and fishers, a simplification of both the natural world and the economic sphere.

The two ways of knowing and assessing fish resources are not entirely opposed, as scientific assessment is often based on fishers' catch reports. This creates a vicious cycle: catch reports are inaccurate for many reasons (fish price, the desire to hide a part of the catch from the state, etc.), assessments of fish populations and quotas for the following year are established on these catch reports, which in turn affect future fishing practices and catch reports. This cycle has serious environmental and economic impacts.

Observing how social realities are shaped in interaction with natural processes within the existing frame of power relations allows us to infer a more general image of the clash between LEK and scientific expertise. They are very different epistemologically, but they are surprisingly entangled and interdependent at the level of practices.

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Notes

1 We thank Mark Carey for this observation.
2 This is a larger debate that we will not address here. For different analyses, see Todorova (1997, and especially the Afterword to the 2009 updated edition), Chari and Verdery (2009), or Dorondel and Serban (2022).
3 According to an interview with a fisherman in Mahmudia took by Stefan Dorondel (August 2021).
4 It is only logical to put the state and experts on the same boat: experts' salaries and research funds are paid by the state from public funds, and their scientific assessments are used by the state in issuing its policies.
5 The Razim-Sinoe complex of lakes covers 87,000 ha, encompasses 11 big lakes and several smaller ones, and represents the most important lagoon system of the Black Sea. See Vadineanu et al. (1997).
6 For more details, see Dorondel (2021).
7 For more information on the decline in fish catches in the Senegal River basin, see Bruckmann (2016).
8 For more details, see the organisation Pour la Mise en Valeur du fleuve Sénégal (https://www.omvs.org/).
9 The observation can be extended to other natural resources as well.

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19

HISTORICAL MEMORY AND TECHNOCRATIC FAILURES IN ENVIRONMENTAL IMPACT ASSESSMENTS

Javiera Barandiarán and Ricardo Oyarzún

Introduction

Environmental Impact Assessments (EIAs) have become a politically important type of scientific assessment. EIAs combine scientific information with public participation to assess the environmental impacts a proposed development project may have. When first adopted in 1970 in the United States, EIAs promised to democratise science for decision-making by requiring government agencies to consider the information submitted by an array of affected groups (Caldwell 1982; Milazzo 2006). Now, EIAs are used worldwide in nearly every country, possibly becoming the most emulated US policy in the regulatory playbook (Greenberg 2012). Yet after over 50 years in use, EIAs have become an object of conflict: often, communities opposing development projects like a hydroelectric dam, industrial plant, or mine mobilise against the project but also against (and through) EIAs (Jaskoski 2022; Walter and Wagner 2021). Affected communities criticise that EIAs are designed to greenwash development rather than seriously consider local input or hold companies to high environmental standards (Goldman 2005). While those who designed EIAs believed they would help democratise environmental decision-making and install environmental concern across all areas of government decision-making, scholars have since documented the ways in which EIAs are ineffective, fan conflict, or advance industrial interests. What about EIAs has led to this historical arc? Why have the promises of EIAs seemingly lost their appeal after more than 50 years of global practice?

This chapter opens with two sections that chart the global diffusion and then criticism of EIAs. We argue this trajectory reflects a preference for, and then disillusionment with, technocratic forms of government (Antonello and Howkins 2020; Callon et al. 2012). During the second half of the 20th century, "the Cold War and its traveling technocrats ushered in new fantasies and utopian dreams about modernity and ways to remake, control, and harness both nonhuman nature and technologies" (Medina and Carey 2020: 314). EIAs reflected these ideals: through scientific knowledge, democratically sourced, they could help responsibly remake nature, anticipating and preventing future environmental harms produced by productive technologies. In the process, EIAs contributed to making "hybrid landscapes" that intermingle nature and culture, and a modern, linear time, in which studies of the past

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informed present actions and projected a "malleable future" (Bergwik and Ekström 2022: 2; White 2004). In the third section, we examine the results of 22 years of EIAs approved by Chilean environmental authorities greenlighting the construction and expansion of industrial activities in Quintero-Puchuncaví, two coastal towns that have for decades seen high levels of pollution and whose residents suffer cancer, illness, and other negative consequences (Gayo et al. 2022; OPS/OMS 2018). In many ways Chile's application of EIAs and Quintero-Puchuncaví's toxic-fuelled tragedy are typical (Huneeus et al. 2021; in California, poor governance has also led to toxic build-up, see Rubio et al. 2022; Tejeda 2022). What the Chilean case highlights well is the decentring of the state and diversity of expert voices that occurred as markets became the preferred mechanism for generating knowledge and organising government (Barandiaran 2018; Medina and Carey 2020).

The final two sections examine the consequences of EIAs for temporality. Through their baseline and impact studies, EIAs privilege the creation of environmental scientific knowledge that both normalises past environmental degradation and directs attention to the future through predictions of expected impacts (Barandiaran 2020a). The present moment – with all its environmental challenges and demands – is thus epistemically erased in a twin movement that is necessary to maintain faith in the promise of managerial control. EIAs thus reflect a Western tradition that kept human and natural time separate (Bergwik and Ekström 2022; Martin 2022). However, in a world grappling with climate change, pollution, and demands for more fair and just forms of governance, the technocratic promise of managerial control appears to have lost its shine: the explanatory power of linear time is weakening when faced with the limits of ecological restoration (Martin 2022) or the temporality of climate change, which is "bringing the past and future closer to the present" (Bergwik and Ekström 2022: 4). Faced with such an array of challenges and demands, policymakers need to devise environmental policy tools that ask new questions to connect the environmental past, present, and future with greater care, trust, and legitimacy; the final reflection section suggests some such questions.

EIAs: origins, global diffusion, and basics

In the 1960s, US political scientist Lynton Caldwell developed Environmental Impact Assessments and translated them into policy through the groundbreaking National Environmental Policy Act (NEPA), signed into law in 1970 (Milazzo 2006). Caldwell sought to "legislate environmental awareness" by forcing state officials working at every office involved in the planning and licensing of infrastructure projects to consider a new project's environmental impacts and how these might be lessened. NEPA's promoters saw EIAs as revolutionary because they democratised expertise: before NEPA, these decisions were made by officials relying on specialised expertise drawn from within their agency, meaning that they were effectively shielded from knowledge claims brought by outsiders (Caldwell 1982; Greenberg 2012). With NEPA, state officials could no longer justify a project solely on their agency's internal knowledge. Instead, they had to show that they had considered information provided by a variety of affected groups, including citizens, indigenous tribes and communities, civil society organisations, universities, consultancies, think tanks, and other agencies. NEPA thus simultaneously democratised expertise and consolidated its place in the decision-making process – first in the United States, then globally (Hironaka 2002).



Figure 19.1 Polluted beach at Quintero-Puchuncaví, with industrial facilities in the background. Photograph by Tristan Partridge, August 2021.

Endorsed by global environmental NGOs in the 1970s, the European Union in 1985, the World Bank in 1989, and the 1992 Rio Earth Conference, EIAs were adopted by governments worldwide to promote sustainable development (Cashmore et al. 2007; Horberry 1985; Pope et al. 2013). EIAs provided a managerial approach to reconcile growth and the environment that appealed both to those with the power to invest globally, like the United States and the World Bank, and those concerned about the impacts of those investments, like environmental organisations (Goldman 2005; Macekura 2015; Najam 2005). Part of their appeal lay in the use of science, seen to be apolitical (Hironaka 2002). For example, during the 1970s, the US government touted EIAs as a science-driven policy tool to promote their use in Antarctica (Antonello and Howkins 2020). Scientists opposed to drilling in Antarctica turned to EIAs once they accepted the projects would go ahead; if they could not be defeated, then better to work to reduce their negative impacts through this new policy. Years later, such diverse entities as the World Bank in Laos (Goldman 2005) or the national government in Peru (Li 2015) similarly promoted use of EIAs as a technocratic tool for managing competing economic and environmental interests. Latin American governments embraced this global template, even as local institutions and histories explain why practices vary by country (Orihuela 2014).

The basic principles of EIAs have remained remarkably stable over time and across the globe (Glasson et al. 2012). First, all EIAs intend to be preventative in the sense that a company or entity that seeks to develop a project or industrial facility must submit its environmental studies prior to obtaining a license to build or operate. Second, all EIAs are based on

data and science, starting with a study of impacts which is vetted or supplemented by studies and information provided by interested parties, including local communities, interested parties, and state agencies. Third, all EIAs seek to identify the impacts a project is likely to have and propose ways to avoid, mitigate, or compensate for these impacts.

Within this template, national practices vary. For example, in most countries, EIA studies are done by consulting companies hired by the company seeking a license to build or operate. In others, however, authorities intervene in this relationship either by keeping a roster of valid consulting companies or by hiring consultants directly. The basis of comparison in EIAs can vary. In some EIAs, consultants compare impacts under alternative scenarios, including not building the project or building in a different location. But this does not occur in most countries, meaning that EIAs cannot change the most important design decisions. Another significant difference is who makes the final decision – whether environmental authorities only, or some combination of representatives from various areas of the state (e.g., mining, agriculture, etc.). And practices vary regarding a state's enforcement capacities and how long EIA permits are issued for. The terms Environmental Impact Statements, Environmental Impact Review, Environmental Impact Assessment, or Declaration of Environmental Impact are used in different countries to refer to this same basic template. In this article, EIA is used to describe a single study or project, and the plural EIAs for the system as a whole.

For reference, a more detailed account of Chile's EIA process is provided. Required since 1994, but regulated only since 1997, Chile's EIA law defines which impacts trigger an EIA and which require only a simpler DIA ("D" for declaration; Decree 40/2013, article 4). Based on these reports, and after a favourable assessment by state officials, a permit is issued, which could be suspended in the event of non-compliance. EIAs typically consist of a baseline study, an impact assessment, and plans to address the anticipated impacts. Baseline studies record existing environmental conditions (e.g., geology, soil conditions, hydrology, social setting, etc.), while impact evaluations assess and rank how the project will impact those conditions. The impact assessment usually consists of ranking hundreds of potential impacts, on topics from water quality to solid waste management. For each potential impact, the project proponent proposes measures to manage impacts, and the authorities verify whether the project is in compliance with applicable laws. The Environmental Assessment Service then proposes under what conditions the project can be approved, and a committee of ministerial representatives votes to approve or reject the project. The committee can withhold approval if the project violates environmental quality standards or is expected to impose undue burdens on the affected communities. In Chile, a streamlined version of EIAs is also used, called DIAs: these do without baselines and in most cases without public participation, and they require only impact evaluations.

EIAs increasingly drive environmental conflict

Over the last decade, EIAs have been criticised for a number of failures. Many of these reflect a common problem with technocratic solutions: as stated by Antonello and Howkins (2020: 3) for the case of Antarctica,

> despite the pretense of technocratic neutrality, this form of environmental management functioned to promote US political interests in the continent through the reduction of conflict, the crowding out of subtly different environmentalisms, and the maintenance of the political status quo.

Scholars have reached similar conclusions analysing very different EIAs and contexts, where national or even international (e.g., World Bank) interests are the ones being advanced (e.g., Goldman 2005). Li (2015), in a study of the EIA for a very large mine in Peru, examined how EIAs excluded knowledge of impacts that could not be managed as well as indigenous knowledges about local ecosystems (see Chapter 1, this volume). Fiske (2017) analysed the performance of technocracy in an Ecuadorean oil field where the EIA for the project circumscribed the area of influence to narrow down the expected impacts of oil extraction. Another way to maintain the status quo is to exclude whole groups of affected peoples: Kelly (2019) analyses such a case in southern Chile, where the EIA for a hydroelectric facility omitted indigenous communities entirely from the study. And in the Falkland Islands (Malvinas), scientists tagged penguins to fill in "data gaps" in an EIA seeking to validate oil drilling while advancing British corporate-national control (Blair 2019). Experiences like these, where EIAs have failed to protect the environment and advanced industrial interests over those of citizens, have led many scholars, activists, and affected communities to lose faith in the technocratic promises of EIAs. They also illustrate the need for environmental historians to examine Latin America's industrial or hybrid environments, to complement the larger literature on agriculture, tropical forests, and conservation (Soluri et al. 2018).

Such experiences resonate also with broader findings that position Latin America as central, and not peripheral, to global science-driven policies (Medina and Carey 2020). As Latin American nations adopted EIAs, they helped define central EIA practices related to the role of the state and the diversity of expertise. EIAs seemingly centre the state by putting state authorities in charge of reviewing projects. However, since the 1980s EIAs have advanced a de-centring of the state as corporations and industry consultants are put in charge of conducting baseline and impact evaluation studies for EIAs, leading to questions of bias, exclusion, and unreliability (Barandiaran 2018; Goldman 2005; Li 2015). Once the studies are done, many states lack the analytical capacities to vet EIAs or, as detailed next, the regulatory tools to hold industries to high standards or even accountable for their actions. The de-centring of the state was driven also by the diversification of expertise promised by EIAs. For example, experiences with public participation in EIAs vary from meaningful to perfunctory (Canel et al. 2010; Walter and Wagner 2021), yet a common theme in these studies is their use by communities to protest against state agencies or to enrol their own experts (Aguilar-Støen and Hirsch 2017; Canel et al. 2010; Jaskoski 2020; Walter and Wagner 2021). More powerful still has been the power of industry and of markets to de-centre state-employed experts.

The Chilean case illustrates the commitment to markets over state-led governance particularly well (this paragraph is based on Barandiaran 2018; see also, Barandiarán 2020b, 2021). Chile's 1980 constitution, drafted under military rule and by individuals active in global networks of neoliberal intellectuals, contains the subsidiarity principle, which limits state action in favour of private, market-led initiatives. The subsidiarity principle had several consequences for EIA practices over time, as officials working in state agencies increasingly came to see themselves as umpires tasked with "neutrally" applying the rules on private parties. Scientific claims in this regime were seen to be the private property of competing (private) interests, produced by consultants hired through the market. The Chilean state remains central to this history of science and environmental governance, but with diminished agency against that of industry-paid experts.

Although EIAs have been called a "self-regulatory regime" (Li 2015: 199), they operate within a regulatory context that includes zoning laws, emission standards, enforcement

mechanisms, environmental law, and other legal requirements. The section that follows describes how the Chilean state has applied EIAs in one industrial area since 1997, when they became required for all new projects. The data presented in the next section illustrate the de-centring of the Chilean state described in this section, aided by rules that have demanded little in terms of environmental protection. Failures in the EIA and weakness in the regulatory context have thus worked together to produce appalling environmental and human health outcomes in one of Chile's most polluted areas, Quintero-Puchuncaví, located on the coast of Valparaíso region in central Chile.

EIAs regulate air pollution in Quintero-Puchuncaví, Chile

Since 1954, numerous facilities dealing in oil, copper, natural gas, coal, or industrial waste have expanded their operations in the neighbouring towns of Quintero and Puchuncaví (Q-P), in what is called as the Ventanas Industrial Complex. As a result, this once picture-perfect coastal area came to be known as one of Chile's most polluted (INDH 2018; OPS/OMS 2018). In 1993, under laws passed by the new democratic regime, Q-P was declared "saturated" for sulphur dioxide (SO_2) and large particulate matter (PM_{10}) and, in 2015, for micro-size particulate matter ($PM_{2.5}$) and latent for PM_{10}. "Saturated" and "latent" are legal status for areas where pollutants regularly exceed or are close to existing environmental quality standards and which triggers designing a Decontamination or a Prevention Plan, respectively. Q-P residents suffer from both chronic and acute levels of pollution. In 2011, 2013, 2018, and 2022, acute intoxication events captured national headlines as schoolchildren and other residents reported nausea, headaches, and other symptoms caused by "toxic clouds" (DW 2022; Navea 2020; OPS/OMS 2018). Residents are also chronically exposed to cancer-causing pollutants (Colegio Médico de Chile 2018). When asked about how they live with such pollution levels, many locals report a web of relatives and neighbours suffering from cancer (Tironi 2014; Valenzuela Pérez 2016). In 2022, after yet another acute intoxication event, the government announced the closure of the state-owned copper refinery at Q-P.

Industrial pollution at Q-P began to accumulate well before EIAs became required, but intensified after their implementation, despite the observed ill effects on human health. The first industrial facilities were built in the 1960s, when the copper industry promised national prosperity and sovereignty (Vergara 2008). Installations grew in the 1970s with new fossil fuel facilities, and then again after 2000 when new facilities producing energy from coal and dealing with liquefied natural gas and industrial waste were built and the copper refinery doubled its capacity. Since 1997, when EIAs were fully implemented, Chile's environmental authorities approved dozens of projects in a small area of only about 500 hectares. In this section we analyse 68 EIA/DIA projects approved since 1997 for 12 of the largest companies operating in Q-P (Table 19.1; a complete analysis of this data, as well as information on the governmental monitoring and fiscalisation of such project after approval, is available in Navea, 2020). The analysis highlights not only the failures of EIAs but also the need to expand environmental historiography to consider industrial pollution in Latin America; though better known in the historiography for its fields and forests (Soluri et al. 2018), Latin America is home also to industrial legacies and highly polluted hybrid landscapes.

The first thing that stands out in examining the 68 assessments is that the majority (59 projects) completed limited declarations (DIAs), not full studies (EIAs). Although some

Table 19.1 Number of impact studies submitted since 1997 by major companies in Q-P

Company	*Number of impact studies*	*Industrial Sector*
AES Gener	7	Energy
CODELCO	9	Copper
COPEC	9	Energy
ENEL	4	Energy
ENAP	8	Energy
ENEX	1	Energy
GASMAR	2	Energy
GNL Quintero	9	Energy
Melón	3	Mining and materials
Minera Montecarmelo	1	Mining services
Oxiquim	9	Petrochemical
Puerto Ventanas	6	Industrial freight and ports

of this is explained by the fact that some of the projects are older than the enactment of the environmental law, in practice, this means that companies operating large, polluting facilities in the area, including the National Oil Company (ENAP) and National Copper Company (CODELCO), have never submitted a full environmental impact study to operate in this area, only less demanding declarations. This applies despite declaring, in most of the impact statements, to be building facilities related to the "production, storage, transport, disposal or reuse of toxic, explosive, radioactive, flammable, corrosive or reactive substances" or, somewhat less frequently, declared to pertain to the construction of "ports, waterways, shipyards, and maritime terminals" or "environmental sanitation projects, such as … disposal of liquid or solid industrial waste". And this applies despite Q-P being legally "saturated" for pollution since 1993. That state-owned industries are allowed to evaluate their projects through DIAs, while state authorities rubber-stamp their decision, is a first, glaring weakness in Chile's environmental regulation.

Another weakness has to do with the common practice of fragmentation (though in theory, it is forbidden). In 2008, ENEL submitted an EIA for a new coal-fired power plant, and in parallel submitted three smaller declarations (DIAs) to build complementary infrastructure associated with this coal-fired power plant. Thus, the state authorities evaluated as if they were four separate major industrial interventions: the coal-fired power plant itself, a high-voltage power line, an oil pipeline, and an underground transmission line that would serve the power plant. This is a common practice that reduces regulatory complexity by fragmenting projects, and which Chilean regulation has not addressed through, for example, cumulative impact assessments that have become common in other countries (Foley et al. 2017). Fragmentation reduces opposition, as communities have a harder time mobilising against multiple projects at once and compartmentalises impacts into seemingly less harmful parts. Expertise is also fragmented and siloed with this practice, while consultants benefit from the multiple contracts they obtain.

In 2007 another company, AES Gener, submitted impact studies to build a new power plant known as Campiche. Approved in May 2009, Campiche became emblematic of the kind of regulatory perversion many Chileans are angry about (Valenzuela Pérez 2016). After authorities approved Campiche's EIA, local organisations sued in court, arguing that Campiche's EIA

misrepresented environmental and human health harms and that it could not be built as proposed because the site was in a flood zone set aside for a park in the 1993 Decontamination Plan. Activists told judges that the evidence used by Campiche to predict human health impacts from air pollution was inappropriate: it failed to reference public health studies and relied on monitoring data collected by AES Gener. Campiche's EIA thus ignored existing evidence of negative impacts on humans and nature. The Supreme Court agreed and voided the environmental authority's decision, calling it "arbitrary" because it was based on inadequate studies that did not consider local environmental conditions (Supreme Court 2009). Nevertheless, by 2013 Campiche was up and running after AES Gener – which had begun construction of the plant without environmental approval – successfully lobbied the government to change the site's zoning. Although the activists and the Supreme Court agreed that Campiche's scientific studies were faulty, this was not enough to halt the construction of yet another polluting facility in Q-P.

Campiche is not unique in having incomplete or faulty air pollution studies in its EIA. Of the 68 studies we analysed, 42 used emission factors to quantify projected emissions, yet the majority of these were debatable: most used factors developed by the US Environmental Protection Agency in 1995 (AP-42), and several used a guide developed by Chilean environmental authorities in 2006 intended for use by real estate projects. Using inappropriate emission factors leads to an accumulation of estimation errors which increase uncertainties in estimates. This hampers a proper evaluation of the effects of pollutants on the environment and human health; and it carries into models of the fate and transport of air pollutants, magnifying their inaccuracies and rendering them of little real use for the identification of contamination problems and mitigation measures. The inappropriate use of emission factors and failure to adapt these to local conditions is, unfortunately, a common practice in Chile (Bernal et al. 2017). Additionally, only 29 of the 68 studies analysed how air pollutants would disperse. Most relied on just one model, and none used the model recommended for this purpose by Chilean guidelines: AERMOD, adopted in 2005 by the US EPA as their preferred regulatory model. Because most projects in Q-P submitted DIAs, not EIAs, they were not required to account for other sources of pollution in their models. Finally, air pollution standards in Chile are substantially less demanding than World Health Organization guidelines (Table 19.2) – meaning even facilities complying with Chilean applicable standards may, ultimately, produce harmful levels of pollution (Colegio Médico de Chile 2018).

Although Chile has adopted some global standards for measuring and assessing air pollutants, Q-P's trajectory illustrates that these do not travel simply from core to periphery. Rather, emission factors, dispersal models, or pollution standards must be actively adapted by a diversity of local experts to function; this should include ecologists and engineers, but also public health studies (e.g., Colegio Médico) or citizen science. In addition to further illustrating the curtailed or de-centred role of the state, the case points to the need to study the environmental history of Latin America's industrial landscapes to advance our understanding of the cultural resonance of so-called "sacrifice zones" like Q-P (Medina and Carey 2020; Soluri et al. 2018).

Scientific dreams and blinders

The previous sections have tracked the rise of EIAs during the 1970s–2000s – when a technocratic policy tool advancing modernity was welcome – to their growing failures, just some of which have been discussed here: de-centred states have lacked the authority or capacity

Table 19.2 Comparison of the maximum permissible limits (μ g/m^3) of different air contaminants

Pollutant	*Chile*	*WHO 2006*	*WHO 2021*	*Concentration*
Particulate material (PM_{10})	50	20	15	Annual
	150	50	45	24 hours
Fine particulate material ($PM_{2,5}$)	20	10	5	Annual
	50	25	15	24 hours
Sulphur dioxide (SO_2)	150	20	40	24 hours
Nitrogen dioxide (NO_2)	100	40	10	Annual
	400	200	200	1 hours
Ozone (O_3)	120	100	100	8 hours

Sources: SINCA (n.d.); World Health Organization (2006, 2021).

to enforce EIAs; expertise is diversified, but with mixed results. Expertise, like projects, is often fragmented into seemingly more manageable parts. Affected communities and activists have had mixed success raising their voices, even when, as in Q-P, their scientific arguments are seen as valid by the Supreme Court. And state experts' authority has been displaced by industry-paid consultants. At best, EIAs slow down the pace of pollution, as the long-term analysis of EIAs in Quintero-Puchuncaví in central Chile demonstrates. In theory, better regulation and political willingness could produce better EIAs (Enríquez-de-Salamanca 2018). But this would miss the deeper problem with EIAs at this historical juncture, characterised by intersecting crises of science, modernity, and climate change. Moreover, awareness of how EIAs institutionalise a modernist temporality has consequences for environmental historiography (Bergwik and Ekström 2022).

Let's first examine the backward-looking segment of EIAs, baseline studies. Worldwide, EIAs typically require baseline studies to document existing conditions, as well as impact assessments to make predictions from the baseline. Baselines capture present conditions in ways that simultaneously transform them into the past to be conserved (Barandiaran 2020a; see also Ureta et al. 2020).[1] Each subsequent baseline normalises a degraded environment, producing the "shifting baselines" phenomenon (Pauly 1995). In EIAs, shifting baselines are not a problem to be solved by adding more or better data; on the contrary, in normalising a degraded environment, baselines ensure that modernisation and industrial processes are never called into question. Adding new voices or pieces of data – as EIAs promised to do – has not changed this dynamic.

Scholars have documented practitioners describing baselines as equivalent to "taking a photograph of what is there" or relying "on the fiction of being able to stop time" (Barandiaran 2020a; Fiske 2017: 69). An analysis of EIAs in various countries found a systematic bias in favour of "presentist" scientific methods in baseline studies (Foley et al. 2017; for a broader perspective, see also Martin 2022). These descriptions of baselines point to a dual function they play: to record a timeless past, and to focus the gaze on the future. Seen like this, baselines operate as a "memory device"; that is, an object commonly used to create a timeless, universal knowledge (Bowker 2006). Modernity relies on such memory devices; by simplifying or even erasing the past, memory devices hold it constant and can thus create an ideal of the eternal present. In other words, EIA regulation institutionalises the "shifting baselines" phenomenon and thus normalises it: it preserves already-degraded environments while erasing memories of a healthier environment. Missing from this perfect past is a record of

industry's well-known impacts, a step which enables new rounds of industrial development. How else can we reconcile environmental authorities' decisions, over such a long time period, to approve 68 assessments expanding industrial activities in an already polluted environment? Some may say these decisions reflect malice or disinterest; rather, we argue it reflects the modernist commitments built into EIAs.

Globally, the impacts of copper and oil refineries, liquefied natural gas terminals, coal-fired power plants, and industrial waste treatment are well known. Those committed to industrial development, therefore, *need* for EIA baselines to normalise progressively worsening present conditions (Barandiaran 2020a). How hard it would be to sustain the promise of progress and the illusion of human control over nature (including over industry's environmental and human health consequences) without shifting baselines. By normalising an environmentally degraded present, EIA baselines provide a measure of comfort to societies grappling with the environmental consequences of ever-larger, more intensive, and polluting industries (Gordillo 2014). Coping happens through faith in the review process and good industrial management, premised on the promise that harms can be appropriately mitigated or compensated, and that someone, in the future, will be able to use this information to hold the industry accountable for anything that goes wrong. EIAs routinise a managerial logic of assessment, prevention, control, and mitigation, which is difficult to challenge, as the Quintero-Puchuncaví case helps to illustrate. Disruption requires changing what baseline and assessment knowledge is produced and how, a topic we'll return to in the concluding reflection.

Second, the forward-looking aspect of EIAs entrenches an ineffective logic of prevention and accountability. Accountability often occurs after pollution or destruction have already occurred; indeed, some EIAs provide a benchmark to hold polluters or destructors legally responsible (Barandiaran 2018). The preventative spirit of EIAs is thus annulled. Moreover, predictive models have proven to be of limited use for policymakers or communities (Coen 2021). In Q-P, for example, air pollution models are typically based on just one year's worth of records to predict futures for projects that have stated useful lives of 20 years or more. Modelling the impacts of petrochemical pollution over such a scale of time, space, and industrial intensity is beholden to technical decisions. Under EIAs, past, present, and future are linked linearly; but historians know that alternative temporalities can exist and, as Bergwik and Ekström (2022) have written, climate change temporalities are a complex mix of time frames and historical rhythms that throw prediction into question (see Chapter 14, this volume).

Through the 1980s and 1990s, climate scientists accumulated experiences where predictive models failed to work on the ground as expected (Coen 2021). Audiences around the world often lacked the capacity or willingness to act on information about coming storms or droughts. Sometimes they had interests or goals that did not align with the models' recommendations, or feared the political consequences of acting on an untested prediction. Oftentimes predictive models produced winners and losers at the local level; for example, by favouring the activities of industrial fisherpeople over artisanal ones (Coen 2021; Miller 2004). Although many scientists have remained committed to the ideal that increasingly accurate climate change models would sway politicians and policymakers to act, this has not occurred (Bergwik and Ekström 2022).

In contrast, some climate researchers developed an altogether different scientific practice, grounded in relationships and interdisciplinarity. They seek to develop usable science based on learning from history, engagement with diverse knowers, and constant self-reflection on methods and processes. They worked closely with their audiences, be it policymakers or

community members, to develop "a more sophisticated and sympathetic understanding of the multiple perspectives involved" (Coen 2021: 50, citing scientist W.C. Clark). In a brief history of these efforts, Deborah Coen (2021: 51) says, "breaking with established modes of scientific assessment, proponents of usable climate science framed the research process as a form of problem-solving through interaction, not rational analysis". Far from seeing environmental assessments as a mere document or a simple "photograph" of an ecosystem, assessments need to be understood as a social process (Farrell and Jager 2006). Questions of trust, legitimacy, and care should thus be central to attempts to predict future impacts (Coen 2021).

Final reflections: EIAs for the Anthropocene?

The policy and practice of EIAs need major improvements. When proposed in the 1960s, EIAs advanced regulation and democratised decision-making when environmental concern was rising in light of industrial development. During the 1980s and 1990s, EIAs helped globalise environmental regulation, often becoming the first serious attempt to institutionalise environmental awareness in a country – this was certainly the case in post-dictatorship Chile. EIAs were a revolutionary policy for their time, democratising expertise and institutionalising environmental concern. But the historical perspective used in this chapter shows their limitations in practice – as in the tragedy at Quintero-Puchuncaví, grounded in decades of poorly conceived regulatory governance – and in terms of the normative commitments to modernity embedded in EIAs. Climate change and seemingly unbounded environmental destruction caused by industrial development have overflowed the capacities of EIAs. Although regulatory fixes could improve many frustrating aspects of EIAs, these would not overcome the broader failures of modernity. This requires fundamentally rethinking temporality, to interrogate rather than separate human and nature time (Bergwik and Ekström 2022; Emmet and Lekan 2016; Ureta et al. 2020).

One path forward for environmental historians writing today is to place care – an affective, practical, and ethical concept, yet also ambiguous and complex – at the centre of our practices and theories (Coen 2021; van Dooren 2014). For example, faced with an epistemic crisis stemming from the realisation that environmental harm cannot be undone, restoration ecologists have turned to the concept of repair as a form of justice and as a hopeful and active response to ecosystem change (Martin 2022). Similarly, we propose reinventing EIAs by introducing new questions that scientific assessments should henceforth consider:

1 How will this project make climate change worse, how will climate change impact this project's local impacts, and will predictions of future impacts made today remain valid in light of climate change?
2 What forms of life will survive this form of development?
3 Can we live with the forms of life that will result?

These new questions have practical implications and also open up possibilities for critically engaging with new temporalities. Here we propose them as a fix to EIAs, but they are equally valid for historians to ask in their work. For example, in the case of a new facility wishing to build in Quintero-Puchuncaví, for example, these questions should force EIAs to grapple with some important issues. The first question is straightforward; most industrial facilities should be able to measure their greenhouse gas emissions. However, answering the follow-on questions requires a thorough literature review of the area to assess sea-level

rise, tidal waves, changing sea life, and much more. Requiring that such a review include every article published about the Q-P area is not far-fetched and would help to repair the distrust that currently exists. Questions 2 and 3 are where the discussion gets more interesting – and it is worth noting that even in neoliberal and commercial settings, relations of custodial care and affect between various life forms can emerge (Parreñas 2012). EIAs should have to answer for forms of life, such as chronically ill bodies, which are already living in Q-P and many other toxic settlements worldwide. They should also have to identify potentially new forms of life the proposed project might bring into existence (what new mutations might occur as the industry grows?) and identify those with the best chance of surviving beyond the project's useful life.

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Note

1 Some areas of knowledge, like geology, are likely unaffected by the problem of shifting baselines. For a broader discussion grounded in restoration ecology, see Martin (2022).

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20

CITIES, FOOD, WATER, AND ENVIRONMENTAL HISTORY IN CHINA, THE USA, AND INDIA

Making Bubbles

Shen Hou and David Biggs

Many years ago, one of the founders of the field environmental history, Donald Worster, wrote "Human history starts with human bellies". So also does the history of cities. In the ancient past, cities grew from the surplus food produced by agriculture relying on irrigation. As humans began to settle, expand, stratify, and build, they constructed villages, towns and, finally, cities. Since then, food and water have been the two most essential resources needed by cities to sustain themselves and grow. Conversely, the increasing demand of cities for food and water has profoundly transformed those places producing and providing those resources. Scholars have called these places "hinterlands" – "behind lands", at first geographically, later on economically and culturally, when hinterland came to mean "backward lands", contrasting with the cities.

With globalisation, a city's hinterland could be on the other side of the world. Today's Beijing, for example, has created a hinterland in faraway South America. Middle-class citizens in Beijing have begun devouring avocados, a new fashion of diet rising in China in the last decade, grown in Latin America, leading to deforestation and water shortage in those places on the other side of the Pacific Ocean. In 2017, China imported 32,000 tons of avocados, 22% more than 2016, around half of which (16,707 tons) came from Chile, 8,754 tons from Mexico, and 6,667 tons from Peru. "According to Mexico's National Institute for Forestry, Farming and Fisheries Research, 2,000 litres of water are needed to produce a kilo of avocados", while countries like Chile are suffering from severe lack of water (Cuéllar 2018). In a way, urbanisation has turned the whole planet into the hinterlands of cities, as urban theorist Neil Brenner (2014) suggests.

Urban history can be understood as the product of their hinterlands – but there is never only *one* hinterland. Nor does any hinterland support only one urban centre. On the contrary, the process of environmental development creates *hundreds of hinterlands* which are like *bubbles*, big and small. Rather than calling this process of creating resources providing and consuming relationship between cities and the rest of the earth "making hinterlands", we suggest calling it "making bubbles".

"Hinterland" in its essence is a geographic term, referring to a specific place. "Bubbles", however, emphasises the economic relations, implying how volatile and vulnerable the

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relationship is. Each city or even small town has its bubbles which can overlap. They are not perfectly round in all directions, but usually irregular and sometimes very elongated into the interior or, increasingly, extending globally. Those bubbles have proved to be far more capricious and unstable than their creators ever anticipated. They present different human cultures, soils and vegetation patterns, different species of wild animals, different evolutionary histories, different river patterns and water flows, different energy resources (e.g., oil, gas, coal), and, not least, different climates and climate cycles. Each bubble is unpredictable in shape. Each offers both opportunities and resistance to the plans of the city builders.

Water and food are the crucial subjects of the bubble-making process. In recent decades, urban people have acquired these two central resources too cheaply and conveniently, therefore, there is always an illusion that cities function free of them as well as the places generating them, or at least, function on a solid material foundation – the so-called hinterland. Yet, when we examine history, too often cities rely on fragile bubbles for their prosperity or even subsistence. This chapter intends to examine the bubble-making process in a planetary sense with a few examples coming from different parts of the world. It argues that bubbles are not created once and then simply remain in an endless state of stability, control, and permanence. They can be disturbed and even fall apart. Sometimes, unlike a hinterland, a bubble pops. Much of urban environmental history has been about the failure of schemes of economic development (what we call "bubble popping") in the face of misunderstood, underappreciated, and unstable natural conditions. There is also the adaptation of the bubble to its ecological reality, quite distinct from the city's design.

Humans are not the only force in the process of making bubbles, nor do they play a unified role. Some of them are bubble boosters, some are food producers, and all of them are consumers. Meanwhile, nature, as a noncultural force, has never been absent, supporting cities' existence, furnishing them with possibilities, defining their patterns, limiting their expansion, and sometimes, undermining their ambitions. Nature is not a stagnant backdrop for cities, appearing only at the beginning of a city's history, but has been a shaping force always present during urban evolution. Seeing cities integrated with nature does not mean that nature loses its autonomy as an independent and spontaneous force, nor does it suggest any complete human triumph over nature. Nor does it try to repeat the old dichotomy regarding city as a pure human invention in which nature plays no role. Instead, it argues that humans and nature together create and define cities as two interactive and relational, yet in many ways autonomous forces. We need to "understand the city's place in nature", as William Cronon (1991: 8) writes in *Nature's Metropolis*, a foundational work of urban environmental history. In order to do that, we must go into the deep past of that tangled story that links cities' relationship with their hinterlands.

Before the birth of modern environmental history, Lewis Mumford was arguably the most important analyst of the ruptured city-nature relationship from a historical perspective. Born in Flushing, Queens, New York, in 1895, Mumford called himself "a city kid", shaped by growing up in one of the world's biggest cities. He walked New York's streets and alleyways, witnessed its expansion and densification, and reflected on its changes and trends. He became a philosopher of the urban environment, but also a critic of the transformation of the city into the megalopolis and into mega-machines, a psychological healer of the modern urban trauma. Although not trained as a professional historian, he was inclined to go back into the history of urban evolution to understand present issues and dilemmas (Miller 1989).

In his masterpiece *The Culture of Cities*, first published in 1938, Mumford suggested that the concept of the "region" would be useful in both the study and design of cities. For him,

the region referred primarily to a place defined by nature rather than humans. His strategy reflected his own political philosophy of decentralisation, but also rested on an appreciation of nature's diversity and recognition of his philosophy's connections with nature. The region's natural elements, such as topography, climate, rivers, soils, vegetations, food and drink, and minerals, he argued, influenced the city in an immediate and yet profound way. "The city", wrote Mumford (1970: 319), "may cover a visible terrain more cramped than that of the village or its fields. But its invisible regional base, embraced through the raw materials that reach it, … is much broader". Mumford concluded:

> the region, then, is a warp upon which the fabric of communal life is woven. Even when the coarse geographic threads are unnoticed, their quality and number and closeness will affect the weaving of the ultimate cloth. The variety of these natural influences, the complexity and their individuality of their assembled character in the city, are in fact a perpetual guarantee against man's inveterate tendency toward over-simplification.
>
> *(Mumford 1970: 319, 322)*

Unfortunately, much of Mumford's reflection on cities and their regions was ignored by following urban historians. They wrote from *within* the cities, neglecting the surrounding region. Like most people living in cities, they regarded cities as the achievement of human labor and mind, focusing their research on people only. They belonged to the generation influenced by social history, emphasising the stratification and mobility of an urban population, the racial, class, and gender tensions and interactions among urban people, the flow of capital, the distribution of power, and the sparks from ideas. Cities, according to those historians, despite all their evils and injustices, were the places that set people free of conventional restraints, rural mentalities, and ecological limits. Few of them looked on cities as an ecological habitat, shared by many life forms including human beings, connected with a long rural past, and still relying on the places from which energies come.

