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Free as a bird?

Geography of marine ornithologists' (im)mobilities to the field site

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Declaration

I declare that this thesis has been composed by myself and that the work presented is my own, except where explicitly indicated otherwise in the text. This work has not been submitted for any other degree or professional qualification

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Abstract

How do researchers choose the places where they collect scientific data? In the study of seabirds, this question is particularly complex because the birds have intricate logic in selecting their nesting sites, often far removed from human presence. The challenge for marine ornithologists is to negotiate access to certain bird colonies and turn them into suitable sites for collecting scientific data – reliable, replicable, while also reflecting the specificity of the site. Thus, marine ornithology provides a striking opportunity to understand the complex interaction between the trajectories of researchers and the organisms they study, leading them to shared sites: the field. This issue is especially pressing in the Anthropocene era, characterised by global ecosystem destabilisation and rapid declines in seabird populations.

Building on the case of seabird research, this thesis aims to contribute to strengthening the dialogue between Science and Technology Studies (STS) and human geography, which have come together around an emerging sub-discipline, 'geography of science'. Examining the distribution and location of scientific field sites (why do researchers go *there*?), which draws from the study of scientific mobility, I open the consideration of (im)mobilities in science studies. (Im)mobility refers to the stability and repetition of movements by researchers accessing, staying, leaving, and returning to bird colonies throughout their careers. This contribution seeks to consider not only change, innovation, and dynamism in science, but also what remains and is maintained; thus, recognising that this involves active work.

This thesis is based on interviews with marine ornithologists and ethnographic work on monitored seabird colonies in the Arctic and North Atlantic regions, mapping the geography of field sites 'beyond maps'. I address three aspects of researchers' (im)mobilities. First, I explore how researchers choose their field sites and how these (im)mobilities are interwoven with their scientific trajectories. I show that beyond scientific discourse, various factors make a colony attractive to researchers. I also emphasise that the choice of a colony is significant beyond research inquiries, as field sites play a major role in ornithologists' identity within the scientific community.

Secondly, I demonstrate that access to colonies matters in the long term – what counts for researchers is the ability to return to the colonies they study. Thus, I investigate how these (im)mobilities are structured within long-term monitoring agendas, especially since they do not align with the short-term nature of modern science. Finally, from the case of disruptions from the development and miniaturisation of tracking devices, I delve into how researchers reinforce and justify their (im)mobilities at seabird colonies. On one hand, they negotiate careful, shared (im)mobilities with specific birds, and on the other hand, they fragment their (im)mobilities within international tracking collaborations.

Ultimately, this thesis demonstrates that what matters for marine ornithologists is not just getting access to the right colonies, but being able to stay and return to these sites. (Im)mobilities deserve our full attention as they reveal the negotiations, motivations, and personal entanglements of ecological fieldwork conceived in the long-term, at a time of constrained academic resources and environmental crisis.

Lay summary

This thesis contributes to geography of science, which investigates the location and distribution of scientific activities. How do researchers choose the places where they collect scientific data? Seabirds, such as the Atlantic puffins, tend to breed on remote islands or steep cliffs, and migrate to faraway areas in the open ocean. As their mobilities cross land, air, and sea, the study of seabirds is an interesting case to understand the challenges of conducting fieldwork and turning some sites, homes for seabirds, into homes for science. Do researchers studying birds actually follow the birds? In the context of climate change, some colonies even disappear, and the trajectories of seabirds are disrupted. How are researchers able to maintain the study of seabirds on their colonies?

From interviews and ethnographic fieldwork, I demonstrate that many factors influence researchers' choice of colonies to study, and that some colonies are more suitable to be turned into sites for science than others. Beyond the selection of a colony, I show that what matters to ornithologists is coming back to these sites, ideally for decades. Against logistical, personal, financial, and environmental constraints, I thus delve into what I call the (im)mobilities of seabird scientists who access, stay, leave, and return to colonies over and over again.

This thesis contributes to unravelling the active work of marine ornithologists to create and maintain the study of seabirds on often removed sites, particularly in the North Atlantic and Arctic areas. In the face of numerous changes, including global warming, shifting values of commitment, technological advancements in remote sensing, and incentives for rapid and results-driven science, I argue that (im)mobilities to seabird colonies warrant our full attention.

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Chapter 1

Introduction

> For as long as we human beings can remember, we've been looking up. Over our heads went the birds – free as we were not, singing as we tried to. We gave their wings to our deities … and their songs to our angels. We believed the birds knew things we didn't, and this made sense to us, because only they had access to the panoramic picture … a vantage point we came to call 'the bird's eye view'.
>
> Atwood, M., "Act now to save our birds". *The Guardian*, 9 January 2010.

> What is an anarchist? One who, choosing, accepts the responsibility of choice.
>
> Le Guin, U.K., 1974, "The Day Before the Revolution", p. 985.

Prologue – Free as a bird?

Are birds as free as a bird? Interestingly, they are said to have total freedom, expressed in both their movements and character. Birds do not seem to adhere to any rules or boundaries, except to shatter them. Perhaps it is because they symbolise every human's hope to be free that they are so intriguing. Their aerial trajectories, mysterious as they are, particularly fascinate us. Throughout the ages, many stories have been told about the tension between the mundane familiarity of their presence and the mysteries of their periodic absence. Vinciane Despret begins her philosophical essay *Living as a Bird* (2021) with her fascination for a blackbird singing every morning in her garden, inspiring her to pay attention to other ways of inhabiting space[1]. In her account, the blackbird sings to mark the transformation of seasons, from the harsh winter to the promising spring, the season of bird reproduction. Other birds, like most seabirds, have the strategy of

[1] In the original French version, the book is entitled *Habiter en oiseau.* '*Habiter*' rather translates to 'inhabiting' or 'residing' which renders a more embodied way of 'living'.

migrating for several months to destinations often unknown and mysterious to those observing them from their breeding grounds.

