

# Introduction: Knowing Nature, Making Space

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# 1 Introduction

## Knowing Nature, Making Space

*Raf de Bont and Jens Lachmund*

In 1908, the German animal ecologist and museum curator Friedrich Dahl coined the notion of “biotope” (literally, “life place”) to refer to the physical settings in which communities of species live (Dahl 1908). Also later in the history of ecology key terms such as the “ecosystem,” the “biome,” and the “biosphere” carried a profoundly spatial meaning. Indeed, ecological knowledge has often been organized around tangible spatial formations of the natural environment. Much of the day-to-day work of ecologists consisted in identifying such spaces, in mapping and listing their biotic and abiotic features, and in formulating concepts that express such features in more generic terms.

Yet, ecological knowledge-making has not only been *about* space. One might argue that ecological knowledge has also been constructed *through* space. Observing ecological phenomena happened largely *in situ* through the embodied presence of scientists in the field and through their practical engagement with its spatial characteristics. For example, when Dahl formulated his notion of the biotope, he had already acquired a strong familiarity with particular spaces – both through his activities as an excursionist in the region around his home town of Berlin *and* as a traveler to more distant places in the Baltic region and the North Atlantic (Bischoff 1930). The development of Dahl’s theories has to be understood in the light of his own traveling, his manipulation of the places he traveled to, and the movement of specimens, samples, and data from these places to his museum in Berlin.

It is through its relation to space, finally, that ecological knowledge has been tied to the constitution and exercise of power. Ecological research has often been employed to foster regional, national, or even international identities, and it has been translated into programs for managing natural resources. In the 1970s, for instance, Dahl’s concept of the biotope became a policy instrument of the West-German *Länder*, which through comprehensive surveys of “biotope-mapping” hoped to identify ecologically valuable spaces. Once labeled as “biotopes,” these areas became the object of political struggle and were subjected to new planning instruments such as “biotope management,” “biotope area factors,” or “biotope densification” (see Lachmund 2013). Far from being just scientific concepts, labels such as

the “biotope” became foci of legal and ethical commitments, or even objects of emotional attachment.

This book probes the mutual entanglement of ecology and space from a historical perspective. Its first and most immediate goal is to advance space as a critical context for the study of the history of scientific ecology. Through ten case studies of significant episodes in late-nineteenth- and twentieth-century ecology, this book investigates how these spaces have mattered in the production of knowledge. Space, the case studies will show, is neither a neutral nor a trivial setting of knowledge production. It is of significance which spaces ecologists select as objects of research; how these spaces are delineated, classified, and inspected; and how they are surveyed, sampled, and mapped. Spaces are entangled both materially and symbolically in the research practices of the ecologist. It is through their engagement with particular spaces that ecologists make some features of the natural world visible and accountable as scientific phenomena, while, at the same time, keeping others out of sight. This book highlights these processes by focusing on the spaces in which ecologists perform their everyday work, on their representations of these spaces, and on the geography of the networks through which their scientific work circulates.

The second goal of this book is to use ecological knowledge processes as a lens to shed new light on the spatial history of the natural environment. Our claim is that natural spaces are not only constitutive elements in knowledge production, but that, *vice versa*, scientific knowledge is also constitutive in shaping natural spaces. In all the cases studied in this book, ecological knowledge practices serve as ordering devices that culturally and materially intervene into the history of particular spaces. The ecologist’s work, after all, redefines what these spaces are, how they should be treated, and how they relate to other spaces. It is in this respect that our book also points to the profound political nature of ecological knowledge-making.

In this introduction, we review recent discussions on the use of space and place as analytical concepts in the humanities and social sciences, and probe their relevance for the history of ecology. We then build on these discussions in order to develop the intellectual agenda of this book.