Across the globe, cities are expanding, but for a long time in human history, they were home to only a small number compared to a predominately agricultural population. Until the beginning of the 20th century, most people in the world were still living in the food-producing countryside, working on the land directly and raising food for themselves, seldom for export (see Figure 20.1). Once there had been a metabolic connection between countryside and city, but when urban wastes were not returned to restore the fertility of the land, when the so-called "metabolic rift" occurred, cities lost their organic tie with the countryside (Foster 1999). In a modern urban industrial era, every grain of every crop traveled a longer and longer way from field to urban dining table; consequently, urban residents began to believe that their food came from supermarkets and their water flowed magically from faucets. It became easy for historians to think the same way, to ignore the process by which cities acquired, transported, processed, distributed, and consumed food and water, which should have been the most fundamental and permanent theme of urban history, as shown by Cronon's *Nature's Metropolis*.

Environmental history has its human-centred problems, too, but it can be and should be more subversive than that. It should be grounded in the view that humans have been and always will be part of the natural world on this planet. Environmental history puts much greater emphasis on the material dimensions of our lives and generally takes a more materialist

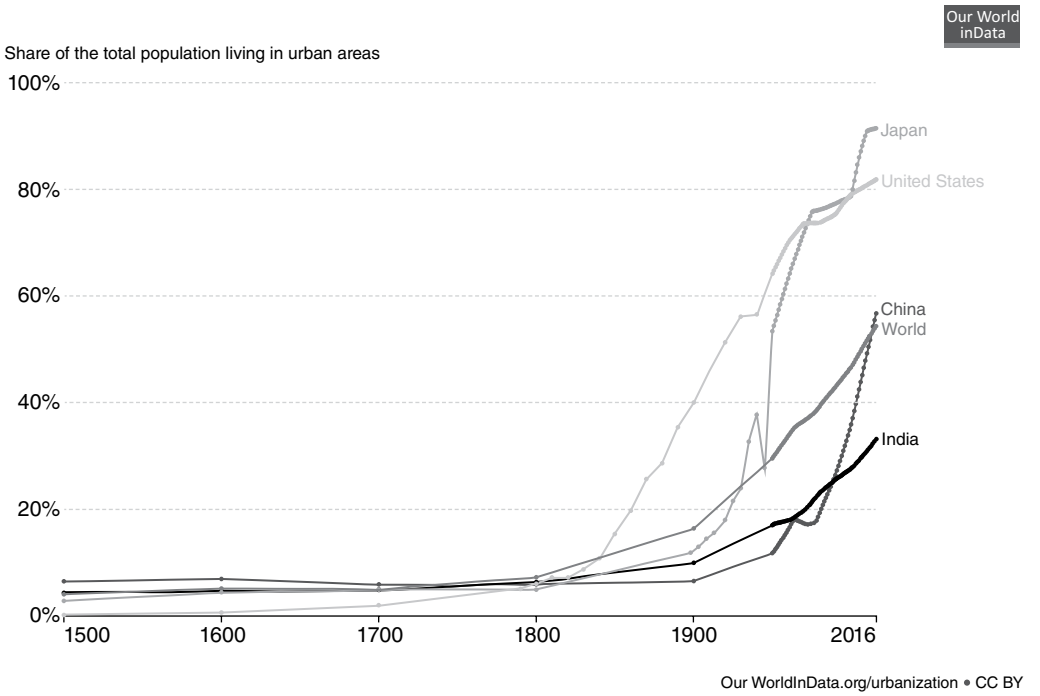


Figure 20.1 Urbanisation over the past 500 years, 1500–2016. One World in Data, https://ourworldindata.org/grapher/urbanization-last-500-years, accessed 15 February 2023.

approach to the past. It emphasises food, water, and soil, all forms of nature that fall outside urban understanding among historians.

What, then, is an environmental history of cities? Martin Melosi and Joel Tarr were among the first historians to locate cities in their surrounding landscape as early as the 1980s, and they wrote several historiographic essays to define this new subfield in the 1990s (see Melosi 1981).[1] Energy, water, sewage, and pollution within and beyond cities have concerned them the most. Like many later practitioners of urban environmental history, they pay attention to social justice and environmental inequalities among various social groups living in cities. By investigating how cities evolved from "organic city" to "sanitary city", they ask why pollution was generated, who suffered from it, and how ideas about urban environmental problems were altered (Melosi 2008; Tarr 1996).[2] Urban environmental historians also have increasingly explored the history of disasters; urban parks; animals such as horses, pets, and pests; trees, weeds, and microbes; and their changing relationship with different races, classes, and genders.[3] More urban environmental historians choose to study a specific city, to capture a sense of that place, to show the individuality and specificity of the natural environment.

Another landmark in the field is Cronon's *Nature's Metropolis: Chicago and the Great West* published in 1991. He called it an urban biography, but unlike biography, it goes beyond the limits of Chicago and reaches out to the great west, the "hinterland" (in Cronon's word) with which the city has a deep ecological bond. Cities have always relied on the countryside to feed them. Yet in most urban history, except for a few capital cities, like Beijing

during the Ming and Qing periods of China, which depended on the Grand Canal to bring crops from the Yangtze River valley, most cities were geographically connected to their hinterlands. Moreover, in a subsistence economy, although hinterlands produced the food for cities, their production logic was local and did not follow the market or capital logic in cities. But this state changed as Chicago and other midwestern American cities began to rise. Those new hinterlands stretch and swell, becoming much more distant, formless, and fluid, not just behind or surrounding their cities any longer.

Cronon's Chicago is thus quite unlike a traditional city. He locates it in a broader historical and ecological space. Through analysing the influence of various commodity flows between the metropolis and its hinterland, he shows how Chicago became the largest city in the American Midwest. He focuses on the connections between the ecological systems of nature and the economic system of the city. Symbolised by modern technologies like railroads, grain elevators, and refrigerator cars, Chicago broke through the geographic, seasonal, and other natural restraints and transformed the Great West into a subordinate periphery. In that process, wheat fields took the place of native prairie, cattle replaced bison, the forests of the Great Lakes became urban construction materials, and the nature of the West was gradually commodified. As the hub of all those commodity networks, Chicago grew to be "nature's metropolis", an imperial centre. Capitalism inserted its logic into the ecology of the Great West's system. Cronon writes:

> What had once been a diverse prairie landscape produced fewer and fewer species. Although the local ecological conditions of first nature continued to influence which species grew where, the economic imperatives of second nature – distance from the city, cost of transportation, supply and demand, price – played an ever more important role in determining the shape of the landscape. As the human inhabitants of Chicago's hinterland responded to the siren song of its markets, they simplified local ecosystems in the direction of monocultures.
>
> *(Cronon 1991: 267)*

This is undoubtedly a provocative argument. But Chicago's environmental story, as Cronon well knows, did not end with the imperial triumph of the 1890s White City, the Chicago World's Fair ground, where Cronon wraps up his narrative. Nature was not yet conquered completely. Nor did capitalists entirely dominate the size and durability of the bubbles. Nature did not really become simply "second nature". Although capitalism's logic did go on to spread globally in the last two centuries, nature has always been an independent power. As a spontaneous, self-generating force, nature persisted within cities, even in the nearby countryside where the power of capital and cities seemed to be most potent.

We can see this more complex story if we look at Chicago's fellow midwestern city Kansas City, which straddles the Missouri–Kansas state line. Compared to Chicago, Kansas City is a smaller, much more obscure city internationally, but it shares the same bubble with Chicago and shows many similar environmental experiences. Furthermore, as a more "ordinary" city, it tells a more common story of the relationship between cities and their bubbles. Sitting at the junction between the Missouri River and the Kansas River, Kansas City was destined to become a "gateway city". It served as a natural transition place where thousands of people heading down the Santa Fe Trail or later across on the Oregon Trail would switch from boats to wagons to cross the Great Plains, searching for a new life and new wealth. This crucial geographic location made the land where the Kansa and Osage indigenous peoples

lived and fought, where bison roamed, and where wolves lurked become an active stepping-off place by 1855. But its real opportunity to expand did not come until the end of the Civil War, when the United States began moving westward to grab land and grow crops, and to construct more solid homes instead of merely accumulating some quick but temporary money in the form of mineral resources. Like its big brother Chicago, Kansas City became a centre of wheat and cattle production, making its own particular bubble (Hou 2021).

The early boosters of the city were clearly aware of the indissoluble connection between the city and nature, more particularly the nature of soils. Their confidence and ambition to create a great "agriculture capital" in the heartland of America was derived from the extraordinary fertility of the Great Plains, which came from millions of years of soils eroding from the Rocky Mountain uplift and vegetation living and dying on those soils. As early as 1857, three years after the American Congress passed the Kansas-Nebraska Act, people were already celebrating the wealth of nature at their doorstep, a wealth that glittered before the "ambitious little city". In a history of Kansas and Nebraska, one author came up with a long subtitle that began with "soil" (Sloan 1857: 17). Throughout the rest of the 19th century, Kansas City's leaders continued to celebrate the fertile bubble stretching to the west and to see in it a prosperous future for the city. They argued that Kansas City would become great because of "the laws of nature". Nature would make it "the gateway into the most fertile and productive territory in the world", a "territory of incomparable fertility and productiveness".[4] As the Board of Trade of Kansas City expressed their dependency, "the relations between Kansas City and the New West are so intimate and sympathetic that whatever affects the one immediately affects the other" (Miller 1879: 9).

To a great extent, the rise of Kansas City follows a typical American story of urban success. By 1891, it was already one of the most famous "cow towns" of the nation, ranking second only to Chicago. Hundreds and thousands of livestock were arriving from the fertile grasslands into the city's stockyards – "the animal hotel" from which they would be transferred to eastern markets or consumed right in the city. As the Annual Report of the Board of Trade and Commerce vividly put it,

> If the total number of cars of livestock which have been brought to Kansas City were put in a continuous train, this aggregation would reach from Louisville, Kentucky, to San Francisco and back again, and if this train were going at the rate of fifteen miles an hour it would take it fourteen days to pass a given point. The livestock placed in single file would make a living line 39,376 miles long.[5]

When the city planning commission looked backward in 1945, their city (which had been merely a fur trade town less than 100 years earlier, home to a few dozen people) had grown fat on the land. It now

> ranked the first in normal years in the production of mill feeds, and for a number of years has been consistently the second in the United States in the production of wheat flour. This is related to the fact that Kansas City has for some years ranked first in the United States, if not in the world, as a winter wheat market.
>
> *(City Plan Commission 1945: 14)*

Along with Chicago and many other "gateway cities", Kansas City turned the Great Plains into a vast bubble supposedly under the control of a market economy. Also like Chicago,

this city faced, on the one hand, the great west, gathering in its abundant resources; while, on the other hand, it faced east, providing food to the cities there and even abroad. Just as the City Plan Commission wrote:

> Into her rail and truck terminals pour livestock and grains, milk and dairy products, poultry, eggs, vegetables, and fruit from a rich farming area. There they are moved to packing houses, storage plants, wholesale markets, processing plants, retail outlets, and exchanges. Some are consumed in their raw state, others are first processed and then used in Kansas City. Some move on through the city without even leaving the cars or trucks and are used in distant centers.
>
> *(City Plan Commission 1945: 3)*

Everything seemed to be working smoothly and efficiently. The bubble produced, the city bought and sold, and people everywhere consumed. The buying and selling sector, however, was an unstable link between producers and consumers, while the link between the city and its hinterland was not to be depended on. Consumers were only concerned about whether the food in the grocery stores or supermarkets was adequate and affordable. As for those producing and consuming the food, perhaps most did not have much knowledge or even interest in the origins of their food, or realise how vulnerable they were.

A hidden bond, however, did not mean a broken bond. In fact, the buying and selling side – those who thought they controlled everything – had been conscious of its connection with the bubble and seemed to consider it always in its plans. But they took it for granted all the same. In the same report was a reminder to people in Kansas City to understand that they were "as an economic unit … [dependent on] this area upon the agricultural hinterland". "The metropolitan area of Kansas City", the report went on, "exists because of a very productive agricultural hinterland which is tied to it by a spider-web of rail and truck lines" (City Plan Commission 1945: 1–3). Yet little did they know how that dependency could upset their lives.

Interestingly, a word which had frequently appeared in 19th-century boosters' vocabulary was missing in this 1945 report – "nature". Although the commissioners acknowledged that Kansas City could not exist independently of the Great Plains, they did not see the full force of nature, the nature that continued functioning outside of capitalist logic. This blindness and vulnerability Cronon overlooks. At the end of his story, nature has become a man-made hinterland – "second nature" – a landscape under the full control of capitalism. The hinterland, he presumes, was an invention of human design, and a thoroughly successful invention, tamed, orderly, and predictable. Once in a while, there might be some "spasms", but always the region would get back to the original track to progress. Nature, however, had remained in many ways an unfettered force. When human culture tries hard to adapt to the land, the two forces might achieve a relatively stable cooperation. But more often they are in a state of confrontation and competition, especially when the human culture is determined to conquer and dominate nature. Sometimes, technology and capital have the upper hand, but once their exploitation of nature reaches a certain limit, the force of nature could explode. Although it does not necessarily lead to revolutionary changes, that moment of backlash could still spoil the city's plans, bringing disasters, and force the conquering powers to yield. Kansas City was not exempt.

After almost 80 years of marching along the road to victory, Kansas City, like thousands of other cities, encountered the shock of the Great Depression, the biggest ever failure of the

urban capitalist economy. But what dimmed the skies of the city was not only the collapse of the eastern stock market, but also a series of massive dust storms coming from the Great Plains. The bubble that had promised fertility and abundance ceased to produce in the way expected by urban capitalists and consumers. Severe drought and prairie destruction brought high winds and blowing dust. Drought had long been normal in the Great Plains (Worster 2004, afterwords). Even in the city's annual trade and commerce reports, droughts are often mentioned, implying crop failure. Drought and dust proved they could destroy the profit that Kansas City expected from the agricultural business. Drought alone did not produce the dust storm. Those occurred when people destroyed the perennial native grasses and planted annual crops with short roots which failed to hold the soil during severe drought.

One of the most infamous environmental disasters in human history, the Dust Bowl debacle in which agricultural expansion on the Great Plains of North America overran the natural, cyclical limits of the land, causing severe wind erosion and economic collapse, is the subject of another classic work in environmental history published in 1979, Donald Worster's *Dust Bowl: The Southern Plains in the 1930s* (Worster 1979). Worster is concerned with grasses, waters, soils, and people creating and suffering the "dirty thirties" on the Great Plains. Yet he does not pay attention to the impact on Kansas City, nor does he try to connect the ecological changes on the Plains to the cities that supported them. Cronon, on the other hand, does not anticipate the Dust Bowl and its impact on his city. Although he also tackles the question of capitalism's plunder of nature and is critical of the rise of nature's metropolis, he does not suggest that Chicago was heading to a major ecological disaster. Furthermore, he focuses only on the commodification of nature within the city, while none of the natural disasters, droughts, locusts, floods, or dust storms happening to the west, the hinterland of his metropolis, shows up in his history. This is not to criticise either author. Rather, their works inspire us to connect the two stories, to reflect on the impact of nature on cities, rather than cities on nature. Urban environmental history would then be more balanced in analysis and perspective – more alert to the continuing power of both human and non-human agencies in the past and present. We would achieve a more interactive, dynamic understanding of the city's role in nature. While power in that interaction may have shifted over time towards humans, cities are still shaped by the power of climate, rivers, soils, microbes, and other natural phenomena. Historians should not leave us with the illusion that the earth is a blank slate on which humans write whatever they want.

The meaning of the Dust Bowl for Kansas City should have been obvious. From the annual reports of trade and commerce made from the 1900s, we can easily see how the rise and fall of the city's economy was influenced by natural forces out in the bubble. In 1921, the largest harvest of wheat after World War I brought more profits to Kansas City. In that year, the city received 139,629,550 bushels of grain, including 110,204,550 bushels of wheat and 15,495,000 bushels of corn. Over the next decade, the market was more or less stable. Even during 1929–1931, when eastern cities were shattered by the Great Depression, the crop and livestock market in Kansas City maintained its prosperity. In 1932, however, drought started affecting the Great Plains and the yield of crops. The grain arriving in the city was only half what it had been in 1921, while the wheat reception decreased even more, falling to only one-third of what it had been in 1921. By 1936, there was a minor increase, yet, the general decline did not end until the next year, when the rains returned.

Kansas City did recover from that Dust Bowl disaster, and its economy boomed again. Nature and city alike showed some resilience. But if those pioneers of the Great West, including the founders of Kansas City, had aspired to possess a permanent Garden of Eden,

they were doomed to be disappointed again and again. Bubbles are blown up by people, but none of their bubbles can withstand the forces of nature, which can always reject or challenge the people's plans, grand or small. Cities cannot expect their hinterlands to remain stable, sustainable, and domesticated once they are built. The truth is that they will be disturbed, broken, and sometimes popped. The Dust Bowl in the 1930s for Kansas City popped a big bubble; but it was, after all, an unusually big disaster. Sometimes, bubbles vanish when natural resources are exhausted. More often, the changes in a bubble are more gradual and subtle, reminding its creators that they constantly adjust the design, or even abandon it.

No one would deny that cities change, but those changes are not merely about growth or decline. For most cities in history and present, the changes are new adaptations, conforming to whatever nature allows their bubbles to be. Once they exceed that limit, they might face new failures. Perhaps they will revive, like Kansas City did from the Dust Bowl, but those failures require a generation or several generations to pay a high cost; and often those people are the common folk living in an inner city or farms. But as both Worster and Cronon point out, historians should recognise another victim – that is, a dynamic, vibrant, and diverse ecosystem, consisting of the rest of nature, all the other lives living there for millennia or even millions of years.

Once an ecosystem is lost, it is lost forever. A city could perhaps recover from its failure, but will its revival then become a new victory story? Will a city learn how to live within its limits and face ecological reality? A city always belongs to its region, just as Kansas City and Chicago belong to the Great Plains. As Worster suggests in *Dust Bowl*:

> A mere century or two of American domination of the Plains is not an adequate base for making any predictions about the long-term survival rate of any society or its institutions. On the basis of such a short period no historian, environmental or other, is in a position to pick the future's winners. But scrutinizing the past, distant or recent, can suggest where one might best put trust or confidence, can reveal what has failed in the past and what may fail again, and can sort out what looks like good news from the bad.
> *(Worster 2004: 253)*

If human history starts with food and urban histories are about material and spatial relationships extending far beyond the city's limits, than the role of water in cities is critical to understanding both the geography of cities and what geographer Erik Swyngedouw, in his study of Guayaquil, Ecuador, terms the "urban metabolism". Water literally animates life in cities in its metabolic-like circulations: as arterial routes for transport, as the essential requirement for human and other life, as a necessary substance for manufacturing, and as the primary medium for the elimination of waste. *Unmanaged* water also highlights the double-edged nature of water in cities. Broken pipes, flooded districts, dried-out reservoirs, and mosquito-borne diseases all attest to the potentially deadly effects of *unmanaged* water. Writes Swyngedouw (2004: 175), "this urban transformation of water is a manifestation and expression of wider relations that clearly transcend the simple question as to who does and who does not have access to water". A closer analysis of water's multiple roles in urban life shows a deeply political geography in almost every city with respect to *who* lives in flood-prone, pestilential areas, *who* controls government-sanctioned, public or private monopolies over water utilities, and quite literally *who* gains and *who* loses in battles over a limited resource.

Perhaps no city in the modern world illustrates the extreme politics of water distribution than Los Angeles in the United States. Located on the Los Angeles River, the original Mexican Pueblo de Los Angeles numbered just 1,610 people in 1850, when California fell under American control. By 1890, the population of the city grew to 50,000; and by 1900 it doubled again to over 100,000 (Hundley 2001: 138). As in other newly established cities in this time, citizens of Los Angeles clamoured for a public, municipal water authority, and one of the most powerful water agencies, the L.A. Department of Water and Power, was formed. Its first superintendent, William Mulholland, quickly gained national fame when he moved to acquire a more plentiful source of water in the snowmelt-fed Owens Valley of the Eastern Sierra Mountains. While cities have long relied on peripheries for food, labor, fuels, and water, in this case the water source was located 235 miles away across harsh deserts and earthquake-prone mountains. Mulholland led LADWP through a decade of legal wrangling, backroom deals, contentious court cases, and even eco-terrorism (blowing up the pipeline) before Owens Valley water flowed into Los Angeles in 1915. Such distant places with water-starved, downstream communities became "water colonies" of the city (Hundley 2001: 142–67). This urban takeover of a distant watershed effectively launched a wave of water reclamation projects across the United States accompanied by the construction of monumental dams such as Hoover Dam built on the Colorado River. Los Angeles' metabolic reach, along with other south-western cities including Las Vegas, Phoenix, and San Diego, extends several hundred miles into the reservoirs and aqueducts of the Colorado.

Cities are centres of economic and legal power; but as densely inhabited, built environments situated along rivers and coasts, they are also centres of intense vulnerability. In 2005, when Hurricane Katrina made landfall at New Orleans and caused levees to rupture, floodwaters poured through a 1,000-foot hole and inundated 70% of the city. Over the next several weeks of nightly news coverage, the story of the storm and the failure of the levees developed in several distinctive ways with respect to Swyngedouw's idea of "urban metabolism", how politics figures in to the geography of such disasters. First, news stories moved from the *natural* disaster of the hurricane to the failures of engineering, city and federal policies, and problems of corruption that prevented long-needed maintenance to flood control systems. Second, the news focused on one neighbourhood hit the hardest by the floods, the Lower Ninth Ward, whose residents were majority Black and lower income. By looking at spaces of *unmanaged* water in cities, especially after flooding events, we can often see how inequalities in water distribution and flood protection lay bare other disparities marked by differences in race and class (Kelman 2003).

Largely because cities have grown so rapidly in the past century, floods now have a greater potential to render large numbers of people homeless and even cause urban abandonment. A warming climate is causing seas to rise and increasing rainfall in some areas, which in turn increases the pressure on people and their governments to respond. Perhaps nowhere did this buildup of urban space along powerful rivers have more devastating consequences than in China in 1931. An especially cold winter with heavy snows combined with unusually heavy spring rains to flood the Yangtze, Yellow, and other rivers and inundate China's densely populated, coastal plains. Floodwaters covered over 180,000 km^2, and cities like Wuhan on the Yangtze were especially hard-hit. After the end of the Second Opium War in 1858, foreign powers gained access to this river town 600 miles upstream from Shanghai. Like Chicago, Wuhan emerged as a powerful exporter of industrial commodities that literally "fed" China's more well-known, coastal cities with meat, tea, tobacco, steel, iron, and silk. Unlike American cities, however, Wuhan had been a densely populated

megacity with a population of over 1 million for many decades. Before the weakening of the Qing dynasty in the Opium Wars, a combination of traditional practices and centuries of engineering and policies aimed at "living with the river" precented the sort of flood that ravaged Wuhan and killed more than 2 million people across China. Chris Courtney's account of the Wuhan flood shows that the 1931 flood was a product not simply of extreme natural events but also a result of the collapse of traditional, popular and city-level practices that ultimately strengthened dikes and coordinating popular labor contributions necessary to maintain water defenses. One symbolic example of this cultural and ideological divide between modern technocrats and working-class occupants of Wuhan occurred in 1930, one year before the floods. Town planners ordered the destruction of the Dragon King Temple in order to construct a new road. After the floods came, thousands of residents blamed them on the destruction of this powerful river deity's temple. Courtney shows how this popular religion, with an annual Dragon Boat Festival, offered an important way for many people – especially migrants and the working poor – to pay their respects to this highly volatile, river force where most of them worked and lived (Courtney 2018: 101–7).

Another challenge that modern cities pose with respect to waterborne vulnerabilities is the global trend from the late 19th century to fill in swamps and marshes and to *fix* what were naturally moving river banks. In Seattle, Washington, in the decades after the 1898 Klondike Goldrush, urban boosters used hydraulic cannons from the goldfields to reduce steep hills and cover the city's bays with a layer of fill. Native peoples who traditionally fished all around the Salish Sea, aka Puget Sound, increasingly found that either their fishing grounds had been destroyed by wharfs and reclamation or that new laws and posted signs criminalised their access to the waterfront. Similar conflicts between city-builders and Indigenous peoples can be found around the world, from Boston to Cape Town to Kolkata, but Seattle was one of the first modern cities where Indigenous people successfully regained their rights to the city's marshes. During the civil protests engulfing American cities in the 1960s, Native peoples with support of the American Indian Movement staged "fish-ins" along Seattle's waterfront. Native groups successfully fought in American courts to regain their traditional rights to Seattle's fisheries, and in the process they helped push Seattle's residents to embrace some of the most pro-Native and pro-environmental policies in the world (Thrush 2007: 187–90).

The urban reclamation of swampy land exposed stark class differences, and in many cities, it remains a highly contentious issue as seas rise and descendants of "untouchables", indigenous peoples and others seek to re-establish ties to ancestral lands. In Kolkata, India, as in Seattle, the riverbank was not just an important site for commerce but a sacred space of passages and rituals intimately linking water to urban life. The *ghat* or river steps along the Ganges River formed an important cultural sphere where riverine commerce intersected with festivals and rituals. Historian Debjani Bhattarcharyya shows how collections of boat-men songs, tidal songs, and minstrel songs portrayed a life on the urban-water edge that blended spiritual practices with commercial trade. She writes, "As a precolonial archival source, the poems of the *Mangalkavya* genre attest to the complexity of the space of the ghat where the river and its banks are depicted as sites of both worship and trade" (Bhattarcharyya 2018: 120). British surveyors and colonial governors worked to *fix* the waterfront of Kolkata in order to turn this riverfront property into some of the city's most valuable parcels, and they used all manner of material-engineering and political wrangling to dispossess Bengalis of access to the *ghat*. In the present era, as worsening typhoons batter these areas and rising seas threaten to inundate urban shorelines, different constituencies, including Indigenous

rights advocates and even conservative urban planners, are coming together and turning to the pre-modern history of cities in efforts to open paved-over creeks and even restore urban wetlands.

Restoring a city's wet spaces, however, is also politically complicated. One well-studied case is the Cheonggyecheon Stream running through the middle of Seoul. Once covered by a street and later used for an elevated freeway, the stream and its neighbourhoods were some of the most polluted, blighted areas of the city by 1980. In 2003, the mayor of Seoul pushed for a $350 million clearing of the aging freeway and re-opening of the stream. The project is now regarded as a successful example of "eco-branding", for it gained global attention, and the newly opened spaces fostered rapid economic developments with pedestrian shopping and more valued residential spaces. However, critics question whether the effort was really "restoration" or rather a form of urban landscaping primarily designed to *fix* this "blighted" waterway in ways that in turn produce more urban revenue (Lee and Anderson 2013). In the context of urban renewal, environmental cleanups and historic preservation, these publicly drawn contrasts between modern/colonial and pre-modern/traditional landscapes often continue to obscure underlying economic and political pressures to "greenwash" urban shorelines – even when done in the name of restoring Indigenous landscapes.

If cities are super-metabolic bubbles consuming food, energy, and water from surrounding sinks, then the problems of sewage and waste removal might be a fitting conclusion. Until the late 19th century, sewage flowed from factories and neighbourhoods via surface and underground conduits into rivers and the sea. Rivers and shorelines in cities have always served three purposes: as upstream sources of clean water, as transport conduits, and as downstream sinks for sewage. Before the 19th century, nightsoil collectors removed the nitrogen-rich wastes of humans and work animals for use as fertiliser in farming; but the advent first of guano and then of industrially synthesised, ammonia fertilisers eliminated the market for nightsoil. As cities worldwide began to skyrocket in growth, they were also drowning in poop. Daniel Schneider's *Hybrid Nature: Sewage Treatment and the Contradictions of the Industrial Ecosystem* details a complex and truly metabolic engagement as businessmen, engineers, and city leaders explored the development of activated sludge as a way to purify and recycle wastewater. Activated sludge is wastewater with an activated bacteria culture or microbiome that eliminates or controls potentially harmful bacteria such as *Escherichia coli* (*E. coli*) and separates nitrogen-rich solids from purified water. Cities such as Milwaukee supported the launch of new businesses selling the sewage-based fertiliser; and to continually reach more customers, the makers of Milorganite even developed new products like Milarsenite – a combination of arsenic and sludge-based fertiliser designed to feed grass but kill (via the arsenic) broadleaf weeds (Schneider 2011: 155).

As urban industries have added thousands of new chemicals and contaminants to city waste streams, these blends of organic, living, and inorganic, possibly toxic ingredients have become too difficult to manage. The Milwaukee Sewerage Commission stopped selling Milorganite in 1972 when the passage of the US Clean Water Act required cities to monitor waste streams for dozens of chemicals deemed hazardous to human health. The boundaries dividing "natural" and "artificial" in these flows of water through pipes, into homes and factories, and out to sewage treatment plants have become permanently blurred. Today cities in water-scarce environments must develop more technological fixes to insure a continuous supply of fresh water and the safe elimination of sewage as well as salty brine, toxic metals, and bio-pathogens. In Orange County, California, the city of Huntington Beach

desalinates sea water, pumping it more than 50 kilometres uphill so that it flows downhill to augment waters flowing down the water-parched Santa Ana River. This short river, like the neighbouring San Gabriel and Los Angeles Rivers, flows for much of the year at a trickle. Cities upstream consume the seasonal waters fed by snowmelt and occasional rains. In fact it is their treated sewage water, released back into the river, that flows downstream where large water users like Disneyland take up the water again, filtering it before sending it into the water supply system. Increasingly, cities are relying on desalinated and twice- or thrice-recycled water to maintain urban life.

Piercing the "bubbles" of the city and its outward surfaces shaped around tall buildings, streets, and monuments, we find what Italian novelist Italo Calvino and countless *noir* stories like Roman Polanski's *Chinatown* (1974) identify as an "invisible city", the flows of water, food, energy, and waste through this urban shell (Calvino 1999). In *Chinatown*, a Los Angeles politician contends an aqueduct is needed to bring water to the city from the hinterland 200 miles north: "Beneath every street there is a desert, and without water the dust will rise up and cover us as if this place never existed". Who controls these flows and who lives in the differentiated spaces of cities, those living closer to farmers' markets and fountains versus those living near sewers and dumps, is often the focus of *noir* fiction, crime procedurals, and fantasy movies that unpeel a city's outer layers to reveal these hidden worlds.

Notes

1 For some historiographic essays, see Melosi (1993), Platt (1999), Rosen and Tarr (1994), and Tarr (2004: 25–40).
2 Besides Melosi and Tarr, for environmental justice issues, see Hurley (1995). For a more recent work about the social approach to study urban environmental history, see Kiechle (2019).
3 Urban disasters are one of the major themes of urban environmental history. Besides industrial disasters, especially air and water pollution, floods, earthquakes, hurricanes, and forest fires have intrigued many urban environmental historians. Some recent works include: Courtney (2018), Dyl (2019), and Horowitz (2020). There are several dozen works on the environmental history of urban parks all over the world, including Hou (2013). As for the environmental history of different life forms, besides Clay McShane and Joel Tarr's book on horses (McShane and Tarr 2007), three more recent works deserve some special attention: Biehler (2015), Falck (2016), and Brown (2019).
4 Charles Deatherage, *Early History of Greater Kansas City, Missouri and Kansas, the Prophetic City at the Mouth of Kaw*, Vol. I, Kansas City, MO: Interstate Pub. Co., 1927, p. 574; *Notes on Kansas City, including Tables and Statistics Showing the Extent of Her Financial, Mercantile and Industrial Interests*, compiled and published by the Winner Investment Company (Willard E. Winner), Kansas City Bank Note Co., Printers, 1887, p. 18; *The Leading Industries of Kansas City: A Review of the Manufacturing, Mercantile and General Business Interests of the "Gate City of the West," to Which Is Added a Historical Sketch of Its Rise and Progress*, Kansas City: Reed & Co., 1882, p. 3.
5 *Twelfth Annual Report of the Trade and Commerce of Kansas City*, being the first under the auspices of the Commercial Club of Kansas City, for the commercial year ending 30 June 1891, Kansas City: Press of Hudson-Kimberly Publishing Co., 1892, p. 47.

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21

URBAN ENVIRONMENTAL GOVERNANCE

Historical and political ecological perspectives from South Asia

Jenia Mukherjee and René Véron

Introduction

In the context of environmental crises and rapid urbanisation (in South Asia and elsewhere), the issue of urban environmental governance has come to the fore in regional and global forums. Cities, the environment, sustainability, and governance are increasingly discussed in their intersections, as exemplified in the United Nations' Sustainable Development Goal 11 (Sustainable Cities and Communities). According to Mahfuzu Haque (2017, 1), environmental governance

> comprises of rules, practices, policies, and institutions that shape how humans interact with the environment. It is a process that links and harmonizes policies, institutions, procedures, tools, and information to allow participants (public and private sector, NGOs, local communities) to manage conflicts, seek points of consensus, make fundamental decisions, and be accountable for their actions.

(Urban) environmental governance gives importance to all levels of government – national, regional, state, and local (municipal) – as well as to non-governmental social and political actors, in managing the environment.

But what does this imply on the ground? Mike Hulme (2017: xii) argues that effective environmental governance requires "governing the full range of human activities, technologies and institutions – *and the imaginations which give rise to them*" (emphasis added). We believe that it is within this context that history and historical analyses matter, as they provide a holistic perspective on the (re)making of urban environments across complex and dynamic interactions between city, nature, technologies, and institutions along long-term temporal scales and wider spatial conjectures that go "beyond the urban" (Mukherjee 2015; see also Chapter 20, this volume). Consulting a wide range of archival sources, including correspondences, gazetteers, proceedings, administrative and revenue reports, and diary entries, historians investigate and show the evolution of the urban (environment). They reveal when technological apparatuses, social arrangements and governance mechanisms

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bring about (un)intended expectations and consequences and lay out path-dependent trajectories that determine larger questions of sustainability.

However, historical analyses risk falling short in scientifically exploring "the full range of human activities" that shape, and are shaped by, (urban environmental) governance scenarios. The renowned political ecologist Michael Watts (2013) warned about the subjective bias in historical interpretations and cautioned against "the distorted optic provided by a wholesale dependence on archival sources", as these are essentially class products. This is where political ethnography and research fields drawing heavily on ethnography, such as recent approaches in political ecology, can complement historical investigations on environmental governance by advancing nuanced interpretations of diverse actors as well as their positions, lobbying capacities and power relations that are imbricated in infrastructural planning and implementation (see Chapter 2, this volume).

This chapter maps the emergence and development of urban environmental history (UEH) in South Asia and the lessons it offers to understand and analyse pertinent questions of urban environmental governance in recent times. However, it acknowledges the limits of historical research (especially due to its reliance on the archival methodology) and points to the need to complement UEH with other critical social sciences. Towards this end, we present a detailed overview of urban political ecology (UPE), particularly recent poststructuralist approaches, which use an array of qualitative research methods to analyse governance scenarios in situated contexts. With South Asia as the empirical context,[1] we finally establish our argument regarding the significance of integrating and cross-fertilising historical and political ecological perspectives to convey larger and deeper narratives of urban environmental governance.

Colonial urban ecologies: infrastructures for "improvements"

After a long tradition of an assumed antithetical relationship between the "city" and "nature" in both urban and ecological literatures, UEH emerged in the Global West during the 1990s to challenge this view. Critically engaging with the work of Donald Worster (1990), William Cronon (1991) and Martin Melosi (1993) showed how American cities are interconnected with the "natural" world. They have conceptualised and advanced UEH as an interdisciplinary domain that combines "the study of the natural history of the city with the history of city building and their possible intersections" (Melosi 1993: 2). These ideas gradually percolated to South Asia, where historians have investigated overlaps, synergies, and trade-offs between the "urban" and the "environment", addressing larger questions on urban sustainability.

A large gamut of South Asian UEH scholarship[2] entails the study of urban infrastructure (i.e., water provision and waste disposal) and its evolution within the specific historical context of (British) colonialism. South Asian historians have analysed the transfer and imposition of Western technologies and epidemiological discourses and traced the trajectories of the creation of colonial cities through the manipulation of environments. This scholarship examines intersections between the city, nature, and technology with scattered descriptions of social antipathies and resistances against the colonial state. The thick narratives – carved out from colonial records on the construction of utilities related to water provisions and waste disposal – depict complex relationships between religion, race, power, and politics that propelled colonial town planning and urban governance anchored in the principles of social exclusion and capitalist profit.

Several South Asian UEH studies describe the epidemiological context that led to the emergence of the "sanitary city" in Europe and discuss the transplantation of its rationales and techniques to the colonies. For example, John Broich (2007) investigates the British water supply systems and its transfer to colonial cities such as Bombay, Karachi, Colombo, Hong Kong, and Singapore. He reveals the inherent interconnection between urban governance and infrastructure, and between Europe and Asia. Influenced by sanitary debates in Britain from the 1840s onwards, physical and moral "improvement" went hand in hand through urban planning and infrastructure schemes. The (colonial) state – both in Britain and in Asia – attempted to ameliorate urban society by reconfiguring the environment and the relationship between cities and their hinterland (through damming rivers, installing piped water networks, etc.). Broich demonstrates how municipal reform and heavily funded, modern utilities marked a departure from "decentralized" to "more centralized" water systems (347). The modern centralised governance structures, however, caused resentment among the locals, who showed concerns and protested against new financial reconfigurations or the taxation system for projects over which they lacked control. Finally, Broich argues that in both places, Great Britain and the empire, the ultimate effect of the water system was the consolidation of the authority of the modern state. "Thus, Bombay and Manchester were 'colonized' in the same way" (365).

In a similar vein, Michael Mann's (2007) work on water management, sewage, and excreta in Delhi reveals the politics of sanitation in colonial India during the 19th century. In addition to the technological and moral dimension of the analysis, Mann captures the political setting of the post-1857 period. The 1857 uprising[3] motivated colonial officials to add the principle of security (to the one of sanitation) in the reconstruction of cities in British India. To ensure military security, parts of the central wards in Lucknow, Kanpur, and Delhi, for example, were dismantled and transformed into a *cordon de sécurité* ("cantonment") and a *cordon sanitaire* ("civil lines"). The latter formed European and local elite residential areas, dotted with spacious houses and greenery, and having well-connected water and sanitation facilities. By contrast, the "native" quarters suffered from inadequate amenities. Consulting records from the Delhi public works department, Mann (2007) shows how racial segregation was embedded in urban planning and governance of municipal Delhi, for example. Colonial water supply projects inscribed unequal access to utilities as provincial government made deliberate plans to give preference in the form of providing piped water supply in the Cantonment and the Civil Lines. Some communities such as *chamars*[4] were not even provided with the right to fetch water from public standposts – constructed with the official objective to cater to the needs of the majority population. Furthermore, as the city wall that separated Old Delhi (native habitat) from the Civil Lines (the British and *rais*[5] residency) was not demolished in the early 20th century, the old walled city became "the metaphor for the subjugated Indian people" (Mann 2007: 11), and "Europe's Oriental 'Other'" (Mann 2007: 10).