Migration and the mystery of their trajectories followed greatly contribute to the fascination and admiration birds inspire. Among those who 'pay attention', there are those who, like Vinciane Despret, allow themselves to be captivated by chance encounters with birds and touched by their unique way of living. Some others decide to follow birds at all costs, immersing themselves in their mobilities. Geographer Mark Bonta writes that "Only to a birder, I suppose, can a garbage dump or a sewage pond be a place of beauty" (2010: 146). It is the encounter of birds and the supposition of their mobilities that creates the 'beauty' of birding and following birds. In Bonta's paper, the group of birders travels from the U.S. to Honduras to observe local birds. In this case, it is the trajectory of the birders, not the birds, to an 'exotic' destination, that creates the thrill and beauty of encounter.

I myself experienced this urge to encounter migratory birds and unravel the mystery of their seasonal disappearance. While we can imagine great destinies for birds, in my case, it was in the car park of a power station at an hour's drive from Edinburgh, where we found traces of a group of passerines that had flown from Siberia. For us, a group of young amateur birders, our fascination did not come from where the birds were going – since it happened to be in a car park – but from where they came from. And I thought, amused, that perhaps a few enthusiasts like us, from Siberia, wondering where these birds were heading, would be surprised to know they were in the bushes of a power station car park in southern Scotland. It might be best if they remain in the mystery of birds' trajectories.

While I admit I was a bit disappointed that day, settling for a car park to encounter distant migratory birds, this thesis has since led me to many other places. Instead of following birds, I focus on the scientific community that seeks to follow them and understand their oceanic trajectories. As seabird scientists 'follow' seabirds and their trajectories, I, too, aim to 'follow' seabird scientists and understand how their scientific trajectories intersect those of birds and bird colonies. This interest in the geography of seabird science has also created my own trajectory. It has taken me from France to Scotland, where I am writing this thesis, and to field sites on Skomer Island in Wales, the harbour town of Boulogne-sur-Mer in northern France, and Iceland, across a dozen colonies around the country. It

also led me to the cities of Cork, Ireland, and Coimbra, Portugal, where two Seabird Group conferences were held. As such, this research has frequently led me to places I never thought I would visit, but which are part of a seasonal routine for seabird researchers working on islands accessible by small boats on capricious seas, by rope climbing harsh cliffs, and by walking through shallow terrains.

Yet, I have understood that seabirds' trajectories are not necessarily mysterious. In fact, some sea-birds are seabirds only in name. Like Despret, I have paid attention to a gull I watch every day from my window, proudly perched on a chimney roof. It does not sing, but in its own way, it marks its territory and mode of inhabiting. While one would expect it to venture far out to sea to tirelessly find sustenance, it stays there, even for much of the winter, in the heart of the city of Edinburgh. Ultimately, it is by remaining where it is that this gull symbolises freedom.

Figure 1. An ornithologist observing a guillemot and kittiwake colony, from a puffin colony (Skomer, 08.05.2023)

Seabirds' unruly and fragile geographies

Often, to amuse themselves, the men of a crew
Catch albatrosses, those vast sea birds
That indolently follow a ship
As it glides over the deep, briny sea.

Scarcely have they placed them on the deck
Than these kings of the sky, clumsy, ashamed,
Pathetically let their great white wings
Drag beside them like oars.

That winged voyager, how weak and gauche he is,
So beautiful before, now comic and ugly!
One man worries his beak with a stubby clay pipe;
Another limps, mimics the cripple who once flew!

The poet resembles this prince of cloud and sky
Who frequents the tempest and laughs at the bowman;
When exiled on the earth, the butt of hoots and jeers,
His giant wings prevent him from walking.

Charles Baudelaire, "The Albatross", 1859. Translation by William Aggeler, *Flowers of Evil*, 1954.

In contrast to urban gulls, albatrosses are among the seabirds that epitomise the image of oceanic travellers, such as the Wandering Albatross (*Diomedea exulans*), with the largest wingspan. The French poet Charles Baudelaire was amused by the contrast between their grace at sea and clumsiness on land, which nonetheless remains a source of inspiration and self-reflection.

Two cases from the book *Flight Ways* by philosopher Thom van Dooren (2014) show the ambivalence of seabirds' trajectories, mobile and tied to fragile places. When describing the lives of albatrosses on the Midway Atoll in the Pacific, van Dooren highlights how the biological reality of seabirds contradicts the mythical image of freedom projected onto them. Indeed, "despite their adaptation to and immersion in a world of wind and waves, albatrosses remain utterly tied to the land as well, required to return each year to lay eggs and fledge young" (2014: 24). Van Dooren asserts that, if we stop seeing albatrosses as individuals and instead consider them as a species, they form part of a collective narrative shaped by evolutionary history and movements between land colonies and open oceans.

> Approached with an attentiveness to evolutionary history and a focus on the complex and difficult emergence of each new generation, it is clear that this thing we call a "species" is an incredible achievement. Each of the literally millions of generations of albatrosses that have followed one after the other has itself been ushered into the world through this narrow passage: laid, incubated, hatched, guarded and fed by parents, before taking those first steps toward flight and the world beyond. (…) In this context, a species must be understood as something like a 'line of movement' through evolutionary time (ibid: 27)

As free as they appear, albatrosses are bound by a collective responsibility and effort to return tirelessly to the same breeding sites – remote islands that, as van Dooren shows, also lead to their decline due to irreversible damage from human activities. Seabirds fascinate humans but are also endangered by them due to overfishing and bycatch, or pollution of waters and coasts (Dias et al. 2019). In the continuation of the chapter, van Dooren describes how plastic pollution on Midway threatens future generations of albatrosses.

In another chapter, he tells a similar story of seabirds' dependence on certain places – sites that are disappearing and transforming. Penguins, too,

> remain utterly tied to the land as well, required to live their lives between these two worlds. Since their distant ancestors abandoned the skies for a life beneath the waves, penguins have maintained a connection to the land, drawn out the sea each year by their own avian biology and the desire to breed and reproduce (Van Dooren 2014: 63).