## **Taking Spatial Turns**

Space and place, for a long time only the preoccupation of geographers, have recently begun to occupy a central role in the research agenda of the humanities and social sciences. This “spatial turn” (or sometimes also *topological turn*), as this reorientation has been dubbed, has manifested itself in a new interest in the cultural dimension of spatial entities such as cities, regions, nations, and landscapes (Schlögel 2003; Blackbourn and Retallack 2007; Döring and Thielmann, 2008; Warf and Arias 2009; Withers 2009). At the same time, however, it has expressed itself in studies that have taken a spatial perspective on phenomena hitherto treated as placeless productions

of human life – such as ideas, institutions, or power relations.<sup>1</sup> Thus, the spatial turn has not simply been about giving “more” attention to space, but also about addressing the topic differently. Space-sensitive scholars in the humanities and the social sciences moved beyond the conventional Euclidian understanding of space as merely a passive container of things and events. They advanced novel vocabularies, research approaches, and even literary forms to better grasp the spatial production of “society,” “culture,” and “nature,” while, at the same time, showing how the reification of these categories interferes with the way we live.

Authors who advance a “spatial turn” have often referred to Henri Lefebvre’s *La production de l’espace* as an important – if not their most important – source of inspiration. Inspired by Marxist theory, Lefebvre understood “space” as a medium of both the material reproduction and contestation of capitalist relations. Lefebvre thereby stressed the triadic relation between “spatial practices” (the *perceived* spaces of everyday social life), “representations of space” (the *conceived* spaces developed by planners and “technocrats”), and “spaces of representation” (the *lived* spaces imagined and symbolized by its users). It is these latter spaces that, in Lefebvre’s view, serve as a basis for resistance against the (capitalist) orderings produced by the other two (Lefebvre 1994). Lefebvre’s more general interest in the entanglement of power relations and everyday life in the social construction of urban spaces proved hugely influential. Several scholars, including David Harvey, Edward Soja, and Rob Shields, have built on his work, which received a revived interest in the 1990s, when several of his books were translated into English (Shields 1991; Harvey 1996; Soja 2009).

In parallel to the Lefebvrian tradition, with its comprehensive concept of “space,” a number of geographers and sociologists have organized their research agenda around the more specific notion of “place.” More particularly, they have been interested in how meanings are ascribed to concrete places and how these meanings become intrinsic parts of the places themselves. Starting with Yi-Fu Tuan’s work in the 1970s on the role of personal experience in place-making, this interest has substantially expanded and diversified over the past decades.<sup>2</sup> The work of sociologist Thomas Gieryn can serve as a good example. In Gieryn’s definition, a “place” has to be conceived as “a unique spot in the universe” such as a room, building, city, or nation. For such a spot to *become* a place, he believes three elements have to come together: a geographical location, a material form (such as a building), and an investment with meaning and value (such as naming, interpretation, and imagination). Places, thus, have to be distinguished from “spaces” – a term Gieryn only uses for the “abstract geometries (distance, direction, size, shape, volume) which are detached from material form and cultural interpretations” (Gieryn 2000).<sup>3</sup>

Gieryn (2006) has not only been interested in the relation between place and meaning-making, but also – and here we come closer to the core topic of this book – between place and knowledge production. This theme can

be traced back to one of the other oft-cited pioneers of the “spatial turn”: Michel Foucault. Indeed, spatial metaphors abound in Foucault’s work on the history of the human sciences. In his study on the birth of the prison (1975), among others, he focused on material spatial settings and their mediating role in the formation of scientific knowledge and political power. Of special relevance for a history of spatial relations is Foucault’s later work on so-called “governmentality”, which has recently been taken up by several social scientists. In the slipstream of Foucault, the governmentality literature describes the concrete material and social arrangements through which populations, individual subjects, and the territory are made known and are subsequently constructed as “governable” objects (Dean 1991; Foucault 1991; Rose, O’Malley, and Valverde 2009). It is these arrangements, including centralized surveys and landscape planning schemes, that enable policymakers – to use James Scott’s (1998) phrase – to “see like a state.”