Mann's research also reveals the tensions between the central and provincial governments and the municipal bodies that manifested themselves through urban infrastructure projects. After the inordinate increase of the "India Debt" in the post-1857 period, the fiscal system was decentralised, and municipal committees were formed. While the Delhi Municipal Committee (DMC), established in 1863, could formally initiate independent public expenditure, it had to constantly negotiate with provincial and central authorities for financial aid. Lord Ripon's legislation of 1892 liberalised urban administration, facilitating

legal and fiscal competences of local municipalities, but public funding remained a problem during the entire colonial period.

Urban environmental governance in British India was further shaped by "Improvement Trusts" that were bestowed with the task of controlling disease outbreaks (cholera and plague) and mortality, as well as of ameliorating ventilation, buying and selling land on urban fringes, developing residential areas, and rehabilitating the poor (Meller 1979). However, the Trusts often failed to improve the sanitary situation due to colonial racial ideologies. In Bombay, for example, urban land was redistributed to the elite classes at the costs of the poor and of migrants: between 1904 and 1912, 40% of impoverished people inhabited only 4% of the urban space in Bombay (Kidambi 2001).

Similar to Broich and Mann, Awadhendra Sharan (2011: 426) argues that "Colonial governmentality was a careful calibration of distancing and intervention". Especially during the post-1857 period, North Indian cities, such as Delhi, Lucknow, and Kanpur, that were physically ruined by the war, emerged as important sites for realising utility projects through which, "their spatial organisation and everyday routines refashioned in a bid to assure health, safety and security" (426). The making of modern Delhi through the rhetoric of "progress" and "improvement" across public work construction projects, especially water supply and sewage treatment, consisted of governance concerns around the (im)purity of water and narratives of pollution along mediating authorities, actors, and agencies. Sharan's work is unique in terms of its focus on both quantity and quality of water, from source to mouth; i.e., the "simultaneous consideration of water as infrastructure and as environment, as much a network of pipes and drains as matters of pollution and well-being" (427). Sharan's (2011) work also points to city-hinterland relations through the construction and management of water and sanitation infrastructure and to struggles, negations, and mediations between upstream and downstream municipal authorities regarding water distribution and sewage flows in the Ganges, affecting northern Indian cities such as Benares or Agra, and even the felt effects in Calcutta.

In his later work, Sharan (2017) builds upon his earlier argument to show connections between urban waste, river flows, and upstream-downstream dynamics. For instance, when modern waterworks and a sewerage scheme for Benares were delayed by the Municipal Board, community organisations petitioned before the Viceroy, "bemoaning the unsanitary condition of the city" and suggested the construction of a large subsoil canal to drain urban filth and discharge at a designated spot to the river. When the municipality did not take up the project on grounds of huge costs, the local *Maharaj* and an association of the local gentry embarked on a crowd-funding initiative. The municipal authorities finally considered the proposal given its multiple benefits for health, hygiene, and the protection of sacrality for the River Goddess Ganges. However, communities downstream, the Sanitary Commissioner of Bengal, and officials of the Public Health Society of Calcutta opposed this project, leading to a long and intense debate between the governments of the Northern Provinces and that of the Bengal Regency. Sharan shows how official negotiations around public works had to consider colonial municipal governance, technology, and Hindu religion. Governing infrastructure on rivers (especially the Ganges) in colonial India was delicate and had to accommodate and navigate between "two distinct senses of purity and pollution, one drawing upon sacred texts and ritual performances and the other on the science of sanitation" (Sharan 2017: 214).

Ranjan Chakrabarti (2015) further elaborates on the contestations between the colonial episteme on and the Hindu ritualistic ideas of purity. Reflecting on the transplantation of

western technologies and associated sanitation governance in Calcutta, he describes the modernist-capitalist production of urban space. The article depicts apathy of the Hindu "natives" towards the combined sewage and drainage system that was built to discharge both rainfall and sewage from Calcutta to the saltwater wetlands, while there was apprehension for the purification of the Hooghly River, a distributary of the Ganges. Chakrabarti (2015: 193) explains this disjuncture with the fact that "Within the traditional Hindu worldview, words such as pollution and purity had sacred and ritualistic connotations, while to the sanitarian regime, these had secular, physical and moral meanings".

More specifically addressing environmental policy formulation, Janine Wilhelm's (2016) book on sewerage technologies along the sacred Ganges traces the origins of contemporary river pollution to the late 19th and early 20th centuries. Investigating the introduction of sewerage systems in Kanpur, Allahabad, Benares, Lucknow, Agra, and Calcutta, she analyses different debates around the discharge of (un)treated sewage into the Ganges, involving officials at different administrative levels and the Indian public, including different interest groups such as industrial and agricultural lobbies, and Hindu religious groups. Based on the colonial-capitalist calculus of rule, officials sought the cheapest available sewerage technologies that caused extensive river pollution. They constructed waterborne sewerage systems and discharged untreated sewage into rivers without investing in purification facilities such as sewage farms. Wilhelm not only "offers the first extensive historical study on the evolution of colonial river pollution policy and its impact on the future of India's rivers" but also "clearly shows that individual debates around sewage disposal and river pollution in cities … must not be treated as isolated discourses, but as components within an overarching process of policy formation" (30).

Moving beyond the focus on urban environmental governance through infrastructure provision, Debjani Bhattacharyya (2018) provides a nuanced, politicised analysis of the reclamation of colonial Calcutta from the tidal swamp between the second half of the 18th century and the early 20th century. She describes how dynamic geographies of fluvial land(water)scapes shaped colonial legal machinations and, in turn, got shaped by these. Her book *Empire and Ecology* is the story of governing and fixing the "fluidscape" (Mukherjee et al. 2021) through the implementation of infrastructural schemes carried out by various urban bodies, such as the Mayor's Court, the Privy Council, the Justices of Peace, the Lottery Committee, and private individuals in the 18th century, and by the emerging town-planning and municipal bodies in the 19th century. In the fixed and consolidated landscape of the 20th century, when memories of the soaking ecology of Calcutta had eclipsed, new actors, including hoarders, planners, and land developers, flourished in an increasingly financialised and intrusive urban property market "muddying the lines between older and newer authorities and modes of governance" (Bhattacharyya 2018: 40).

In sum, the previously cited UEH studies provide important insights on the role of central and local institutions in decision-making regarding the construction and management of urban infrastructure and land, but they largely fail to provide nuanced interpretations of the choreographies of power and conflict, collaborations, and negotiations between plural actors that also play out in operational dynamics and the everyday impacts of urban utilities. This can be considered as a limitation of UEH research, the major reason being its dependence on archival sources. Furthermore, with very few exceptions such as Broich's research, environmental historians have not been able to establish links between the local governance of colonial cities in South Asia and the global economy and polity. Therefore, we argue that deeper and thicker narratives of urban environmental governance can be

produced when historical analyses are informed by and complemented with critical social-science approaches, such as (urban) political ecology, that use and apply an array of ethnographic methods and thus allow archival data to be triangulated.

Urban political ecologies: power, politics, and place

Similar to South Asian UEH, UPE scholarship has emphasised urban networks and utilities, particularly piped water infrastructures. Like its western counterpart, South Asian UPE scholarship has studied contestations surrounding uneven urban geographies – bringing to the limelight social hierarchies and power asymmetries that underlie environmental governance in cities and beyond (Anand 2011, 2017; Gandy 2008; Ranganathan 2014).

In South Asian scholarship, first traces of UPE thinking were evident in critical urban studies disapproving of urban ecological visions promoted by neoliberal policy in India during the early 1990s that adhered to the Sustainable City Programme. Researchers critiqued the conservationist-beautification ethic for urban India, as it was "set against the backdrop of an increasingly globalised world in which the North dominates the South in economic terms" (Mahadevia 2001: 243). While Darshini Mahadevia (2001) denounces the concept of "sustainable city" and considered its application to India as part of a larger "green"-capitalist scheme, Arabindoo (2005) and Baviskar (2003) introduce a class critique of urban environmental governance in India, revealing an alliance between the urban middle classes and the state for the protection of the environment against the urban poor and at the cost of excluding their needs, voices, and aspirations. Amita Baviskar's work on Delhi (2003) exposes these practices of the middle and upper classes as "bourgeois environmentalism" and shows how these classes use Public Interest Litigations (PIL) to impose their urban ecological imaginaries.

However, more recent work has challenged the view of the urban poor as hapless victims who are entirely excluded from governing urban environments by pointing to South Asia's diverse, complex, and multifaceted urban natures. Poststructuralist UPE researchers, in particular, have probed into complex processes of interactions and mediations among actors and thus challenged linear expositions of power hierarchies between the state and local communities. For example, Alex Follmann (2016) studies multiple challenges of governing the Yamuna River in Delhi and explores the role of non-state actors, especially environmental non-governmental organisations (ENGOs). Acknowledging their critical responsibilities as watchdogs and exploring their day-to-day practices, actions, discursive strategies, and networks, Follmann reveals their complex interactions with different tiers of government, political parties, and international agencies that represent "formal and informal negotiation processes between state and non-state actors that take place beyond the arenas of representative democracy" (2). In these processes, he sees the emergence of a new, expanded form of urban environmental governance in India in the 1990s and early 2000s. The author concludes that though ENGOs are significant actors in terms of "collecting, disseminating, (re) interpreting and (re)producing environmental knowledge" (15) and fostering democratic control over contested riverscapes, they find it difficult to negotiate with urban planners and policy circles outside the spheres of the media and the judiciary. Nevertheless, Follmann's case study challenges the notion of "bourgeois environmentalism" (Baviskar 2003) by showing the possibility and reality of environmental activism across social classes in Indian metropolitan cities. Anchored in concern for long-term ecological viability and social justice,

ENGO-induced activism around riverscapes also unveils the limits of sectoral approaches in governing urban nature and questions land-water, urban-rural, city dweller-farmer dichotomies.

In a similar vein, Amit Jain's (2018) case study on the Kudasiya Ghat at the banks of the Yamuna in Delhi complicates the dualisms between domination and resistance, and between the state and the "urban poor", or commoners. Beyond challenges caused by state-led encroachments on the ghat, Jain studies everyday forms of negotiations between the "legal" and "illegal" via acts of bribing, formations of temporary houses, and performance of rituals, indicating (re)generation of the bank during the immediate post-demolition-displacement period.

Follmann's and Jain's studies exemplify that South Asian UPE has progressed and expanded from an overarching emphasis on networked infrastructures (most specifically piped water) to non-networked or "other urban waters" (Cornea et al. 2016). Furthermore, it expanded to explorations of wastewater (Karpouzoglou and Zimmer 2016), solid waste (Cornea et al. 2016; Sharma and Parthasarathy 2018), air pollution (Véron 2006), urban parks (Sen and Pattanaik 2018, Zimmer et al. 2017), and beautification (Bose 2013, 2015; Follmann 2015). The most important contribution of recent UPE is its focus on micropolitics; it unveils pluriversal possibilities in the world of governance, exposing us to both challenges and opportunities in governing large, diverse, complex, and multi-layered South Asian urban environments. The poststructuralist turn has implied UPE's orientation toward ethnographies of everyday governance, that is, "the plurality of governance actors, their practices, rationales, normative orientations, interests and imaginaries as well as their relative and contextual power that shape local (urban) spaces and environments as well as access to (urban) resources, amenities, and services" (Cornea et al. 2017: 2). Breaking with the state versus civil society/local community binary and the view of power in the frame of simple domination and subordination, UPE unpacks how multiple actors negotiate, adapt, bargain, hybridise, and formulate norms and regulations that are not (always) thrust upon them but evolve across complex (and sometimes lengthy) processes of mediation. In this way, UPE enables the analysis of the myriad ways through which rules and policies are framed, debated, modified, managed, and controlled. It even pays attention to how a plurality of norms is (re)produced, as "negotiations between actors are not only about means and ends but also about the imaginaries, set of norms, or normative registers, to apply in a given situation" (Cornea et al. 2017: 4).

Unlike UEH, South Asian UPE scholarship has used governance as an analytic concept for the study of the relationship between state and other non-state actors in the era of the neoliberalisation of the political economy and of nature in India. For example, Cornea et al. (2016) shows how the everyday governance of the "pondscape" in the small town of Bardhaman in West Bengal is largely controlled by neighbourhood clubs and local political party cadres while formal property rights hardly matter. These actors apply registers of social values, but also unspecified threats of violence, in structuring access to particular ponds. By shedding light on public-private partnerships for water supply in Bangalore, Gopakumar (2014) examines the "networks of counter-experimentation" and argues that these alternative utility provisions "simultaneously forward the marketization of water-supply services while inadvertently providing opportunities for residents, local associations and activists," poignantly exposing "governance failures" in meeting drinking water needs of expanding cities in the neoliberal era (393). Ranganathan's (2014) specific focus on "water mafias"

as informal sovereigns and its collusive connection with local state agents in supplying drinking water (from illegally tapped aquifers) to non-networked informal urban settlement unfurls the world of everyday governance and public authority "conjugated with the idiom of the state" (102).

South Asian UPE studies on everyday governance often have often referred to the framework of "situated urban political ecology" (SUPE; Lawhon et al. 2014). SUPE points to the need for a highly contextualised analysis of power relations and urban environments and is critical of the unreflective application of theories and concepts from the Global North to the Global South. Indeed, Indian case studies unpack specific trajectories of urban nature and provide place-based descriptions and political specificities (see the articles in the special issue of the *South Asia Multidisciplinary Academic Journal* edited by Zimmer and Cornea [2016]). For example, using the Lefebvrian concept of space production, Rao Dhananka (2016) reveals the conflict between heterogenous slum communities and other actors in the context of Bangalore's urban housing (resettlement) projects for lower-income groups. She demonstrates how the constant manipulations and negotiations around these projects lead to complex layers and fractures in governmentality. Along similar lines, Hagn (2016) discusses the roles played by political leaders and "fixers" in mobilising community participation in the city of Puri in Orissa. The study shows how vote banks are created and consolidated around the central government "Basic Services to the Urban Poor" programme through an array of tactics.

Apart from SUPE's attention to place-specific political actors, power constellation, and micropolitics, UPE has a long tradition to consider the influence of specific biophysical dynamics on environmental governance, a factor that is hardly recognised by UEH. The different resource characteristics of water and air, for example, can shape interest, interest groups, imaginaries, and thus politics (Véron 2006; Zimmer et al. 2020). More radically, post-humanist UPE considers non-humans, including animals, infrastructure, or algorithms, as actors (Gabriel 2014). Blurring the boundaries between people and infrastructure, for example, Yaffa Truelove portrays hybrid state arrangements in water provisions in Delhi, where lower-class women having to fetch water from afar replace piped water infrastructure. While exploring intra-settlement differences in governance and practice, she examines the "micropolitics of water governance in unevenly shaping [gendered] bodies, spaces and incongruent urban environments" (Truelove 2016: 19). Apart from extending UPE to accommodate embodiments, her analysis overcomes the binaries between formal and informal water governance in historically evolved "legal" and "illegal" settlements. For instance, even formal middle and affluent classes depend on non-formal "extractive" technologies to access water due to erratic access and unreliable functioning of piped networks.

A further addition to South Asian UEH, which focuses on metropolitan areas, is South Asian UPE's increased attention to small towns. For example, Véron (2010) lays out a research programme on India's small cities, which face distinct challenges of environmental governance enhanced by limitations in political clout and in technical and financial capacities. The ensuing research in Gujarat and West Bengal finds complex relations between municipal authorities and the state government and a generally stronger role of clubs, political parties, and business association as compared to the importance of ENGOs in India's metropoles (Cornea et al. 2016; Zimmer et al. 2020). Furthermore, Müller and Dame's (2016) explorations of the small city of Leh (Ladakh) tease out an "arena of negotiations" (11) among a web of actors, including state officials, the Hill Council, NGOs, religious

groups, and local communities. Using a historical perspective, the authors examine the debate of tradition (cultural heritage) versus modernity (market-oriented development) in the context of an urban beautification scheme that unveils clashing aspirations and agendas between national and local leaders. The authors situate these debates within the larger context of the struggle for Ladakh's autonomy, for which "beautification" adds a layer to the already-recalcitrant relationship between the centre and regional governing bodies. The article also depicts how the socio-natural (re)production of urban environment and governance frameworks are shaped by strong imaginaries evolved across temporal, political, and local religious-cultural dynamics.

To sum up, UPE scholarship has pointed to links between local environmental governance and global processes (of neoliberalisation). More recent UPE scholarship in South Asia has examined urban environmental governance through ethnographic methods and unveiled complex processes of everyday politics and nonlinear power relations between multiple actors in situated contexts. It moved beyond the study of metropolitan areas and challenges mainstream governance concepts by pointing to the role of resource characteristics and non-human agents.

Historical urban political ecology (HUPE): a cross-fertilised framework to study urban environmental governance

In critical South Asian urban ecological social science, there is an emerging realisation of the importance to integrate methods and methodological approaches to develop more comprehensive and nuanced understandings of the (un)makings of urban nature across shifting political trajectories. This is not an altogether new venture in the global urban political ecological scholarship. The importance of complementing ethnography-based empirical investigations with archival knowledge was recognised in earlier traditions in political ecology, where scholars have warned about the limits of historical research on one hand (Watts 2013), and on the other attested how historical investigations remain imperative in guarding against "apolitical" analyses (Davis 2015).

In classic UPE, which conceptualises cities as socio-nature, the relational politics of environmental infrastructure has been historicised, particularly along the colonial and the neoliberal era (Gandy 2008; Ranganathan 2015). More poststructuralist UPE also makes the case for a "more temporally oriented UPE" (Zimmer and Cornea 2016: 9). For example, Truelove (2016) recognises urban environmental assemblages as dynamic and fluid, and thus also situated in time. Similarly, Müller and Dame (2016) pay attention to the temporal shifts in cultural imaginaries that have influenced conservation and beautification in Leh, which through time has transformed from an international commercial centre to a national periphery, and where romantic-eulogistic imaginaries of former life in the mountainous landscape are reproduced.

South Asian UEH, too, has boldly asserted the colonial-contemporary connect through case studies, showing how post-independence pollution, sewage, and scarcity in accessing drinking water need to be contextualised within colonial policies of urban ecological infrastructural governance during the 19th and 20th centuries (Mann 2007; Sharan 2011, 2017; Wilhelm 2016).

Through the formulation of a "historical urban political ecology" (HUPE) framework, Jenia Mukherjee (2020) foregrounds the importance of the application of a historical lens in

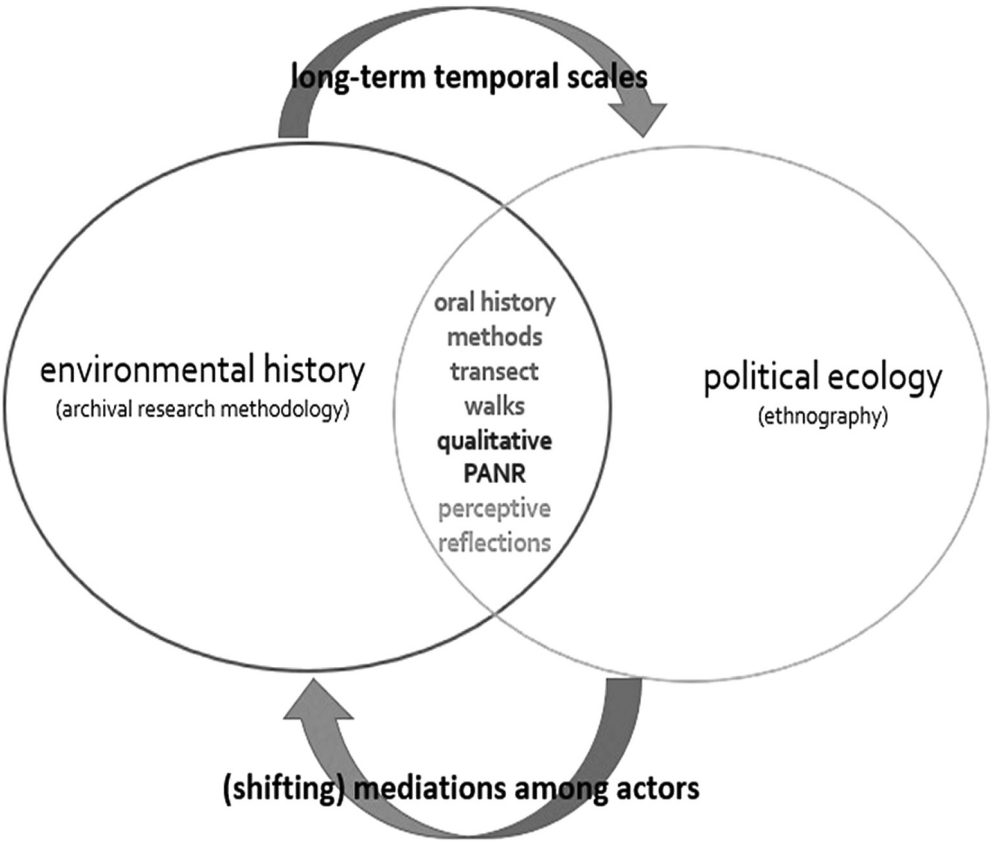


Figure 21.1 The HUPE framework. Mukherjee (2022: 36).

political ecological analyses and vice versa. By coupling UEH and UPE approaches, invisible "storylines" (Moore 2007)[6] in the manipulation of urban nature along long-term and across large spatio-temporal scales can be made visible. In HUPE, history provides long-term temporality to ecological processes and governance scenarios in (micro)political settings involving multiple (more-than-human) actors and mediations among them. The historical research enables explorations of shifting priorities and choices among multiple stakeholders determining urban environmental trajectories across dynamic political-economic imperatives in different eras. HUPE is nuanced, comprehensive, and robust, as it allows comprehending "urban ecological transitions by triangulating information from multiple sources and stories narrated by multiple actors at different points in history" (Mukherjee 2022: 34–5). It exposes researchers to competing claims and narratives shaping environmental governance, unpacking the relationship between cities, their environmental infrastructures, and multiple institutional mechanisms and arrangements, transforming across changing temporal scales (Figure 21.1).

Box 1: The Kolkata Case Study on "Blue Infrastructures"

While exploring contemporary challenges faced by Kolkata's canal and wetland systems caused by rapid urbanisation and associated real estate speculation, Mukherjee (2020) used the back-casting methodology of looking into archives. Through this case study, she formulated, empirically informed, and applied the HUPE framework to address the debate among scientific communities regarding risks and resilience encountered by, and predicted for, the delta city of Kolkata, located on the northern part of the vast and expansive Sundarbans. Is Kolkata environmentally vulnerable or ecologically subsidised? While historian Bhattacharyya (2018) exposes colonial property-making initiatives through the reclamation of the city from the marshes and connect the climate vulnerability of present-day Kolkata to the colonial-capitalist efforts of reclamation, for the sanitation engineer Dhrubajyoti Ghosh, Kolkata is an exemplary example of an ecologically subsidised cityscape that benefits from the optimal use of its ecosystem base and traditional knowledge inherited from its origins. Although these opinions strongly diverge, Bhattacharyya and Ghosh converge by opposing the state (colonial and contemporary) to local communities, including farmers and fishers drawing livelihoods from agrarian lands and wetlands in the eastern periphery of Kolkata.

Using HUPE, i.e., by triangulating information and inputs from multiple sources and stories narrated by multiple actors at different points and nodes in history, Mukherjee (2020) maps interests and aspirations among different agencies and stakeholders, including government actors (Municipal Corporation, Departments of Fisheries, Irrigation and Waterways), NGOs, local organisations (such as Fish Producers' Association, Wastewater User Committees), and local communities. In her research over more than 15 years, she finds collaborating interests and aspirations that are pivotal in ensuring the functioning and survival of the city with no separate constructed sewage treatment plant to date. The East Kolkata Wetlands recycle 750 million litres of waste and produce 22 tonnes of fish and 150 tonnes of vegetables per day. The entire system evolved as a planned network across collaborations between different sectors and agencies, optimising upon the possibilities of municipal wastewater governance, connecting the city with its eastern marshes through manipulations of natural ecologies along an intricate network of primary and inlet canals. Clashes among governing lobbies and institutions have been common as evident from colonial gazettes, reports, and correspondence, and from contemporary key informant interviews conducted with municipal officials, engineers, and executives. The distribution of wastewater has been one of the major bones of contention between the Kolkata Municipal Corporation, I&WD, and the local fishers in recent times. Yet, HUPE investigations of the institutional mechanism in the evolution and functioning of Kolkata's organic effluent treatment design demonstrate strong attributes of municipal-local interactive governance that can be harnessed at its best towards effective urban infrastructural and governance pathways. Beyond "linear choreographies of power equations … HUPE conveys the 'plural' by exemplifying collaborations, compulsions and contingencies that mediate urban ecologies" (Mukherjee 2022: 32).

Conclusion

In this chapter, we have discussed the significance of engaging with long-term urban ecological trajectories for the search of sustainability in South Asian cities and their hinterland. UEH usefully goes beyond the dominant discourses separating the urban from the rural, and the city from nature. It explores historical layers of environmental governance by revealing the context, time, and culture that operated in specific periods. By reading and deciphering the urban (environmental) palimpsests across large time-space scales, as well as considering plural imaginaries of the urban environment, UEH contributes to contemporary and future theorisations and creation of possibilities of environmental governance.

However, UEH is imbricated with some limits, primarily emanating from an overarching reliance on archival sources. Although there is scope for triangulation within historical research (e.g., comparing and contrasting different archives), the complex and multifaceted processes of South Asian urban environmental governance involving plural actors seem to require ethnographic study, too; for example, from UPE. Therefore, this chapter has provided a detailed overview of the South Asian literature of both UEH and UPE, demonstrating how these two fields can complement and inform each other. The combination of UEH and UPE usefully reveals the role of religion, caste, class, and ethnicity, as well as the choreographies of power and embodiments, in managing and governing urban ecologies of diverse and plural urban landscapes in South Asia.

Finally, we have presented the HUPE framework, a cross between UEH and UPE, to unravel complex relationships among multiple actors across state and non-state agencies that shape, and get shaped, by urban environments evolving along dynamic political-economic conjectures. HUPE unpacks the politics and politicisation of environmental governance, an element often missed or sidestepped in conventional climate change and urban sustainability research and discourse. HUPE allows to capture the diverse meaning and significance of the "urban", "infrastructure", "environment", "governance", as well as their encounters, in specific contexts that might be unique or resonate across spaces and times. For example, our comparative HUPE study of the urban "deltascapes" of Arles (in the French Rhone Delta) and of Kolkata (in the Indian Ganges Delta) points to connected global processes in particular historical periods that influence river and flood management (Mukherjee et al. 2021). While South Asian UEH and UPE have been inspired significantly by research in the Global West, we argue that historians and political ecologists everywhere can learn key lessons from cross-fertilised approaches like HUPE that have the potential to blur North-South binaries and to contribute to more comprehensive, temporally dynamic, and politicised understandings of global urban environmental governance that is sensitive to local specificities and complexities.

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Notes

1 This chapter draws mainly on UEH and UPE studies from India because of their relative abundance. However, we refer to South Asia at times because colonial India included today's Pakistan, India, and Bangladesh before Partition (1947).

2 We refer to South Asian UEH (and UPE) scholarship and researchers when the studies are situated in South Asia and regardless of the whether the authors are affiliated at an institution in South Asia or elsewhere.
3 Variously described as the Indian Mutiny, the Revolt of 1857, or the First War of Independence.
4 *Chamars* represent the Dalit community. Classified as a Scheduled Caste, they are widespread in North India, their hereditary occupation is tanning leather.
5 *Rais* is an Urdu term which implies the nobility or the elite section of the society.
6 "There are dominant, counter, and even suppressed story lines in each city that demand our attention" (Moore 2007, p. 23).

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PART V

Practices and Actions for Current Socio-Ecological Crises


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22

PEDAGOGY FOR THE DEPRESSED

Empowerment and hope in the face of the apocalypse

Michelle K. Berry and Emily Wakild

Bzzzzzzzzzzz bzzzzzzzzzzzzzz.

It's not uncommon for undergraduate students in large university classes to arrive with water bottles brandishing stickers with their beliefs. A popular one now is "save the bees", with any number of caricatures softening these creatures. "Let it bee" or "Plant these, save the bees" slogans support campaigns to plant native plants and reduce pesticides. Emily's university even has a "bee team" where students steward a colony of bees on the roof of the Student Union Building. But do the bees need our help? Are they not saving us? And why do we make space for pseudo-bees on stickers and not actual bees in our stories?

Pollinators populate the world right under our noses. They do so in ways nearly imperceptible to human senses and with tenacity across individuals and collectivities. They are stunning in their organisation and drive. The challenges facing pollinators are catastrophic. Colony collapse in honeybees and the continual decline of forests where monarch butterflies overwinter pose radical challenges to these beings in our midst. Within those contexts, though, the persistence of pollinators is impressive. So why not invite them into our classes as the centre of and participants in our learning?

Pollinating is more than a metaphor. The persistence of pollinators demonstrates values of reciprocity and more-than-human ways of being that we think are urgently needed in the environmental history classroom (O'Gorman and Gaynor 2020). We use the term more-than-human here as a noun to recognise that beings exist and shape the past despite not being human. We recognise them not as less than or compared only to humans as a standard; the term "non-human" fails to get us away from the binary between humans and nature. The relationships embedded in the world through processes of pollination move through time in patterns reflective of culture and technology (Bonnell and Keraj 2022; Márquez Osuna 2022). Attention to such collective action should be important pillars of future environmental history pedagogy.

Anthropologist Jake Kosek provides a powerful opportunity to consider bees. His article on honeybees and empire transforms the ways students think about beekeeping and bee behaviour (Kosek 2010) by using a lens of empire. Kosek considers the military uses of bees – to detect plutonium on the landscapes of northern New Mexico, for example – and the ways bee social behaviour – swarming, building hives – has been adapted for use in

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forms of modern warfare such as drones. The interest here is less in insects as attacking soldiers or as metaphors for weapons, and more in the ways their actions put humans in tune with alternative ways of experiencing the world.

Insects have capacities of, and perhaps intelligence for, enhanced sensory experiences. As Diogo de Carvalho Cabral and his co-authors note, leafcutter ants responded to human deforestation for agriculture in 19th-century Brazil in consequential ways that must be considered creative, not only reactive (Cabral et al. 2022). Leafcutter ants remove parts of plants to grow underground fungus to feed their colonies; that is, they farm. In farming, they also responded to and shaped human settlement patterns, legislation, and technologies. Farmer ants grow their own food using plant material from crops humans were themselves cultivating. Europeanised agricultural settlements improved ant habitat by providing single crops – sugarcane, coffee, tobacco – which had no chemical defences against the foraging ants. From the ants' perspective, humans served them by opening the canopy, clearing the ground, and facilitating food for them. By debilitating the multispecies forests, humans also reduced the birds and animals that would otherwise consume the ants. What a partnership (for the ants, anyway)!

The story of the ants as told by Cabral suggests that humans and more-than-humans have fascinating and entangled pasts. It is simply not accurate to say that humans ruined species' habitat in Brazilian forests by clearing land for farming. We appreciate this complexity and suggest in this chapter that by shifting the ways in which we teach environmental history (maybe all of history) to focus more on the complexity of relationships among organic beings and even inorganic elements, we can lend students enough hope to get them engaged in demanding very real and substantive changes in western culture (Mauch 2019). Maybe enough hope so that the false dichotomy of human well-being and ecological well-being can be done away with permanently as we move into an era of mutual reciprocity.

With hope comes power, and our students should leave our classes feeling empowered with complex knowledge and community-based skills. Like good pollinators, we hope to spread some ideas for how to achieve this in our chapter. First, we'll outline ways to embed change in the environmental history classroom by both embracing new and time-honoured concepts and cosmologies. We then offer specific convictions that state our beliefs in the importance of interpretive perspectives and values of care and compassion in how we choose content and create assignments. Finally, we highlight the ways conversations can be restructured to celebrate the ways, alongside our students, we can fumble towards understanding together. Doing all of this requires a humility of experience and a commitment to inquiry. It also requires us to rethink established practices – such as participation – and celebrate new ways of being in relationship within a more-than-human world.

Join us! It will be the bee's knees.

Concepts and cosmologies

In the roaring '20s of the 21st century, we needn't focus solely on the fact that humans suck. In our experience, the students sitting in our classrooms do not need to be convinced of that and, if anything, they need to be convinced that humans have great capacity to change direction, reform their ideas, and alter their own history. Much like the ants in Brazil.

When we first created our outline for this chapter, we had the first section titled "Why to Teach Like the End Is Near Without Setting Yourself or Your Students on Fire". As we set about to write that section, we struggled mightily to put pen to paper (in analogue speak).

We couldn't figure out why we were having such an issue getting started, and then we realised that we were not convinced by our own set of terms. The end of what? How near? And why the heck shouldn't we spark our students into action? It finally dawned on us that the premise and proposition of this chapter is counter to our first section's title – indeed, we believe that we shouldn't only teach as though the end is near and that we should light our students on fire (figuratively, of course). And by saying we shouldn't *only* teach as though the end is near, we don't mean in the climate-denier, head-in-the-sand sort of way.

When we were being trained in environmental history, one of the profound debates centred on declension and progress narratives in the field. (Sounds quaint, doesn't it?) The demand was being made that environmental historians had to shift from a narrative of progress to one that was more honest and realistic: negotiation, hybridity, culture (O'Gorman and Gaynor 2020; Sutter 2013; Worster 1990). Indeed, we needed to tell stories that were raw and hard-hitting about all the ways in which humanity had messed up. Now, we think it is time to shift that fatalistic storytelling. By focusing mostly on the part of the story that suggests the end for humans is near, we do a disservice to the generative learning that students can experience in our classrooms. The convergence of so many ecological, social, political, and economic crises paralyses us all. Crisis serves as a conversation stopper. Rather than inspiring discussion about possibilities and deliberation on problem-solving, the declensionist interpretations so prevalent in environmental history today promote cynicism and hopelessness. It's hard to move anywhere from there.

Yet, interpretation, as the field has demonstrated time and again, is a choice. Environmental history has increasingly become more inclusive with regard to the agency and subjectivity of people who identify as Black, Indigenous, Latinx, Asian, female, and queer. In a generation, the field has broadened its focus from mostly a United States–centric discipline to one that is global in scope, as evidenced by new journals, societies, and consortiums. Even what we consider "environmental" has shifted and broadened (Hersey and Brady 2019; Stewart 1998).

It is now an established fact that interpretation – progress, decline, catastrophe, hybridity, and so on – is a choice. So why not use this in the way we choose to offer our material to our students? Of course, it is important that they learn the end is near for some 37,000 species on planet Earth, including *Homo sapiens*, but perhaps it is just as important to learn that the end is likely not near for some 8 million more. Learning why and how that has come to be, how the ants have saved themselves, and why humans have at times been partners in their salvation, can powerfully reorient our students' and our own thinking about the future. That shift in thinking will strike many scholars as naïve and even annoyingly optimistic, but in our classrooms the shift might just save us all from, well, the end, by inspiring our students not only to take our classes but to become committed to and empowered by the promise of persistence.

In calling for profound revision to environmental history pedagogy, we must pay attention to a bias that few are willing to face – namely the idea that humans and nature are diametrically opposed. While the debates about the inaccuracy and simplicity of the human/nature binary are occurring in other fields, rarely do they trickle into the non-graduate classroom (Alaimo 2016; Hayward 2008; Mortimer-Sandilands and Erickson 2010; Sturgeon 2008). We suspect the dualism on which environmental history has anchored its epistemology serves us no more. So, as we make pedagogical choices about how we should teach about the end, it would behove us to think about where we begin our courses and the frameworks we establish at the outset.

Beginnings matter because they establish cosmologies. We have found that one of the ways to get students to begin to shift their preconceived dualistic frameworks is to teach texts and authors who offer ideas for new (and sometimes ancient) ways of thinking. When we choose to begin with those kinds of narratives, students can start to reframe their own operating assumptions about both humans and nature.

To accomplish this, we very often begin classes with texts not authored by environmental historians. Robin Wall Kimmerer is one author who helps students of many backgrounds begin to shift the way they conceive of nature and humans (Kimmerer 2013). Even when we have students in our learning communities who are from non-western cultures, it is helpful to have a text that we can share as common reference in orienting to different ways of thinking about human and more-than-human relationships. Kimmerer's book, *Braiding Sweetgrass*, is the first text Michelle has assigned in nearly 25 years of teaching that students overwhelmingly say they wished they had read the entire book (versus the four chapters they were assigned to read). There is something important to learn here – Kimmerer writes with a language of pragmatic hope, and our students are hungry for such messaging. They sense the ways in which Kimmerer's narrative is different and necessary because it is both cutting edge and traditional, creative and factual, idealistic and achievable. Doomsday it is not. Kimmerer, an enrolled member in the Citizen Pottawatomi Nation, urges her readers to think differently about the power of more-than-human relationality. Kimmerer is also a biologist who complicates western scientific understandings of nature by putting them in conversation with traditional Indigenous ways of knowing. Of course, Kimmerer is also intrigued by bees.

Kimmerer explains early in the book the story of her return to Indigenous ways of knowing. As we might expect, one of her earliest examples is that of the similarities among more-than-humans. In particular, Kimmerer keys in on the commonalities that humans and bees share when seeing goldenrod flowers and purple asters. Both groups perceive those blooms as beautiful because the colours yellow and purple, especially when taken together, make them attractive to both species' ways of seeing. In a couple of short paragraphs, Kimmerer shows the reader the ways in which the dualism of human and non is artificial and unhelpful. She states that the study of these relational flowers is really a "question of science, a question of art and a question of beauty" (Kimmerer 2013: 46). What if we offer our students the opportunity from the start to study environmental history from the perspectives of science, art, and also from the bees and the asters? Kimmerer admonishes us to begin to think about the ways in which science and traditional knowledge, nature and human, are more fully understood when they are considered together (Simpson 2021). Bees and flowers, flowers and humans – not in opposition but in concert.

Let's take a tangible example of a historical topic that exemplifies our admonition that beginnings matter. In teaching about the monarch butterfly, we can begin the story with histories of their near extinction due to deforestation and other habitat destruction at the hands of corporate agriculture and economic "development". If we set out only to show students the history of humans ruining the lifecycle of monarchs, the emotions generated will likely be indifference or grief. Neither of those emotional states are sustainable, especially if we hope for learning to continue. If, however, we begin the story by focusing on the monarch and its relationships to forests and to plants like the milkweed and privilege the part of the story that explains how all kinds of humans have come to know the monarch through ancestral knowledge and modern storytelling, the beginning emotion of our students might be awe or wonder. If our origin story about the environmental history of the monarch includes not just how monarch numbers began to decline, but also how many

thousands of humans rushed to tell the insects' story, plant pollinator gardens to give monarchs a safe place to harbour, and create events that celebrate the incredible journey of the butterfly from North to South and back again, and if we ask students to think about how the monarchs' story is their story – of movement, of support, of threat and forbearance – and if we blend science, history, materiality, and spirituality to the narrative from the beginning, our students will understand the story of the monarch more fully (Brower 2006; MonarchNet 2023; Pringle 1997; SaveOurMonarchs 2023; Urquhart 1960). Of course, some will say that the story of the decisions to decimate habitat far outweigh the stories of monarchs feeding on milkweeds planted in a backyard garden in Tucson. But learning about the magic of the more-than-human to draw humans to their needs should be a central part of a pedagogy for the depressed. That kind of knowing is empowering, and it's an excellent beginning to perhaps allow us to avoid the end.