Through this dependence, they have developed "their own particular relationships with (…) *specific* places" (p. 64). Van Dooren particularly discusses the fate of a colony of Little Penguins (*Eudyptula minor*) off the coast of Sydney, Australia, whose nesting site is disappearing, destroyed in favour of seawalls, replacing the sandy beaches with concrete.

> And yet, year after year, the penguins keep returning.
> I am captivated and unsettled by a singular image (…). It is the image of a penguin returning to a burrow, to a breeding place, that is no longer there or has been transformed so dramatically that it is no longer habitable (p. 66)

I am deeply inspired by the spatial resilience of seabirds, as the spaces they cross and the places they inhabit undergo profound changes. While van Dooren's penguins invariably return to their nests, even wedged between seawalls, other groups of seabirds change their trajectories, relocating their colonies and adapting to human infrastructure. Increasingly, studies report on growing populations of urban seabirds nesting in cities, where they are regarded as undesirable, creating conflicts of 'co-existence' (Wilson 2022). Seabirds embody a sense of freedom, but in the face of climate change and the Anthropocene era, their relocation to unexpected places shows us above all that their mobility is a matter of survival.

Seabirds thus fascinate through the ambivalence between their sea-faring skills and clumsiness on land, whether albatrosses or penguins; between the vast, mysterious distances they travel, and their insatiable, inspiring loyalty to specific places they return to each year, upon which the survival of their species depends. While they convey an image of freedom, they are particularly fragile, exposed to extinction threats in the Anthropocene era. As fascinating as these avian trajectories are – and deserving of further discussion – this thesis focuses not on the seabirds themselves but on those who study, document, and seek to understand their movements at sea and the trends in their fast-dropping declines.

Situating those who study seabirds

As a geographer of science, I aim in this doctoral research to demonstrate that the geography of those who study seabirds is just as fascinating and complex as that of the seabirds themselves. This thesis does not focus on marine biology or ornithology, but instead centres on the scientific community of seabird researchers, falling within Science and Technology Studies (STS) and human geography. The previous sections have highlighted the inspiring spatial practices of seabirds, whose geography spans terrestrial, oceanic, and aerial realms. This presupposes a scientific interest in documenting and understanding these trajectories as well as the worldwide decline of seabirds. If seabirds are known for flying to distant destinations in the open sea, how is it possible to study them and follow where they go? At the intersection of geography and STS, I examine the trajectories of scientists studying seabirds between their colony breeding sites and the open sea.

Those I will conveniently refer to as 'marine ornithologists' – the scientists studying seabirds – are both highly mobile and highly dependent on specific locations. In Thom van Dooren's chapter on albatross colonies, I was struck by the resonance of one of his sentences with the main argument of this thesis.

> We often do not appreciate— and perhaps we cannot truly grasp—the immensity of this intergenerational work: the skill, commitment, cooperation, and hard work, alongside serendipity, that are required in each generation to carry the species through (2014: 27)

Indeed, I aim to show that the geography of marine ornithologists, like that of seabirds, is constituted of movements of comings and goings, individual and collective efforts, choices, and perhaps chance, allowing researchers to study the birds.

This thesis focuses on the marine ornithology community as it is situated in space, time, and society. In particular, I explore *where* field researchers go to collect scientific data, and why *there*. This inquiry intersects the common interest of STS and geography to *situate* (scientific) activities. While geographers are concerned with "the space of societies [and] the spatial dimension of the social" (Lévy and Lussault 2003: 399), STS is known for studying science as a socially situated activity (Haraway 1988). Yet, despite this strong connection, the 'geography of science', a branch of academic inquiry at the intersection of geography and STS, has struggled to take hold in the literature. My thesis is a contribution to this dialogue and brings new conceptual tools.

I am interested in the professional research community – spanning biology, ecology, ecotoxicology, and ethology – which studies seabirds in what they call 'the field': the bird colonies. In STS, scientific field sites have been approached as *hybrid* places, inspired by and distinct from the laboratory and defined above all by a set of situated practices – in place and time (Kohler 2002a, 2002b; Vetter 2012; Arpin and Granjou 2015; De Bont 2015). In geography, the field is defined as a space constantly generated, transformed, and circulating, relying on specific locations but primarily a space of representation (Driver 2000; Greenhough 2006; Calbérac 2010). Across both disciplines, the field is thus a moving and malleable spatial entity.

While various studies have focused on the situated nature of the field, e.g. as a "place that answers questions" (Rees 2006) or as a "truth-spot" (Gieryn 2006), to my knowledge, none have offered a comprehensive analysis of why the field site is located where it is. Particularly, some historians and anthropologists recount the trajectories of fieldworkers and what brought them to a specific field. For example, Jane Camerini (1996) tells the story of Alfred Russel Wallace's fieldwork trajectories across the East Indies, in search of birds of paradise. However, these accounts remain anecdotal and do not allow for drawing conclusions on the significance of doing fieldwork in a particular location. In geography, researchers such as Marion Maisonobe (2015, 2020) have mapped the distribution of scientific publications, revealing that some regions concentrate scientific production while others remain on the periphery. In these

analyses, field sites also remain peripheral, despite being crucial places of scientific production.

In my empirical study of marine ornithologists, I analyse, throughout this thesis, their geography across field sites, primarily seabird colonies. I argue that the study of seabirds is particularly intriguing because it intersects with several spatial concerns: seabirds nest in often remote colonies, on isolated islands or cliffs; when near human settlements, it often leads to 'conflicts of coexistence' (Wilson 2022); and these colonies tend to disappear in the Anthropocene. In this context, understanding how researchers select their field sites, the colonies they study – asking *where* and *why there* – becomes even more complex. Indeed, for seabirds, the selection of the *right* breeding colony[2] involves many parameters (Kralj et al. 2023) as they tend to remain loyal to a specific site throughout their lives. For marine ornithologists, particular parameters undoubtedly influence field site selection and whether they, too, remain loyal to a site during their academic careers. Building on Maisonobe and colleagues (2017), who revealed that scientific activities are concentrated in certain areas, I make a similar hypothesis for fieldwork: some seabird colonies are more conducive to scientific study, just as they are considered more suitable for seabird breeding. It is critical to understand the conditions and features that make these colonies attractive for scientific activities. Furthermore, aligned with the literature on field sites, I argue that these colonies become spaces produced by researchers. Colonies only become field sites when investigated by researchers – through specific practices that need to be identified and understood. Just as Thom van Dooren (2014) describes how seabird colonies are formed by the movements of comings and goings of birds, I approach field sites as constituted by the movements of researchers who access the colonies, stay, leave, and, importantly, return. I am calling these scientific movements of researchers that constantly generate, maintain, and transform field sites, (im)mobilities – a spatial concept that has received little attention in STS.