Alongside Foucauldian perspectives, present-day spatial scholarship in the social sciences is to a large degree inspired by so-called Actor Network Theory (ANT) and related “post-humanist” perspectives. What distinguishes ANT from the aforementioned approaches is its radical relationist perspective.<sup>4</sup> In an ANT perspective, human and nonhuman entities (“actants”) do not have intrinsic properties; the properties of the actants only emerge through their relations with other actants. For the study of space and place, this has three main consequences. First, material or organic entities – including what we usually understand as the “natural environment” – are not only considered as objects of meaning or power strategies. As nonhuman actants, these entities themselves are seen as important agents in the shaping of human-nature relations and their spatial orders.<sup>5</sup> Second, ANT scholarship has inspired a more dynamic understanding of the entanglement between geographically distant sites, and the coordination and connectivity that emerge between them.<sup>6</sup> As such, places themselves are seen as constantly “becoming” through the convergence of material and social flows that extend far beyond their own territorial confines (Amin 2004; Jones 2009; Anderson 2012). Finally, an ANT approach also implies that the “abstract geometries,” from which Gieryn distinguishes the socially constituted “places,” are not just the pre-given neutral plane on which society projects its meaning. Abstract spaces themselves have to be seen as the outcome of historically specific practices of abstraction and standardization (e.g., the work of cartographers who frame the world according to geometric parameters) (November, Camacho-Hübner, and Latour 2010).

The spatial sensibility – whether in the sense of Lefebvre, Foucault, or the proponents of ANT – has not been lost on historians of science (see, among others, Ophir and Shapin 1991; Smith and Agar 1998; Livingstone 2003; Naylor 2005; Finnegan 2008; Meusberger, Livingstone, and Jöns 2010). For several decades now, they have criticized the idea that science can offer “a view from nowhere” (Shapin 1998). In contrast to the assumption that science can be understood as disembodied and placeless, they have

studied knowledge production as a highly situated activity. Knowledge, so this literature claims, is profoundly local in origin – i.e., shaped by the contingencies of particular “places of knowledge” (such as laboratories, clinics, and museums). A complementary theme that has emerged more recently on the agenda of the history of science is the “transfer” (Secord 2004) or “circulation” (Roberts 2009) of knowledge *between* places. This includes the forms of communication, encounters, and material exchange through which science travels at a virtually global scale. Analyzing the spatial dimensions of science, thus, entails attention to both local specificity *and* translocal mobility. In this book, we will probe these two dimensions with regard to the history of ecology.

### **Spatializing the History of Ecology**

Given the spatial focus of its themes and concepts, one might expect that historians of ecology have devoted substantial attention to space and place. This, however, has only been partially the case. As with the history of science in general, histories of ecology have long been structured around the careers of individual ecologists, theoretical schools, national research traditions, or broader institutional and political contexts. This meant that little attention was given to the question of how ecological ideas and methods were related to the concrete spaces and places in which they were produced and to which they referred.

Indirectly, however, the existing scholarship does provide some valuable insights that help underpin the spatial history presented in this book. The fact that many ecological concepts refer to geospatial entities means that any intellectual history of ecology can be interpreted as a history of – in Lefebvre’s words – “representations of space.” Some of these intellectual histories have focused on categories, which are still largely bound to the world of scientific ecology such as “ecosystem” and “biosphere.”<sup>7</sup> Others have analyzed the development of spatial labels that ecologists borrowed from a wider culture such as “landscape” and “*Heimat*” (e.g., Köstering 2005). Particularly, the latter studies have shown how ecology’s (spatial) language was not developed in isolation, but continuously absorbed elements from the broader intellectual culture in which it was generated. Like most intellectual history scholarship, however, these studies have paid relatively little attention to the materiality and the social makeup of the spaces in which ecologists work. The ways in which ecological concepts “take place” (to use Stephen Bocking’s expression) have only very recently been considered as a serious object of study (Bocking 2016; see also Greer and Cameron 2016).

A second (largely implicit) spatial theme in the history of ecology has been the geographical diversity of ecological theory itself. If science is culture dependent, after all, one should be able to see regional or national differences. Starting from this assumption, Bocking (1997) compared the practice of ecology in the UK, the US, and Canada and went on to explain

differences with reference to the political and institutional contexts of these countries. For their part, Astrid Schwarz and Kurt Jax (2011) have stressed the importance of different scientific languages (in so-called *Sprachräume*) in setting the “local conditions” for the development of different ecological traditions or schools. Heuristically and conceptually, however, such studies do not differ from historiographies of other disciplines, which also have referred to larger geographical contexts in the shaping of science.<sup>8</sup> Such studies tend to refer to relatively large scales when they situate the “spaces” of ecological knowledge production, typically nations. They also mostly take these spaces as the pre-given setting against which ecological researchers or schools can be mapped. For a spatial history of ecology, this volume argues, it is vital to further unpack these spatialities and to probe how the results of site-specific knowledge are actually scaled up and aligned with the making of larger geographical spaces such as nations or *Sprachräume*.