All of that is to say that environmental historians would do well to incorporate more scholarship like Kimmerer and other practitioners of traditional ways of knowing into their classes. In privileging those voices early (and often) in the class, students can begin to build a new framework that prioritises thinking about relationships and reciprocity in the ecological past. Such reconceptualisation will provide a hopeful foundation on which to build their learning of environmental history.



Figure 22.1 A Painted Lady butterfly (Vanessa cardui) visits a wildflower in Coronado National Forest on Mount Lemmon outside Tucson, Arizona. Painted Ladies have been observed to fly 100 miles in one day. Photo Courtesy of Michelle K. Berry.

One of Kimmerer's most important points in the book is about mutual flourishing, a core value for the Potawatomi people and so many other Indigenous communities. This concept of mutual flourishing is not too far-flung from the lesson that Paulo Freire gives to all educators in his 1968 book *Pedagogy of the Oppressed*. This chapter's title plays on Freire's, and even though the book is normally used by social justice educators, it contains helpful ideas for environmental history educators as well. Consider the following:

> in order for the oppressed to be able to wage the struggle for their liberation, they must perceive the reality of oppression not as a closed world from which there is no exit, but as a limiting situation which they can transform.

Freire's notion is powerful for asking students to engage with environmental history as an inquiry-based, problem-solving, possibility-filled educational opportunity (Freire 1970: 49). What if we offer students stories of and engagements with environmental history that allow them to see themselves not as members of the dominant species (the oppressors) that has been hellbent on ecological annihilation, nor as hapless victims of a capitalist system that is closed and immovable (the oppressed)? What if, rather, students emerge from our classes understanding themselves as complex participants in an ongoing narrative of resilience and problem solving? In this approach to teaching environmental history, students can come to recognise their positionality in a moment of "transition politics" where they can feel empowered to be co-creators of a world wherein all kinds of species flourish (Powell 2018). That should be the central goal of teaching environmental history now and in the foreseeable future – before the end comes.

Freire's historical context was important to his belief that teaching could empower the oppressed. We share that theory, but we think that the historical moment in which we find ourselves requires us to work toward rectifying another force (in addition to oppression) that is all too present in our students' lives – depression. As Christopher Schaberg notes in his book with a similar title, there appear to be surprisingly few texts that use "depressed" to play on Freire's concepts (Schaberg 2022). It suits our present moment and our topic here because of the growing convergence of mental health crises among young people and the greater scientific understanding of the role of trauma in learning. The changing context of higher education has shifted the sand under what were once assumed to be traditional and typical classrooms. While the interpretation of this veers towards the tragic, we suggest that depression need not be the end state. Addressing – and calling out – depression as a lens through which our students may approach environmental everything, allows us to creatively reinterpret the atmosphere for learning within our classrooms. That is, tweaking our pedagogy – our way of attending to learning styles and acquisition – can provide relief from the depression that is exhausting our – and our students' – capacities to deal with the sources of environmental angst and grief. As historians, let us play the long game rather than expire after every crisis.

Assigning texts that offer concepts – even cosmologies – for thinking about ecological relationships is the opening for practicing a pedagogy for the depressed. We believe it will draw students into environmental history as a generative field. An essential element to that kind of pedagogy is emphasising the importance of the kinds of stories we tell. If we tell only stories of decline and catastrophe, then it will be difficult for students to see a beginning, let alone be motivated to gather the skills necessary to set off on a new path. It would be inaccurate and unethical to sugar-coat the dire moment we are in as a species in terms of

ecological sustainability. But we believe this is a yes/and opportunity for our pedagogy. When we allow students to acknowledge the danger of the present moment while dreaming of a different future based in investigations of past persistence (of humans and more-than-humans), then the purpose and outcomes of studying environmental history become more useful and intriguing to students with a variety of backgrounds, interests, and futures. Michelle assigns excerpts from Terry Tempest Williams's new book of essays, *Erosion*, to help students wrap their heads around the idea that we must tell stories in a variety of ways. Williams writes, "We are eroding and evolving, at once. Let this be [the] mantra to be repeated daily. What if beauty dwells in the margins of our undoing and remaking?" (Williams 2019: 212). It is no coincidence that Williams's raw and sensitive attention to narrative includes her personal loss of a brother to depression as she wrote the book. Hers is a lived experience of the perils of hopelessness. Reading Williams, Kimmerer, and Freire can help environmental historians cultivate a pedagogy for the depressed and the oppressed that invigorates both us and our students with hope. Assigning these texts to students is particularly useful as the wisdom in the texts helps students begin to understand that storytelling, memory making, and relationship building are essential tools for learning and unlearning about our collective ecological past.

Part of the unlearning is eroding the duality of nature and humanity. As long as that duality exists in western thought, we will only be able to continue down the current path; unable to imagine a new world of reciprocity and mutual flourishing. As Williams says,

> If we are to flourish as a species, an erosion of belief will be necessary, that says we are not the center of the universe, but a dynamic part of an expanding future … that celebrates and collaborates with uncertainty.
>
> *(Williams 2019: 249)*

In our opinion, that erosional process is rather urgent in light of the fatalism fatigue we have both experienced in our classrooms. Students are increasingly exhausted by all the ways in which the world is broken. They seem less and less exposed to historical examples of honourable triumph. We would argue the sole focus on mistaken humanity that characterises so many environmental histories and courses leads too often to a consistent message of fatalism. Nothing has really changed, our students often say, so what's the point (of learning history, of participating in problem-solving, of thinking beyond themselves)? The risk in this is that students increasingly become hopeless (at best) and indifferent (at worst) when confronted with current ecological challenges.

One way that we counter the pitfalls of fatalist interpretation is to focus on the more-than-human. After all, let's be honest – we get excited about bugs and beavers far more than we do about laws and factories. Increasingly, the field is producing impressive scholarship that has at its centre the more-than-human. Research focusing on the power of insects, flowers, llamas, and ice to influence the trajectory of history offers wonderful material for students that gets them thinking about the agency of nature in new ways (Berry 2023; Bonnell and Keraj 2022; Carey et al. 2016; Enright 2023; Few 2019; Melillo 2020). When they begin to consider the vulnerability of humanity in the face of so many "natural" entities, then they come to recognise the more-than-human as a powerful presence in history and in the present. Moving away from declension – from the notion that all of history "happened to" nature – opens up space for students to think about how humans must work in partnership with the more-than-human to move forward in more sustainable ways.

Exposing our students to radically different ways of thinking about the relationship between humans and nature in history can start with the texts we assign at the beginning of our courses, but then we have to walk the walk. We bring to History the practice of working in Studies departments – Women's and Gender Studies for Michelle, Environmental Studies for Emily. In some cases, these programs have moved from being on the outside or fringes of the liberal arts experience to being at the centre. At the same time, decreasing enrolments in History are an artefact of many of the complications of our current political moment as well as a heritage of exclusion not remedied in time. While there has been some reflection on why this is and what it means for the structures already in place, we suggest that an alternative approach that is readily available is to lean into the things that attract students to historical thinking – namely, the opportunities for storytelling and perspective taking. What follows are some of the stories we tell and co-create with students in the hope of making good on our desire for a pedagogy for the depressed.

Convictions

Beaver jail was empty that blustery February morning. More like a kennel than a jail, this facility felt cold when visited by 25 undergraduate students, two graduate students, a professor (Emily), and two Fish and Game agents. Yet, it was the way-station between trajectories of life – a nuisance in the city or a new lease on life on a ranch far away. Beaver jail is 15 miles outside the city of Boise, on a hill adjacent to a wilderness management area and along a popular hiking trail. Most hikers would never know the facility was there, as it sits behind a shade-blocked chain link fence with no signage. But as the agents explained the ways they use the facility in the summer, showed us pictures of beavers being soaped and bathed to remove parasites and disease, and delivered data on the more than 50 beavers they'd translocated, the fates and the futures of these furry creatures were top of the students' minds. This experience happened in a unique class, but it can still serve as an example of the ways we can shift our pedagogy to empower students to use and think about environmental history to restore hope in the present.

The return of healthy populations of beavers to the North American West and the use of beaver dam analogues in stream restoration are history in action. Beavers and beaver dam analogues are two related issues of environmental relevance, although they may seem esoteric at first mention. Due to the fur trade, beavers were nearly trapped out of Idaho before permanent European settlement; yet, other than a few paradigmatic examples (including of parachuting beavers in the 1950s away from settlements and into remote wild lands), little is understood about the story of their return and revival in the state (CSKT 2005; IDFG 2017; Wood 2020). In the last two decades, as scientists have come to understand the dramatic effects of beaver engineering, some have introduced techniques that mimic beaver dams in riparian systems that require restorative action, calling these techniques "beaver dam analogues" as one component in larger movement for process-based restoration (Beechie et al. 2010; Nash et al. 2021; Pilliod et al. 2018). Beaver return and beaver-based restoration strategies have social, cultural, and geophysical effects that merit deeper inquiry. These effects are ripe for the critical intervention and retelling of historical narratives using time and context. These are real skills historians do well.

How do beavers get us out of depression? They are one very real example of imagining the ability of animals to forge their own futures. Beavers did not return with the intervention of the Endangered Species Act – at least not directly. They were never listed as endangered,



Figure 22.2 Checklist and fence for beaver containment facility, Lucky Peak Wilderness Management Area, Idaho. Photo courtesy of Emily Wakild.

though they nearly disappeared. They are rodents, varmints, or, according to the first wildlife survey of Idaho, "gnawers" (Rush 1942). Their return came of their own volition, of their own subjectivity. Beavers acted when they saw opportunities, and they have seen those opportunities across what Laura Ogden calls the "Beaver Diaspora" (Ogden 2018). Beavers in Idaho are flourishing in many contexts – despite the chance that they would end up in jail – but beavers in Tierra del Fuego are also flourishing but are leaving greater ecological destruction in their wake as they have few natural predators. The southern beech (*Nothofagus*) forests did not evolve defences for such aggressive gnawing. Many locals consider beavers to be "invasive" and a plague on the fragile islands. The obvious conversation that arises in this contrast is, who belongs where, and why? How long does it take to be native to a place? How can we understand the beavers and also the beech? Considering the activity of these erstwhile engineers is empowering for students precisely because it gets us out from the hegemony of the human disaster paradigm. What we mean is that so much in the realm of environmental literature is in fact, depressing. As such, it can serve to paralyse and petrify our students. Or, as Sarah Jaquette Ray suggests, guilt and burnout are the enemy of resilience and justice (Ray 2019). We suggest actively cultivating the opposite. Beavers help.

Beavers, of course, need water, and if there is any entity that represents stories of more-than-human resilience and an opportunity for recognising human dependence on the more-than-human better than water, we have yet to meet it. It floods, it pours, it freezes, it

disappears, it trickles, it flows, it provides, it withholds. As Kimmerer says, "there is no stopping water" (Kimmerer 2013: 310). Indeed, it's the perfect subject to anchor a pedagogy for the depressed.

In a class segment on water history, it behoves us to ask students not just to think about the substance itself, but to *feel* it. Go ahead and give it a shot – take a minute and listen to water. Maybe it's a recording of an ocean wave. Maybe it's the sound of water running from your faucet. Maybe it's the pitter-patter of raindrops on your roof. If we consider water to be a primary source, what does reading the source do to your understanding of the subject? How does water make you feel? What story is it telling in that particular form, and how does it spur you to action? Maybe you choose to turn the tap off rather quickly because you live in an arid place where water is scarce and sacred. Maybe the rain makes you think about grabbing your umbrella. Maybe the ocean sounds conjure peace or even anxiousness. No matter what, the water you interact with (just by listening!) moves you to some sort of feeling and some sort of action. This simple exercise when used in an US environmental history course that centres water can reorient students. Pair that with a reading from Winona LaDuke (Anishinaabekwe [Ojibwe]), an excerpt of Elizabeth Hoover's work, and a video of Lorraine Herder (Diné [Navajo]), and students can immediately begin to conceptualise water as an entity that drives humans to act in relationship with it and with each other (Hoover 2017; Herder 2023; LaDuke 2020, 2023; Narang 2023).

Those relationships can oftentimes be violent. They can be unjust and toxic, but they can also be generative and restorative and perhaps even loving. It all depends on context and perspective. Water in the past, as much as in the present, has moved humans into different kinds of endeavours. It has, in every culture on earth, informed human experience and forced human decision making that has had profound effects on the more-than-human, and thus, water, at the centre of an environmental history course, demands that students take a variety of perspectives.

Floods are beneficial or hurtful, depending on which perspective you take. The decision to concretise rivers to prevent flooding, as the city of Los Angeles has done over the past 150 years, makes some political and geographic sense, but almost no ecological sense (Morrison 2022). The flooding of the Colorado River to initially create the Salton Sea in Imperial Valley was a "natural disaster" only in the minds of those trying to control the river (State of California 2023). To the migratory waterfowl who now call the sea home, that initial flood and the continual feeding of the "Sea" by irrigation runoff has been lifesaving. A drying of the sea due to climate change threatens all life in the surrounding area and presents complex challenges that require innovation and deep consideration (Fountain 2023; Voyles 2021). One can focus on the Colorado River as ruined or as the "hardest working river in the West" (Babbitt Center 2023). Thinking about aquifer restoration in the Tucson Basin not just as an outcome of human effort but also as a result of snowfall in sky islands that pepper the Sonoran Desert shifts the interpretation ever so subtly (di Chiro 2003). No matter the story, the decision to centre water itself allows students to think differently about the past and the future of this essential substance and its entangled relationships with humans.

When water or bees or beavers become the centre of the classes we teach, students stop learning stories where humans are doing things to a passive and helpless nature, and begin to see a longer, more complex history of the environment as collaborative and dialectic – this transcends the once-called-for trend toward "hybridity". Conversations about causality shift in ways that offer more complicated and ultimately more accurate understandings. Unpacking the past to offer a critical lens on the present requires us to erode some of our

previously held conceptions and cosmologies. We could stop at the dismantling, but that would not do justice either to history or to the processes of nature. Indeed, as erosion occurs, so too does accretion. In a pedagogy for the depressed, we would do well to help our students amass a set of skills to utilise as they forge a sustainable future, after all humans and more-than-humans have built as much as they have destroyed.

Conversations

We can create projects and assignments in our classes that foster a skill set for collaboration – conversations, if you will. The most important of these skills, in our opinion, are negotiation and deliberation. Assignments such as collaborative writing using Google Docs, social reading using tools like Perusall or PowerNotes, creation of digital archives of a topic or even of an entire class, or something as simple as having students ask probing questions to guide discussion offer students opportunities to practise the skills of collaboration, negotiation, and deliberation that mimic the skills present in the ecological stories we tell through a pedagogy for the depressed.

In the age of Covid, we have learned that it is worthwhile to also ask what the skills are that must be present to help students feel empowered to engage in those conversations. We believe care and belonging are two essential attributes. To nurture both, we are rethinking the long-valued "participation" part of our classes. Participation has usually meant a professor assigning reading, lecturing about the same topic as the reading, and then asking for student ideas toward the end. Participation has been subjectively defined yet remains essential to the interpretive aspects of understanding the past. We prioritise the goal that every single student will have their voice heard. Creating collaborative assignments where students are able to make their voices heard in a number of ways is one of the best ways to nurture empowerment. But Covid's protocols have also helped us rethink participation as a pedagogical strategy by centring care and support over individual actions.

We stand by the conviction that dynamic, engaged participation and attendance are necessary because history class ought to be based in discussion and dialogue. That is where insights emerge and knowledge is gained. But what happens when students just can't make it to the assignment (whether in-person to a traditional classroom or in the virtual realm)? We understand that living in a global pandemic and adjusting to care for others and ourselves sometimes means we are absent from class. We want students to be able to overcome absences without undue penalty and without an additional burden on us, the instructors; but we also want them to practise the skills of collaboration and deliberation, which is impossible to do alone after an absence. To meet both desires – a desire for a classroom of care, belonging, and support, *and* a classroom that teaches collaboration and deliberation – we are moving away from taking individual attendance and moving towards a model of colleague support. In the last few years, we have thought a lot about how students might use the classroom to model care for each other and community values. In this realm, participation for students who have to miss class is expanded to include note-taking and improving/revising Jamboards (visual-digital whiteboards editable by all, useful for shared note-taking) or online mindmaps that may have been created in class. At the start of each class, Emily will ask for two volunteers to take notes and deposit them in the Canvas folder for notes. In the end, the points students earn for colleague support and participation give credit to students for contributions to collective learning and intellectual growth while nourishing an ethic of care. Participation should be a means to a conversation, not an end in itself.

Conversation is really the beginning of any history – either already made or in progress. And history is a story of negotiation. When activists work to incentivise big box stores to label plants that have been treated with neonicotinoids so that consumers can knowingly avoid the poison so lethal to bees and butterflies, it started with a conversation. When monarchs flit fearlessly toward milkweeds saved and cultivated by botanical warriors across North and South America, when beavers move back into their ancestral homelands, the chances are that those developments occurred due to relentless negotiation among species over time. The conversations and negotiations took deliberation, care, and resilient collaboration (and, of course, sometimes conscious opposition). Learning mastery of those skills through classroom assignments equips our students with the abilities to engage in restorative ecological efforts and empowers them to think beyond the end. If designed with the more-than-human in mind as essential historical actors, those same assignments can gently nudge students beyond the dualism of nature and humans and begin to consider, in the words of Kimmerer, "the shimmering threads" that hold it all together (Kimmerer 2013: 46).

Community

What if we watch wildlife like we listen to water and let the bees inside? In Emily's "Animals in Time and Space" class, she gives groups of students semester-long access to game cameras, also called camera traps, to observe the world of life that inhabits and shares our space when we aren't looking. Game cameras have motion sensors and infrared lights so they take pictures of movement, capturing animals without their noticing. While the results are not earth-shattering or revolutionary, they are fun. And, they seem to increase the empathy of our students to the more-than-humans that hide in the shadows around our lives and merit more careful attention.

The project works like this: Students are already in research project groups who "check out" a middle-of-the-line (about $75) game camera with fresh batteries and a clean SD card. We fiddle with them in class, making sure everyone knows how to use them, setting them up on desks and in hallways, and then playing with video or photo settings. Groups then plan an experiment (Christensen 2016). I ask them to respond to a set of prompts geared towards inquiry: What do you want to learn? How will your game camera help you do that? Where will you try the camera first? How will you share data and distribute responsibility for analysis? About three weeks later, we share images and preliminary answers to these questions and then refine the inquiry and repeat the share. I encourage students to set the cameras up on campus to try to gather place-specific data, but often a student has noticed animal activity nearer to where they live – a mink den on the river bank, a bald eagle nest on a power pole. As others note, this is an exciting, if accidental, characteristic of modern cities and backyards (Alagona 2022; *New York Times* 2021). We grapple with the human threats – how to set the camera up to not get noticed or stolen, how to "surveil" a site without being indecent, and largely, what it means to watch when no one thinks you are watching.

This assignment is set in the present, but it easily becomes historical. For example, one group captured three still photos of a bobcat walking along the riverbank adjacent to campus. In one photo, the cat was clear; the others were a bit harder to identify. The bobcat was exciting – we pondered what the right thing to do with that information might be – should the rest of campus know that this amazing animal inhabited the night a few steps from dormitories? We use a historian's attention to time and context to understand and give

nuance to the changes in this landscape. The Boise River existed in many forms before its current system of plumbing and irrigation. Ancestors of the bobcat knew a river that moved at least 100 feet on either side of the bank students photographed. Such a dynamic course meant the beaver, the bobcat, and the student of the landscape saw meanders in what is now the centre of the city, channelled away.

One of the most gratifying aspects of this game camera "lab" is the ways it sparks conversation. We can talk about the practice of capture – do we need permission to do these experiments? Whose? We consider what should we do with that information – could we compile it over time in a shared dataset, or give it to the city managers? Existentially, and more importantly, we must also consider what that bobcat might be thinking about the camera, about us, or about the water, bees, and butterflies. No matter what the end location for the game camera photos may be, the act of collecting and curating them empowers our students to centre the world around them and to make sure humans doing hopeful things are readily in view.

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23

ACTIVIST ENVIRONMENTAL HISTORY

On war machines and guerrilla strategies

Regina Horta Duarte, Bruna Luiza Costa Pessoa, and Lucas Erichsen

Introduction: entering Manoel's room

When the mother enters her teenage son's room, she notices that the computer is broadcasting a show in which three young speakers discuss a historical issue. She, a historian, stops to listen, observes her son's interest, and asks him: "Is this a radio program?" And he explains: "No, Mom, it is a podcast". Mother and son sit on the bed and listen to the episode for almost an hour. He confesses that he can learn history better this way. She tells him that it reminds her of a radio show. But there is a significant difference: the podcast is available on the internet and can be accessed anytime and anyplace in the world by anyone with digital access.

This happened around 2010, and that mother is one of the authors of this article, Regina, a Brazilian professor and environmental historian. Eager to bring environmental history to an audience beyond academia, that event inspired her to inaugurate a weekly radio show with short five-minute episodes three years later. The episodes explored themes from environmental history and were produced and disseminated by the educational radio studio of the Universidade Federal de Minas Gerais, Brazil. After their first broadcast, they were integrated into an educational YouTube channel.[1] While producing over a hundred episodes, she always had in mind an audience like her young son, her mother (who had grown up listening to the radio), or her former students, who now worked as schoolteachers and could use the shows to introduce environmental history in their classes.

In 2018, Regina and Bruna, a young visual artist and history undergraduate student (co-authors of this article), decided to explore film language to address environmental issues. Brazil, a medium-income country, has faced increasing economic and political instability since 2016, a context in which state funding became scarce, especially for humanities projects. They went ahead anyway, filming scenes with a non-professional camera, searching for old movies in archives, editing all the materials by themselves on a laptop, and looking for copyright-free pieces of music. They produced two short documentaries about zoos and urban animals, considering these potentialities. These were exhibited at some festivals, and now they are available on YouTube.[2] Movement images are powerful and full of possibilities of their sensorial and emotive appeal; their meaning goes far beyond simple

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representation. The film language, or cinematographic language, is dynamic in technic-aesthetics (shots, camera angles, lighting, sound, editing, etc.) and representational dimensions (Martin 2001: 21–38; Metz 1991: 31–90). The short documentaries and the podcasts were publicised, and they encouraged broader connections among Facebook, Instagram, and Twitter users.

These modest initiatives illustrate how environmental historians have embraced filmmaking and online platforms as dynamic and experimental media to reach a range of audiences while aiming for political or social change, assuming the transformative potential of researching and teaching. To burst the academic bubble, environmental historians aim to engage the broader public in a critical vision of the natural environment, always inseparable from human action. These perspectives explore the socio-historical roots of things usually thought timeless. Based on good documentary research, we (environmental historians) construct narratives about the transformations in the complex and diverse relationships between societies and the environment over time. Historians not only want to understand the present as it is. As noted by Castoriadis, "any elucidation we may attempt is finally an *interested* one, it is *for* us in the strong sense, for we are not here only to say what is but to make be what is not" (Castoriadis 1998: 164, emphasis in original). Herein probably lies the core of environmental historians' activism: the goal to transform our societies.

It is undoubtedly challenging to define precisely what an activist environmental history is. In contrast to traditional positions by which historians should avoid activism to preserve supposed impartiality, emerging scholars have been positively experimenting with tangential initiatives towards activism. The rise of digital history and engagement with platforms and social media have been decisive in this process (see Chapter 24, this volume). In a recent debate proposed by the Network in Canadian History & Environment (NiCHE) about scholarship informed and rooted in activism, it was defined as "the act of working to address inequalities and social injustices" to be performed inside and outside the academy. Inside the academy, it implies renewing teaching; removing hierarchical academic, racial, socio-economic, and gender barriers; and encouraging all scholars to engage with public platforms. Activism also demands "breaking down walls" and creating "conversation, partnerships, and collaboration between academic researchers and the public". It involves, inside and outside the academy, "making connections and bridging gaps" (Green 2019).

In this activist leaning, environmental historians face the need to go beyond written language and academic discourse to interact with wider audiences. They must explore filmic languages and orality and adapt their writing to the conciseness and clarity of communication on social networks. There are many practical obstacles. The risk of losing the historical contribution's uniqueness is considerable, potentially sacrificing the complexity and quality of the critique in an eagerness for greater public reach. With so many podcasts, films, and websites dedicated to environmental issues, historians should prove they can contribute to a debate.

Once thriving, one could ask if these efforts will result in the audience's effective engagement, far beyond mere information and fleeting entertainment. To what extent will this activism of environmental historians succeed in awakening practical actions and new attitudes towards the environment? Thinking that the concept and the historical object of "nature" are constructed both by non-discursive and discursive human practices (Foucault 2002: 55–71), we propose that all environmental filmmaking and online platforms' activities are already activism. These initiatives and their interactions outline a contested virtual territory, since our contemporary world blends the "real" and the "virtual". In these "changing digital

geographies", the creation of a "more-than-real" space is quite a political strategy of "activism through the digital". It enables social movements and engagement "that stem from but are not limited to the 'more-than-real'" (McLean 2020: 7).

After providing a brief panorama of environmental history's political and social commitment since its appearance in the 1970s, we explore filmmaking as activism and as profoundly connected to the politically engaged goals of environmental history. We centre this discussion on pioneering experiences by environmental historians in the 2010s and early 2020s. We then trace some initiatives by online platforms in different countries. Exploring the challenges and possibilities in these practices, environmental historians have been developing new skills while undermining traditional views that divorce nature from society.

Casting a wider net

In 1993, three leading scholars published essays advocating activism in environmental history as a decisive step. At the same time, they discussed some challenges when following this path.

Donald Worster emphasised the duty of environmental historians to offer ideas to the public instead of producing "knowledge chasing its own tail". They should "try to take part in the great public issues that animate our times" (Worster 1993: viii–ix). Environmental history in the United States emerged in the 1970s in tandem with the environmental movement. In turn, it was rooted in a cultural legacy where moral activism was among the most inspiring qualities. Since his first works, Worster has cultivated political activism and engagement by environmental historians. As stressed by White, "in looking at the reorganisation of nature, he is most definitely concerned with the reorganisation of society" (White 1985: 3). But he has also emphasised that the field developed into "a scholarly enterprise that had neither any simple nor any single moral or political agenda to promote", expanding and taking on "greater and greater sophistication" (Worster 1988: 290).

Martin Melosi, in detailing the relationship between public and environmental history, stated that this last "was born in advocacy", although it "rarely attained a strong public voice". He argued for the need to find a "consistent path along which to reach the policy community or to successfully address many people within the environmental movement itself". Environmental history was "a mode of thinking", not one more study area. It was time "to cast a larger net" by disseminating results and increasing the public presence of environmental historians. The attentive use of historical methods was key to bypassing bias while cultivating conviction. This field could "offer leadership in understanding the essential relationship of humans to their physical world" (Melosi 1993: 11–20).

William Cronon evaluated that "many if not most environmental historians aspire to contribute to contemporary environmental politics". To this end, they must broaden the audience to historians of other fields, professionals of different disciplines, policymakers, activists, and ordinary people. There are obstacles to doing this, such as preserving the rigours of historical methods, resisting the seduction of power, and evading moral expectations to find clear heroes or villains. Environmental history could be an antidote "to naïve assumptions, decontextualised arguments, excessive generalisations, and plain old-fashioned wishful thinking". When presenting the question "What's the story?" the historian reminded everybody of the complexity and unpredictability of history and nature itself. This distinctive attitude could open both an understanding of the past and a path to change the future (Cronon 1993: 3, 12).

The concerns of these authors were not new in the environmental history debate. Two decades before, in 1970, Roderick Nash gave a course entitled "American Environmental History" at the University of California to respond "to the cries for environmental responsibility" and to help its Department of History to be "more responsive to the problems of society" (Nash 1972: 362). Fifteen years later, Richard White observed that environmental history had already "emerged on the academic scene deeply involved with, if not married to, modern environmentalism" (White 1985: 299).

Notwithstanding this long tradition of environmental historians coveting broader audiences and contemporary challenges, there was a new and decisive context when Worster, Melosi, and Cronon published the cited works: in 1993, the internet became available for general use, booming in the following years and changing the world, reaching people's daily lives in a dizzying spiral. (Abbate 1999; Castells 2001: 9–36). It seems that Worster, Melosi, and Cronon felt something new in the air, prospecting for its possibilities for historians.

Members of the American Society of Environmental History (ASEH) had been managing an electronic discussion list since 1991, housed on a couple of computers at Texas Tech University, which would be replaced by an H-Net hosted at Michigan State University in 1996 (Williams 1996). The ASEH and the European Society for Environmental History supported the creation of the H-Environment website, the first of several initiatives that would establish unprecedented opportunities for communication about environmental history on a global scale (Christen and Mighetto 2004: 10). This digital space allowed the inclusion of new voices in environmental history debates. This was the first opportunity (to give an example) for one of the authors of this chapter (Duarte), a Latin American woman and scholar, to access and join the international debate on environmental history in the early 2000s.

Over the years, the relationship between environmental history and the internet has mobilised researchers in several other parts of the world.[3] In 2011, Stefania Gallini, an environmental historian at the Universidad Nacional de Colombia, was one of the editors of a pioneering dossier on digital history in the Web 2.0 era. The editorial invited Latin American historians to explore the internet's possibilities, develop new skills, and learn appropriate communication approaches. On that continent, digital history was still in a foundational state. In 2014, Gallini was one of the organisers of a virtual exhibition on the history of water in Bogotá in the 20th century, still available on the Environmental Society Portal (Gallini and Noiret 2011; Gallini et al. 2014).

Other initiatives emerge from environmental history as new academic trends, which advocate "the urgency of opening academia up for reflexive thinking about the production of knowledge, challenging orthodoxies and cannons, power relations between researchers and their sources of indigenous activists knowledge" (*Final Report* 2015: 3). The Academy and Activism Network is an international network run by the Center for World Environmental History (CWEH) at the University of Sussex. As of this writing, CWEH is led by Vinita Damodaran, a historian of modern India and an enthusiastic advocate of the intimate relationship between environmental history, environmental policy, environmental activism, and environmental justice. The first meeting of the Academia and Activism Network was in September 2014, bringing together people from different parts of the world and other areas. One of the interdisciplinary workshops at the meeting was "Using Social Media for Mobilization" by Myka Peck, Senior Lecturer in Ecology at the University of Sussex. As of this writing, the Academy and Activism Network maintains a blog, a Twitter account (@CWEHActivism), a regular newsletter, an online photo gallery, and open online seminars.[4]

In Damodaran's words, "the issue is that we cannot put activists in silos and academics in silos" (Damodaran 2020: 284).

Defining the boundaries between activism and academic work is undoubtedly not a simple task for an environmental historian. On one side, we know that the writing of history is performed by people who are, consciously or not, entangled in their contemporary crossroads. On another side, there is no incontestable formula to explore this path. It requires significant theoretical discussions, implies methodological challenges, and raises ethical questions about the role of historical knowledge. Immersed in this dilemma, environmental historians have been exploring various possibilities to cast a wider net beyond traditional academic limits and risk themselves blending research, education, and activism.

Filmmaking: a guerrilla strategy?

In April 2016, environmental historian Claudia Leal visited the region of La Macarena to conduct fieldwork on the history of forests and national parks in Colombia. It was a time of great hope in this country, as the federal government was negotiating a peace treaty with the FARC guerrillas (Revolutionary Armed Forces of Colombia). One of the region's national parks, the Tinigua, hosted the Macarenas Ecological Research Center (CIEM), which the Universidad de Los Andes maintained. This camp housed several biologists and ecologists between 1986 and 2002, but activities were interrupted by the resurgence of the guerrillas.

Together with her research assistant, Pablo Mejía (son of biologist Caturo Mejía, former director of the CIEM), Claudia decided to make a documentary. They intended to offer the work as an argument for getting the CIEM back up and running, supporting peacebuilding and environmental conservation. The initiative was supported by a small film production company and by the university. It was produced with much effort and little money. The final product was *Paradise Lost* (*A Orillas del Duda*), 40 minutes in length; it premiered in 2017 and is now available on YouTube, hosted on the Universidad de Los Andes channel.[5]

Environmental historians have long explored the power of film. They have been cultivating the cinematographic experience in their meetings, and consulting the meetings' archives will reveal numerous examples. In 2003, the opening ceremony of the 2nd European Society for Environmental History (ESEH) Conference in Prague, Czech Republic, included the documentary *The Water Is the Element – Floods in Bohemia*, followed by a debate. In 2022, the ESEH Conference included a keynote on *Wildlife Film Making* with Stephen Dunleavy. ASEH's annual meetings frequently integrated Mini-Film Festivals in their programs, such as in 2005 (Houston, Texas), 2010 (Portland, Oregon), 2011 (Phoenix, Arizona), and 2014 (San Francisco, California), promoting conversations with the directors after the films' screening. An announcement in the program of the ASEH meeting in Madison, Wisconsin (2012), encouraged the participants "to grab some popcorn" and join the biennial free environmental film festival, *Tales from Planet Earth*, founded in 2007 by the Nelson Institute's Center for Culture, History, and Environment (CHE). The organisers wanted both to provoke and entertain, in their conviction that "issues don't move people, stories do".[6]

Most ASEH conference programs also included several sessions and presentations of films. The roundtable *The Plow that Broke the Plains and the Role of Film in Environmental History*, a 25-minute documentary directed by Pare Lorentz (1936), joined Donald Worster, Gregg Mitman, Finis Dunaway, and Mark Madison (Boise 2008). Recently, environmental historians joined four experimental sessions about films at Streams 2021, organised by the KTH Environmental Humanities Laboratory in Stockholm, Sweden.[7]

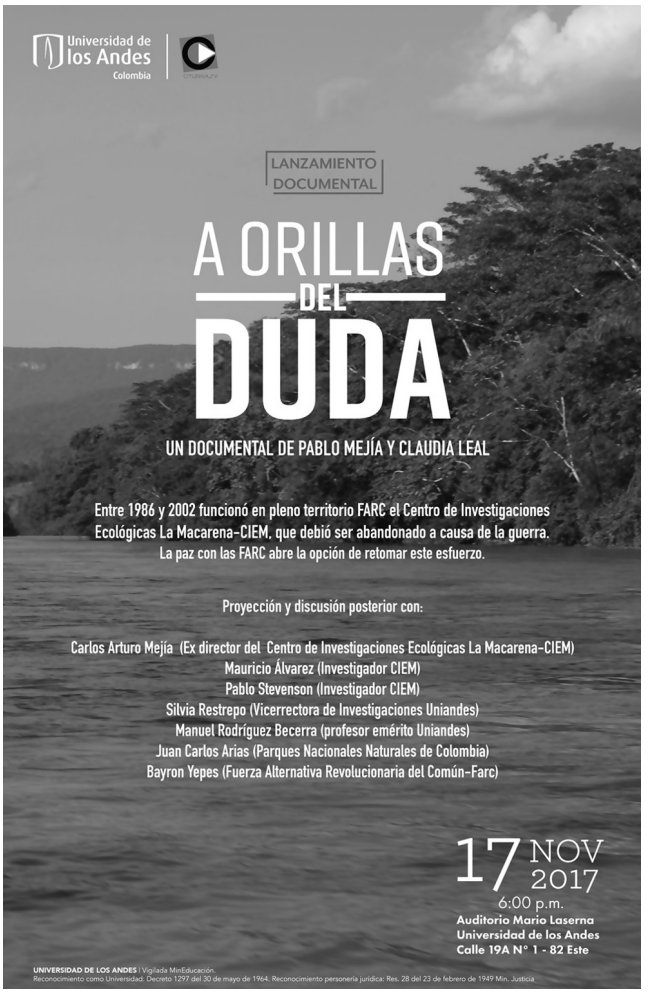


Figure 23.1 Poster for the launch and debate of the documentary on CIEM in the context of negotiations between the Colombian government and the FARC. Universidad de Los Andes, 2017.

The connections "among art, science and activism" attracted particular attention from Gregg Mitman, author of a foundational book for film-enthusiast environmental historians, *Reel Nature*, first published in 1999. Mitman's research was initially about the history of animal behaviour, but as it evolved, it highlighted the importance of filmmaking and its power to persuade audiences. Mitman realised how wildlife films had been fuelled by people's aspirations to get involved with animals, simultaneously nourishing tourism and profitable entertainment ventures in so-called natural environments. He also noted that wildlife films usually reinforce a pristine and mythical nature. Human presence and action were expunged from the scene. However, as "the stories of people and wildlife are intertwined", filmmakers must explore surprising ways that "matter in the lives of people and animals throughout the world". They need to show how the diversity of life is "troubled by

unprecedented environmental change and injustice", mobilising the audience's enthusiasm to find "ways of linking content to action" (Mitman 2009: x, 213, 220; Shell and Mitman 2017: 852).

Mitman set up the film festival *Tales from Planet Earth* to bring together people dedicated to environmental films and those from wildlife documentaries, putting them in conversation with one another. As a curator, he has been determined to connect environmental justice/social justice and natural history/wildlife filmmaking (Mitman 2009: 217). Working as an expert consultant on films, Mitman decided to become a filmmaker when handling footage from a 1926 Harvard University-led expedition in Liberia at the request of the Firestone Company. The collaborative work brought Sarita Siegal, Liberian PhD candidate Emmanuel Urey, and an extensive team. They produced two documentaries: *In the Shadow of Ebola* (2014, 23 minutes) and *The Land Beneath Our Feet* (2016, 60 minutes). Both films use cinematic language to strengthen Liberians' voices. A scene from *The Land Beneath Our Feet* is emblematic of this stance. In it, international student Emmanuel Urey, the film's main character, who at the time was doing his doctorate at the University of Wisconsin–Madison, shows images from documentaries of the Harvard Expedition to Liberia in 1926, when the Firestone company invested in rubber exploration in that country. The camera alternates its focus between images of ritual dance and the reaction of the assistants, men and women, the elderly and children. One of the older villagers recognises elements of their ancestral culture that Firestone destroyed. Liberians who watch the documentary take the floor, talk about their memories and reconstruct their identities and history, in front of the film crew and in front of us, the film's audience.

In addition to interacting with local communities and decentralising the construction of the historical narrative, the team worked to repatriate images taken in Liberia in the 1920s. This "subtly subversive film" aimed to decolonise visual culture, supporting the contemporary challenges of that African country. In addition to the exhibits in Liberia, there is a digital public history/community sourcing website with which the public can interact.[8]

In Sweden, Jacob von Heland is another example of a filmmaker from environmental humanities, a faculty member of the Division of History of Science, Technology and Environment at KTH Environmental Humanities Laboratory, Stockholm, Sweden. With Henrik Ernstson from the University of Manchester, he produced and directed *One Table, Two Elephants* (2018, 84 minutes), the first of a trilogy on "the silences, violences and knowledges of postcolonial ecologies in South African cities". Aiming to subvert "lines between disciplines, text and films", they present biologists, hip-hoppers, wetland activists, a revivalist shaman, and plants, all intertwined with race, nature, and urban issues. Following Latour's network theory, they merge people, things, technologies, and places.