[2] Most seabirds do not immediately breed on the colony they were born and prospect for their breeding sites.

The geography of marine ornithologists' (im)mobilities to the field site

The initial motivation for this thesis is to understand how researchers select the sites where they collect scientific data, while also contributing to a deeper understanding of the geography of science. The case of marine ornithology is particularly interesting because fieldwork takes place in seabird colonies, often remote and difficult to access. Undoubtedly, this emphasises how crucial and delicate site selection should be for researchers. The first set of questions I ask in this thesis is thus:

- **Are marine ornithologists following seabirds, and if so, how?**
- **How are scientists choosing the sites they study?**

As marine ornithologists cannot follow all seabird colonies, they select certain ones that, due to particular characteristics yet to be unravelled, are more attractive to scientific fieldwork.

This thesis thus contributes to the dialogue between geography and STS within the overlooked field of 'geography of science'. First, it examines the spatial dynamics of scientific activities outside the 'centres of calculation' (Latour 1987) of science, and explores science as it is truly conducted in space, not just as it appears through traditional narratives. The dominance of laboratory studies, especially in Western countries, has prompted many researchers to de-centre the analysis of scientific activities (Tousignant 2013; Dumoulin Kervran, Lamy, and Verlin 2024). Among the 'peripheries' in the social studies of science, polar regions have notably received little attention despite concentrating scientific issues (Jouvenet 2022). It is from this observation that I got interested in unravelling the spatialisation of scientific activities. In previous research, I explored how the Norwegian archipelago of Svalbard, located in the High Arctic, is a central field site for numerous research programmes due to scientific policies that encourage countries (often far from the Arctic) to support the construction of field stations. The construction of Svalbard as a scientific space plays a major role in structuring scientific networks, as researchers do not work on Svalbard solely for scientific reasons, but follow external incentives (Strouk 2022; Strouk and Maisonobe 2024). Following on from this earlier work, in this thesis, I will focus on the seabird

research community working on Arctic and North Atlantic colonies, which is structured around specific research networks, such as the SEATRACK programme, which I will discuss in Chapter 6, and the Seabird Group Conference, which I attended twice (Chapter 3). I have chosen this focus on the marine ornithology community working on Arctic seabirds, as it uniquely combines the concern to access seabirds, particularly challenging in the Arctic (Mallory et al. 2018), and the disappearance of seabird colonies under global warming[3]. Throughout this thesis, I observe the interplay of factors influencing marine ornithologists' trajectories to specific field sites. Given seabirds' wide mobility between remote colonies and open sea, this case study allows me to highlight scientists' strategies to negotiate access to challenging field sites.

Additionally, this thesis contributes to understanding the spatialisation of scientific activities. In line with how Maisonobe et al. (2017) mapped scientific publications and revealed, across multiple scales, hotspots and deconcentration dynamics, I map where scientists collect scientific data, outside their offices or laboratories: the field site. However, I am not proposing a Euclidean mapping of field sites, which would be represented as simple points on a map. Instead, I follow some contributions from the geography literature, critically Driver (2000) and Greenhough (2006), that show how field sites are not mere fixed places, but generated spaces of practices and representations. Drawing on this work and extending traditional ideas of field sites as 'places' and fieldwork as 'practices of place' (Kohler 2002a, 2002b), I show how marine ornithologists' field sites are generated, produced, and maintained. I thus study field sites as dynamic spatial entities instead of fixed ones.

Beyond the traditional dichotomy between place and space, which has been dominant in the geographical study of science, I am focusing on scientific (im)mobilities. As detailed further in the next chapter, (im)mobilities encompass the mobilities and immobilities of marine ornithologists to seabird colonies – how they access, stay, leave, and, importantly, return. I argue that it is through these (im)mobilities that field sites are generated and maintained. This translates into my second strand of research questions, relating to the genealogy of field sites:

[3] According to the latest IPCC report, the Arctic region is warming three or four times faster than the rest of the globe.

- **How are seabird colonies turned into sites for science?**
- **How are marine ornithologists maintaining these colonies as field sites?**

Through these research questions, I explore scientists' trajectories to field sites throughout their careers and discuss how they establish new sites for science, turn seabird colonies into scientific places, and manage to return, sometimes for decades, to these sites. Focusing on (im)mobilities allows us to emphasise that science also importantly happens through the maintenance of movements and practices, beyond traditional focus on change and innovation (Russell and Vinsel 2018). I demonstrate that marine ornithologists are acutely concerned about the maintenance of field sites, more than setting up new ones. Subsequently, I argue that encompassing movements and stillnesses in the field, (im)mobilities highlight that innovation and maintenance, change and stability, are always interconnected. It is the stability and repetition of marine ornithologists' access to the colonies that produce them into field sites; just like it is seabirds' (im)mobilities that produce them as colonies.

Moreover, just as seabirds must face numerous challenges to maintain access to their colonies and secure the future of their species (van Dooren 2014), I explore how marine ornithologists must *negotiate* their (im)mobilities to field sites. These negotiations, strategies to access, stay, leave, and return to colonies, and with specific birds, are central concerns for ornithologists. In particular, they must negotiate through disruptions, including the disappearance of seabirds, the acceleration of academic time (Vostal 2016), and the development of remote sensing technologies (Gabrys 2016). Seabirds are mainly threatened species, and as I will show, some studied colonies are vanishing altogether or, as Van Dooren (2014) explained, are relocated. Under the broad regime of 'social acceleration' (Rosa 2013), academics work with limited time and resources, which directs research towards short-term projects. Technologies that enable remote data collection in the field, such as tracking loggers, are increasingly adopted and significantly influence field practices (Benson 2010). Amid these multiple developments, how marine ornithologists manage to maintain seabird colonies as sites for science becomes an even more crucial and complex issue to investigate.