In contrast to intellectual and institutional histories that only indirectly touch upon spatial topics, recent work on scientific research *practices* provides a more direct heuristic starting point for our book. This more recent scholarship has zoomed in on the concrete day-to-day activities of scientists in particular research settings. While initially the focus was on the spatial aspects of laboratory research, fieldwork is now increasingly taken into account.<sup>9</sup> For the historical study of ecological field practices, notably Robert Kohler’s *Landscapes and Labscapes* (2002) served as a catalyst. Kohler studies the hybrid culture at the “border” between laboratory and field biology. He shows, among other things, how ecologists tried to transplant laboratory ideals and methods into the field, while adapting these to the particularities of place. Follow-up research to Kohler’s work has further enriched our understanding of the day-to-day practices of the ecologist (Kingsland 2009; Vetter 2012; De Bont 2015). Scholars have also explored the traveling and communication habits of ecologists – in this way linking the topic of site-specific ecological research with that of the circulation of knowledge (Cameron and Matless 2011; Kohler 2011; Bocking 2013). Our work draws on a similar perspective on the *in situ* practices as this body of scholarship. In this book, the focus will not, however, be so much on the practices themselves as on the way in which they feed back into the history of the concrete places ecologists study.

By bringing space into the history of ecology, this book also takes inspiration from environmental history. This field has experienced an extraordinary boom over recent decades. In their work, environmental historians have deeply engaged with the changing ecologies of particular spaces. These spaces range from rivers (such as the Rhine) (Cioc 2002) and estuaries (such as Long Island Sound) (Anderson 2004) to cities and their hinterland (such as Chicago) (Cronon 1991). Through eco-biographies – to use Mark Cioc’s expression – we get a strong sense of the place-specific histories the natural world has on offer. Until recently, however, the history of science (and the history of ecology in particular) had been absent from such place-bound

environmental histories. This literature mostly did not treat scientific knowledge as a topic of study by itself, but rather as a source on the past state of nature.

More recent work, however, helped pave the way for a convergence between environmental history and history of science. Of late, historians have shown an increasing interest in the involvement of ecologists in the conception, management, and reification of particular political spaces – be they regional, national, imperial, or global in scope. They have, for instance, focused on ecology’s part in the development of German *Heimat* politics, in the creation of the “moral geography” of the English landscape, and in the “naturalization” (and thus legitimization) of British imperial policies (Matless 1998; White 1999; Anker 2002; Lekan 2004; Blackbourn 2006). They have, furthermore, indicated how ecology could serve as an instrument of postcolonial cultural imperialism, how it was incorporated in state policies in the global South, *and* how it served the revaluation of local (subaltern) knowledge (Lewis 2004; Tilley 2011). Ecologists and conservation experts, as suggested, simultaneously engaged in the construction of political spaces at several levels. Yet, while such historical studies at the interface of environmental history and the history of ecology have provided important insights into the political mobilization of spatial knowledge, they have rarely been connected to site-specific knowledge practices that scholars of ecological fieldwork study. As such, they have focused on the performative effects of ecological knowledge rather than the spatial processes through which such knowledge is constituted.

In this book, we build on the angles the various outlined literatures offer, and also further integrate them.<sup>10</sup> We believe that the conceptual and the material cannot be understood in isolation from each other, nor can political ordering, scientific practice, and our relation to nonhuman nature. Scientific work, we maintain, is simultaneously spatially situated and productive of space. We believe that scientists’ day-to-day interaction with research sites, their abstract conceptualizations of spaces, and the material ordering of places through their science are all closely intertwined and continuously shaping each other. In this book, we therefore want to describe the making of ecological knowledge in terms of historically situated *spatio-epistemic processes*. With this term, we refer to the processes in which science is co-produced with the social and material order of particular spaces.