The European filmmaker's perspective is made explicit in some scenes, as in the first minutes, when the director's eye appears from behind the camera lens. The cinematic conception of *One Table, Two Elephants* approaches *what* is known, *how* things are known, and, most importantly, *who* is in the know, in an activist proposal of decolonialisation. The film is accessible on a website, with teaching materials, courses, publications, and news.[9]

Mapping environmental historians in film production is not so simple. First, it is tough to define precisely what is an environmental history film. The expectation has been to contest the concept of nature only as a wild, pristine reality. Vanguard tendencies mix society and the physical environment, the present and the past, alternative knowledge and expertise, conflicts, and cultural and political movements. Second, historians work here in an entirely collaborative medium, unlike the humanities' academic work at universities, where they

publish authored books and articles. Third, it is easy to find initiatives by professionals working in the Global North, but accessing those of the Global South is difficult. Finally, documentary films and videos on environmental issues have been booming in the 21st century in nomadic festivals with fluid boundaries.

Festivals decentralise film production as well as circulation. Some of them are well structured and visible. When searching the internet, it is easier to find events held in more affluent countries in Europe and North America. Some events have great structure, significant sponsorship, and sophisticated and dynamic websites, such as the *Environmental Film Festival in the Nation's Capital* (Washington, D.C., since 1993); *Tales from the Planet Earth* (Madison, Wisconsin, 2007), *CinemAmbiente* (Italy, since 1998).[10]

However, it is possible to locate festivals in several countries, including the Global South. The *Green Film Network* promotes communication among 34 regular film festivals. This network distributes films, improves professional skills, and encourages new initiatives. The range of members is varied, such as FINCA (Buenos Aires, since 2010), *Borneo Eco Film Festival* (Kota Kinabalu, Malaysia, since 2011), *Mostra Ecofalante de Cinema Ambiental* (São Paulo, Brazil, since 2012), *Cinema Planeta* (Cuernavaca, Mexico, since 2009), *CMS Vatavaran* (New Delhi, since 2002), *Festiver* (Santander, Colombia, since 2010), EFFA (Albania, since 2011), One World (Prague, Czech Republic, since 1999). Outside of this circuit, it is possible to find others on the internet, such as *Green Screen Film Fest* (Trinidad and Tobago, since 2012) and *Festival International des Films d'Énvironment* (Chefchaouen, Morocco, since 2011).[11]

In addition to the most popular festivals that can be found on the internet, there are a myriad of festivals and initiatives. These are not always easy to locate. The explosion of documentary films and visual productions on environmental themes in the 21st century certainly stems, among other factors, from the "miniaturisation of professional quality video production technology and by the expanding diversity of window of distribution" (Duval 2017: 2). There are festivals and workshops on a sporadic basis organised in small towns and isolated communities. They introduce practices to stimulate simple interaction, and even with the rising of new talents. Participants are encouraged by the speakers to use their cell phones as cameras to express themselves and become filmmakers. At these events, a polyphony of stories emerges. Visions of minorities and social movements occupy screens mounted in squares, schools, small cinemas, or theatres. These independent films can significantly impact small groups or single-issue community causes, as they highlight local conflicts, worldviews, and problems through their own members' eyes and create poetic and aesthetic images and sonorities that interpret and re-signify their daily lives and social identities.

Most importantly, these productions are not "giving voice" to minorities. Instead, these people raise their voices, laying the foundations of an epistemological turn. The increase of cameras in action establishes fertile grounds for contestation, with new seeds sprouting here and there, as in the spread of a guerrilla movement. Rapid mobility in decentred space constitutes the strength of those who fight for environmental and social justice. Low-budget productions create a universe of unknown and hitherto-silenced stories. They reaffirm cinema as a tool of activism, a war machine that undermines intellectual, social, and political hierarchies (Deleuze and Guattari 1986).

Video nas Aldeias (Video in Villages) is exemplary in an ocean of local events that grew and have now strengthened. It began in 1986 and has already involved 37 indigenous peoples from 127 communities in Brazil, resulting in 87 films. Indigenous filmmakers such as Wewito Piãko (from the Ashaninka people, in the Amazon), Takumã Kuikuro (from the

Kuikuro people, in Xingu National Park), Zezinho Yube (from the Huni Kui people), and Patrícia Ferreira (a Guarani woman), among others, are taking control of the cameras. During workshops, the villages immerse themselves in cinema, with native filmmakers from these and other communities' open-air exhibitions. Children deserve special attention as future filmmakers, as they follow all the activities of workshops and exhibitions with fascination. (Araujo et al. 2010; Araujo et al. 2011: 199). In one workshop at an Ikpeng people village in 2001, located in Xingu Indigenous Park, Brazil, three indigenous filmmakers (Natuyu Yuwipo, Karané, and Kumaré) directed four Ikpeng children in the documentary *Marangmotxíngmo Mïrang* (*From the Ikpeng Children to the World*). They present their village, place, and daily life, asking other children from other areas to send their own images in return.[12]

New strategies spring up to facilitate the circulation of alternative productions and empower different people, such as *Her Wild Vision Initiative*, an online directory of women filmmakers and photographers on environmental themes. Navigating the site, one can find award-winning filmmakers such as Akanksha Sood Sing from India, and lesser-known professionals from the Caribbean, South America, Asia, and Africa, including BIPOC, disabled people, LGBTQIA+, and Latinx. Applications to join the directory are free.[13]

As we said earlier, Claudia Leal made a documentary at a time of promises of peace in her country after years of guerrilla violence. But the guerrilla strategy could be helpful in historical/socio/environmental cinema, empowering different agents in their struggles. There is a rich terrain to be occupied. However, historians and humanities researchers rarely appear at festivals, most of the time restricting themselves to academic events. There is much ground to cover if environmental historians are determined to reach new audiences.

The internet: "Mind the gap"

Five years after the release of the documentary "*In the Shadow of Ebola*", on 7 June 2019, people took to the streets of Monrovia, Liberia. Suddenly, a shutdown interrupted the internet for hours, affecting communication among citizens and restricting their movement. Similar episodes have recurred across the globe. From 2016 to 2021, there were 850 deliberate internet shutdowns promoted by governments. In 2020, in India alone, there were 109. Governments often use shutdowns around elections and widespread protests – but the overall control of the internet may be constant. For instance, Russia's Sovereign Internet Law of 2019 mandates Internet surveillance and grants the country an internet independent from the global web. In China, besides the "Great Firewall" disallowing websites from operating in the country and the ubiquitous censorship, the government traces a misleading strategy, sometimes allowing some individual manifestations, but suppressing all material that presents a collective action potential (King, Pan, and Roberts 2013; Roberts 2018). Controlling the internet can also be done in subtle ways, by throttling URLs to slow their function, blocking websites, or restricting the use of mobile data. Overall, events like Monrovia's internet shutdown deepen the argument that the internet divides and that digital democracy is still nothing but a delusion.[14]

Countries like Liberia face many other problems besides temporary internet restrictions. In 2019, only 28% of Liberia's population had access to electricity. Among the 46 Least Developed Countries (LDCs) listed by the United Nations – which gather 1.06 billion inhabitants – 26 had less than 50% of their population access to electricity that year. Some countries reached tragic figures in this survey, such as Chad (only 8%), South Sudan

(7%), and Burundi (11%) (ITU 2021a: 5–6). Access to electricity is an essential driver for digital inclusion. This reality is far from being overcome in Sub-Saharan Africa, for example, "at the current rate of progress, it would take another 35 years to achieve universal access to electricity" (Houngbonon et al. 2021).

According to the 2021 report of the International Telecommunication Union, an estimated 4.9 billion people use the Internet, 63% of the world's population. Most people live within a mobile broadband network range, but blindspots that reflect global inequalities and social justice remain. The difference between urban and rural populations' internet use is small in Developed Countries (DCs; 89%, 85%, respectively), but they are prominent in LDCs (47% and 13%). Gender is not a divider in DCs (89% of men; 88% of women), but it is in LDCs (31% of men; 19% of women), proving that women remain digitally marginalised in many of the poorest countries. Generation is another gap: 71% of the world's youth between 15 and 24 years were using the internet in 2020, compared with 57% of the other age groups (ITU 2021a, 2021b).

Other factors to be considered in this "usage gap" are digital literacy, lack of Internet awareness, and affordability. A survey in 70 countries in 2020 shows that the price of smartphones in Africa was about 63% of the average monthly income, compared with 12% in the Americas and 16% in Asia and the Pacific (excluding India). Even LCD countries present disparities: the devices are relatively more expensive for an inhabitant of Sierra Leone than a person in Lesotho (600% and 16% of average monthly income, respectively). The connection costs also vary noticeably compared to the average income in different countries (ITU 2021b: 23).

Environmental historians eager to use the internet as an activist tool must scrutinise these inequalities. The environmental challenge is an issue to be tackled globally, including all peoples in all regions. The disparity in internet access is part of a broader picture resulting from historical processes. The historical narratives should highlight the intrinsic relationships between society and the environment. More importantly, historians must demonstrate that the environmental issue cannot be tackled *after* overcoming inequalities. Any triumph over poverty will be possible only if environmental issues are addressed. Poor communities are often the most vulnerable to environmental problems and the consequences of climate change, as they are deeply affected by floods, landslides, diseases related to industrial waste pollution and pesticide application, and lack of access to clean water. Finally, "giving voice" to excluded peoples or minorities is far from enough to change how things are now: it is essential to act for the conditions where they will be listened to and respected. The environmental historian encounters the activist at this point: only empowered peoples will be protagonists in telling their histories. Besides being only a technological issue, internet access is a political issue.

Despite these obstacles, the good news is that internet services and devices are getting better and more low-cost in many developing countries, where environmental historians are encouraged by these virtual opportunities. The examples are numerous and promising.

Guillermo Castro, from Panama, maintains the blog *Martiano Digital*, whose title honours the Cuban writer and activist José Martí. The author is a founding father of the Latin American Society of Environmental History (SOLCHA, since 2013) and the Associated Academic Director of the Ciudad de Saber Foundation, Panama. He has been publishing the blog since May 2013, an intellectual production that is in itself activism. Castro mixes environmental history, political ecology, and ecological economics and argues that Latin America's environmental history is unique in its struggle for social justice and critique of the prevailing development model.[15]

Another blogger is Vipul Singh, from the University of Delhi in India. *Speaking History* has educational purposes, presenting history as essential knowledge to "think about the contemporary problems" and to be used as "a guideline for the future". He has been publishing regularly since 2018, offering book reviews, announcements of workshops and conferences, texts on several themes in English and Hindi, and links for online talks about his research on the Ganges River socio-environmental history.[16] Interestingly, Singh participated as a screenwriter and director in the documentary *Brick-Making the Gangetic Basis*, approaching landscape transformation, embankment, floods, poor labour conditions, and urban construction.

Crowdsourcing initiatives benefit the circulation of knowledge and the democratic spread of information. One example is the Online Library of Environmental History (BOHA), edited by Lise Sedrez, Ana Marcela França, Ayelen Dichdji, and Natascha Otoya. It is available in English, Portuguese, and Spanish and offers a database on Zotero, an open-source search tool. It was first launched in 1999, and now it is hosted on the website of the Federal University of Rio de Janeiro, Brazil, and is one of the initiatives of SOLCHA.[17]

Several researchers, laboratories, and societies maintain YouTube channels with interviews, courses, and seminars on environmental history. *Lutz Global*, by Elenita Malta (Rondonópolis Federal University, Brazil), discusses the history of environmental activism in Brazil. The *UGC19 HS30*, coordinated by Satyapriya Rout (University of Hyderabad, India), offers 108 educational videos on themes such as the environmental history of India, environmental injustice, climate, water governance, and others.[18]

Research groups and environmental history societies – such as SOLCHA in Latin America – also run online journals and accounts on Facebook, Instagram, and Twitter (rebranded as X in 2023). Recently, the Research Group on History and Nature (GRHIN) at the Federal University of Pará, Brazil, has created an account on TikTok, a trendy video-based social network (*historiaenatureza*).

In Nigeria, in 2014, John Agbonifo and Noah Echa Attah – from Osun State University and Federal University of Kashere – created the African Network of Environmental Humanities to facilitate communication among African researchers circulating information on meetings, publications, and new initiatives.[19]

These and other numerous initiatives parallel existing web and social media networks built by leading Global North associations, such as Network in Canadian History and Environment (NiCHE), ASEH, the Australian and New Zealand Environmental History Network (EHN), and the Rachel Carson Center for Environment and Society. More than establishing a place on the internet, these groups seek to multiply connections by engaging the audience, always looking forward to attracting more visitors, followers, and interlocutors.

NiCHE has a dynamic website that offers open access to edited collections, book reviews, and posts under Canada's Anthropocene. The YouTube channel brings more than 100 videos with lectures, conversations, and lives. The podcast *Nature's Past* has interviews, lectures, and round-table discussions. *Programming Historian* offers tutorials for historians to develop digital skills to create websites, blogs, and databases and better explore geographic information systems and digital archives.[20]

In 2018, the ASEH Strategic Plan aimed to increase visibility and guarantee national and international leadership in promoting environmental history. The plan stressed the importance of digital media in securing attention and academic reputation. Engaging young professionals and rising generations would need a Digital Communications Committee's efforts

to ASEH's digital presence, attracting "a broader network or people of all ethnicities, nationalities, genders and sexual orientations". To this end, ASEH's aspirations include enhancing its social media presence, a revamped website for friendly use on small-screen devices, and an active, engaging, and collaborative web presence.[21]

The Rachel Carson Center, a non-profitable institution founded in 2009 and linked to Munich's Ludwig-Maximilians-Universität, offers the *Environment & Society Portal*. The portal opens exciting possibilities for exploration, knowledge, and experiences with more than a million users. It publishes peer-reviewed journals such as *Arcadia* and *RCC Perspectives*. It also hosts *Virtual Exhibitions* that "put digitised material into interpretive contexts". The *Multimedia Library* brings vital and valuable documents. *The Archival Gems* is a growing collection of digitised images. *Art & Graphics* "combines contemporary and historical environmental art, as well as comics and illustrations". At *Books & Profiles*, full-text books, excerpts, profiles, and reviews can be found. Other collections gather documents from environmental movements, articles from academic periodicals, and links to other environmental websites, blogs, networks and collaborations. *Sound & Vision* showcases audiovisual content on the human-environment relationship, like podcasts and videos.[22]

All these materials are searchable by exploration tools. The Map Viewer exploration tool opens a world map where the user can click the multiple map-pin indicators in countries of all continents. This map viewer exploration tool reveals a unique feature of the Rachel Carson Center, whose mission is related to education, research, and international cooperation. In addition to these internet activities, the scholarship programme attracts and welcomes people of different ethnicities, genders, and countries. The Society of Fellows of the RCC keeps them in touch, cultivating the relationships established during their stay at the central office in Munich. But it also paves the way for connections between those who joined the program at different times. The entire RCC agenda makes this institution a genuine global player in the environmental humanities, mediating researchers from the Global North and Global South. The RCC is a physical and virtual place for them to work together, share their experiences, and learn from each other. After a period of sponsored residence, fellows from all over the world join the Society Fellows, a robust network of researchers on environmental history. In 2022, the Society Fellows had 268 members. The RCC also promotes frequent engagement of its members and fellows with politicians, activists, conservationists and public figures.

In March 2022, the project Occupy Climate Change! (OCC!) launched the virtual and growing *Atlas of the Other Worlds*. Among the several researchers engaged there are some leading environmental historians, such as Marco Armiero, Lise Sedrez, and Roberta Biasillo. The *Atlas* highlights case studies of organisations and initiatives in cities around the globe, highlighting "diverse, dynamic and self-organised responses to loss and damages caused by climate change". It offers inspiring stories such as the "Let the Onça Drink Clean Water" and the "A Million Wells for Bengaluru", both social-environmental movements in the city of Belo Horizonte, Brazil, and Bengaluru, Karnataka, India, among others.

The OCC! aims "to ignite an imaginative exploration into the future", asking people to write about "how would the place where you live look like in year 2200?" These narratives, available on the platform, focus on several cities such as Quito (by Nicolás Cuvi), the Namibian village Onangholo (by Bruno Venditto), and Stockholm (by Hanna Erikson). The OCC! also intends to be a global activist network with academic initiatives such as

publishing books and articles and delivering conferences, presentations, and academic teaching. But the project also focuses on activities outside the academy, such as popular press articles, public engagements such as the Cross Cuts film festival (2018), and workshops. In September 2020, Marco Armiero organised events on decolonising political ecology within the Venice Climate Camp in Venice, Italy. The network activities, as well as the Atlas, are available at https://occupyclimatechange.net/.

Even considering all these valuable endeavours, when dealing with the internet as a knowledge production tool, we must always "mind the gap". The gap has profound historical, political, and social roots, and the big challenge is to create a bridge for all to cross.

Conclusion

This chapter considered the promises and paradoxes involved in scholarly environmental history and activism dialogues. We assume that the writing of history is already activism when thought and action came together, and historians have long cultivated this practice.

However, environmental history is a practice other than activism. Otherwise, it may lose the original contribution it has to offer. To face this impasse, we must build an in-between place where they meet and contribute to each other in a dynamic and transformative way in time/space. Historians need to go beyond writing, and activists need to go beyond action because we share the urge to communicate with each other.

We also dealt with the immense difficulty of reflecting on the shifting realities of the internet and filmmaking by historians and scholars' awakening to activism. Things are changing vertiginously in a world where the limits between the real and the virtual are blurring. Moreover, it is not just about using new technologies or acquiring new skills. All these actions occur in a world of profound political and social inequalities. Thus, no effort will result without facing the prevailing development model and social injustice.

History is a transformative knowledge, and all historians must constantly renew themselves and their methods. In a time of socio-ecological crisis, filmmaking and the internet are more than tools for activism: they can be "war machines". To explore all these possibilities, environmental historians must develop new skills. They should work with a range of professionals, teaching and learning many things. They need to trespass academic territories and disciplinary boundaries.

When Regina entered her son's room years ago, she surmised the "internet galaxy" was promising fieldwork for her as a historian. She had already read Worster's recommendation to historians to buy a good set of walking shoes and head out to fieldwork (Worster 1988: 290). Behold, she realised an original and almost unexplored virtual field from Manoel's computer transmission.

Nowadays, more than getting out of the office, she and many environmental historians are risking themselves through digital spaces, films and documentaries, podcasts, blogs, and social media, as well as developing new skills. They strive to explore the porosity between academic knowledge and activism, facing up to decisive socio-environmental contemporary challenges.

It will not be enough to adapt to the existing paths since we are treading on extraordinarily fluid and changing soil. Years ago, we could not have imagined today's social media and technologies and all their possibilities for historical practices. The future is likely to be just as surprising, and there isn't any ready-made script for us. For 21st-century historians,

it remains to explore, with imagination, creativity, and boldness, the intersections between historical research and teaching, activism, film language, new technologies, and social media. These are times of fluid global contexts of environmental challenges and social inequalities (outside *and inside* academies) between races, genders, classes, and age groups. It is in this entangled scene that historians have been reinventing themselves, and this has included openness to activism.

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Notes

1 URL: https://www.youtube.com/c/AsQuatroEstações
2 URL: https://youtube.com/playlist?list=PLxuwTXuzVtoOx6mE80877fBLTV58iJZSU
3 Undoubtedly, the different timing of these actions is due to inequalities in working conditions and uneven access to technologies based on gender and racial inequity. We will discuss this issue later in this chapter.
4 Visit https://www.sussex.ac.uk/cweh/research/academia_and_activism
5 Leal 2017 URL: https://youtu.be/t7OXEJNPc5k
6 Program of 2nd Conference ESEH (2003): 1; ASEH Conference Program (2005): 11; ASEH Conference Program (2010): 9; ASEH Conference Program (2011): 12, 18, 31, 33, 37; ASEH Conference Program (2014): 15,45; ASEH Conference Program (2012): 13. All these ASEH documents are available at the URL https://aseh.org/conference-archives
7 ASEH Conference Program (2008): 18. For Streams 2021 Program URL: https://www.meetstreams.com/schedule/
8 Dunaway (2017): 8–12. See the websites' URLs: http://liberianhistory.org/; http://intheshadowofebola.com/; and https://www.thelandbeneathourfeet.com/
9 URL: http://www.situatedecologies.net/
10 Among the co-founders of Cross Cut, in 2018, there are some environmental historians, as Marco Armiero. For the websites, see; https://cinemambiente.it/
11 For the sites of each festival, activities, and agendas, see the URLs: https://www.greenfilmnet.org/; https://filmfreeway.com/InternationalFestivalofEnvironmentalFilmsofChefchaouenMorocco; and https://filmfreeway.com/GreenScreenFilmFestival
12 Visit https://vimeo.com/ondemand/dascriancasikpeng. There is a platform created by the project with all the films and documentaries on demand: http://videonasaldeias.org.br/loja/
13 URL: http://www.situatedecologies.net/
14 Mengonfia, Mark (2020, July 31), "The Day Liberia Shut Down Freedom of Expression amid a Mass Protest", *ADVOX Global Voices*; Giles, Christopher, and Peter Mwai (2021, January 14), "Africa Internet: Where and How Are Governments Blocking It?", *BBC News*; Ryan-Mosley, Tate (2021, September 9), "Why You Should Be More Concerned about Internet Shutdowns", *MIT Technology Review*; Partlett, William (2021, October 4), "Russia Is Building Its Own Kind of Sovereign Internet", *The Conversation*.
15 URL: https://culturadelanaturaleza.wordpress.com/. See also Mayo & Dutra (2021).
16 URL: https://speakinghistory.wordpress.com/blog/
17 URL: https://boha.historia.ufrj.br/html/solcha.html
18 URL (respectively): https://www.youtube.com/c/lutzglobal; https://www.youtube.com/channel/UCF5XZU7elJCO_FxRzv-2p2Q/

19 URL: https://aneh-africa.net/
20 URL: https://niche-canada.org/
21 ASEH Strategic Plan 2018, pp. 8–12. https://aseh.org/resources/Documents/ASEHstrategic%20plan%202018FINAL-ExComm%20vote.pdf
22 URL: https://www.carsoncenter.uni-muenchen.de/digital_project/index.html

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24

COMMUNICATING ENVIRONMENTAL HISTORY

Reaching diverse audiences through online forums

Jonatan Palmblad and Jessica M. DeWitt

Advancements in online communication over the past decade have changed and enhanced the way in which environmental historians conduct and communicate their research. Blogging, social media, digital livestreams, and other forms of online communication have enabled environmental historians to take up space in public discourse that was not available to them in prior decades. With this enhanced public presence comes an opportunity to communicate to increasingly diverse audiences as well as the responsibility to learn how to communicate to these audiences effectively and ethically. Although we acknowledge the importance of direct communication, in particular that of face-to-face teaching (cf. McNeill 2017), this chapter is dedicated to the many opportunities made available online.

As Sean Kheraj and K. Jan Oosthoek noted in 2016, environmental historians have consistently stood at the forefront of online communication within the environmental humanities – and arguably, in academia more broadly – since the mid-1990s. Beginning with the development of the online scholarly communication network H-ASEH (now H-Environment) in 1996, environmental historians have adeptly adapted both their professional networking and research communication to the ever-changing online landscape. The crowning example of online environmental history communication is the hashtag #envhist, which was first used on Twitter in 2009. At the time that we are writing, the hashtag acts as a robust international meeting place for environmental historians and those interested in environmental history inside and outside the academy on various online platforms (Kheraj and Oosthoek 2016).

This emphasis on online community-building and communication within environmental history has led to a strong network of scholars whose impact has grown exponentially in other fields and amongst the public, leading to increased interdisciplinary communication and public visibility (DeWitt 2019). To the extent that the humanities' societal usefulness can be found in its idiographic nature and its ability to understand and tackle crises (Jordheim et al. 2014), environmental history has thereby taken an important initiative by its engagement with new means of communication. "Building these digital tools and publics", as Cheryl Lousley noted in 2015, "has enabled [environmental] historians to act as *fast responders* to contemporary events" (emphasis in original). Further, due to the pre-eminence

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of environmental issues in contemporary public consciousness (i.e., climate change, biodiversity loss, etc.) environmental history research has a unique opportunity to contribute to public environmental dialogues.

The authors of this chapter have considerable experience in the work of public-facing and online environmental history. Jessica DeWitt is an executive member of the Network in Canadian History and Environment (NiCHE), co-editor-in-chief of NiCHE's website and blog *The Otter/La loutre*, and has served as NiCHE's social media editor since April 2014. In her work at NICHE and elsewhere, DeWitt has focused on using social media and other forms of digital communication to create community amongst environmental history and humanities scholars and is particularly passionate about using digital methods to break down the walls between academia and the public in order to democratise knowledge access. Jonatan Palmblad was the managing editor for the Rachel Carson Center's peer-reviewed online journal, *Arcadia: Explorations in Environmental History*, and a curator of its open-access project, the Environment & Society Portal, between 2018 and 2022. He helped develop the multi-format online journal *Springs: The Rachel Carson Center Review* and now serves as a member of the European Society for Environmental History's (ESEH) communication committee and a communicator for the International Consortium of Environmental History Organizations (ICEHO).

Reflecting on our first-hand experience, we will in this chapter provide an overview of the basics of how to bring environmental history to diverse audiences. First, we will define "diverse audience" and discuss how to choose a topic and write to best reach the audience that you are targeting. Secondly, we will provide a general overview of the platforms and publications currently available for publishing publicly. Third, we will discuss how to promote one's public-facing work with an emphasis on community-building and how to think about impact. Communication is not only for communicators but something we all do to some extent; we aim at giving some concrete recommendations while also providing examples of different paths to take. Most importantly, we will argue that successful communication of environmental history is a collaborative effort.

Because of its connection to current environmental topics and sciences, such as ecology, environmental history is often viewed by scholars both inside and outside the field as an inherently activist and interdisciplinary field (Samson 2021; Sörlin 2011). While this activist imperative of environmental history is discussed in detail in Chapter 23 of this volume, we would like to note here that this is an integral rationale behind communicating environmental history to diverse audiences. Although some environmental historians may be wary of the presentist label (Hunt 2002), we assert that the act of educating both inside and outside the classroom is an intrinsically activist act wherein the instructor or scholar actively shapes the future that they wish to see. In the same vein as David Armitage's assertion that historians should ask themselves how they can contribute to "human flourishing", we contend that, as global citizens, environmental historians have the responsibility to use their education, social positioning, and understanding of the past to be active participants in the goal of creating a future in which humans, non-human animals, and the environment can flourish (Armitage 2022).

This goal may seem insurmountable upon first glance, but the large is always a reflection of the small, and by taking care of each other and our space inside and outside the classroom, as well as by focusing on reaching increasingly diverse audiences with environmental history research and knowledge, environmental historians can (and do) make a difference (brown 2017; DeWitt 2019). It would be remiss not to note that this vision requires the

academy to considerably shift its position on public-facing work. Too often, such work is treated as a distraction from the work of "serious" academia. This attitude is wrong. Public-facing environmental-history work needs to be acknowledged equally alongside more traditional academic accomplishments, and, most importantly, it needs to be funded. This holds true for the humanities in general, and much of what follows will be relevant also to other disciplines, especially those with an environmental edge. But environmental history is a trailblazing field that shows the relevance of humanistic research in times of crisis, and we hope that this chapter will contribute to the whole field of the environmental humanities.

How to write

The diverse audience

When sitting down to write for a diverse audience, one must keep one's eye on the main consideration at hand: the audience. When writing for an academic journal or monograph, the primary audience is one's peers who will read, critique, and engage with the text's argument and contribution to the field. This system of academic peer review produces a relatively standard writing process and output. When writing for a diverse online audience, however, one must think first and foremost about the intended recipients of the information and adjust the information and the way it is presented to best reach this audience.

Before examining the possible strategies one can use to reach a diverse audience, it is helpful to define what we mean by "diverse". The *Global Warming's Six Americas* project, developed by the Yale Program on Climate Change Communication, has identified six distinct audiences for climate change information in the United States that range from "dismissive" to "alarmed". The idea behind these six classifications is that totally different strategies need to be developed to effectively communicate climate change information to each of them (Roser-Renouf et al. 2020; Yale n.d.).[1] Environmental history's audiences must be conceived along other lines but can similarly be broken down into at least six categories:

1 *Historians*. At the first level, we are always communicating with other historians, whether their area of expertise matches our own or not. Other environmental historians are the easiest audience to draw in because they already have a penchant for the field and the training to understand the information. Non-environmental historians are most likely to be drawn into environmental history topics when they cross over with their own geographic, interdisciplinary, temporal, or pedagogical interests.
2 *Other Academics*. The second level of audience consists of academics in other disciplines. Although trained in an academic discipline and accustomed to academic rhetoric, unlike the first two levels of audience, it is unlikely that this audience is trained in understanding historical scholarship and research. This audience is most likely to be drawn in by environmental history that crosses over in some way with their own research. Further, some academic disciplines will be easier to engage in interdisciplinary interest than others; for instance, it may be easier for an environmental historian to communicate the importance of our discipline to an environmental anthropologist than it may be to communicate it to a chemist.
3 *Policymakers*. At the third level are policymakers or individuals who have influence over the development of public policy and laws. In order to garner the attention of policymakers,

environmental historians must appeal to contemporary concerns, acknowledge and grapple with financial, social, and political realities, and construct explicit connections to current environmental issues (Dovers 2000). In addition to public writing, garnering the attention of policymakers may require direct communication.

4 *Undergraduate Students*. Already immersed in an academic atmosphere, the undergraduate student is the fourth level of audience. Undergraduate students are most likely to engage with environmental history scholarship that matches their own interests or assists in their coursework.
5 *The General Public*. The most diverse audience is the general public at level five. This level consists of any member of the public who is not actively engaged in an academic pursuit, including academic training and independent research, or has direct input into policymaking measures. This level is the key demographic for reaching a "diverse audience", and are most likely to become engaged in environmental history scholarship that resounds with them on a personal level and helps them make sense of current events. The level of engagement by the public may vary considerably, and the goal should be to turn the "general" public into an "interested" public.
6 *Youth*. The final level of audience is that of children and teenagers. It is at this level that environmental history scholarship has the most work to do.

This six-level audience categorisation focuses on education level and level of involvement in academia and government. It is a good starting point for identifying what aspects of your research you will highlight and what platforms you will publish on or utilise to communicate your research. However, the aforementioned groups not discrete monoliths, and these audiences are not representative of all types of diversity, including socio-economic status, race, and geographic location. Such categories cut through and intersect with the six audiences of environmental history and should be considered for a maximally diverse outreach. Although work has begun to diversify the scholarship cited and used in environmental history research and teaching, more work needs to be done to ensure that environmental historians are reaching racially, geographically, and economically diverse publics (Fisher 2020; Langston 2018).

One of the most glaring diversity issues in online environmental history is the dominance of the English language, a problem that Dan Finch-Race and Katie Ritson (2021) refer to as the "anglophone dilemma". As language is one of the key conduits by which individual cultures foster unique understandings of the natural world, the predominance of English in the environmental humanities communication risks to overwrite and undervalue other worldviews. As Ritson points out, if all open-access, public-facing writing in environmental history and humanities is in English, then it is not truly accessible. An effort needs to be made to publish open-access scholarship in all languages and to work to return non-Anglo research to its original languages (Corridor Talk 2021). Even though writing in English makes your work internationally accessible, not taking English literacy for granted – e.g., by considering translations and writing in other tongues – helps identify an even vaster dimension of diversity.

How to choose a topic and communicate it to a diverse audience

Now that you have an audience in mind, it is time to hone your topic. In media, coverage is what denotes importance. The more the media covers a news story, the more the public tends to consider it important (Priest 2020). As environmental historians seeking to reach a



Figure 24.1 Trees branch out both above and below soil and constitute an apt metaphor for outreach and communication. But to grow and thrive, they depend on healthy relations to other trees, species, and soil, and this adds an important dimension of interdependence and mutual aid to the metaphor. The communication of ecological insights, then, can sometimes benefit from an ecological mode of thinking. Illustration from George L. Clarke's *Elements of Ecology* (New York: John Wiley & Sons, Inc., 1954), p. 422, public domain.

diverse audience, we have the ability to influence the public. Not only is it critical for us to provide accurate information that contextualises news stories that are making the rounds in popular media, but it is also imperative that we communicate what is important. For many of us there are aspects of our research that the public and other academics will never be privy to unless they read our peer-reviewed publications. Writing for an online audience, therefore, provides us with the opportunity to bring our knowledge and expertise to the light and to actively direct attention to what we deem important or interesting.

To draw the reader's attention, one should choose one's topic for public, online writing with narrative and connection in mind. The following list provides several suggestions and questions to ask oneself when narrowing one's topic.

1 *Current Event: Does my research relate to or bring clarity to a current event?* One of the most evident ways to draw in a diverse readership and highlight the importance of one's

research is to connect it to a current event. Writing about a current event ensures timely interest in the topic and enables one to more easily capitalise on search engine and social media algorithms.

2 *Contemporary Concern: Is there an aspect of my research that connects to a major topic of contemporary concern?* Related to the current event is the broader contemporary concern, which enjoys widespread public awareness. Climate change, environmental justice, and biodiversity loss, for instance, are larger topic umbrellas under which one can write and be more likely to garner the attention of a broader audience. Providing detailed stories that contextualise contemporary concerns can help general readers better understand and connect to broader issues that may otherwise seem abstract.
3 *Place: Does my research tell something new about a specific place?* One of the ways that humans relate to the environment on a personal level is through place. If one can narrow one's research down to a story about a specific town, state/province, or even bioregion, one is likely to garner the attention of people who have a connection to that place.
4 *The Personal: What is my personal connection to my research?* People are drawn to first-person narratives. In academic writing, we are often dissuaded from writing from a personal angle, but in public, online writing, the personal can engage readers in topics that otherwise may not interest them, and it breaks down the divide between researchers and the general public. Did your experience playing near an urban dump when you were growing up shape your research into environmental racism? That's a story that people will want to hear and will relate to.
5 *Biographical: Is there a specific person from my research that I can highlight?* Biographical articles offer a clear narrative path and are popular with general audiences.
6 *Specific Source or Artefact: Is there a specific source that I can show the reader and explain its significance?* The sources that academics use are not often clear to general readers. Homing in on a specific source, such as an artefact or photograph, can create an impelling narrative and actively invite the reader into the historical research process.

Once you have decided what audience you are targeting and what topic you are going to write about, one must think about *how* one will write. Depending on what website or platform you are adapting your research to, they may have their own set of guidelines to follow. However, there are still a set of basic rules to keep in mind when writing online, which differ from those of the texts we usually write:

1 *Short, Descriptive Titles*. The main topic of your piece should be clear from the title. That may mean leaving the puns and 20-word subtitles behind.
2 *Short Paragraphs*. Short paragraphs are key for communicating clearly to a diverse audience. They are easier to digest and follow for the average reader. Short paragraphs are also easier to read on most digital platforms, particularly on mobile devices.
3 *Organisation, Subheadings, and Pull Quotes*. One must give particular attention to the way that one organises their online writing. Subheadings are especially useful in online writing because they help to guide the reader through the piece and identify key ideas. Additionally, if the platform you are writing for supports pull quotes, these can be a great way to draw the readers' attention to the main ideas that you are presenting.
4 *No Academic Jargon*. When possible, use plain language. When you need to include an academic term, make sure that you define it clearly for the reader.

5 *Aesthetics and Multimedia*. One of the best aspects of writing online is that you are generally not confined by the media restrictions that you encounter when publishing in print. Most platforms can integrate multiple, high-quality images, videos, audio, and other media into your online writing. Integrating multimedia is essential for drawing in and engaging a diverse audience with differing levels of education and learning styles.

Ultimately, your enthusiasm for the topic will be the most important aspect of your public writing. Although Rachel Carson wrote before the internet, her ability to write with a sense of wonder serves to prove this point. As Saskia Beudel (2019) notes, this constitutes "a form of pre-emptive or anticipatory activism", by which Carson successfully communicated expert knowledge to a diverse audience beyond academia (273–4).

Platforms

Platforms for communication

When you have identified an audience, chosen a topic, and considered the ways that you can communicate this topic in a clear manner, it is time to choose the platform and the means by which you will communicate this information to your audience. The most well-known form of online scholarly communication is blogging. Blogging, at its most basic, is the act of writing entries or "posts" on a website on which the posts are displayed in reverse chronological order. In environmental history, there are two main groups of blogs: personal and group. Personal blogs are maintained and curated by a single scholar, often feature shorter-length posts, and can serve as a form of research methodology (Jørgensen 2016). Personal blogs have the advantage of flexibility but are less likely to reach large, diverse audiences. Group blogs maintained by academic associations and other research collectives curate pieces submitted by scholars and other researchers and generally enjoy a more widespread readership and online presence. Blogging is the most similar form of public-facing scholarship to academic article or op-ed writing, and is thus the most popular and most readily adopted form of digital media amongst scholars.

As mentioned earlier, digital publishing enables one to interweave a wide variety of media into one's blog post or other written content. The inclusion of images, audio, video, and other multimedia – which can be easily featured in a blog post – not only increases engagement and audience retention, but it also makes environmental history research more accessible. Not everyone has time to sit down and read a full article, nor does everyone have the training to easily pick out the main points presented in a written piece. Further, the inclusion of multimedia into textual writing increases accessibility for those on a spectrum of visual and auditory learning styles (Vincent and Ross 2001).

While inclusion of multimedia in online writing is crucial for reaching a diverse audience, environmental historians should also consider branching out to utilise other forms of communication beyond writing. Podcasting is the act of creating episodic audio files that listeners can download and listen to at their own leisure. K. Jan Oosthoek launched his podcast, *Exploring Environmental History*, in 2006, and since then a host of environmental history podcasts have joined the fray, including NiCHE's *Nature's Past*, Climate History Network's *Climate History Podcast*, and *Edge Effects*' podcast. Podcasts come in varying lengths – usually 15–60 minutes – and can follow either an interview or a storytelling format.

In recent years, digital livestreams of panels and lectures have gained popularity within environmental history. These digital livestreams are usually broadcast using Zoom, YouTube, or other teleconference services and are often archived after the fact on YouTube. These livestreams increase the accessibility of environmental scholarship by opening lectures to individuals inside and outside academia without the limitations of geographic location. Platforms like Facebook and Instagram have opened other livestreaming opportunities to environmental historians. For example, over the past two years, DeWitt has hosted a regular interview series for NiCHE on Instagram Live called "NiCHE Conversations". These conversations are designed to last for 10–20 minutes and are published afterwards on both Instagram and YouTube.