Thesis roadmap

This thesis contributes to the geography of science and its intellectual agenda. The next chapter, ***There, why there, and back again***, focuses on the spatial dynamics underlying scientific activities and knowledge, and further explains the theoretical background of my work. Whereas 'place' and 'space' have been the dominating vocabulary when discussing the geography of science, I draw attention to the geographical concept of (im)mobility. Placing scientific activities, I argue, must acknowledge that places are produced within spaces. Thus, they are not entirely fixed, but are actively generated by groups of actors through their (im)mobilities: movements that, by their repetition and stability, give a site its meaning and value. Accessing, staying in place, leaving, and returning are meaningful; and I argue create, generate, and maintain sites of scientific knowledge production. Typically, then, field sites are not situated places but produced spaces, both by scientists and by the organisms inhabiting and composing them. Attending to the (im)mobilities that constitute field sites thus allows us to understand that these are actively generated and maintained entities. In this sense, I argue that seabird colonies are constantly being generated and maintained through scientific (im)mobilities.

Chapter 3, ***Following those who follow seabirds***, provides the methodology and context of the case study I developed to explore the marine ornithology community. I will trace the evolution and particularities of seabird research in the field, demonstrating that it is a relatively recent pursuit. Ornithology depends on privileged observational sites, but as geographer Mark Bonta (2010) noted, it must also adapt to the possibility of encounter – and actively provoke it. In professional marine ornithology (distinguished from birdwatching or 'birding'), these encounters mainly happen in colonies, and rarely from a distance. The encounter with birds must be continuously negotiated: the aim is to be with birds with certainty, unlike the unpredictability of amateur birdwatching. From the initial idea of mapping the distribution of field sites, I turned to ornithologists' narratives to understand how this *negotiation of field sites* with the birds unfolds, which I term 'mapping beyond map'. Consequently, I developed a methodology to study these negotiated encounters between birds and scientists through various materials, such as stories, imageries, and biographies. I focus on investigating the stories of researchers negotiating (im)mobility – accessing, staying, leaving and returning to colonies

coincidentally with the birds. To understand their practices, representations, motivations, and trajectories on seabird colonies, I conducted a series of interviews with marine ornithologists alongside multi-sited participant observations across four seabird field-based projects.

Chapter 4, ***Following seabirds?***, explores how marine ornithologists select the colonies they study. This selection process transforms colonies, researchers, and the particular sites. I show how colonies become sites for science and how researchers' scientific trajectory is greatly influenced by their access to the field – and to particular sites. Therefore, negotiating access to a colony is an important part of marine ornithologists' professional identity and position within the community. More than just a place or space for science, I argue that field sites are *territories* for researchers. In particular, I demonstrate that the selection of a field site is crucial for scientists' career trajectories and that many factors shape this process. Beyond the traditional discourses of epistemic motivations or serendipity, I expose the critical role of accessibility, which is not just epistemic but also relative, logistical, and social. In sum, selecting a site is not a straightforward and logical process, and researchers have unequal abilities to choose the *right* colony to study. They need to negotiate between several incentives that play a role in the process of turning sites into territories, including their identity and value within the community.

Chapter 5, ***Long-term commitments***, focuses on the temporal dimension of field sites, generated by marine ornithologists, but also, crucially, maintained. In the study of seabirds, long-term monitoring – following a single colony for decades – is a critical practice for understanding underlying population dynamics and a baseline for most research projects. However, maintaining the study of colonies is a complex endeavour because of funding agendas, personal trajectories, and environmental changes. This chapter thus sheds light on the undervalued practices to maintain work, in contrast to the traditional focus on innovation and change. The capacity to maintain access to a site in the long term, for decades to conduct monitoring studies, builds careers and expectations, and reflects how scientists must align their 'environmental vision' (Benson 2012) with external realities, such as the pressure for short-term projects and the global disappearance of seabirds. Ultimately, I show in this chapter that fieldwork importantly

matters as a narrative in the seabird science community and that, like all dominant narratives, it is shifting and contested.

Chapter 6, ***Capitalising (im)mobility*****,** describes the debate around the potential 'end of fieldwork' in biology and ecology, along with the development and miniaturisation of tracking devices. These loggers, attached to seabirds, enable scientists to follow them at a distance across their foraging or migrating trips and know their trajectories beyond direct observations at the colony. Despite arguably 'revolutionising' the field, I instead show that tracking practices reinforce the need to do fieldwork and the value of being able to negotiate access to specific birds. I demonstrate in this chapter that even under a context of technological innovation, the values and narratives of marine ornithologists remain oriented toward a deep understanding of colonies, especially negotiated across decades of work. Because seabirds need to be captured and recaptured to be equipped with loggers, tracking heightens the need to be at the colony and be attentive to the (im)mobilities of specific individuals. However, tracking studies do participate in the general acceleration of academic time, which is also prevalent in the field. As marine ornithologists value long-term fieldwork, tracking studies participate in legitimising their renewed presence in the field, but with constrained time.

Finally, the concluding chapter, ***Negotiating (im)mobility***, goes back to the main contributions of this thesis, particularly the importance of movements and stillness in generating and maintaining field sites. I argue that marine ornithologists need to work alongside three critical concerns: following, maintaining, and capitalising. This comes back to my overall argument in this dissertation, that seabird colonies as field sites are produced through the (im)mobilities of marine ornithologists. Finally, I explain that (im)mobilities can be further developed and understood as *interweavings*, *territories,* and *rhythms*.