The spaces that matter in this context can be specific research locations, for example the fieldwork sites where research about the desert ecosystem takes place (as in the chapter by Etienne Benson), or the wider region that is mapped in an ecological survey (like the Scottish Highlands discussed in the chapter by Mark Toogood). Ecologists thereby engage both with abstraction and commensurability, and with the crafting of geographical imageries that constitute spaces as “places” with specific meaning and identity. Creating space and creating place, therefore, rarely stand in clear opposition, but both of them are aspects that mutually feed into each other (as, for example,

in Nils Güttler's study on the mapping of nature in nineteenth-century Germany and its relationship to place identity). The interactions of ecologists with their object also take other spatial forms, such as the dispersed networks of exchange relations between researchers and sites. This includes the mobility of researchers, classifications, explanatory models, and even of living organisms (as Raf de Bont describes in his chapter on the European bison). In that respect, our work touches on studies of geographical flows as they have been advanced in ANT and mobility studies.<sup>11</sup>

By unravelling how spatio-epistemic processes surface, how they evolve, and also in some cases how they dissolve, we want to reframe the history of ecology in a spatial idiom. We argue that particular spatial constellations both restrict and afford trajectories of knowledge-making, and, in turn, we want to trace how these trajectories themselves reconfigure existing spatial imaginations and orderings. We explore how spaces and places are defined within such processes, how their boundaries are marked and maintained, and how objects and practices are circulated. In this respect, the volume goes beyond the motive to simply localize science in particular places; it also seeks to problematize what these places are and how they are produced in the interplay with other locations.

## **Overview of the Volume**

Each of the contributions to this volume offers an analysis of one spatio-epistemic process. The contributions study these processes on different scales, ranging from single research stations through ecological regions to the global activity sphere of international nature conservation. The authors have chosen different narrative strategies to approach these spatio-epistemic processes, taking as their starting point either concrete research sites, certain environmental entities, or the circulation of people, objects, or skills between different locations of ecological practice. Although the authors all share a commitment to the "spatial turn" in the history of ecology, they approach their topics from different angles highlighting different aspects of the space-knowledge nexus.

The first section of this book focuses on the spatio-epistemic processes implicated in the crafting of ecological "zones" and "regions." The focus is both on the ways in which specific localities have shaped the emergence of such categories (for example by providing paradigmatic cases of study and demonstration) and, conversely, on how their ecological categorization becomes part of the social definition and treatment of these places. The section starts with a chapter by *Nils Güttler* on the ways in which academic and amateur plant ecologists in the late nineteenth century collaborated in the construction of the Southern German forest areas as part of the floristic district of "Hercynia" and as a regional *Heimat* (homeland). Focusing mainly on the observers' network around the plant geographer Oscar Drude, Güttler shows that such categories had a dual function as

both scientific representations of space and markers of a regional sensibility. The fact that knowledge generated by “homeland researchers” such as Drude was also performative of space becomes clear in their eventual proposals for ecological landscape protection.

In the following chapter, *Roderick Neumann* studies how, in the early twentieth century, the concept of “life zone” was instrumental in structuring space in the US. The concept of life zone was developed by Clinton Hart Merriam as a part of his wider theory of the geographic distribution of species in North America. The chapter argues that the theory was particularly successful in the region where it was originally developed (the Californian mountains), while ecologists working elsewhere believed it did not fit with their empirical findings. Despite the fact that the success of life zone theory remained largely regional, it did have tangible results. The life zone, after all, proved not only a concept to think about nature, but also a tool to actually manage it. Neumann shows, for instance, how it provided the spatial logic of the research reserves that would be set up in Yosemite National Park in the 1920s. While the life zone theory thus ultimately “failed” as a universal theory of nature, it nonetheless established a particular way of spatializing nature in the western mountains of North America.

*Megan Raby* studies similar processes, but in an entirely different geopolitical context. Through the example of the Cinchona ecological research station in Jamaica, she explores the interaction between colonial power, place, and the evolution of tropical ecology. Originally set up by British colonialists as a garden for plant acclimatization, after 1904 the station became a base station for American ecologists carrying out field studies on tropical rainforests. Raby discusses how scientists attributed various meanings to the site and how they came to select it as a place for fieldwork. She describes how the specific features of the natural surroundings of the station (e.g., the extraordinary diversity of species or the occurrence of a landslide) offered ecologists observation possibilities which became manifest in the path-breaking works of early tropical ecologists such as Daniel Trembly MacDougal and Forrest Shreve. Such work, she shows, eventually was instrumental in creating the “tropics” as an ecological object.