Though the publishing of live recordings on sites like YouTube has increased over the past several years, environmental historians have not yet embraced the production of curated videos to the same extent. This lag is largely due to a lack of training and resources within the academy and beyond. Videos (and storytelling podcasts) require digital skill-building, funding, and time. This dearth in support for digital skill-building and creation is an additional reason why writing remains the primary form of communication practiced by environmental historians and other scholars. Social media platforms, like Instagram and TikTok, and associated social media design apps offer accessible and affordable media-production options for creating engaging visual and audio content to accompany and enhance written blogs and articles or as stand-alone content.

All platforms come with possibilities as well as restrictions, and casting too wide a net – rather than focusing on a limited selection of platforms – can be counterproductive. Due to the mutability of online formats, however, a narrow focus may be just as restrictive. We therefore recommend that environmental historians widen their digital toolkits and hone their digital skills, learning from the insights of the digital humanities. Cultivating our digital literacy and skills makes it easier to adapt to the ever-changing digital landscape. As Gregg Mitman (2021) has argued, building such skills does not merely give us new tools for outreach, for "digital projects, when successful, teach valuable artistic, social, and technical skills vital to the pursuit of careers inside and outside the academy" (113). His point that scholars should keep pace with the evolution of digital media, originally made in 2010, is even more relevant today.

Models for online environmental history communication

Building up a digital skill set enables the historian to make the best of the means available online, but also to create born-digital content that directly engages with the audience and which, if successful, will be shared by those who encounter it. While some such projects, like documentaries, can be both expensive and time-demanding, it is worth remembering that the internet is a great means for low-cost, short-format productions as well. Much work has already been done: as long-time leaders in online, digital communications, environmental historians wishing to increase and diversify their reach have a number of examples to draw upon and well-established communities and platforms to participate in. We will present a selection of these that could be helpful for those who are considering different platforms.

The Network in Canadian History and Environment (NiCHE) is one of these communities. NiCHE was founded in 2004 by Alan MacEachern and a group of environmental historians and historical geographers in order to develop a national research network with the

goal of disseminating environmental history scholarship specifically to academic and non-academic audiences (Kheraj & Oosthoek 2016). Because of this direct aim to reach outside of the academy, NiCHE was an early adopter of digital technologies and social media and continues to be at the forefront of environmental history curation and community-building online. Today, NiCHE boasts over 10,000 social media followers across all platforms and maintains a website and blog that sees nearly 200,000 international readers a year. In addition to the website and social media presence, NiCHE maintains a podcast, an Instagram video interview series, independent project websites, an e-book series, digital livestream events, a digital peer-reviewed publication, and more. NiCHE is an example of how attention to community-building and openness can lead to exponential growth and influence both inside and outside the academy.

What starts out as a small project may over time grow into something more comprehensive. *Edge Effects*, originally an ambitious blog run by graduate students, developed into an even more ambitious digital magazine. Running a magazine or even a blog is often labour intensive, however, and this is likely to increase along with success. As *Edge Effects*' founding managing editor Adam Mandelman (2021) points out, it is hard to give guidelines on how to succeed, but – apart from having the resources to run such a project – setting hard deadlines rather than using arbitrary timelines makes it easier to realise. *Edge Effects* also serves to prove that resources are not only about funding, but also about passion: the magazine is still led by volunteering graduate students, and one of the returns is the opportunity to improve their digital skills (Hamilton 2021).

Another format to consider is the "virtual exhibition", exemplified by the Rachel Carson Center's many exhibitions on the Environment & Society Portal. Similar to the blog, the virtual exhibition can feature a wide variety of multimedia, but it constitutes an academic, chapter-based, and peer-reviewed publication. By virtue of this, it is a great way of making text, videos, audio, interactive maps, and other media formats harmonise together. As Kimberly Coulter (2021) has pointed out, the virtual exhibition enables the audience to explore curated content while it also helps enliven archival documents and other historical sources. A well-curated exhibition can bring life to "dead" objects and texts by providing commentaries, high-resolution images of diary entries and maps, annotated timelines, and much more. It has never been easier to create a website than it is today and, provided that one has the financial means, the limit to what is possible is chiefly set by the imagination. While a large budget undeniably augments the possibilities of a virtual exhibition, smaller investments in such projects can also yield a high return in terms of outreach: "By creating virtual exhibitions", Coulter writes, "even small cultural heritage institutions can win large audiences for their treasures and spread the word about their significance" (Coulter 2021: 76). Using free or inexpensive content-management systems like WordPress, the individual historian, too, can create a multimedia-rich exhibition without spending much time, money, and energy on making it look compelling.

While the Environment & Society Portal's virtual exhibitions can be regarded as meta-platforms, by virtue of their diversity of content, the website they are hosted on serves as another example of how a plethora of material can be brought together under one umbrella. Launched by the Rachel Carson Center and the Deutsches Museum in 2011 under the direction of Kimberly Coulter, the Environment & Society Portal is a custom-made Drupal platform that makes research and material on human-environment interaction available for free. The diversity of this material, which includes but is not limited to peer-reviewed content, accommodates the website's two main target groups: the scholarly community and the interested public. Apart from the virtual exhibitions and the journal *RCC Perspectives*,

the website features the peer-reviewed in-house publication *Arcadia: Explorations in Environmental History*, which aims "to publish radically short, open-access, and peer-reviewed articles on events in the history of environment and society around the world". Despite being run by one person at a time, the journal has grown in both scope and size since 2011, now featuring articles written and read by people from all over the world. This success is largely due to the specific and concise format (900-word articles on specific events in environmental history), the diversity of the themes, and the open-access form under which it is published – but also to the outreach work done by the various managing editors (Palmblad 2021). Lastly, the Environment & Society Portal features a multimedia library of scholarly articles, videos, and books originally published elsewhere under an open-access license. This has made the website a gateway and a discovery tool for all kinds of research within and beyond the environmental humanities, much of which is done by environmental historians, and it attracts visitors from all over the spectrum of audiences. Communicating the research of other scholars thus helps draw attention to the website's own born-digital material.

These are just some examples, some backed up by considerable funding, but mimicking and modifying successful formats and platforms can be a good start, just like filling the gaps by using new and different media. Letting formats overlap and integrating the work of others therefore not only helps you reach out, but it also contributes to the growth and diversity of online environmental history.

Access, promotion, and community-building

The virtues of open access

Common for the aforementioned platforms is that they are freely available to anyone with an internet connection. This means that language and online access – and literacy, in the case of written material – are the only factors limiting the potential audience. For the same reason, material protected by a paywall limits the potential audience not just in terms of size but also in terms of diversity. Paywalled material can help you reach a larger audience if you write for a professional publisher, but when our goal is diversity, we must also ask ourselves who this audience consists of. Writing for an outlet such as *The New York Times* may of course be worth it due to the massive readership, but it only fathoms certain audiences.

This problem warrants a consideration of the terms of publication also when it comes to our scholarly writings, which could interest independent and underprivileged academics as well as the interested public. The adverse effect on diversity of restricted-access publications becomes especially salient if we consider the demographic of those with access to a good university library. Depending on the country, many groups that could be interested in research output are denied access to universities, and universities in the Global South cannot always be expected to afford online access on par with those in the Global North.

Publishing open access is not always an option, however, and the crux of the problem is often the conflict between publishers' pursuit of profit and the aim at making publicly funded research freely available to those who fund it (i.e., the taxpaying public). But, as Robert Darnton has argued, there are signs of hope. Despite the hard work of lobbyists to prevent public access to the material hosted by major publishers, some of the same actors have come to realise that the increased distribution entailed by open access can generate even more profit – and, by the same token, that increasing subscription fees sometimes leads to

universities unsubscribing. Many publishers have therefore adopted a "flipped" model, in which the authors (often via their universities or research grants) pay a fee in order to make their writings open access (Darnton 2014). While this does not eliminate the conflict between profit and free research, or the exploitation of academics and public funds by commercial publishers, it at least makes publications freely available to readers all over the world.

Open access, then, can even be argued for in the case of for-profit publications. For example, in a white paper by Springer Nature (Pyne et al. 2020), open access was shown to have a significant impact on the outreach of books: 10 times as many downloads and 2.4 times as many citations. Moreover, the geographical diversity among readers also increased, including the number from low-income countries. The study was conducted prior to the COVID-19 pandemic, and the numbers are said to have increased significantly since its start. The effects on online visibility, however, were not significant – this necessitates further engagement on the part of the authors that we will cover below. If open access makes material available, we nevertheless need to make an effort to make it appeal to and reach a diverse readership.

We are arguing not against publishing via commercial venues, but in favour of considering open access when your aim is a broad-ranging audience – be it for academic or public-facing publications. Freely available material can also be distributed and reused by anyone, which is why we recommend publishing under a Creative Commons license when possible. This way, you maintain the copyright but encourage and enable free use and distribution of your material. Coincidentally, Creative Commons depositories like Wikimedia and Openverse provide authors with a cornucopia of freely available multimedia that you can integrate in your own output. Moreover, using and contributing to the pool of reusable material furthers a culture of cooperation that challenges that of competition.

Promotion and communities

Making sure that at least a part of the research output is publicly accessible, the first part of an effective online communication is thus completed. This way, anyone interested in your research can not only read it but also help communicate it. Although this can be done by anyone, it especially facilitates the collective communication work already done by environmental historians. Promotion is thus not only about spreading the word and making yourself heard – it is just as much about building a network and becoming a part of those that are already in place. Environmental historians have a history of using digital technologies that reach back to the early 1990s. Beginning with small but active listservs with primarily North American recipients, the first online forums for discussion, announcements, and promotion eventually grew into international networks with an outreach far beyond their original scope (Kheraj and Oosthoek 2016). The second step of efficient promotion – if open access is the first – is therefore to make sure that you are partaking in this community: being in the right digital environment will make sure that your promotion does not get lost in the void.

We have touched upon the dynamic nature of the internet and the implication this has for what platforms to use, but at the time that we are writing, Twitter (or X, if this name lasts) is the largest forum for environmental history. This might change, but what works there is likely to work also on alternative platforms filling a similar function. As mentioned in the introduction, the hashtag #envhist serves to bring the environmental history community together and will make sure that your posts are seen by other scholars in the field. It highlights not only new publications and conference calls, but also discussions, questions, and

recommendations. In this sense, it is comparable to the tag #Twitterstorians, coined by historian Katrina Gulliver in 2007. This is a so-called "tight crowd network", which is "characterized by a dense web of users who follow each other, share, and engage with tweets" (Varin 2014), and it constitutes another community in which environmental history is recognised and acknowledged. Another important tag is #envhum (environmental humanities), which is also a wider community in which our field has a given place. Conversely, niches within environmental history also have their own established hashtags. To name just a few: #histtech (history of technology), #climhist (climate history), and #wxhistory (weather history). Whatever your niche is, try finding out if an active online community already exists.

Every platform has its own functions, and new digital technologies, not to speak of new algorithms, will alter what constitutes an efficient strategy. Hashtags work on other social media platforms, but some, like Facebook and LinkedIn, also offer discussion groups. Rather than giving more examples on how to grow your network, we encourage you to explore what groups and communities there are. If we were to give some general advice, however, we would recommend that you consider the following steps:

1 *Select your platform(s)*. The wider your presence, the better – provided that you have time to update and use your different accounts. Sometimes less is more. The choice of platform will also have an impact on who you reach. For example, as of 2023, visual media-based apps like Instagram and TikTok lack integrated communities for environmental history scholars, but will help you reach more young people than most other platforms. "Think of different platforms as means that are more or less expedient depending on your goals."
2 *Think about your motivation*. Promoting your research is likely one of your motivations, but can you articulate other motivations to use social media? For example, maybe you are looking for scholarships and other opportunities, want to hone your digital skills, or seek recommendations on literature and syllabi. This way you can make the most out of social media while also increasing your visibility with content that matters to you.
3 *Go beyond the research*. Communicate not only your research, but also the passion that drives it. If you can show why your topic and environmental history matter, your communication will stand out – and inspire others.
4 *Interact and grow your network*. If you approach social media as a competitive environment in which you want to make yourself heard, you are less likely to effectively communicate than if you think of it as a venue for collaboration. Share the posts of others, promote works that are not your own, join discussions. Helping the community grow will improve the forum for communication.

If you feel overwhelmed by the number of social media platforms out there, find it hard to maintain the ones you use, or simply want to economise the time you spend on them, you may want to consider a social media management platform. You can then handle accounts on multiple platforms and schedule posts. This is especially convenient for institutional accounts. Most platforms have inbuilt scheduling tools, however, and some – like Facebook and Instagram – allow you to cross-post. Just remember that genuine interaction is likely to get you farther, and that quantity should be matched by quality.

Social media is not for everyone, and their vices are many, but one of their virtues is that your posts will reach people beyond your intended audience: even if you have a target group in mind, odds are that people in any of the six audiences mentioned earlier will read your posts. A diverse audience sometimes grows organically out of active engagement.

As Wilko Graf von Hardenberg has pointed out, making the most of this possibility is particularly important for a transnational and transdisciplinary field such as environmental history. Social media, he writes,

> give[s] the opportunity to be heard by and interact with an audience that goes way beyond, both geographically and conceptually, the limits of academia and includes not only amateur historians and practitioners of other disciplines (e.g., the natural sciences), but aims also to involve the general public.
>
> *(Hardenberg 2021)*

In other words, your work can be useful to others in ways you cannot foresee.

Getting into online fights can be tiresome, however, especially for an academic in a post-truth world, and we advise you to use your energy wisely. Enter a debate when you can contribute with your expertise; leave it if nobody listens. This cannot be stressed enough, since social media engagement easily makes us targets for aggressive users and networks. If this happens in relation to your environmental outreach, know that there is help available, for example via the Climate Science Legal Defense Fund.

Usefulness and impact

If you are interested in communicating your research, it is likely that you hope to have some sort of impact. This leads us to the controversial question of usefulness. As John McNeill (2017) has argued, environmental historians do not *need* to be useful, but those who want to be should make the attempt. Despite his rather pessimistic view on what impact an individual environmental historian can have, he nevertheless belongs to one of those who tries. Doing so, we believe, will also have a positive impact on our communication, and it becomes easier when we effectively reach people across the audience spectrum.

Being useful is too often measured in monetary and quantitative terms, but as Helge Jordheim et al. (2014) maintain, the humanities in general are useful both when studying new crises and when supporting or contextualising the research of other disciplines. Such usefulness can make a difference both in quality and quantity, and we see environmental history as especially apt for both tasks. The pressure to be quantitatively useful has of course long harrowed the chiefly qualitative disciplines of the humanities, but according to Peter Coates, "environmental historians are better placed than many other historians to make a case for impact construed in these terms" (2011: 39). Regardless of what type of impact is aimed at, however, environmental historians often study subjects that have direct bearing on – or that can be used to illuminate – current topics of high importance for policymakers and society at large. Rather than simply trying to reach out, then, we should perhaps ask ourselves:

> is there anything of practical value that the non-specialist can draw from my work? Were there solutions in the past that could be adapted to today's problems? Could I craft a coherent policy statement or memo based on my study of the past?
>
> *(Zelko 2011: 40)*

Historian Per Högselius, who actively comments on current environmental affairs, has even argued that we have an obligation to engage in the public debate. One way to do so is through what he calls the "zooming-out strategy", which means to contextualise the debate

by correcting misunderstandings, debunking fake historical claims, and challenging the current use of terms. This will be facilitated by formulating problem-based research questions related to pressing societal issues, which automatically will make your research relevant beyond the scope of academia. Högselius also presents another approach that he calls theoretical, which enriches the public debate by means of historical analogies. If your research can shed light upon contemporary issues by comparing them to historical events, this might be a good approach (Leibniz-Zentrum für Zeithistorische Forschung Potsdam 2021). This last approach provides a way for those historians whose topics lack direct bearing on contemporary issues to positively contribute to the discussion.

While environmental history gains usefulness in proportion to its relevance for understanding current-day issues and crises, it also enjoys many strengths of its own. It follows that the discipline should not be wholly instrumentalised but also regarded as important and useful in itself. On this note, Patricia Limerick (2011) believes that engagement with contemporary discussion indeed is needed, but that there are reasons to believe that the field offers hope for the future in such an engagement. By doing what they are good at, she argues, environmental historians contribute with a wider temporal and environmental dimension to everyday affairs and politics, explaining their complexity and the need to think beyond polarised political discussions in order to solve them. More than showing how the past helps us understand the present, however, Limerick contends that environmental history may contribute to a more constructive and contingent approach to the future. Lastly, she points out that the inherent interdisciplinarity of the field can help counteract today's increasing fragmentation of knowledge and bridge the gap that has surged between the sciences and the humanities. Since specialism will only get us so far, environmental history possesses an important role for integrating various forms of knowledge needed to understand and solve the issues we study. Hence, contributing to the growth and presence of the field, rather than focusing on addressing specific issues, also has a use and an impact.

The strengths of environmental history are many, but they are only true strengths as long as they are embraced by the community at large. Even if you are a widely acknowledged historian, the individual impact you may have is likely to be very limited. Community building, both by new initiatives and by joining existing networks, is therefore key if we are to make communication and impact two sides of the same coin. Moreover, even though we must be cautious about the imperative of usefulness, and despite the fact that a critical distance to activism can be constructive, the nature of the unfolding environmental crisis rapidly blurs the border between communication and advocacy. Possessing knowledge while remaining aloof in the face of human-induced biodiversity loss, habitat destruction, pollution, and global warming is simply becoming increasingly harder. Keeping our critical strengths in mind, environmental historians who seek to improve their outreach and communication thus have everything to gain by an increased and collaborative engagement with current environmental debate, discussion, and policymaking – as well as by promoting environmental history as such. To these ends, we believe that it is crucial to reach out to as diverse an audience as possible.

Conclusion

As environmental historians, we think it wise not to abuse the term "ecology", but – because we *are* environmental historians – we think that ecological metaphors are apt for our view on communication. Effective communication is achieved by finding a niche within an

ecology of researchers, organisations, policymakers, and the interested public – and thus reaching out also to the not-so-interested public. Becoming the apex of the ecosystem is not the goal, however: due to gate-keeping algorithms and the abundance of mainstream content, we may all too easily approach communication in a competitive mode, but ecology is also about mutual aid (Kropotkin 2006) and what Anna Tsing calls "contaminated diversity" (2012: 95). Pursuing our own goals and interests is important, but survival is just as much about reciprocity and collaboration. Reaching a diverse audience presupposes a diverse communication in which we do not regard ourselves as isolated or self-sufficient. As Rob Nixon (2021) argues, the collaborative dimensions of forest ecology, which has gained popularity and acknowledgement over the last years, challenge those metaphors that emphasise self-interest – interdependent forest networks have more in common with the internet than we may think. To communicate in an ecological sense, then, involves the growth of roots and branches, but also means to grow like a taproot, a rhizome, in which transversal pathways are drawn and intersect at unexpected places as traditional hierarchies are undone (Deleuze and Guattari 2020). Successful communication is not a solitary endeavour, but a reciprocal community building that benefits everybody. This is how environmental history communication started; this is how we believe that it will continue to thrive.

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Note

1 "The **Alarmed** are convinced global warming is happening, human-caused, an urgent threat, and they strongly support climate policies. Most, however, do not know what they or others can do to solve the problem. The **Concerned** think human-caused global warming is happening, is a serious threat, and support climate policies. However, they tend to believe that climate impacts are still distant in time and space, thus climate change remains a lower priority issue. The **Cautious** haven't not yet made up their minds: Is global warming happening? Is it human-caused? Is it serious? The **Disengaged** know little about global warming. They rarely or never hear about it in the media. The **Doubtful** do not think global warming is happening or they believe it is just a natural cycle. They do not think much about the issue or consider it a serious risk. The **Dismissive** believe global warming is not happening, human-caused, or a threat, and most endorse conspiracy theories (e.g., 'global warming is a hoax')" (Yale Program on Climate Change Communication n.d.). See also Roser-Renouf et al. (2020).

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25

ENVIRONMENTAL HISTORY IN MUSEUMS

Past practice and future opportunities

Luke Keogh, Liisi Jääts, Nina Möllers, and Libby Robin

Introduction

More than a billion people worldwide are estimated to visit a museum each year (Falk and Dierking 2013: 23). Museums have become sites of conversations, interactivity, memories, and confrontational storytelling. Environmental degradation, habitat and species loss, exploitation, and justice are pressing issues of our times. Environmental history is an important "cross-discipline", encompassing artistic, humanities, and scientific perspectives, that casts fresh light on long-held collections. As museums over the last half century have grappled with their shifting obligations to society, environmental history plays a critical role in a new emerging "ecological museology". Environmental history enlivens old materials and reconnects disparate collections with new stories. Science and technology collections meet natural history collections; social history collections examine the environmental effects of human behaviours; artists reflect on historical objects or natural history specimens to unpack the crisis of mass extinction, and why we care about it. Environmental history has never been more important, as museums reach out to deal with the environmental implications of their existing collections and their ecological footprints, both physical and imaginative. Many major institutions – including national museums and art galleries, natural history museums, and science and technology museums – are working to include environmental storylines. Smaller museums, regional galleries, art collectives, pop-up museums, historical societies, and heritage sites also have focused an environmental lens on their programmes and engage local and travelling audiences by the tens of thousands (Keogh 2022).

A brief survey of world museums reveals that environmental history has become widespread across galleries, libraries, archives, and museums (known as the GLAM sector). For example, the Smithsonian Institution in the United States has employed a curator of environmental history and actively collects and engages in our field. Just outside Tokyo, the Museum of Natural and Environmental History, Shizouka, opened in 2016. The Estonian National Museum (discussed in detail later in this chapter) includes significant engagement with environmental history. Environmental galleries break down traditional institutional boundaries between arts and science, and between archives and society. The recent exhibitions at

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galleries, such as the Frankfurt's Kunstverein, have combined not only the work of contemporary artists but also collections from Frankfurt's highly regarded Senckenberg Natural History Museum. There, recent exhibitions have included *The Intelligence of Plants* (2021–2022) and *Tree of Life – Stories of a Damaged Planet* (2019–2020). Also of interest here is another German show, *Garden of Earthly Delights* (2019) at Gropius Bau, Berlin. These are just three of the many gallery exhibitions that are engaging with historical and contemporary socio-environmental themes. Themes that have formed the foundations of environmental history – long-term environmental change, species loss, the Anthropocene epoch, and more-than-human histories – can regularly be found in museums and galleries around the world.

In the early 2000s, Jeffrey Stine noted that the collective involvement of environmental historians in creating exhibitions to reach audiences "could be – and should be – substantially expanded" (Stine 2002: 566). One of the first environment galleries conceived and curated by historians was the National Museum of Australia's (NMA) *Tangled Destinies*, the first gallery encountered in a museum that opened in 2001 (Robin 2013). Environmental history has now come of age, with many museum professionals aware of the discipline. In 2022, the NMA opened the *Great Southern Land*, a second-generation gallery of environmental history, that more seamlessly integrated Indigenous cultural practice and new environmental challenges. There are many other examples across the museum world of small and large exhibitions led by environmental historians.

This chapter showcases environmental history as it is practised in museums and galleries, highlighting a number of recent projects completed in Australia, Estonia, and Germany. Each of the authors has worked in museums as a curator of environmental history and reflects on their own experience. Throughout the chapter we explore some ways that environmental history has engaged in core areas of gallery and museum functions, and what sorts of futures museums might offer to new audiences who have grown up with a world already in environmental crisis. The next section is a brief historical analysis of the shifting foundations of the museum world and the roles of ecological issues and environmental history in this transition to what has been described as "ecological museology" (Wehner 2017). We then finish with three major case studies. By engaging audiences, museums not only showcase environmental pasts but become places of collaboration and discussion around environmental challenges and potential futures.

Ecological museology and the value of environmental history

At around the same time that environmental history was beginning to be recognised as a subdiscipline of history, museums were undergoing paradigmatic changes. Commencing in the late 1980s, the "new museology" emerged as a way to challenge traditional ways of thinking in museums. Around the world there were different conceptions for this. Many of the early proponents for the new museology suggested critically engaging in collections, reimagining authorial voice in museum exhibitions and collection statements, and widening the scope of what a museum can do and where the storylines could follow. In the widely quoted definition of "new museology", Peter Vergo (1989: 2) defined it by contrasting it to what it was not – the old museology. This old museology was about institutional "how to" matters such as administration, education, or conservation, whereas the new museology was about conceptual assumptions and foundations that shaped these in the first place (Macdonald 2006: 2).

Anthropologist and long-time museum commentator Marjorie Halpin (2007) described it as "critical museology" that enabled a deeper examination of what museum practitioners were doing in these institutions. As Sharon Macdonald described it, practitioners began to scrutinise the "centuries old assumption that people visit museums in order to commune silently with objects on display, and that our professional function is to care for and present such objects" (Macdonald 2006: 2). There must be something more. Ultimately, the new museology and the varying approaches that emerged served as a clear shift "to seeing the museum and the meaning of its contents not as fixed and bounded, but as contextual and contingent" (Macdonald 2006: 2).

Giving objects the chance to take on multiple meanings, liberating them from the straitjacket imposed by a historical collection philosophy, treating them as "vibrant matter" is central to the "new museology" (Robin and Boyden 2018). Beginning in the French-speaking world in the 1980s with the idea of "eco-museums, social museums, scientific and cultural centres, and … using local heritage to promote local development", the new museology also includes "critical discourse on the social and political role of museums" (Desvallées and Mairesse 2010). As it aspires to a more democratic museum experience, it opens curating to communities, particularly Indigenous cultures that are represented in the collections, who have distinctive and important relations with environment or Country as it is called in Australia (Andrews 2021).

Museology also includes "intangible heritage", a concept originating in Japan and Korea that includes oral histories and "human carriers" of stories, something picked up by UNESCO in its 1993 recommendation on the Safeguarding of Traditional Cultures and Folklore. Along similar lines, the so-called new "Indigenous Museums" challenge historical anthropological practice and re-interpret Country and culture through Indigenous leadership (Mead 1983). Such museums have a philosophy of care for historical cultural objects, but they concentrate more on their use, through performance and private engagement of communities (Newell, Robin, and Wehner 2017). As postcolonialism, First Nations voices, gender, and ethnic rereadings and critiquing collections have come to the halls of museums, the environment has a new history. Showcasing and presenting alternative views of environmental history – what constitutes "degradation", for example – opens up new imaginative spaces for future environmental history audiences, exhibitions, and performances.

As national institutions and many major state-funded institutions have grappled with the new challenges of their museological foundations, "land" became an important storyline for many museums (Robin 2013). But more recently, as museologist Fiona Cameron (2015: 18) has argued with respect to climate change, "[t]he modern museum form based on hierarchical and dualistic principles is, however, inadequate in its ability to deal with climate change because it fails to acknowledge the entanglements between human and nonhuman actants". Indigenous curators also argue for Sea and Sky Country – land is not the only environment with a history – and Country as being embodied not just "out there". As Cameron (2015: 18) suggests, traditional museums and galleries often fall short of producing "the kind of knowledge and cognitive frames necessary to deal with the messy and complex environmental problems currently facing the world". Only a greater diversity of curatorial voices and methods can keep environmental issues lively and pertinent in a rapidly changing world.

The "anti-museum" has emerged in the contemporary art world with major and resounding impact not only on content and challenging audiences but also on visitor numbers and creating change (Franklin 2020). The artistic intervention in a traditional museum context – or even places like botanical gardens – can refresh the way people see things. *The Hive*,

originally created for the UK Pavilion at the 2015 Milan Expo by artist Wolfgang Buttrose, now has found a permanent home in Kew Gardens, London. This artistic installation allows people to think and hear like a bee (Kew Gardens n.d.). "Ecological museology" creates opportunities to rethink modern forms of the museum and its cousins, botanical gardens and herbaria (Janes 2009; Robin 2007b; Wehner 2017). Curator Kirsten Wehner (2017: 87) advocates "Ecologizing the museum", even where this depends on "disrupting institutional assumptions about the kinds of histories embodied by particular objects". Environmental history can be used by curators to reinterpret collections along these lines, whilst also bringing together disparate projects and diverse voices.

Presenting environmental history in museums and exhibitions is not new. If we think closely about what galleries and museums have presented over hundreds of years of exhibitions, we see stories of earth and stories of humans, whether that is prehistoric bones or exquisite artworks of times past. However, as Nina Möllers (2015: 108) writes, our new age of dramatic environmental degradation "marks a caesura, particularly for the museum as an archive, exhibition centre, and place for knowledge". As degradation and environmental issues enveloped the whole world, no museum could purport to collect or even keep a record of all of these changes, yet every museum is forced anew to think about the sustainability of environments into the uncertain future, and to showcase stories relevant to that future (Robin 2013). Anthropocene thinking now colours museum collections and exhibitions. New exhibitions sometimes might better be thought of as modern cabinets of curiosities, exploring a post-European Renaissance. In an exciting way, museums are no longer "archives of the Anthropocene, but actors within it" (Möllers 2015: 112). Reconsidering the role of museums, the agency of both the institution and audiences, is an important element in the creation of new environmental history-orientated exhibitions.

Exhibitions are one of the most important ways that museums and galleries showcase themes and events in environmental history. Exhibitions are "fundamentally theatrical", as Kirshenblatt-Gimblett (1998: 3) notes, "for they are how museums perform the knowledge they create". Exhibitions regularly see visitation in the hundreds of thousands of visitors. If they are permanent exhibitions – such as the new gallery of the Anthropocene at the National Museum of Australia – they will reach millions of people over their display period. Or if they are temporary, such as *Welcome to the Anthropocene: The Earth in Our Hands* that showed at the Deutsches Museum Munich from late 2014 to early 2016, audiences can be in excess of a quarter of a million people. But it is not just the major museums that showcase environmental history. Medium and small museums as well as regional galleries and libraries also engage wider audiences with environmental history. These smaller, often regional, museums will also reach a similarly large audience over the life of the exhibitions due to longer exhibition show times.

Each museum is characterised by their unique mix of collections, exhibitions, and programmes (Falk and Dierking 2013). The three case studies in this chapter capture that varied range across the museum sector. On the one hand, small to mid-size museums that operate on micro-budgets and experience rapid turnover (rarely discussed in the literature on ecological museology) play a vital role for local communities and in dynamic storytelling. The first example, *On the Land: Our Story Retold*, is a retelling of the Australian wool story using a lens of environmental history that was produced with such constraints. On the other hand, major museums have multimillion-dollar project budgets and are well-resourced. With this capacity they have wider potential to engage in digital interpretation, produce shows with multi-year development schedules, and engage extensively with wider audience groups.

The recent reopening at *Eesti Rahva Muuseum* (Estonian National Museum) and the emerging redevelopment at BIOTOPIA in Munich, Germany, including major investment in public programming, are examples of these practices.

Exhibitions that don't cost the earth: National Wool Museum, Australia

In Australia, the National Wool Museum is located in Geelong, a regional city located south-west of Melbourne. It is a medium-sized museum focused on telling the story of Australian wool, yet it is fully funded by the local municipality. Housed in a heritage-listed 1872 former wool store, the museum opened in 1988 and was conceived as a site of memory for a wool industry that had operated for over a century but had largely seen the best of



Figure 25.1 *On the Land* exhibition at the National Wool Museum, Geelong, Australia. Courtesy National Wool Museum, Geelong.

its days. In the 1950s, almost one in two residents in Geelong were employed in the woollen manufacturing industry; by the late 1980s, this number was significantly lower.

As a site of memory, the original concept of the museum celebrated the rich story of pioneers of wool production on the rich grasslands in the Western Districts and the manufacturing of wool in cities such as Geelong and Melbourne. After many successful years, by the 2000s the museum was in need of renewal, with visitation declining and an aging permanent exhibition. In August 2020, the museum went about reimagining its permanent galleries. Housed in the heritage wool store and maintaining its status as the National Wool Museum, of course wool would remain an important ingredient in the museum, but making the museum relevant by reflecting on the industry's hand in land dispossession, its role in colonialism and land degradation was important for a "relevant" museum (Simon 2016). It was here that environmental history was the inspiration for retelling the wool story.

The museum arrived at *On the Land: Our Story Retold* as a new permanent exhibition concept: a retelling of the wool story that started with the land of Geelong and worked its way out to the state and to the nation. As the name suggests, *On the Land* is all about the rich and bountiful land that many people are connected to. But there is an underlying tension implicit in the exhibition. How do we reconcile the rich and bountiful social and economic history of the wool industry with the drastic environmental and cultural impact of the industry over the previous two centuries?

At these moments of tension, environmental history plays a critical role in the exhibition. Works such as George Main's *Heartland* (2005) and Cameron Muir's *The Broken Promise of Agricultural Progress* (2014) were inspirational. All showed the importance of First Nations' voices in any Australian environmental history project (see also Robin 2013: 51). They also showed "slow violence" of land development in Australia and also pointed to the possibilities of regenerative practices (Nixon 2011). And they showed that specificity of one location can reveal local stories that expose the environmental history of the nation. This perspective was coupled with Libby Robin's *How a Continent Created a Nation* (2007) that showed how a colonial social history played out on an ancient continent. The gallery also attempted to curate against popular books that would have been influential in the 1980s in the original exhibition concept. Margaret Kiddle's *Men of Yesterday* (1983) was displaced by an overt reliance on First Nations' voices, female voices, and perspectives of sheep.

While we could see *On the Land* as potentially just a declensionist story reminiscent of early works in environmental history, exhibitions often tend to work more broadly than just an historical perspective. Blending past, present, and future is critical in reaching audiences in museum spaces. Despite the ambition of the project, the exhibition was delivered by using only the National Wool Museum's annual exhibition budget. The exhibition was achieved with only $AUD150/sqm (and in the same year, five other exhibitions were delivered in the building). The proposition that the project team started with was that a good story does not necessarily need a huge budget; *On the Land* delivered on that belief. Deep concern with storytelling in all its forms were omnipresent in the exhibition (see, for example, Benjamin 1999; Cronin 1992; McMurtry 1999; Ryden 1993). The most innovative part of *On the Land* is the deep care to listen to the stories of the land surrounding Geelong and regional Australia. Bringing various voices and stories into conversation about the past, present, and future of the land delivered a uniquely rich experience. The exhibition is polyvocal. In each of the ten themes of the exhibition, we hear different perspectives; cumulatively, this gives the effect that in the end we are all conversing in our passion and care for the land, albeit coming from different viewpoints.

On the Land is the story of wool in Victoria as a microcosm of the Australian wool experience. It starts with a major new exhibit on the Wadawurrung people, the Traditional Owners of the Geelong region. Created by the Wadawurrung community of elders and artists, the section includes stories from traditional owners, traditional language, and a new artistic motif. Farmers not only farm sheep; they look after the land. Today farmers manage nearly half the Australian continent; they are the biggest land managers. The gallery includes stories of the impacts on both sheep and the land, new films discussing the impacts of farmers and the major loss of 99% of Victoria's native grasslands are showcased alongside regenerative revolution on some sheep. There are also new acquisitions on show, such as a complete set of the prototypes of the Numnuts pain relief devices (the world's first device that delivers pain relief during sheep marking).

On the Land was created with environmental history research and art. Artistic installations in the gallery include contributions from leading local artists. New contemporary sculpture from the School of Lost Arts shows the plains wanderer bird using vegan paper taxidermy. An immersive sound installation condenses 24 hours on a native grassland into seven minutes. And landscape photography shows the land and captures the audience to engage deeply with their place in it. The final section of the exhibition looks to the future to ask: how are we to remain on the land? A number of possibilities are proposed, from seaweed to solar, from friendships to partnerships, but ultimately puts forward the perspective that all of these practices must be in tune with the land.

On the Land was a major success. It was the first major exhibition on Australian wool for over two decades. Furthermore, the whole exhibition has also been held up as a best-practice example for First Nations' and community engagement for the City of Greater Geelong. It has won state and national awards for its dramatic storytelling despite the micro-budget. But most importantly, the exhibition reached its community with a relevant and reflective exhibition that re-engaged the community with its deep roots to the land and its history.

While large museums work with multimillion-dollar budgets to tell environmentally conscious stories and entertain patrons, the example of *On the Land* shows that storytelling informed by environmental history coupled with collaboration with community can deliver exhibitions that are relevant, are successful, and help to inform the region about the significant environmental issues facing us. Exhibitions don't need to cost the earth to tell important environmental histories.

Encounters in environmental history: Estonian National Museum

Raadi Manor in Tartu was the Estonian and Livonian capital of horticulture in the late 18th and early 19th centuries. Its garden, greenhouses, and interior rooms together had the largest exotic plant collection in the Baltic provinces. German and Russian gardeners led the taste for orchids, azaleas, and palm trees, which eventually spread to public botanical gardens and private living rooms. By the end of the 18th century, the first books in Estonian and Latvian with instructions for manor gardeners on how to graft trees and grow pineapples, asparagus, and figs started to appear. Raadi Manor became a centre for national knowledge as well as a place of beautiful plants. The Estonian National Museum (*Eesti Rahva Muuseum*) was established in 1909 as the repository for historical national collections. In 1922, it took over Raadi Manor Farm as its first public building.

The Raadi area was reserved as a Soviet military airport for much of the 20th century, so the public lost access to this historical centre of Estonian culture. Extensive natural countryside

grew up in the space around the airport in the decades of the Soviet era. In 1991, Estonia gained independence and looked to redevelop its National Museum to reflect the dramatic changes in the lives of ordinary people. For its centenary (2009), the museum ran an international competition for a design for a new building that would encompass its complex century of history. Paris-based architects DHG (Dan Dorell, Lina Ghotmeh, and Tsuyoshi Tane) created the winning design, *Memory Field*, with a roofline that took off like a runway to the sky, referencing the former use of the space. The building, with vast interior galleries, looks out on the gardens and spectacular natural countryside formed by the history of people and nature, first Raadi Manor and then decades of rewilding by neglect.

It was a major building project, and while it was under construction, the curators had to plan the galleries inside, in time for the formal opening in autumn 2016. People and nature created the grounds and opportunity for this vast project. They also informed the themes of the exhibitions. A plan for an environmental history gallery emerged early. The biggest permanent gallery, *Encounters*, includes an environmental history exhibition, *Inimene ja keskkond* [People and the Environment]. The philosophy of the exhibition, like that of the building itself, was to build from the ground up, from the field of cultural memories where the museum is sited. The environmental history of dwelling in eastern Estonian farms, of occupation and of the new independent Estonia, all come into focus with the local place.

The environmental history team developed five themes to tie the local environmental stories to national and international stories. All the storyline texts are available in Estonian, English, Finnish, Russian, French, German, and Latvian via a code on the entry ticket. The five themes were:

- *Disease*: the exhibits here include a medieval plague mask, topical again in Covid times, and the pharmaceutical herbs in the traditional bottles of apothecaries, which are displayed on a bed of modern pills.
- *Manure/human excrement*: a storyline delightfully titled "Shit is the Mother of Bread" is overhung with historical dung forks, looming from the shadows of the ceiling, cleverly reversing the soil below/sky above trope.
- *Gardening*: tells the story of gardens, greenhouses, and exotic plant collections.
- *War*: The storylines in "The Raadi Military Airfield" and "Protected Areas" reflect very different environmental legacies of a difficult period. This exhibit is the starting point for guided public excursions, which are, effectively, exhibits "beyond museum walls" that explore Raadi military history and its environmental impact.
- *Water/waterways*: The river Emajõgi historically provided a navigation route and reason to locate Tartu where it is now. It also supplied the water that grew the food and flowers.