Chapter 2

There, why there, and back again

Contribution to the geography of scientific (im)mobilities

Proposing a thesis that explicitly subscribes to the field of 'geography of science', offering a renewed dialogue between human geography and Science and Technology Studies (STS), may seem simultaneously both mundane and necessary. Mundane, because as Steven Shapin, in his review of Livingstone's *Science, space and hermeneutics* puts it: "Where else could science take place but in places and how else could it travel but across spaces?" (Shapin 2003: 90). Necessary, because yet there is no 'geography of science' tradition where History of Science, Philosophy of Science or Sociology of Science are established fields in the literature (Withers 2002: 9).

Since the 'spatial turn' in social sciences (Besse, Clerc, and Robic 2017), the situatedness of science has been a central inquiry for STS, beyond the traditional idea that science is universal. Instead, STS scholars have unravelled how science is a 'view from somewhere' (Haraway 1988: 590) and that 'the location of scientific endeavour […] affect the content of science' (Livingstone 2003: 1). But, even when speaking of 'place', like in the case of Haraway, STS literature feels more comfortable talking about power positions rather than about space or territories. The language of 'above' or 'below' has prevailed over the 'where' or 'there'. Science is both a social and spatial activity – it is social because it happens in society, and it is spatial because it happens through space. Scientific ideas and people travel and affect societies. Thus, while the connection between geography and STS no longer needs to be justified, there remain wide pathways to enrich the analysis of the spatial dimension of scientific activities.

In this chapter, I will expose the geography of science, presenting it as a set of independent streams of research; after which, I will discuss further what kind of geographic approach to science I subscribe to in this thesis. In doing so, I contribute to

the long-ranging work discussing the *placing* of scientific knowledge and practices – thus going beyond their localisation to consider their meaning, values and representations. However, rather than focusing on these places as generative of scientific circulations, I argue that we should also attend to (im)mobilities as fundamental to the production of scientific sites.

In line with geographer Felix Driver's argument that "a genuine geography of science requires more than the casual adoption of terms such as 'place' and 'space'" (Driver 1994: 389), I propose to open another dialogue between geography and STS around the topic of (im)mobility. Rather than mere movements, I shed light on the *meaningful* and *generative* dimension of scientific mobilities and immobilities. Simply put, I argue that scientific sites – in my case, seabird colonies as field sites – are generated by the (im)mobilities of scientists who transform these colonies as sites for science by selecting, accessing, staying, and returning to these locations. I thus turn to the geographical literature on mobility and immobility to unravel these movements of scientific appropriations. While (im)mobility has largely been discussed – and debated – in geography, it remains an overlooked arena in STS to understand the creation, appropriation, maintenance, and circulation of science through its sites of production. I will also describe in this chapter the many resonances (im)mobility has with both archetypal and recent scholarship in STS around the meanings of moving or staying, acceleration and compression of time and space, and the "art of making things last" (Denis and Pontille 2022: 14). Ultimately, attending to scientific (im)mobilities offers an opportunity to articulate the fixedness and dynamism of science, the urge to be mobile and the attachment to places.

Finally, I apply the (im)mobility approach to the study of field sciences. Despite a traditional literature describing field sites as 'places' and fieldwork as 'practices of place' (Kohler 2002a), a vast array of studies approach the field as produced by specific practices and representations of researchers. I argue that, in addition to the theoretical developments exploring the many ways in which scientists turn natural sites into 'homes for science' (Geissler and Kelly 2016), (im)mobilities are useful for shedding light on how this production of scientific spaces happens through movements and stillnesses. Moreover, as these sites are also home to many other organisms, I subscribe to the 'more-

than-human geographies of field sciences' proposed by Forsyth (2013). Field sites are conducive arenas to understand the entanglement of scientists' and animals' (im)mobilities and how these produce particular spaces of attachment, care, control, and many other possible emotions and representations.

The geography of science

Although a significant number of publications directly engage with the spatial dimension of science, the 'geography of science' is far from a unified field, and much of the literature from STS and geography does not interact. In this section, I will delineate that, in geography, still few works approach science as a direct object of study, and argue that in STS, what is called the 'geography of science' is actually mostly the result of a '*historical* geography of science', nurtured by historians. However, there is a much broader range of contributions, from geographers and STS scholars, that apply a spatial lens to understand the production of scientific knowledge. Thus, in this section, I will portray the 'geography of science' as a rich set of academic inquiries that do not necessarily speak together. The situation of science as a hybrid activity, mobile and fixed in space and time, paves the way for a greater dialogue between geography and STS, to which I wish to contribute in this thesis.

An emerging field?

The development of the 'Sociology of Scientific Knowledge' (SSK) occurred jointly with the 'spatial turn' in the social sciences across the 1970s. Renowned intellectuals expressed their interests in spatial concepts, such as Lefebvre's 'production of space' (1974) and Foucault's 'spatial obsession' for the unfolding of power and knowledge (1980: 69). Ideas from Marxist and postmodern theorists explicitly connected the 'conditions of postmodernity' with liberal claims of the 'death of distance' and general globalisation dynamics (Harvey 1989; Soja 1989; Latour 1991). Simultaneously, STS sought to question another strong claim, that science is universal and neutral. When Kuhn asserted in 1962 that science is not universal and constantly evolving, it did not take long for other scholars to demonstrate that the nature of scientific facts depends on their

context of production. As such, science is not a "view from above, from nowhere" but "a view from somewhere" (Haraway 1988: 589).

Even if Haraway's claim is not framed in spatial terms, according to geographer Richard Powell, "science studies *necessarily* had to confront questions of spatiality" (2007: 310, original emphasis). In a review, he identifies several approaches in the STS literature which can be labelled as 'geographical':

- (1) Architectural studies, notably around Galison and Thomson's book on *The Architecture of Science* in which they ask, "how do the buildings of science literally and figuratively configure the identity of the scientist and scientific fields" (1999: 1). They thus acknowledge the role of specific settings in scientific endeavour and how the design of scientific sites affects the production of scientific knowledge.
- (2) Ethnographic and ethnomethodological studies of laboratory spaces, typically laboratory studies in line with Latour and Woolgar's *Laboratory Life* (1979) or Sharon Traweek's *Beamtimes and Lifetimes* (1988). Although these draw from ethnographic and anthropological methods, focusing on scientific practices, the laboratory is approached as a cultural space that shapes and constructs scientific research.
- (3) Posthumanist theories of practice, based on 'Actor-Network Theory' (ANT) (Callon 1984; Latour 1996; Law and Mol 2001), which focus on the networks between actants that produce particular kinds of knowledge. Although highly influential in geography (Murdoch 1998) and drawing on key geographical thinking, ANT does not particularly situate science within space.
- (4) Post-colonial science studies, which emphasise the localism of knowledge and the power dynamics these generate, in line with the emerging 'third wave of STS' and reconstitutions of 'expertise' (Collins and Evans 2002).