Continuing the analysis of this topic, *Jeremy Vetter* uses the Desert Laboratory in Tucson (Arizona) of the early decades of the twentieth century to study how ecological “regions” arise in interaction with activities on both the local and the global levels. His chapter discusses how the observations within single desert sites were extrapolated to the entire region of the Sonoran Desert, and even in more generic terms the “arid region.” Vetter further explores place-based activities such as selecting the site, controlling the land, and traversing it with automobiles. His focus is on the connections between the experiential character of these activities and the generation of abstract knowledge that might be attributed to larger spatial units. The “region,” he shows, is constructed alternatively as the spatial extension of local experience and as a subdivision of the global according to cosmopolitan scientific criteria.

In the final chapter of this section, *Mark Toogood* highlights the spatial dynamics of the West Highland Survey, conducted by British ecologist Frank Fraser Darling between 1944 and 1955. The Survey advanced a comprehensive understanding of ecology, recording population, land use, soils, vegetation, and environmental history. In the process, the Highlands were constructed as a region of degradation in which population decline was explicitly linked to a story of environmental misuse. Darling appraised the Highlands as ecologically and historically a “devastated terrain,” and identified deforestation and overgrazing as responsible for the space’s decline. The Survey, then, was presented as a basis for a new polity, and Darling optimistically looked to nascent state institutions of ecology and planning in Britain to lead the way to support alternative land uses. All of this was not without political consequences. The chapter discusses the Survey, as an infrastructure for fieldwork, as a politically resonant project, and as the centerpiece of a spatio-epistemic process that reshaped the region.

In the second section of the book, attention is drawn to spatio-epistemic processes that are tied to one of the core activities of modern ecology: modeling. While the modeling of ecological systems typically aimed for abstraction, digitization, and universalism, it was also constitutive of place. *Etienne Benson* develops this point by analyzing the practice of computerized simulation in the Desert Biome project of the International Biological Program (1968–1974). He traces how knowledge bounced back and forth between the field work in concrete places in the desert, and the assembling and computerization of data in sites located far from the actual research site. His chapter shows not only how computer-based research programs organized, defined, and made sense of work performed in a far-off desert, but also how local ecologists were able to question and eventually reform the spatial organization of these programs. He furthermore develops a heuristic vocabulary to explore the complex relation between these different sites of ecological knowledge.

Whereas ecologists for a long time had tended to focus on “natural” ecosystems such as the desert, the 1970s witnessed an increasing ecological interest in the city. In his contribution, *Jens Lachmund* explores the form ecological modeling (understood here as theoretical, visual, and quantitative representation of an ecosystem) took in such an urban context by highlighting the work of Paul Duvigneaud and his colleagues in Brussels. Lachmund analyzes the ways in which ecologists engaged both discursively and practically with the sociomaterial orders of their city, and probes how these scientific activities became reflected in the local policy arena. At the same time, his chapter situates the local activities in the context of transnational circulation of knowledge, in this case provided by the International Biological Program (IBP). It shows how the work of the Duvigneaud group took inspiration from the system-ecology-oriented approach of the IBP and how it adapted this approach to an urban context. As the chapter shows, the initial aim of representing the totality of an urban metabolism was at odds

with the complexities and dynamics of urban space, and gave way to a more modest approach of representing urban space as an ecosystem.

The third and final section of the book highlights the interaction between science, place, and nature conservation. As such, it explores the ways in which the study and spatial organization of “wild” nature mutually shape each other. In his chapter on the European bison, *Raf de Bont* discusses the spatial dynamics of breeding a threatened animal that is spread over different sites. His contribution focuses on the coordinating activities of the International Society for the Preservation of the European Bison – and this for a period in which its object of protection was extinct in the wild. He shows how the breeding practices designed by the Society were heavily influenced by imagined spaces of “original” wilderness in which it was presumed that “pure” and “strong” animals thrived. The chapter also makes clear that these imagined spaces were the object of continuous contestation, even within the Society itself.