The very locality is powerful in national discourse and threads through all the exhibits, but especially the environmental history gallery. The senior museum curators co-curated the exhibition with KAJAK, the centre for environmental history at the University of Tallinn (KAJAK n.d.). There was also collaboration from the Natural History Museum and Botanical Garden at the University of Tartu.

Gardening is about beautiful flowers, foliage, and food, but it has its dangers and disadvantages, too, and these are part of the environmental history of the Raadi area. Cold winters, wars, and pests left their marks on the agricultural landscape. Chemicals, sprays, and dusters bioaccumulated over decades of "fighting pests". Pollution on a greater scale occurred during the 1960s–1980s in the Raadi military airfield years. The worst sources of

pollution were fuel tanks, containers of missile fuel, and huge quantities of de-icing chemicals that were located near Lake Raadi. Diseases rampaged throughout Tartu's history. It was also a centre of medical research. The first inoculation against smallpox in Estonia was in the Raadi area in 1756. For the 21st-century display, the team selected and dried local herb specimens for the apothecary jars. Most of these herb species are widespread in northern Europe. Since opening, the museum continues to develop new environmental history programmes and to find different partners and audiences for its galleries. For example, the *Epidemic Breakout* educational programme is now offered to local and visiting schools. Using problem-based learning through role play, it teaches the local and global together. The research partnership with KAJAK also continues.

Museum-university research partnerships are an important thread in many environmental history museum projects. The first environmental history gallery at the National Museum of Australia was developed through workshops in 1998, 1999, and 2000, co-hosted by the Centre for Environmental History at the Australian National University. The Rachel Carson Center at Ludwig-Maximilians University Munich and the Deutsches Museum co-created the *Welcome to the Anthropocene* exhibition, 2014–2016. And the next case study shows some of the more dynamic ways that the university in Munich and a new museum can collaborate. Cross-institutional partnerships enable a collaboration between research expertise and curatorial experience to enrich exhibitions, enliven programming, and draw international visitors into the museum galleries.

Programming for the planet: BIOTOPIA, Germany

The role of exhibitions is radically changing in some museums. Just like history and technology museums, science museums are deeply rooted in a historical triangle of collections, research, and exhibitions. The largest and most renowned natural history and science museums are also highly esteemed research facilities, housing vast collections of millions of objects collected over centuries, sometimes under more or less dubious circumstances. Science museums also share similarities with other museums when it comes to educating their visitors: for the majority of the 20th century, this happened in a rather linear way.

Highly educated scientists-turned-curators created the museum's exhibitions based on prominent and beloved objects (the typical dinosaur exhibition comes to mind), added a little bit here and there in terms of accompanying material and, when they were done, museum educators moved in, took what they saw, and read and designed museum programmes such as tours, quizzes, rallies, and possibly a workshop to facilitate the content to the people. Such an approach may have worked well with dinosaurs and the like, but it is no longer adequate when dealing with today's complex life science topics such as CRISPR-Cas and global environmental challenges like the biodiversity and climate crises, planetary health, or pandemics. Innovative ways of thinking about programming in museums are needed, and BIOTOPIA, a new museum of life and environmental sciences, currently in the making in Munich, Germany, is taking up the task.

As the successor of the very popular museum "Mensch und Natur" (Humans and Nature), BIOTOPIA aims at bringing science museums into the 21st century by creating not so much another museum, but a communicative interface platform between science, art, politics, and the public. Its mission is to explore, question, and reshape the relationship between humans and other living beings, focusing on behaviours and processes rather than particular regions or periods. With such an approach, BIOTOPIA releases visitors from their passive

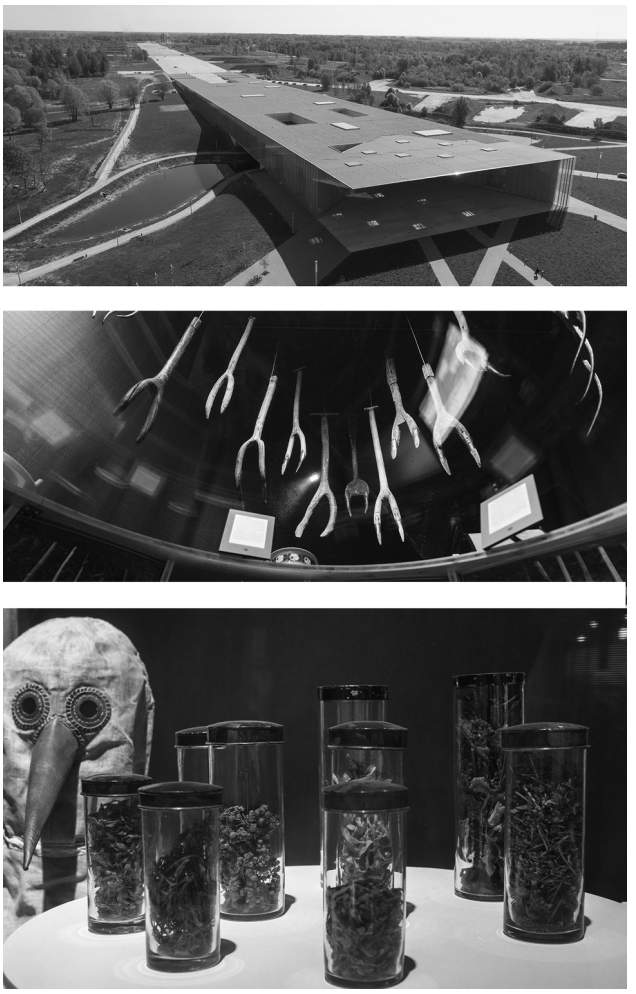


Figure 25.2 *Inimene ja keskkond* [People and the Environment] exhibition at the Estonian National Museum. Images by Arp Karm and Berta Jänes. Courtesy Estonian National Museum.

spectator-position into a more active role. Using our inborn curiosity about life and creating empathy for other living beings, BIOTOPIA aims at creating agency among its visitors to take responsibility for our planet.

At first glance, it may not seem very revolutionary for a science and natural history museum to deal with environmental issues and history. However, more often than not, they have focused on particular moments in time – the Cretaceous period with its gigantic dinosaurs, or the early 20th century as the golden age of modern physics, to name just two examples – and have dealt with them in a rather static way.

Museums as agencies of knowledge and engagement can no longer pretend that humans have no major and long-lasting impact on the earth. What is needed, therefore, is fluidity and extension into time and space. Looking at things from an environmental perspective, whether historical or present-day, offers museums a unique opportunity to enlarge their

social, educational, cultural, and even political relevance. Daring to look into the future – something that most museums feared – has indeed become a very important activity for museums that has proven to be of high interest to their visitors.

Envisioning alternatives, creating chances rather than just assessing the often bleak status quo, is what museums as places of active engagement rather than passive consumption should be doing. Yet, in order to be successful with that, museums need to change from within. According to Michael John Gorman, the founding director of BIOTOPIA, science museums' prime task is no more to generate new scientists or to enlarge civic scientific literary, but "to motivate, inspire, and engage a new kind of person now – flexible, creative, collaborative thinkers and makers who can move between different areas of knowledge, between art and science, between technology, design, and business". Moving from a stable to an agile institution and turning interactivity – the buzzword of the museum world in the late 20th century – into true participation requires the institution to relinquish control (Gorman 2020: 107).

Until recently, many museums have done very well in developing into enjoyable places of fun – some perhaps too much – but particularly science museums are still too often perceived as ruled by the knowledgeable few to be graciously enjoyed by the large public under strict rules of engagement. But what if this changed and museum spaces became places where the large numbers of patrons came on different occasions not just to see, but to do and make something, or just to enjoy the space? BIOTOPIA in essence wants to be just that: a meeting place and platform for different people with diverse backgrounds to come together and actively engage in programming.

An early project, while the larger museum is under development, the BIOTOPIA Lab, located in the Munich Botanical Gardens close to the site of the future museum building, opened in March 2021. The lab is a multifunctional space that allows for pop-up exhibition elements as well as changing programming (BIOTOPIA n.d.-a) During the week, the workshop area offers classes for school groups of all ages around topics such as water, soil, and DNA extraction, but also fungi, Kombucha, and mini-biotops in a jar. On the weekends, the lab opens up to the public with walk-in activities, offering a low-threshold engagement with science and environmental topics. As a meeting space, the BIOTOPIA Lab offers the unique opportunity for both the public and involved science and community representatives to leave their comfort zone and engage in interdisciplinary realms. Working at the intersection of life sciences, arts, and design, but also bringing in policymakers, social groups, and activists, changes the way museum spaces are perceived. They are no longer the place where experts talk to people in a linear way, but where circular and multidirectional communication happens, leading to new ideas, new understandings, and new cooperations. Present and future programming of BIOTOPIA also focuses heavily on going beyond the museum walls. An annual science and arts festival on different behaviours and activities that humans and other living beings share gives a broad public the unique opportunity to experience science and environmental topics from a wide range of perspectives and through different channels of engagement.

BIOTOPIA's project *Dawn Chorus* (BIOTOPIA n.d.-b) goes even one step further. Developed during the first Covid-19 lockdown phase in 2020, when the world stood still and people "heard" nature again, *Dawn Chorus* is the first Citizen Science and Arts project that invites people worldwide to collect bird calls. During its collecting phase in May 2022 alone, more than 13,000 recordings from 46 countries were uploaded. What makes *Dawn Chorus* so unique is its varied usability. While the massive amount of birdsong samples

helps international research on bird biodiversity loss, it is also a great source for creative innovation and artistic renderings of the related topics. Carrying their programming beyond the museum walls into alternative spaces, including the digital realm, and collaborating with people from different fields, backgrounds, and institutions gives museum programming an unprecedented and incomparable magnitude of possibilities – and incredible power if used smartly to bring people from lethargy into action.

These examples show that museums have become spaces with moving boundaries and platforms, bringing together changing contributors to a discussion that goes well beyond traditional sciences. Museums' content is no longer to be "consumed", but to be made of/by/for all people. If truly lived, this would change museums not just for the visitors, but also – more fundamentally, in fact – for the museum professionals within. As Michael John Gorman has described it, going beyond the tokenistic usage of participatory elements would require museum professionals to rethink their own roles and curatorial and programming policies and accept a certain loss of power (BIOTOPIA n.d.-b; Gorman 2020: 108). Considering the long history of museums and related self-perceptions of curators and scientific museum staff, this change will not be done in a day. It's a long journey, but in view of both the environmental challenges ahead and the future of museums, it's worth undertaking.

Conclusions

On a rapidly changing planet and declining ecosystems, museums have taken an ecological turn. Indeed, galleries, libraries, and museums have seen a proliferation of engagement with environmental issues. Since the 1970s, museums have grappled with their own disciplinary foundations, and yet we can see that environmental history is playing a critical role in an emerging "ecological museology". Going further into museum practice, we can see how audiences are engaged with many of the narratives of environmental history. In this chapter we have also shown that the practice of environmental history in museums and galleries is much more dynamic than traditional ways of practicing environmental history. By engaging audiences, curators and programmers must not only showcase environmental pasts, but they also need to collaborate with communities, evoke the challenges and potentialities of our future, and inspire and have fun. In a museum, these are interactive and open-ended ways to engage with our environmental pasts and potential futures, but they are critical in encouraging wider publics in our environmental stories.

Traditionally museums were founded on collections. As Wehner (2017: 100) notes,

> [c]ollections constitute an inheritance, one that embodies older structures of knowledge but that also holds great potential to disrupt disciplinary boundaries and established modes of thinking and acting in ways that open up space for new ecological and empathetic understandings.

Not only can we reinterpret older collections in the light of ecological challenges, but at the same time we reimagine new potential collections to capture this moment of ecological crisis. For example, the NMA acquired a 2.4-tonne coal sample from the New Acland Mine in south-east Queensland, Australia, for its new exhibition to show the deep-time connections between ancient bunya (*Auracaria*) forests and the Gondwanan supercontinent (Main 2021). By taking up the challenge of deep-time environmental histories, deeper even than human histories, museum practices are changing what counts as environmental history.

Robert Janes (2009: 92) argues that rethinking the role of collections in terms of the planetary ecological crisis fundamentally recharges and inspires the missions of museums. "It is clear that museums are not meant to solve climate change or any other global problems, but museums *are* in a position to invent a new future for themselves and their communities" (emphasis in original). Museums are now helping audiences participate in desirable future-making, beginning first and foremost with their local communities. Jennifer Newell and others at the Australian Museum in Sydney have developed a Climate Solutions Centre, bringing together diverse voices "to inform and inspire more Australians to support climate solutions" (Australian Museum 2022).

Understandings of global warming, the "Sixth Mass Extinction", and the Anthropocene concept have coincided with a time when museums have moved away from a focus on collections and taxonomic ordering, and there has been a revival of storytelling, often led by Indigenous and local communities. Museums are in a position to reflect on our past practices, debate the current status quo, and, together with audiences, create potential futures. And it is at this final stage of collaboration that audiences no longer become numbers to justify a museums utility. Audiences are now collaborators in transforming environmental pasts into futures.

While museums still depend on their collections, the context and the imagination used to tell the story of these objects is changing all the time. The concerns and projects of environmental history fit so well into the Anthropocene epoch that many of the museums described in this chapter have turned to environmental history in creating and delivering their exhibitions. But there is still much work to do. As Dipesh Chakrabarty (2019: 18) has argued, "museums – as major institutions of public history will also rethink how they might bring together natural and human histories including the natural history of humans". How we go about doing this in museums is wide and varied, but there is no doubt that in diversity, there is strength.

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26

ENVIRONMENTAL HISTORIANS, POLICY, AND GOVERNANCE

Alessandro Antonello and Margaret Cook

Preparing for the call?

Consider the following two episodes of experts and policymaking from recent Australian history:

In July 2021, the Australian historian Warwick Anderson received an email from the Australian army general who was coordinating the nation's Covid-19 vaccination program. The general asked Anderson, a prominent historian of medicine and the environment, on the "lessons of history" and "what might be learned from earlier efforts to control epidemic disease". Anderson prepared for a short phone call with the general, brushing up on various historic vaccination and public health campaigns, noting how nearly all such efforts required "patient and painstaking engagement with communities" and "infinite sensitivity, sympathy and flexibility". Knowing he was speaking to a military man, Anderson framed this as a "practice of pacification and counterinsurgency". In the end, Anderson spoke with the general for more than 30 minutes, although Anderson "got the impression [he] was mostly confirming what [the general] already knew or had heard before" (Anderson 2021).

In December 2021, the Australia Institute, a prominent independent think tank, released a report questioning claims made by Santos, a major Australian natural gas producer, about the potential of carbon capture and storage at one of its gas fields. The Australia Institute drew attention to Santos's activities within the context of an Australian government policy around emissions reductions – policies which did nothing to reduce emissions. Using Australia's freedom of information laws, the Institute sought access to documents within the Department of Industry to see how the department responded to the report. A member of the climate change policy section of the department wrote: "Crickey [*sic*] – that TAI report is 21 pages long. I'll stick with the summary thanks 😊".[1]

In these two moments, we might either draw hope or feed our cynicism around policy-making today. We live in hope that some people with power wish to draw on expertise and evidence, including historical expertise and evidence, to shape important policies and to improve people's lives. We also live with the knowledge that bureaucracies and policymaking capacities in many countries have been utterly politicised and hollowed out by neoliberal cost-cutting. Scientists working in government and industry routinely have their scientific

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results or publications suppressed (Driscoll et al. 2021). We worry that no amount of evidence, however compelling, will sway policy- and decision-makers. We worry that even a mere 20-page, evidence-rich document will be blithely cast aside.

This chapter explores how environmental historians might interact with, and have interacted with, policymaking and the broader suite of environmental governance that is now in place at all scales, from the local, through the regional and national, to the international and global. At this time of planetary challenges, interactions with policymaking might seem a tinkering approach to environmental problems, both local and global. "Can environmental history save the world?" asked a group of Australian environmental historians in 2008 (Brown et al. 2008). That was a mostly tongue-in-cheek question, and the answers each of them gave explored locally relevant examples in which historians had made important if modest contributions. Other noteworthy environmental scholars have rather more radical answers to questions of world saving – for example, blowing up pipelines (Malm 2021).

Environmental historians should not wait by the phone. If they want to contribute to policymaking, they need both conceptual frameworks and rich case studies as examples to guide their actions. This chapter offers some frameworks and examples for the environmental historian's toolbox. Drawing on policy and political science literatures, it examines the nature of environmental policy and governance. The chapter also looks to the larger literature and experiences of "history and policy" as an area of practice and concern. For environmental historians specifically, we consider a range of important policy issues around data and information, rights and justice, deliberation and community engagement, and communities of practice. All this, we hope, might help an environmental historian who wants to take their research to policymakers.

The scope of "policy"

"We need to protect this river" and "We need to eliminate greenhouse gas emissions" are fundamentally sound and important goals, but they don't quite cut it as "policy". If a historian wants to effect change in governance or regulation, we must start by asking what policy is and what it means for a historian to participate in policymaking; when, where, and with whom can historians influence policy? There is a many-decades-old body of critical policy scholarship from which we can draw to assist how we approach the "policy interface". There is an especially rich literature on the "science-policy interface" – which broadly emphasises the limits of the "linear model" of advice, often critiques of the "interface" concept itself, and covers all areas of public policy from health and social policy to environmental and sustainability policies (Bednarek et al. 2018; Palmer et al. 2018; Pielke 2007; Wesselink et al. 2013).

What is policy? In other words, how should environmental historians think about policy? Stephen Dovers and Karen Hussey define policies as "positions taken and communicated by governments – 'avowals of intent' that recognise a problem and in general terms state what will be done about it. Policies are produced through multi-component and variable *policy processes* that combine government and non-government players". A policy- or decision-maker is someone "with legal competence and responsibility in the relevant jurisdiction to do things" (Dovers and Hussey 2013: 14–15, emphasis in original). Policies are enacted with instruments, tools to achieve desired outcomes. Processes are central: problems are framed and recognised; options for solutions are developed and explored; solutions are chosen; decisions are made and implemented; and outcomes are monitored and

evaluated (broadly drawn from Dovers and Hussey 2013; see also Cairney 2020; Howlett et al. 2020). Historians thus face a variegated terrain of actors and processes when approaching policymaking.

While governments are still central to policymaking, the rise of "governance" and a wider array of actors over the past three or four decades, has enlarged and added a level of complexity to policy processes. There are many sites at which historians might intervene to effect change. "Governance" – often seen as a combined result of neoliberalism, economic globalisation, and the influence of international institutions like the OECD or World Bank – includes not only governments, but also communities, businesses, and non-governmental organisations, and is shaped by political, market, and community concerns embodied in a variety of institutions and ideas across scales (Lemos and Agrawal 2006; Newell et al. 2012). A major example in global environmental governance would include the International Union for the Conservation of Nature. Its very structure combines states with non-state actors across every scale, and its expert commissions, committees, and communities are rich sites of policy development, which can have significant influence across the world (Schleper 2019). In another example, companies, both local and multinational, value legitimacy and social license for their work – primarily as a way of building their wealth. The rise of environmental, social, and corporate governance (ESG) has allowed a range of policy actors to influence business activities, thus potentially achieving certain environmental outcomes. Certification schemes – such as the Marine Stewardship Council or Forest Stewardship Council – have also emerged in recent decades at the intersection of non-governmental action and governmental policy as ways for corporations to sell products and consumers to buy products with certain bits of information (Abrams et al. 2018; Auld 2014). These sites and nodes of governance, sometimes falling outside government processes, are all potential sites for historians to introduce historical expertise and evidence to achieve just and sustainable outcomes for peoples and environments.

Historians and policy

Before further considering the case of environmental historians, it is worth understanding some of the contours and contexts of the contemporary push for historians to be active within policymaking. In many countries, some historians have pushed for the standing and presence of historical knowledge in policy debates and governance frameworks. While many historians are of course concerned to make substantial contributions to, and improvements in, public policy, there is nevertheless an inescapable element of the bureaucratisation of research and universities in many countries to contend with and to keep critically in mind. Historians seeking funding from public bodies are enjoined to predict and aim for "impact pathways" in which their new knowledge – however esoteric, pure, or distant from pressing concerns – is made to connect with some aspect of public policy or community need.

While there are examples of historians engaging in policy development and government from earlier points in history (for some British examples, see Green 2016), perhaps the earliest influential exploration of "history and policy" arose under political scientist Richard Neustadt and historian Ernest May at Harvard University. In the 1970s they began teaching a course on the "uses of history" to their students, many of whom had jobs in government or the military. This led to their 1986 book *Thinking in Time: The Uses of History for Decision-Makers*. Their aim was to create "'mini-' or 'small-m' methods" for use by decision makers, a "checklist of questions to be asked early instead of late", either during crises or in

policy development (Neustadt and May 1986: xvi). Several assumptions guided their work, two of which are worth mentioning here. Neustadt and May insisted that government or policy actors "actually used history in their decisions … whether they knew any or not" (Neustadt and May 1986: xii). One task of the historian was to offer good histories. Another assumption that guided their work was that "Marginal improvement in [policy or decision-making] performance was worth seeking" (Neustadt and May 1986: xvii; see also Cox 2013: 136–7). Neustadt and May's conceptual framework and mini-methods remain valuable.

More recent critical reflection and on-the-ground practice have further elaborated the promises and challenges of "history and policy". Important work has emerged from the United Kingdom, where the History & Policy organisation and web platform is well-advanced in its work (Delap et al. 2014). Historians who have led or been involved in these developments have reflected on their experiences to suggest ways forward for others, including in the following areas.

Following Neustadt and May, it remains crucial to recognise that politicians and policy makers often invoke and deploy history "in an ad hoc way, mostly without the involvement of historians" (Berridge 2008: 323). This opens a space, as Alix Green has suggested, for emphasising history as a disciplined analytical labour that everyone can undertake rather than merely as a source of facts; processes might be more influential than content. Historians should thus de-emphasise "the tangible products of historical research" and consider how simple participation in policy processes, including conversations with influential actors, can be useful and meaningful (Green 2016: 115).

If encouraging historical thinking is an important aim, which part of policymaking structures and processes should that thinking be encouraged in? As Dovers and Hussey outline – as detailed in the previous section – there is a complex terrain of actors and processes. Not all actors and processes can be simultaneously engaged with and successfully influenced. Virginia Berridge's experience strongly suggested that historians had to be aware of existing alliances and networks of actors which they might connect into (Berridge 2008, 2018). One way of assessing which alliance, network, or process might be worth engaging with is to remember, as Berridge puts it, that "timing is key" (Berridge 2018: 377). Not all moments in policy development are equally amenable to outside influence or new data or conceptual input. Berridge's *in situ* work showed that "Particular points in the policy-making cycle were also more 'open' [to the insertion of history] than others" (Berridge 2008: 316). In her policy-engaged work on youth crime and child protection, the historian Pamela Cox has similarly emphasised the necessity of knowing the best moments to intervene (Cox 2013).

As the literature makes clear, these potential interventions and actions are labour intensive and time consuming. Networks and alliances must be recognised and joined, and participation maintained to build trust and understanding; sometimes networks and alliances have to be built. Contributions and changes in policy may only ultimately be marginal or modest.

Environmental historians and policy

Across the wide, diverse, and now enormous literature that constitutes environmental history, there are very few explicit or programmatic considerations of "environmental historians and policy". Certainly, there have been semi-regular reflections on how environmental historians have engaged with broader publics. And there have been moments in which prominent voices have argued that perhaps the field has lost its earlier impulses for advocacy and

public orientation as it has professionalised and grown within the academy. John McNeill, in a highly-cited 2003 overview of the field, argued that "political engagement seems to have declined sharply in the U.S. and Europe, while still surviving in India and Latin America", although he couldn't offer an argument as to why (McNeill 2003: 34). In more recent reflections, he suggests that he has probably had greater influence on solving environmental problems through the thousands of students he has taught than in the few engagements with policymaking into which he was drawn (McNeill 2017). To be sure, public environmental history has a rich body of practice and writing, especially in the United States, where historians often work in government agencies (Madison 2004; Shull and Pitcaithley 2004). A general impression, though, of the contents of one of the field's major journals, *Environmental History*, suggests that explicit explorations and reflections of environmental historians' participation in policy development are quite rare. Interdisciplinarity is more invoked than policy engagement.

Let us consider the reflections of three environmental historians in relation to policy:

In 2000, the Australian environmental scholar Stephen Dovers offered substantial thoughts on how environmental history could contribute to policymaking. He suggested "three categories of relevance" for environmental history: "general historical perspectives, human and ecological baselines, and policy and institutional lessons". While general historical perspectives are useful, Dovers suggests, "there are unlikely to be operational policy suggestions arising"; he does, however, note that history's synthesising and integrative approaches can be helpful for a difficult policy area like sustainability. On establishing baselines, Dovers feels that the potential contribution of historians is self-evident and important. Knowledge of previous states is essential, but he also cautions that this baseline work is fundamentally interdisciplinary (Dovers 2000a: 137–9) – and indeed, in the case of oyster reef restoration in South Australia, the establishing of baselines by historically minded marine scientists doing historical research suggests the transformative effects of actually establishing baselines, both for engaging policymakers and establishing legitimacy with the public (McAfee et al. 2020). On policy and institutional lessons, he also sees a specific instance of how historians can help: keeping and disseminating the detailed knowledge of previous actions, and "being reminded of what we have forgotten". On this latter point, Dovers appears profoundly pessimistic, since he considered that (at least in late 1990s Australia, although arguably in most contexts), "'policy amnesia' is endemic" (Dovers 2000a: 139–40). Like many other historians working in the policy field, Dovers cautions that, in terms of policymaking, historians and policymakers alike, "should not expect too much from history" (Dovers 2000b: 6).

In Britain, Paul Warde has also articulated environmental historians' potential contributions. He suggests that historicising policy processes and central concepts in environmental policy is critical (Warde 2015). With colleagues, Warde has suggested three main forms of historians' policy-relevant evidence: in providing analogues (both true and false analogies); providing direct evidence of past circumstances (which includes baselines); and providing a historical mode of thought, which is integrative and synthesising (Delap et al. 2014: 100) – broadly reaffirming Dovers's points. On contributing evidence, for him, the work of historians – such as reconstructing past environments – will always be "very partial, and becomes far more convincing when allied with sources of information drawn on by scientists … or an understanding of the biological and ecological functioning". But, he adds, historians can help to strengthen the data collected by scientists by using their traditional historical methods (Warde 2015: 150; see also Delap et al. 2014).

Finally, the Canadian historian Dean Bavington has taken a much more critical approach. While he appreciates the potential contributions historians might make to policymaking, he strikes a wary (even weary) note about the instrumentalisation of knowledge, especially within universities. The task of the historian in relation to policy processes for Bavington is more fundamentally about "reimagining eco-social relationships and the industrial mindset that produced the Anthropocene" (Bavington 2011: 4). Bavington wants historians to help with a move away from "control-oriented" policy to a policy that helps communities deal with uncertainty and complexity. Like others, Bavington also demands that we historians critique the violence of abstractions and conceptualisations of nature as "resource" (Bavington 2011).

Many other disciplines concerned with good, ecologically sound, and sustainable policymaking – like conservation biology and environmental management – have also developed their own literatures around "policy engagement". On-the-ground practice in feeding scientifically sound and community-relevant evidence and knowledge into environmental and conservation decision-making is globalised, if uneven, and scholarship and literature analysing and reflecting on those practices is extensive and always growing. Environmental historians seriously considering engaging with policy processes should build awareness of these practices and literatures. The general tendency of this contemporary literature is to recognise that good environmental and conservation decision-making must be built on diverse knowledges and through engagement with varied stakeholders, at all stages of policymaking. Knowledge and evidence should be co-produced with stakeholders and, as David Rose and colleagues summarise, "common principles of effective engagement include trust, reciprocity, respect, transparency, clear benefits to participants, co-learning and identifying all necessary decision-makers". Furthermore, "It cannot be assumed that good practice for working with one type of decision-maker is transferable to working with another" (Rose et al. 2020: 164). But persistence, too, is crucial. From their work on oyster reef restoration in South Australia, Dominic McAfee and other historically minded marine scientists found that "persistent socialization" and normalising of the historical baselines and narratives among government officials and the public was also crucial to leading to policy action, in the form of oyster reef restoration (McAfee et al. 2020).

Data and information, rights and justice

Soon after Donald Trump was inaugurated as president of the United States, climate data seemed to be disappearing from US government websites. If the data itself was not likely to have been destroyed, removing easy public access was taken as a symbol of Trump's hatred of environmental protections. The Environmental Protection Agency (EPA), one of the oldest such agencies in the world, seemed also to be under attack, with Trump appointing the climate-denier and fossil fuel champion Scott Pruitt to be its head.

At such a moment of full-throated political attack on the institutions of environmental protection, what is a historian to do? The policy processes described earlier – such as framing and recognising problems or exploring and developing solutions – can work only if institutions are legitimately constituted and operated, and with quality and accessible data. One pre-emptive response to Trump's attack on data and the EPA was the Environmental Data and Governance Initiative (EDGI), formed in November 2016 after his election. Historians joined other social and physical scientists to keep a keen eye on the US government's websites, to ensure that data sets remained accessible (Vera et al. 2018). Trump's

attack also underscored that, even in earlier times, environmental data was widely dispersed across the government and not especially accessible. In the early Trump era, a range of data activism activities emerged to help preserve environmental data and make it more accessible, including using vital web resources like the Wayback Machine of the Internet Archive.[2]

As EDGI has developed, historians and historical thinking have increasingly been added to its work. An early, significant piece of EDGI work that was informed by historians' sensibilities was its contemporaneous archiving and public historical work with EPA employees at the moment of Trump's attacks on the agency. This involved confidential oral histories with long-term EPA employees (Sellers et al. 2017; Sullivan et al. 2021). Such work, which seeks to actively keep a variety of records and sources on central environmental policy institutions, is an excellent example of a range of ways that environmental historians can help with environmental policy. Not only is it embodied in deeply researched, evidence-based reports, but also in stand-alone, accessible websites such as "A People's EPA".[3] Subsequent developments include the Environmental Historians Action Collaborative, a group within EDGI, many of whose original members had participated in writing an amicus brief for a major youth climate case presented to the US Supreme Court.[4]

The protection of specific data sets or retaining certain bits of information ties into a broader development around environmental rights in recent decades. Historians' engagements with policy processes should not only be targeted to achieve specific policies around ecosystems or sustainability, but should also broadly support principles and processes. Data and information are essential for all peoples to participate in decisions affecting them and their environments. Principle 10 of the Rio Declaration on Environment and Development states that "Environmental issues are best handled with the participation of all concerned citizens" and that nations should ensure that individuals "shall have appropriate access to information concerning the environment that is held by public authorities … and the opportunity to participate in decision-making processes". States should ensure that information is "widely available".[5]

This broad principle on access to data and information, which nearly all states are signatories to, has been given additional legal teeth in subsequent regional agreements. In Europe, the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (the Aarhus Convention) was signed by 47 countries within the UN's Economic Commission for Europe in 1998 and came into force in 2001. This treaty pushed forward international environmental law by instituting obligations of states towards individuals in any state; it pushed forward a vision of environmental democracy (Barritt 2020). In 2018, the members of the UN Economic Commission for Latin America and the Caribbean signed the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (the Escazú Agreement) that, although it has differences to the Aarhus Convention, similarly pushes towards forms of environmental democracy and rights to healthy environments (Stec and Jendrośka 2019).

Helping deliberation

With so many pressing and obvious environmental problems, encouraging more deliberation and discussion among peoples and institutions might seem like dangerous delay. However, as much recent literature and practice in public policy suggests, processes are

essential to policy success and outcomes, especially in the problem and solution-framing phases of policymaking. This is both as a matter of principle – democratic decision-making that is open to peoples at relevant scales is crucial – and as a matter of efficacy and legitimacy.

A noteworthy approach here is "co-design". In recent decades, a concern with ensuring good policy has led policymakers and policy scholars to embrace processes that more actively include the people who might be affected by policies. In one definition, "co-design … [is] a design-led process, involving creative and participatory principles and tools to engage different kinds of people and knowledge in public problem solving". The process holds that "lived experience" is a crucial domain of expertise. It uses "practical tools … to access, generate, and test experiences and ideas", including a range of creative and other approaches which allow people – not just individually, but in a group through deliberative encounters – to tell their stories and to make and test potential solutions (Blomkamp 2018: 731–3).

Historians can be part of this deliberative or co-design process. In February 2003, Marsha Weisiger, then a tenure-track assistant professor at New Mexico State University, wanted to contribute to the question of Mexican wolf reintroductions in the American southwest. She thought that reasoned, open, and respectful discussion among wolf experts, ranchers, environmental activists, interested members of the public, and historians, could bring nuance and light into the debate around the wolf's apparent conflict with livestock, which was being grazed on federal public lands. The symposium was titled "Leopold Forum: El Lobo" as a tribute (and wry, karmic backhand) to the great American conservationist Aldo Leopold, whose "land ethic" has been so influential yet whose early career contributed to the extirpation of wolves in the southwest. Weisiger believed that wolves and ranchers somehow had to inhabit the same landscape, "however difficult that proposition might be". Also, as a beginning proposition, she thought that "science does not offer unambiguous answers to environmental questions", and thus, adding historical, social, and political nuance and complexity to the public discussion might assist in the important task of reintroducing these predators into the southwest rangeland ecosystem (Weisiger 2004: 125–6).

Weisiger took on the enormous task of convening a major two-day symposium that would hopefully foster interactions between conflicting sides of a tense policy issue. Here, the environmental historian was acting as a mediator to allow multiple competing public policy positions to be enacted, ranging from a species reintroduction plan under the US Endangered Species Act, as well as the continued commercial use of public lands to raise beef for sale and consumption. Weisiger asks: "Did adding history into the discussion make any difference?" Her frank answer was "It's hard to say". Certainly, it did not bridge the immense divide between the pro- and anti-wolf positions. But what it did reveal to Weisiger was the kinds of history that were important in these policy discussions. Ironically, it was not the deeply researched and sophisticated histories of her and her academic colleagues that seemed to be most important. It was, rather, following Carl Becker's famous insight, that "everyman" (and every person) was their own historian (Weisiger 2004: 143). That in the deliberative process around wolf policy, the participants found it validating and important to talk of their own histories. A great validation indeed for public history, but perhaps deflating for scholars.

Arranging this deliberation was not easy. As Weisiger says, "Organizing public conversations about contentious environmental issues is not for the faint-hearted" (Weisiger 2004: 144), taking over two years, which included grant writing and the whole coordinating effort, on top of Weisiger's regular teaching commitments. The grants and funding were required – to

the tune of over US$32,000 – to ensure a free event that included a wide range of speakers (Weisiger 2004: 133). Importantly, Weisiger was also conscious about her own limits and those of history. Anticipating conflict, Weisiger drew on her experience and contacts in a conflict mediation course she had taken as a fellow of the Environmental Leadership Program, to plan a "private breakfast" following the main public program, which a skilled conflict negotiator chaired and facilitated (Weisiger 2004: 135). As with many cases of public and policy engagement, Weisiger's openness and ethical dealings with people who held opposing opinions and positions to hers were also important to the process; it embodied what a great deal of positive examples from conservation biology and management say is essential about effective engagement with communities (Rose et al. 2020).

Communities of practice for environmental resilience

Building societal resilience in relation to Earth's natural processes has been a central task of modern states for centuries. In the face of climate change, which increases the intensity and frequency of "natural" disasters, building that resilience is as crucial as ever. Although predominantly considered the purview of technical experts, in recent decades, some historians have engaged with these resilience policy areas and tried to inject historical evidence and historical thinking into the mix (Lakhani and de Smalen 2018). One notable area has been around fire. Stephen Pyne's historical scholarship has investigated fire globally, but he has also engaged directly with wildfire management in the United States (Pyne 2009). In Australia, too, historians like Tom Griffiths and Daniel May have, in parts of their research, directly addressed the place of history in fire policies (Griffiths 2009; May 2020).

Flooding is an environmental event with a long, often disastrous, history, but which also requires ongoing policy adaptations and considerations. Historian Margaret Cook reflects on her experiences as part of a "community of practice" trying to shape flood and water policy in the Australian state of Queensland, especially Brisbane, its largest city and capital:

> Following publication of *A River with a City Problem: A History of Brisbane River Floods* (Cook 2019), I deliberately sought opportunities to work with flood policy makers. A Queensland-based group calling themselves the Flood Community of Practice invited me to speak on my new book soon after its release, following which I fully joined in the Community's work. It was established by Dr Piet Filet in 2014 as a cross-disciplinary network of 550 practitioners and scholars from the private, government, university and community sectors involved in various aspects of flood risk management. Communities of practice have existed for 30 years as a way of sharing knowledge and lived practice as means of collaborative learning about a "real-life problem" (Pyrko et al. 2017; Wenger 2010). While Brisbane-based, it has national and international links (particularly with the Netherlands and Britain) and holds regular, interactive, face-to-face, and online workshops to share and build knowledge among members, aiming to be a voice for proactive and holistic approaches to developing flood resilience. Most members are engineers, hydrologists, scientists, and architects who actively work in disaster management. Although I am the only historian in their cohort, Piet Filet maintains that my "research has proved to be a fresh and alternative way to look at past management choices".[6] My involvement is valued by members who have told me that I bring new knowledge and historical depth to members' discussions and work practices that informs contemporary planning and flood responses.

In the field of flood management, there are rich opportunities to work with town planners, engineers, and architects – those who determine policies that shape our cities.

Each discipline has its own worldview, a way of framing or analysing problems, and the discipline of history can offer new perspectives on old problems. Through archival research and oral histories, historians uncover hydrological and socio-political complexities, reveal the conflicting narratives and disparate voices, and add the human and non-human dimensions to an event. Scientific and policy documents can be selective in fact, or, as Ian Townsend's research on the 1889 Cyclone Mahina in north Queensland uncovered, can recycle scientific "facts" based on erroneous accounts of the events that question the validity of the regions' cyclone modelling (Townsend 2020). Similarly, Tom Griffiths argues that Victoria's "stay or go" policy on bushfires, responsible for many deaths, relied on bad history that pursued "historical evidence that supported their preferred management policy" (Griffiths 2009). Flood histories can change dominant narratives, dispel myths about flood prevention, or challenge political and administrative processes. The prevalence of myths – think "dams will save us", "floods come every hundred years" – can be disproven through historical accounts. Policies are cultural; historical accounts reveal the socio-economic and political factors that shape the decisions behind them. Cumulative actions can "lock in" policies, creating a path dependency that limits the range of decisions made in the future and, with the costs of reversal high, make policy change less likely (Gaynor et al. 2022). Historicising past policymaking can help to nudge future policies in new directions, away from path-dependent ones.