Along with these parallel and sometimes interacting developments, several contributions stemming from historians of science called for a 'geographical recovery' in the 1990s. Livingstone describes this as the "redrawn attention to the constitutive significance of place and space, site and situation, locality and territoriality" (1995: 5). His quote also illustrates that science can be geographically approached around two complementary streams – it is *situated in place, site and locality,* and it *travels in space, situation and*

territories. The importance of approaching science in place has been significantly proposed by Adi Ophir and Steven Shapin in a thematic issue of *Science in Context* devoted to "The Place of Knowledge: The Spatial Setting and its Relations to the Production of Knowledge" (1991). They argue that instead of "floating free in the air, as historians gazed up at them in wonder and admiration", scientific ideas are localised (p. 3). In line with this "localist genre" (p. 5), several publications in this special issue discussed places of knowledge, such as the laboratory (Lynch 1991) or the library (Ophir 1991).

Following place, 'space' appeared as a fruitful concept to explore in the conference organised by the British Society for the History of Science on "Making Space: Territorial Themes in the History of Science", in 1994. They explored issues crossing the history of science and geography, such as the 'politics of space' and 'cultural geographies of science'. Such developments greatly inspired the Irish geographer David N. Livingstone, who happily noted that historians of science presented "an agenda that cultural geographers have pursued in contexts other than that of scientific culture" (1995: 15) and thus proposed to develop a "historical geography of science" (ibid). In his view, such a field would focus on:

> (…) the role of the spatial setting in the production of experimental knowledge, the significance of the uneven distribution of scientific information, the diffusion tracks along which scientific ideas and their associated instrumental gadgetry migrate, the management of laboratory space, the power relations exhibited in the transmission of scientific lore from specialist space to public place, the political geography and social topography of scientific subcultures, and the institutionalisation and policing of the sites in which the reproduction of scientific cultures is affected. (…) draw attention to local, regional, and national features of science—an enterprise hitherto regarded as prototypically universal (1995: 16)

Thus, to Livingstone, many crucial aspects of the "situatedness of knowledge" (p. 27) ought to be understood through a 'geography of science' approach. Livingstone further transcribed these ideas into a book, *Putting Science in Its Place. Geographies of Scientific Knowledge*, which remains highly influential as an enterprise of combining human geography and STS inquiries and methods, and greatly inspired my doctoral research. In this book, Livingstone poses that "science has a geography" (Livingstone 2003: 1), which is displayed across sites, regional scales, and circulations. All of these, he argues, deeply matter in the content of science. Although this work – and the literature which followed[4]

[4] Mostly derived from historians of science, studying the travelling nature of science and its materialities (Bourguet, Licoppe, and Sibum 2003), movements of science between centres and peripheries (Burke 2000; Simões, Carneiro, and Diogo 2010) and the local contexts, places of science (Matless 2003; Withers

– draws from historical cases, the questions they unravel are also relevant for studies of contemporary sciences, as I shall demonstrate with the case of marine ornithology.

However, some later regretted these approaches as "too place-focused" (Taylor, Hoyler, and Evans 2010: 39). They argued that while acknowledging science as mobile, they tend to reduce this mobility to moving from place to place, giving little consideration to the materialities, practicalities, and affect of these movements. My thesis responds to this line of criticism and extension of 'geography of science' beyond the sole account of places, space, and moving between and across them – which I will develop further in the following section of this chapter.

Shortly after these theoretical developments around the use of 'place' and 'space' in studies of scientific knowledge, the geographer Richard Powell, in his review targeted towards geographers, "Geographies of science: histories, localities, practices, futures", is optimistic and tries to encourage colleagues to investigate scientific endeavour. He argues that there are so many topics to explore and questions to observe that "the prospectus for geographers of science is bright indeed" (2007: 15). Almost twenty years later, it is interesting to notice that, still, few scholars, in geography and STS, explicitly register in this field of research, despite these proposals and publications of several manuals[5]. It is also worth noting that this 'geography of science' is highly partial, especially considering the broadness of geography. For example, in her doctoral work from the ANR GEOSCIENCES project, geographer Marion Maisonobe (2015) proposes an updated, mixed-method geography of science, which seeks to produce and analyse the distribution of science globally, engaging with geography of innovation, higher education, spatial network analysis, and spatial scientometrics. Thus, there is an increasing range of proposals to develop and further institutionalise the geography of science, although these do not always come together into a coherent and coordinated programme.

My aim is not to propose an exhaustive review of the literature approaching the spatial nature of science, but to highlight that geography of science is inextricably tied to STS,

and Finnegan 2003; Withers 2005). These are just a few examples of publications that emerged around Livingstone's propositions for a "historical geography of science".