Shifting the attention from the conservation of a single species to natural areas, *Hans Schouwenberg* and *Simone Schleper* zoom into the knowledge practices of international conservation organizations such as the International Union for the Conservation of Nature. They show how such organizations have mobilized ecological concepts for making claims about where nature reserves should be established, and the size and shape these reserves should have. As the authors show, the organization relied on a set of highly schematic representations that abstracted from the specificities of the concrete geographical areas on which they were applied. Following Timothy Luke’s analysis of “environmentality,” they interpret this as a means to standardize knowledge claims, and to allow a central power (in this case, a proposed transnational conservation regime) to stimulate and control local activities in locations around the world. They indicate that despite a recent shift from the conservation of so-called “island reserves” to a more inclusive “bioregional” approach, such centralizing and standardizing tendencies largely persist.

*Anna-Katharina Wöbse*, finally, takes the example of the Wadden Sea in the Dutch, German, and Danish North Sea as the object of her spatial history of transnational conservation efforts. As she shows, the Wadden Sea was not just a pre-given natural space waiting for its protection. It was rather shaped, framed and governed, as a result of the claim-making of conservationists. The chapter shows that various practices – ranging from “Wadden-walking” to aerial photography – enabled the creation of a particular public space to experience nature.

By focusing on different spatio-epistemic processes, the chapters of this book not only attempt to spatialize the history of ecology, but also to historicize ecological spaces. The way scientists give meaning to and interact with space shifts through time. Regional surveys in the Sonoran Desert were stopped as laboratory-oriented biologists increasingly framed these as “a bit of glorified camping and vacationing”; the Cinchona station was shut down because of far-reaching changes in the geopolitical situation in the

Caribbean; regional botany in Hercynia declined after the First World War when new, more nationally oriented visions of *Heimat* gained prominence. The book shows that scientific concepts and practices, as well as the places they refer to and are performed in, are in constant flux. The ways in which ecological knowledge is produced continuously change – and this in close interaction with the changing natural spaces ecology studies.

## Notes

- 1 See, for example, Nigel Thrift (1996) on the spatial embedding of the financial market and Georgia Born (2015) on music and space.
- 2 See Tuan (1977). See also Taylor (1999) as a more recent appropriation of Tuan's framework.
- 3 This has been emphasized particularly by Taylor (1999), who describes tensions between (concrete, lived) place and (abstract, oppressive) space at all scales of social life. Place is thereby associated with aspects of experience and imagination that Lefebvre (see above) identifies with "spaces of representation."
- 4 Interest in ANT has thereby often gone hand in hand with the reception of Deleuzian "assemblage-thinking."
- 5 See, for example, Farias and Bender (2010) on urban spaces. For ANT-inspired work on human-animal interaction as shaping "animal geographies," see Whatmore (2002) and Buller (2014).
- 6 Mol and Law (1994) have described this entanglement in terms of "networks" and "fluids," whereas Urry (1999) conceptualized it as "flows" and "scapes."
- 7 See Hagen (1992) and Levit (2011).
- 8 See, for example, John Harwood's (1987) work on "national styles" in genetic research.
- 9 Laboratory studies took off in the late 1970s and early 1980s with work of, among others, Bruno Latour and Steve Woolgar, Michel Lynch, Harry Collins, Sharon Traweek, and Karin Knorr Cetina. For an overview, see Sismondo (2010: 106–119). In the 1990s, this work was extended with studies particularly looking into the ways in which architecture shaped laboratory (and other scientific) practice. See, among others, Galison and Thompson (1999), Gieryn (2002), and Picon and Ponte (2003). Others have extended this spatial sensitivity to the city as a sociomaterial context of science (Dierig, Lachmund, and Mendelsohn 2003). In the same period, the historical exploration of fieldwork has been much stimulated by Kuklick and Kohler (1996). Vetter (2011) shows how much this exploration has diversified since.
- 10 Of course, we are not the first to initiate such an integration between the history of science and environmental history. See Jørgensen, Jørgensen, and Pritchard (2013) for a parallel undertaking to our own, which, however, is less explicitly organized around the concept of space. A comparable integrative approach can be found in the work on "envirotech" and "techno-nature," which seeks to combine the history of technology, the history of environment, and historical geography: Reuss and Cutcliffe (2010), White and Wilbert (2010), Pritchard, (2011), and Carse (2015).
- 11 On mobility studies, see the programmatic work by Urry (1999).

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