The Queensland Floods Commission of Inquiry held after the state's 2011 floods recommended local authorities revise their flood management policies (Queensland Floods Commission of Inquiry 2012: 46–7). In 2020 the Ipswich City Council, in southeast Queensland, rewrote its flood management policies, drawing on my flood history work. The Council's Emergency Management and Sustainability Manager told me that my research stimulated "evidence-backed discussion that allowed examination and validation of our thinking", equipped the Council officers with "historical context to explain current decisions" and "provided an authoritative, non-government view of the complexities of flooding to point to and encourage people to explore these issues themselves".[7] Drawing on history, officers were able to contextualise past policies and explain the need for change at a series of public forums.

My sustained engagement with government agencies and flood practitioners – both during formal policy processes and in more informal ways – has developed trusting relationships, bringing with it further opportunities to engage with various stakeholders and policymakers. Since the February 2022 floods, my voice had value as a conduit between technicians and the wider public. Disaster managers identify community knowledge of hazards as a tool in increasing community resilience, a key to sustainability (Handmer and Dovers 2007; Krüger et al. 2015). With a wet summer predicted for the end of 2022, Ipswich City Council engaged me to conduct a community forum on flood preparedness based on historical precedents, and I have worked with Seqwater (the authority responsible for managing the region's flood mitigation dams) on a series of educational flood videos for wide dissemination. Memories of floods can increase community preparedness and aid the recovery, but scholars have found that flood memories in Australia can fade during periods of drought (Colten and Sumpter 2009; Garde-Hansen et al. 2017; McEwen et al. 2017). Recording the events is an important part the historian can play in assisting flood policy, building community knowledge through narrative. The value of recording stories and providing historical insight was recognised by the Office of the Inspector-General of Emergency Management. In July 2021 it held the inaugural Queensland

Disaster Management Research Forum, where six academic historians presented papers on histories of disasters and three contributed to an interdisciplinary discussion panel. The event was live-streamed to 300 participants globally.[8] The historians provided temporal depth to the discussions and reminded participants of the importance of social and cultural factors when determining policy and the need to consider the human, non-human, and environmental impacts of solutions in the rush to restore the *status quo ante*. Historians can bridge divides, and in 2022 I chaired a roundtable of disaster managers at the second Queensland Disaster Management Research Forum to discuss community involvement in flood resilience.

Policies can create a world without humans, politics, cultural values, and economics – an unreality that ignores the cultural dimensions of science (Carey 2014). As social scientists, one role for historians may be to historicise policy, to put a human face to the consequences of past poor decisions or adherence to path-dependent practices to remind policymakers to draw on collective insights and disciplines to strive for the best possible outcomes. Floods are a hybrid of human and nature's actions and the creation of false dichotomies in flood management policy based on predictions of nature's actions can perpetuate environmental ignorance or cultural blindness that can be fatal.

Conclusion

The efforts of many environmental history colleagues to contribute actively to environmental policymaking are inspirational. Their labours are often hidden out of sight of the peer-reviewed literature that our disciplines, jobs, and funders demand. But it helps to consider these cases alongside the significant and carefully conceptualised policy studies scholarship, too, since the challenges of working at the policy interface are many and substantial, even forbidding – this policy scholarship is a valuable tool for environmental historians. The literature cited in this chapter is clear about the promises and challenges; it is difficult to make one-off contributions to policy. However, within the constraints of policy frameworks and processes, there are opportunities to build working relationships with stakeholders. While historians are rarely the policymakers, our scholarship has the potential to stimulate change. Often it is just as important to concentrate on processes as much as policy substance. Sustained engagement and public activities make the chances for success and influence higher. Patience is key, since frustration is a central experience, and policy "successes" might sometimes (even usually) only be marginal corrections and improvements. As the environmental scholars David Rose and colleagues put it: "Don't give up!" (Rose et al. 2020: 176).

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Notes

1 Unnamed Australian public servant, email, 14 December 2021. Australian Department of Industry, Science, and Resources, Freedom of Information Disclosure Log Number: 22/004/70320 (www.industry.gov.au).

2 The University of Pennsylvania's Program in Environmental Humanities also contributed to this data rescue: https://ppeh.sas.upenn.edu/historical-page-get-involved
3 https://www.apeoplesepa.org/
4 https://envirodatagov.org/environmental-historians-action-collaborative/ and https://www.ourchildrenstrust.org/court-orders-and-pleadings (see Brief for 78 Environmental Historians).
5 UN General Assembly, A/CONF.151/26 (Vol. 1).
6 Personal communication, Piet Filet and Margaret Cook, 22 November 2020.
7 Personal communication, Matthew Pinder and Margaret Cook, 14 June 2021.
8 The historians were Deb Anderson, Claire Brennan, Margaret Cook, Rohan Lloyd, Scott McKinnon, and Patrick White. Program and recordings available at: www.igem.qld.gov.au/researchforum (accessed 8 August 2022).

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27

FUTURE DIRECTIONS IN ENVIRONMENTAL HISTORY

*Cintia Velázquez-Marroni, Jessica Urwin, Nicolo Paolo Ludovice, Bryan Umaru Kauma, Sangay Tamang, and Jayson Maurice Porter**

Where we are

As of this writing, the Covid-19 pandemic has not abated. When the pandemic became widespread in the early months of 2020, scientists had uncovered the zoonotic or animal origins of the disease. The World Health Organization along with national governments devised protocols that restricted international movement, disease transmission, and enhanced social distancing. Pharmaceutical companies raced to develop vaccines as new strains of the SARS-COV-2, the virus responsible for the pandemic, were discovered with faster transmissibility, some with greater pathogenicity. In the span of three years, hundreds of millions of cases and millions of deaths were recorded worldwide.

For the six of us, our positions as early career scholars were forged under the circumstances of the pandemic. Some of us struggled as we finished our doctoral degrees away from our families. Lockdowns closed archives and libraries, which delayed and limited our research. The pandemic also constricted the academic job market further, aggravating our already precarious situations. We were not alone. This pandemic has had a significant toll on everyone's physical, spiritual, emotional, and mental well-being.

But, in a way, our unusual context brought us together. The limitations of the pandemic ignited the use of alternative and innovative research methods and styles to achieve career goals and deadlines. These methods and styles have, in turn, influenced our own research priorities. Bryan's research examines the impact of climate change on food security, particularly on the role of small grains like sorghum and millet in Africa. Working with palaeoclimatologists, biologists, energy scholars, and local environmental educators, Jayson practises interdisciplinary environmental storytelling and co-creates environmental justice literacy programs for K-12 students of colour in the United States. Sangay investigates the nexus of ethnicity, identity, and environmentalism, with a focus on the forestry and plantations of the Darjeeling Himalayas. Cintia's work with the museum sector allows her to advocate for a more

* The afterword has no first author. The six authors wrote this piece together from start to finish, but since alphabetical ordering of our names put the women last, we decided to put them first. It is also intentional to lead with the environmental scholar among us working most closely between academic and non-academic spaces. We want that work to be more legible.

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environmental view of heritage through the museum collections in Mexico City. Jessica focuses on nuclear colonialism in Australia as a form of environmental injustice enacted through imperial and colonial networks, while Nicolo explores the role of animals and zoonoses in the making of modern health in Manila. Much like our academic forebears, our research and projects are informed by the context in which we move. The pandemic and our climate emergency have encouraged us to think creatively on how we can push our research forward and still offer meaningful outputs, taking further the possibilities of environmental history.

Our disparate research interests, contexts, geographies, political leanings, and even time zones seemed to make an unlikely collaboration at first. In fact, as a result of a long historiographical tradition of maintaining Rankean independence and objectivity underpinned by empirical evidence, it is unusual for historians to work together and have a unitary view of history. This afterword allowed us to, in practice, experiment with global collaborations from a diversity of research and geographical interests. Major highlights were observed not largely in the disagreements, but in areas of similarity, where the dialogue extended to show the vast cohesion across the discipline. In the end, we all agree on one thing: environmental history can no longer operate under the same assumptions, epistemologies, and methodological and systematic approaches as it has in the past. Exchange within and beyond disciplines must be increased whenever possible. So too must we engage in collaborative work that takes on board the knowledges and strengths of individuals whilst also being sensitive to power imbalances and how to, accordingly, develop a professional practice that counters them.[1]

As many have reckoned with, the historical discipline was founded on a Western-centric, colonial, patriarchal, and anthropocentric basis. Like other fields of history, environmental history has at times also supported Western epistemologies and their colonial archives at the expense of non-Western and Indigenous ontologies. At the same time, each generation of scholars in the historical profession has fought its battles to democratise and expand it, whether by incorporating the voice of unrecognised historical actors – for example, workers, peasants, women, or, more recently, plants, animals, and other non-sentient beings – or by being creative about new methodologies, archival evidence and such. Environmental history has also walked that path. Since the 1960s, it has shaken our understanding of life, past and present. Many of the "wicked problems" that sit at the centre of environmental history (particularly in the case of anthropogenic climate change) are the legacies of colonialism and imperialism. They are also an example of destructive scientific hubris, which has come to define human-nature relationships. Environmental history has responded to these challenges and still has much room to grow and to build on emerging, exciting work (Hurley 2018; Leddy 2022; Liboiron 2021; Ureta and Flores 2022).

This afterword outlines our vision for environmental histories that respond to the novel and urgent challenges of the 21st century. This vision seeks to integrate new scholarships such as Black studies, Indigenous studies, gender and sexuality studies, and more-than-human histories to promote environmental justice, include multispecies agencies, and give due recognition to the communities whose narratives constitute our histories. Responding to these challenges requires revisiting the approaches and methods used by historians: the recognition of multiple forms of knowledge, a critical reflection of one's position, the importance of meaningful community engagement, and a redefinition of the archive. Finally, we envision some of the future directions as well as aspirations of doing environmental history in the ever-changing "new normal".

Knowledge(s)

Environmental narratives have been used historically to justify colonisation (Bankoff 2009; Davis 2004; Showers 2005, 2006; Sivaramakrishnan 2008). Consequently, portrayed notions of the superiority of Western environmental knowledge have shaped the pedagogies of environmental studies, while also influencing how the environment is viewed, used, and understood. As some of the last African colonies started to attain their independence from the mid-20th century, the study of the environment was steeped in cultural and racial bias. These inequalities prioritised knowledge from formal Western institutions over local or Indigenous communities, or technical expertise from the Global North over the Global South (Arnold 1996; Moore 2016). A range of authors has recognised how the dominance of Western epistemologies in environmental history has been supported by anthropocentric claims in a range of domains such as agriculture, sanitation, economic growth, and conservation (Cohen, 1996; Cronon 1996; Mitman 2005; Robin 2014).

Any future direction of environmental history must contend with its past. It must expand the knowledges upon which historians rely to meaningfully include Indigenous epistemologies, as well as considerations of dynamic more-than-human relations. Furthermore, more-than-human approaches engage with historical temporalities and interconnections closer to those encapsulated by Indigenous epistemologies (Hurley 2018). They allow historians to "excavate the strategies through which settler peoples have always tried to reconcile … [their] situation as agents of both destruction and life" (Holmes, Gaynor, and Morgan 2020: 237) and expose humans' development of political economies that are both complex and destructive.

Broadening environmental history's knowledge base also brings into focus two critical challenges the field faces going forward. Firstly, Indigenous spatialities and temporalities differ vastly from European understandings of time and space (Pachuau and Schendel 2022). Moving forward, environmental history must recognise various conceptualisations of time, not least as the flows of socio-ecological knowledge, practices, and objects among many communities of the non-West are shaped by teleology, ritual, and fecundity cycles. Secondly, the continued integration of non-human or more-than-human histories into the mainstream will force historians to grapple with the human-nature relationship that sits at the discipline's core. That is, it will involve deeply rethinking taken-for-granted distinctions between natural, environmental, and human history as well as the methods through which such histories will be crafted.

The writing of environmental history needs forms of knowledge beyond those traditionally privileged and confined to the humanities and social sciences. Thus, depending on the research topic and its context, this will require historians to dial back their reliance on formal institutions or to diversify the institutions they rely on – whether big national and state-funded ones, or rural and community-based cooperatives ones, for example – as sources of environmental knowledge. It will also entail developing a different attitude and approach toward those sources, embracing plural ontologies and employing methods that resonate with the shifting research landscape. As the Annales historian Marc Bloch puts it, "human history lived 'behind the features of landscape' as much as it lived in 'tools and machinery' and in institutions" (cited in Amrith 2018: 08).

As part of the process of diversification and search for new sources of knowledge, one research area in expansion is that which incorporates and relies on Indigenous knowledges and ontologies. It is important to note that not all environmental history might need to

engage with them, but whenever it does, it needs to overcome its extractive inertia. The incorporation of Indigenous knowledges into environmental history can provide new pathways towards diversifying the methods and ontologies we engage with in our research. By meaningfully engaging with Indigenous ontologies – through oral tradition, spiritual and cultural practices, cosmology, and cultural politics – environmental historians can reimagine their relationship with place, space, and the more-than-human world.[2]

Moreover, historians must facilitate Indigenous peoples' epistemological equity within global discourses of knowledge production. The incorporation of Indigenous epistemologies in the conceptual and methodological development of future environmental histories will ensure that they are both sustainable and able to respond to the urgency of our times. For example, in recent years, a considerable body of scholarship in the broader context of rural landscapes has highlighted the critical role of Indigenous communities in addressing both historical and contemporary environmental challenges: the exploitation of natural resources intersects with Indigenous land rights and environmental protection in former settler colonies, such as Canada and Australia (Leddy 2017, 2022; Marsh 2013); rice farming communities demonstrate marked resilience in the face of cascading crises in the Philippines (Delina et al., 2023); water courses in the upper Darling River in 19th-century Australia have assisted in conserving Indigenous environmental knowledges (Goodall 2008); and the pushback against conventional development approaches on the "desertification problem" in Morocco through Indigenous pastoral management and range ecology (Davis 2005). By integrating forms of knowledge beyond the formal institutions of learning, the critical examination of environmental issues at the local-global nexus is made more possible.

Urgent environmental histories also require a reckoning with the Anthropocene. In a time when humans' existence as a force of environmental change is undeniable, there is an opportunity to rethink the way we make history, and to delve into how as a species we have become a disturbing agent of the vital "parametric conditions needed for our own existence" (Chakrabarty 2009: 218). As many disciplines in the humanities and social sciences move towards taking account of the Anthropocene in their methodologies, more than ever before, environmental histories are approaching anthropocentric discourses with greater scrutiny, unveiling intricate ecological changes over time and space.

Diversifying the historical actors we build our narratives around, historians are now increasingly engaged in debates about 'more-than-human', multispecies, and human–non-human histories (Pachuau and Schendel 2022: 3). Concomitantly, curiosity about the histories of the more-than-human – such as animals, plants, ores, food products, toxins, and pollution – allow historians to explore connections that unsettle and expand upon hegemonic narratives of history. For example, climate and social scientists have rejuvenated conversations on Africa's so-called "lost crops". They have shown that existing crop hegemonies – such as maize – and environmentally adaptable crops – such as sorghum and millet – have varyingly shaped the trajectory of human settlements through perpetuating widespread use of toxins including fertilisers, herbicides, and pesticides to increase agrarian outputs to obtain wealth and food security. The rejuvenation of sorghum and millets in central and southern Africa, for example, has rehashed societal understanding of the environment, disease, and survival, with notable intersections between environmental agency and culture in appreciating cropscapes (Kauma 2021; Magnan 2016; Staniforth 2000). Another example is the *grana cochinilla*, both an insect (*Dactylopius coccus*) and its byproduct. A red colourant used since pre-Hispanic times, it has significantly influenced art history on a

global scale since the colonial era.[3] A multispecies approach can show us that *cochinilla* biochemically adheres better to animal fibres, such as wool, better than plant-based textiles like cotton. Therefore, the story of how *cochinilla* extraction decreased with the rise of cotton plantations can improve our understanding of capitalism and colonialism at the chemical level: how the divisions of labour that transform raw materials into products and processes are governed by both politics and physics. Both these examples embody a more relational understanding of how human patterns are intimately shaped by other species.

Critical reflexivity and community building

Any future directions for environmental history will require historians to exercise greater reflexivity. That means acknowledging the role historians have played in perpetuating prevailing forms of knowledge production – those that continue to perpetuate the "coloniality of knowledge". As discussed in the previous section, this will necessarily involve being mindful of how the relationalities between the environment and local communities are historical products of power and oppression. Today, more and more institutions are embracing research that shows greater critical reflexivity, engagement, and community impact. Critical reflexivity enables the reformulation of research questions that ordinarily frame the environment as the perennial "Other" (Lakoff 2010) or as a symbol for anthropocentric purposes (Haraway 2003). In exercising critical self-reflexivity, environmental historians also seek to examine forms of resistance, orienting their research alongside community and care work against structures of oppression and violence (Adams 2014; Alvesson and Sköldberg 2017; Gonda et al. 2021).

Pursuing such reflexivity will entail grappling meaningfully with the asymmetrical relations that exist among historians, their subjects, and their target audiences. Historically, much of mainstream research has been produced through the outright exclusion of certain, often key, bodies of knowledge, skewed and exploitative knowledge extraction, and a pre-eminence of scientism (Adams 2014; Mignolo 2009). Beyond the extraction of knowledge, asymmetrical relations between historians and their research subjects and impacted communities have facilitated the portrayal of stereotypes about Indigenous communities (such as those entangled in wilderness debates), the ignoring of local epistemologies, and contemporary forms of "parachute science" (i.e., researchers from highly resourced countries extract data and knowledge without recognition of the local community's infrastructure and expertise; Odeny and Bosurgy 2022) and neocolonial research practices (Kovach 2009; The Lancet Global Health 2018; North, Hastie, and Hoyer 2020; Mwampamba et al. 2022). It is widely accepted that doing responsible historical research requires giving due justice to the people, the communities, and the environments we portray on paper. Environmental history needs to work *for* its subjects and draw *from* their perspectives, rather than merely act on their behalf.

We believe the future of environmental history must therefore involve non-specialist audiences for collective reflection around our historical impact on this planet. Beyond academia, in connection with all the public sphere, history-making can be a collective enterprise – a "work of thousand-hands" (Samuel 1994: 8): a wide and inclusive project of building new ways of co-inhabiting the future. But to do so, environmental history must advocate for a vision where historical knowledge is seen as a common good or public asset that can help in the process of self and mutual recognition. Indigenous and local voices offer the nuanced everyday reflections often lost in academic translation, even though their experiences form the foundations of the history explored. We can let go of the wheel sometimes.

Environmental history is ready to be driven by a range of history-making communities in a complex exercise of exchange and negotiation.

To build up this collective project of public engagement, environmental history has powerful allies and tools. Community agents are, and have been, developing non-institutionalised strategies and readings of the environment. For example, Nicole Fabricant's "toxic tours" through sites of environmental injustice in South Baltimore in the United States presents one model that has become popular in many cities where the toxic relations of capitalism and colonialism expose poor communities to chemicals. Fabricant guides participants through historical time and industrial space as she shows them toxic infrastructure disproportionately impacting Black communities in Curtis Bay.[4] Elsewhere, groups composed of diverse community members, working in collaboration with museum professionals and academics, offer opportunities for exchange. *Museu das Rexistências* is a great example. This is a project to create mobile and recyclable domes that act as a gathering space to dialogue, share, and ultimately preserve the ecological traditional knowledges of Afro-diasporic and Indigenous communities in Brazil (see Figure 27.1).[5] Much like this chapter, the *Museu das Rexistências* was envisioned by a diverse multidisciplinary group of academics working in close connection with communities of *maroleiros* – growers of the marolo plant –, African-based religious groups of Candomblé and Tenda de Umbanda, and agroecological organisations of landless rural workers and *quilombos*.

The *Museu das Rexistências* project shows us that community-based, more-than-academic and public museums can also have an important role to play. Despite the colonialist and



Figure 27.1 Opening of the *Museu das Rexistências* at the João Januário Magalhães Municipal School, 1 December 2022. Photographer: Nayhara J. A. Pereira T. Vieira. Courtesy of Walter Francisco Figueiredo Lowände/Museus das Rexistências Project.

patriarchal ghosts that continue to haunt many museums, some have undergone profound rethinking and become more ethically and socially aware (see, for example, Ashton 2017; Chipangura and Matanga 2021; Lonetree 2012). Museums are organisations that, through trial, error, and commitment, have acquired significant expertise in areas where conventional academia has not: understanding and catering for the needs of very diverse communities; knowing how to communicate knowledge in engaging and inspiring ways; and building safe spaces for public dialogue on "hot topics". They are able to "get a group of people – artists, designers, technology people, scientists, educators – together and get them to produce a creative product; [on the contrary] universities know how to do talking heads" (Sullivan, in Hennes 2007: 104). Museum exhibits, like the *Rojo Mexicano* in Mexico City, or the Cultural Heritage Conservation Museum in Arusha, Tanzania, can be spaces that support ecological networks or interconnections between things and their significance, where "stories flow" and where "creative, lateral, experimental thinking" takes place (Newell, Robin, and Wehner 2016: 2, 3). These are key engagement repositories and community hubs that offer environmental historians abundant opportunities to be creative and expand the bounds of history. Such approaches assist in challenging our human-centric understanding of what historical agency even is through storytelling, embodiment, and co-curation.

The archive(s)

In addition to engaging with our own positionalities, while facilitating the incorporation of multiple knowledges and communities, we also prompt historians to revisit long-debated methodological questions about historical sources: what constitutes a source; what are the limits of the archive; and what alternative (and sustainable) futures are possible by recalibrating the relationship between environmental historians and their archives? Expanding our analyses to include meaningful engagement with both Indigenous epistemologies and more-than-human approaches – while being mindful of the essential nuanced inputs from community engagements and local information hubs – necessitates a reassessment of the "archive" as we know it. Archives are still often thought of as human-made and managed: written, spoken, drawn, etched, recorded, categorised, and stored. And, in many contexts, history or historical writing is (mis)understood as synonymous with the archive. For example, in many parts of South and Southeast Asia, the archive is a record-keeping institution developed in the context of European colonisation. The same applies for most of Africa, Australia, Latin America, and the Caribbean, where imperial expansion and colonial rule captured, recorded, and preserved these exploits. Poorna et al. (2014) assert how historical communities in these locales made artistic use of local landscapes for knowledge preservation, through the creation of sculptures, hieroglyphics, and rock paintings, and this was, and still is, part of their intimate coexistence between knowledge, environment, and culture.

Derrida considered the archive a house where documents undergo the process of "domiciliation" and are "only kept and classified under the title of the archive by virtue of a privileged topology" (Derrida and Prenowitz 1995). The politics of knowledge production through documentation in the archive became prevalent resulting in the "discovery" of diverse communities that appeared distinct and unique in the European imagination. While these communities feature in the colonial archive (though perhaps not explicitly), they have historically been represented as objects of inquiry as a result of Western scientific and anthropological exploration (Cohn 1997; Risley 1892). This reliance on the archive as a source of historical knowledge production became prevalent among historians even in

postcolonial societies as they were "trained to nationalise space and rely heavily on source material produced by states" (Pachuau and Schendel 2022: 6).

Creative interpretations and uses of "archives" offer alternative possibilities for knowledge production. As Bundjalung poet, educator, and researcher Evelyn Araluen Corr aptly asserts, the archive, as it is traditionally understood, is a material and symbolic space of imperial violence for Aboriginal people where the "[s]ilence and erasure" of Aboriginal voices is "employed as a strategy of disempowerment by the settler colonial state" (Araluen Corr 2018: 487–8). Reflecting this, Narungga writer Natalie Harkin described the "yearning" she felt in the archives, "to go right back to … those first colonial-recordings of my family, to the frontier-violence-contact-zone, and trace my blood from there", "to peel back layers of memory and flesh and liberate our story and skin" (Harkin 2014: 3). In order to perform the liberation of her history, Harkin "re-maps" the archive through "art and poetic-prose", creatively addressing "issues of knowledge production as it intersects with colonialism" (Harkin 2014: 5). Doing so importantly unsettles teleological history-making practices that assume "the ability to recover the past objectively, wholly and completely, via the archive" (Harkin 2014: 5).

Rethinking archives is critical for grappling with environmental history's actors and "ghosts" from the past that shape the field and inform its legacies. Expanding upon historical understandings of "the archive" can constitute a form of criticism, reflective of the desire to complicate existent colonial narratives, including the notions of *development* and *modernity* that continue to haunt the environment. This is not to say that the colonial nature of the archive discounts its importance. As Harkin articulates: "[t]he archive is both a site of lost origins where memory is dispossessed *and* a site for hopeful and just futures where 'acts of remembering and regeneration occur'" (Harkin 2020: 165). As Yawuru historian Shino Konishi has written, part of the value of Indigenous writers, artists, poets, and historians working critically within colonial archives is "the unapologetic use and expression of emotion in both connecting to and representing the past" (Konishi 2020: 137). Indigenous voices and interpretations of the past are thus paramount for both challenging *and* illuminating the colonial archive (Leddy 2022: 9–12). But a radical reimagination of the archive also entails redefining the spaces within which knowledge production can take place in local communities, in the mountains, with nature, and outside of the traditional centres of power.

The "documents" of the archive are inscribed everywhere in the environment and point to climactic, natural, or anthropogenic patterns throughout time. The dendrochronological records provided by large tree rings point to drought patterns (Linderholm and Molin 2005). Root biomass and soil compositions act as indicators of grazing patterns, which reveal the evolutionary history of human-animal relations (Milchunas and Lauenroth 1993). Soil samples indicate antibiotic-resistance genes found in soils (Knapp et al. 2010). Even ice cores can be used to think about historical climatological patterns from Antarctica or understand glaciers (Cruikshank 2022; Howkins 2010; Thomas et al. 2019). Environmental archives are all around us. In using environmental archives like palaeoclimatologists and palaeobotanists, we can decentre knowledge production from humans.[6] This also allows for the environment to co-produce its own history.

This idea of co-production has radical potential. While considering the oftentimes insidious and toxic afterlives (and other "wicked problems") of colonial intervention and development discourse in the environment continues to be of importance, it is also possible to rethink the narratives we attribute to the "afterlives" of environmental alteration through a recalibration of what constitutes an archive. For example, scholars interested in the

environmental, cultural, and social impacts of extractive practices are beginning to investigate the alternative "afterlives" of mines by paying closer attention to mine tailings. Tailings are the mineral and chemical byproducts of ore extraction and are commonly considered a highly toxic problem: "gray worlds" characterised by their "shadowy origins" and enormous abundance. Yet Chilean sociologists Sebastián Ureta and Patricio Flores challenge this by considering the various interconnections and ecological co-productions enabled by these mining byproducts. Bio-geochemical relationships between microorganisms – such as bacteria – turn tailings dams and other storage facilities into "green" worlds, "teeming with life" (Ureta and Flores 2022: 3). Embracing non-documentary archives, such as tailings, offers future practitioners of environmental history the opportunity to uncover new and surprising connections while moving beyond narratives that solely emphasise the field's "wicked problems". Furthermore, exploring archives beyond those traditionally consulted unsettles the field's desire to moralise the past as either good or bad, abundant or desolate, living or dead, "gray" or "green".

Future directions for environmental history

The 75th session of the United Nations General Assembly declared 2023 as the International Year of Millets. This marked global leaders' seminal awareness of the existing "wicked problems" and imperial "ghosts" on the ecological and environmental landscape and their increasingly widespread impacts on society. Likewise, as we – a diverse group of early career historians and heritage practitioners – reflect on the future directions of environmental history, we have come to agree on certain fundamental issues.

The first one has to do with the training of future environmental historians. It seems increasingly important to advocate for the social relevance of the historical profession both within and outside the academic milieu. History and historical thinking are under siege in many parts of the world, but historians need not fight these battles alone. Speaking at the World Economic History Congress in 2022, Bruce Campbell aptly observed the need to integrate environmental history into more social and humanitarian disciplines to have a positive impact.[7] Everything has a history, and most disciplines benefit from historical thinking. In a period when few historians are finding jobs, many architecture departments, urban planning schools, and environmental institutes are hiring environmental historians. Environmental history in higher education, including universities, can rethink its role in training historians and a wide variety of other careers in journalism, public education, regional and city planning, community affairs, social services, and more. Its narratives and methodologies are grounds to develop much-needed networks of environmental literacy across university communities.

Also, environmental history can serve as an engine of interdisciplinary teaching in the university. Most history departments tend to emphasise teaching history majors and training history graduate students in the field of national histories. Not only does this disproportionately benefit certain scholars, but it is irresponsibly training too many historians for an unwelcoming market. We envisage a shift towards more interdisciplinarity within academic and civic institutions, growing and learning from one another. Environmental history can help history departments reach students across the university, from engineering schools, to medical schools, to biological science departments and environmental and planetary science institutes. What would it look like to develop a module for engineering students on how engineering intersects with histories of racism, colonialism, and capitalism? How might

environmental historians help train the next generation of environmental justice and climate justice journalists? How could methodologies of environmental history help make climate science and life sciences more accessible and engaged for public audiences? As an example, look no further than Bathsheba Demuth and Kerri Arsenault's Environmental Storytelling Studio (TESS), which they co-founded to collaborate with environmental writers of all backgrounds on prose, narrative, and historical craft.[8] Environmental historians can also learn a lot from Max Liboiron's CLEAR Lab and its commitments to feminist, anti-colonial research, and equitable politics of citation (Liboiron 2021).[9]

To achieve these changes, the university sector needs to radically rethink its priorities. Current structures for determining the value of research within tertiary institutions are reliant upon value-scales that are removed from those upon whom our research impacts. Many of the future directions of the field require institutions to take seriously scholars' and community members' demands for a more inclusive, decolonial approach to knowledge, an approach that aims to radically rethink what research looks like and what its impact could be. Departments need to account for community-driven metrics like community-engaged teaching, public-facing writing, interdisciplinary collaboration, and community-oriented scholarship in tenure-promotion procedures. Such radical rethinking needs to be informed by the appreciation that knowledge is not a commodity that can be quantified and generated on an industrial scale. This is especially so in cases where the ethics of our research methodologies are deemed irrelevant by universities' refusal to facilitate "slow" research or community-guided outcomes. The future of environmental history lies in challenging the traditional output-based underpinnings of the university sector.

Challenging institutional structures also requires us to reckon with interdisciplinarity and the place of historians within its future. There is no denying that the contemporary growth of interdisciplinary research across the world has fostered greater communication between disciplines previously siloed within the university. Environmental humanities and journals like *Plant Perspectives: An Interdisciplinary Journal* offer great examples.[10] Interdisciplinary work has been especially consequential for environmental history, a field that is heavily reliant upon sources and frameworks that bleed across disciplinary bounds. But as interdisciplinarity becomes increasingly enticing to funding bodies and university boards, environmental historians need to critically reflect on our role within these structures. What do historians bring to the table, and why? Are there other tables at which to sit? In many situations, as practitioners in the analytical art of writing, environmental historians often take on the role of narrator or science communicator. But environmental history can offer more. It can offer "a useful corrective to scientific modelling", as Ruth Morgan has articulated (Holmes, Gaynor, and Morgan 2020: 241). By exposing the cultural, socio-economic, and technological aspects of scientific phenomena while accounting for change over time, historians provide additional meaning to scientific data. "Nature is a historical agent", after all (Holmes, Gaynor, and Morgan 2020: 241).

But the future of environmental history, and history more generally, depends on taking history outside of the halls of our departments. Not all academic spaces are classrooms and lecture halls. Furthermore, it is perhaps outside universities where the most significant steps are being taken for the environmental history field. So, for example, how might environmental historians learn from adjacent botanical gardens and herbarium collections? Dumbarton Oaks Research Library and Collections (DO) in Washington, D.C., offers great insights for the future of environmental history. First, its dedication to "plant humanities" work puts historians in conversation with biologists, ecologists, artists, and climatologists.

Moreover, this conversation is made public through rich online publications in its Plant Humanities Lab.[11] Second, Dumbarton Oaks excels at incorporating herbarium materials, actual dried plant specimens from its collections, into the mission of making environmental history accessible to as many audiences as possible.

Another illustrative example of this is COCOON (see Figure 27.2).[12] Created by conceptual artist Kate Browne, COCOON is a series of on-site performance installations that layer memories and materials of historical trauma in geographies of transformation. With Kate's support, local community organisers start with long walks through neighbourhoods with local residents to collect found materials to build little cocoons. The organisers then record conversations with residents on how small cocoons represent the transformation they hope to see in their communities. Lastly, organisers create a large, 26-foot cocoon to place the community's cocoons and conversations. In Mexico City, COCOON happened at Tlatelolco, where the government massacred dozens of student protesters in 1968, and thousands died during an earthquake in 1985. In Jackson, Mississippi, COCOON was invited to the Mississippi Museum of Art, which exists on land that was formerly a slave market. In Paris, COCOON occurred in the historically marginalised community of Goutte D'Or. Even though each COCOON *took place* geographically on a site of layered, historical trauma, the installation itself was an ephemeral product of new materials and memories made during the process. The real art of COCOON was the process of supporting community organisers and community members through networking and historical place-making. This international public space sculpture continues to inform the kind of environmental history we hope to see more inside of universities and beyond.



Figure 27.2 Project Cocoon Hungary: Following the Removals. 27 July 2019. Photographer: Eric Etheridge. Courtesy of the artist Kate Browne.

Research synergies and action networking between different shareholders can connect the values in our interdisciplinary methods and perspectives to the action we hope to see in the future of environmental history. We understand these collaborations of action as organic and imperfect articulations with a diverse range of entities. Environmental history can do more to embolden and cherish alternative strategies and locally produced knowledge. Strategies may include, but are not limited to, environmental history community co-creating databases and archives, practising mutual respect and dignity, recognising other epistemologies, and encouraging transparency.[13] These synergies and networks could also liaise with other organisations and actors, such as artists, museums, and community archives and centres, to learn different social roles and ways of operating and communicating.

As a group of six diverse environmental historians and heritage professionals, we represent a fast-growing network within a larger community of environmental historians who are working to make change where we stand. We recognise that many of us are coming from institutions and departments that are also communities, albeit colonial and extractive ones. We appreciate how our institutions need healing before we hope to work and make tangible impacts with other communities outside the university space. The university needs to see itself as a space embedded in a larger network of communities, with diverse and complementary interests. At the same time, moving beyond community engagement rhetoric, our universities need to appreciate themselves as imperfect spaces that must work towards ending both internal and external practices of extraction. Without attending to this, academics can and have replicated the harms of colonialism, capitalism, or hetero-patriarchy. To this end, we hope environmental history can help build and grow communities and partnerships within history departments, universities, and larger communities. It can change our relationship with communities as something we *think from* and *think with*. We can transform "community engagement" into something less transactional and extractive, into intra- and inter-community collaboration between partners inside and outside the university.

In imperfect but intentional ways, each of us is working to make all of our communities more liveable (Lloréns 2022). Nicolo envisions the establishment of a health-environmental humanities centre in Southeast Asia, which will not only produce research but also maintain strong engagement with the most vulnerable communities across the region. Thinking from the context of food insecurity in southern Africa, Bryan is focusing on how governments first imagine and then allow certain crop hegemonies to foster slow violence against under-resourced farmers. Cintia hopes to see academic communities build widespread ecological literacy with heritage and museum sectors, that involves learning to listen and to dialogue with other knowledges in the public sphere. Relatedly, Jayson wants to use community-driven pedagogy to centre historical sensitivity and analysis across the university and surrounding communities through Black, Indigenous, and plant perspectives. In the pursuit of more sustainable environmental futures, Jessica aims to expand understandings of how contemporary nuclear processes have been implicated in colonising peoples and environments in the past and present. Sangay hopes to bring out a diversity of understanding of the history of the environment in multi-ethnic societies where knowledge about different aspects of floras, faunas, and other natural elements bears distinctive meanings beyond formal institutional knowledge.

That the face of environmental history is fast changing is undeniable. Consequently, this has triggered a need to revisit and rethink social, economic, cultural, and political interactions between sources, actors and materials within history. The possibility of these other strategies depends on understanding history-making as a collective enterprise and struggle that

takes place among a diversity of disciplines, perspectives, and communities. Difficulties will arise as these are difficult times. We are living through a planetary collapse, but in our fight against huge, interconnected forces like capitalism, climate change, and the colonial present, action networks of environmental history can remind us of the accessible daily victories we can reach every day. It is not too late for environmental history to go beyond scholarship focused on critique and theoretical work and to reach toward political action. As exemplified by some of the projects reviewed in this afterword, networks of action reflect and generate new connections between all community members and the environments they hope to rebuild together. Even if rebuilding does not happen right away or at all, these relations embody the climate that we are trying to nurture in the world. As Myles Horton and Paulo Freire insisted in their conversation on the role of experimentation in education for social change, we must try and fail and try again: "we make the road by walking" (Horton et al. 1990). In our much longer struggle to make a safer, more ecologically sound, and healthy planet, our small and affirming relations that we can practise every day really matter.

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Notes

1 The English language can limit these global conversations and collaborations because it actively flattens some voices and bolsters others. The six authors have made a collective decision to lead with content and let the unevenness of our voices reflect the difficulty of this work.
2 We do not suggest that there is a monolithic Indigenous ontology or that every environmental historian needs to engage with Indigenous histories. Indigeneity looks different across different places, times, and themes.
3 Between 2017 and 2018, the Museo del Palacio de Bellas Artes in Mexico City displayed a major exhibition on the *grana cochinilla*, which was called *Rojo Mexicano. La grana cochinilla en el arte*. See http://museopalaciodebellasartes.gob.mx/rojomexicano/
4 Toxic tours are also taking place in Northern and Southern California. See https://www.cbecal.org/get-involved/toxic-tours/
5 See Jairza Fernandez Rocha da Silva, Natalino Neves da Silva, Nayhara J. A. Pereira Thiers Vieira and Walter Francisco Figueiredo Lowande, 'Existances Museums: Postponing the End of the World' (pp. 42–51) in *Reimagining Museums for Climate Action* (London: UCL, 2021). More about the project can be read at https://www.museumsforclimateaction.org/reimagine/exhibits/existances
6 According to Lina C. Pérez-Angel, palaeoclimatologists in the tropics refer to these as terrestrial and marine archives, and they can range from bacterial lipids and corals, respectively. For more on terrestrial archives, see Lina C. Pérez Angel, 'Measuring Past Terrestrial Temperatures with Bacterial Lipids', *Nature Review Earth & Environment*, 1 (2020), pp. 499.
7 B. Campbell, 'Environmental Change, Renewable Resources and the Economic History of the Pre-Industrial World', Keynote speech at the 2022 World Economic History Congress, Paris, 2022.
8 https://sites.brown.edu/tess/home-page/the-course/
9 For more on the Civic Laboratory for Environmental Action Research (CLEAR), see https://civiclaboratory.nl/
10 https://whpress.co.uk/PP.html
11 For Dumbarton Oaks's Plant Humanities Lab, see https://lab.plant-humanities.org/
12 See https://www.bykatebrowne.com/
13 To be clear, we have neither the intention nor the capability to legitimise or validate these alternative epistemologies.

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