[5] I noted some manuals of geography of science (Meusburger, Livingstone, and Jöns 2010; Meusburger, Gregory, and Suarsana 2015; Glückler, Lazega, and Hammer 2017; Olechnicka, Ploszaj, and Celińska-Janowicz 2019), a few literature reviews (Withers 2002; Powell 2007; Meusburger 2008; Mahony 2021) and dissertations (Maisonobe 2015; Fernandez forthcoming).

and that STS itself is strongly influenced by the so-called 'spatial turn' (Besse et al. 2017) and a general sensitivity to how scientific knowledge is shaped by space and in space. Despite these strong connections, 'geography of science' does not formally exist as a unified field – which is rather understandable given the vast array of approaches within geography and STS[6], but regrettable if we consider the potential of creating dialogues between these approaches. For this reason, my thesis seeks to interact with three main trends in the 'geography of science' I identified since Powell's review in 2007:

(1) **(Global) historical geography of science**. Since Livingstone, Withers and other geographers' 'historical geography of science', several contributions drawing from historical case studies have approached science as a mobile activity, not just between places but across scales. Notably, Jessica Lehman studies the International Geophysical Year (IGY) of 1957-59, proposing a 'synoptic geography' which goes beyond science as local; rather, from localised sites, science has a planetary scale (2020). Indeed, the idea that science is deeply situated and localised yet always travels and shapes the world may seem counterintuitive (Stehr 2010: 24). Along with this questioning, the book *Geographies of Science* (Meusburger, Livingstone, and Jöns 2010) draws from historical case studies to explore the nature of science as both grounded and mobile. As I will demonstrate through my use of (im)mobility in science, there are indeed fruitful pathways to connect the local and global, as well as the static and moving, as crucial dimensions of scientific knowledge and practices.

(2) **Mixed-method geography of science**. This body of work has been mainly developed in France, around a network of scholars involved between 2010-2013 in the ANR GEOSCIENCE project. Broadly, using quantitative methods from scientometrics, the group identified 'scientific agglomerations' by geocoding Web of Science (WoS) publications, thereby extending the study of science distribution beyond the national level to cities. They notably identified a global 'spatial deconcentration' of publications, against the idea that a growing number of cities

[6] As Mahony writes, geography of science "is a body of work of increasing vibrancy and diversity – so much so that calls to institutionalise a distinctive subfield of 'geography of science' might not do justice to the variety of ways in which geographers of various stripes contribute to science (and technology) studies" (2021: 587).

(in the Global North) gather most of scientific production (Eckert et al. 2014; Maisonobe et al. 2017). Moreover, such a line of work also engages with discourses and politics of the spatial distribution of science, which promote the idea that scientific activities are concentrated in some privileged areas at the expense of others. By asking where field scientists go to collect data, I also contribute to unravelling the distribution of scientific knowledge production, beyond traditional narratives.

(3) **Geographies of science and technology in the Anthropocene.** This last stream is the most recent and fundamental in my contribution because it engages the most with the changing nature of the spatiality of science. From 2021, Martin Mahony published a three-part review of what he calls 'Geographies of science and technologies' in the journal *Progress in Human Geography*, where Powell previously published his own review (2007). According to Mahony, geography of science should also attend to technologies, and studies of technoscientific practices should reason through scales. Furthering his argument, Chapter 5 of this dissertation, describing the maintenance of seabird colonies as field sites, and particularly Chapter 6 analysing tracking practices, will position technoscientific practices as producing particular spatialities. Relatedly, some contributions show that science does not just have "its geography" (Livingstone 2003: 1), it also produces spaces. For example, geographer Beth Greenhough discusses how field sciences turned the whole of Iceland into a laboratory (2006). Mahony distinguishes this as the topographical (promoted by Livingstone's line of work) versus the *topological* approach to science's geographies (Paasi 2011). The latter emphasises the dimension of space as productive of specific practices, feelings and imaginations. Critical contributions include geographer Jamie Lorimer's description of the 'affective science' of counting corncrakes (2008), which produces particular spaces and crosses traditional boundaries between the laboratory and the field, the surveyors and the corncrakes, the observed and the observer. As such, geography of science does not just focus on science in space but on what kind of spaces it produces and what these spaces mean for the production and diffusion of knowledge.

This tentative and non-exhaustive review of the geography of science literature aims to highlight the strong and critical connections between human geography and STS, which have led to a series of publications, more or less labelled as 'geography of science' but which generally put a particular attention to the role of space in the production of science. The literature on the spatial dimension of scientific activities is vast and impossible to approach systematically, as many ideas and concepts from geography enrich STS, and reversely. My contribution thus does not aim to propose a guideline for a geography of science but rather to create an opportunity – or space – for dialogues between a variety of approaches across these streams in 'geography of science'.

"We ground things, now, on a moving earth"[7] – dilemmas of placing science

'Geography of science' struggles to emerge as a distinct area of study stems precisely from the strong interweaving of geographical thought with STS inquiry, especially around *situated* knowledge – the claim that knowledge comes from somewhere. In both STS and geography, it is well established that the situation of scientific activities influences their content. Indeed, many works in STS approach the seemingly straightforward notions of 'place' and 'space', which are hallmarks of geography. These notions, however, are far from easy to define and are not the only ways to articulate the geography of science. Therefore, in this section, starting from the concepts of 'place' and 'space', which I will define by drawing from both STS and geographical literature, I move towards the conception of science as a mobile activity. Indeed, I will show that STS scholarship has generally tended to reduce the geographical dimension of science to its situatedness in places and within space, and argue that there are opportunities to go beyond that and study scientific (im)mobilities.

In many aspects, this present contribution seeks to 'de-fix' or 'de-ground' the study of science in places. Numerous works in STS and at the intersection of the 'historical geography of science' have emphasised the localised dimension of scientific production. Science is not universal; it also takes place *somewhere*. Similarly, instead of being 'placeless' (Kohler 2002c) and replicable everywhere, laboratories are always situated

[7] Clifford 1986: 22.

somewhere (Traweek 1988; Lynch 1991; Ophir and Shapin 1991; Livingstone 2003). Thus, many studies have "catalogued" (Greenhough 2006: 225) the sites of scientific production, whether it be the laboratory, the field (which I will return to), the museum – or the botanical garden. Beyond cataloguing, excavating the multiplicity and meanings of sites of knowledge production is still an ongoing, fruitful topic. Jane Calvert, for example, reflects on the rooms she has occupied through her career, as "bounded places with associated norms and expectations" (2024: 8). Places, in this sense, are tools to describe where science is done, but also importantly shape the stories and trajectories of scientists. As Livingstone puts it, "*where* we are matters a good deal in trying to figure out *who* we are" (2003: 183, original emphasis).

A fundamental contribution in STS around the meaning of places is Thomas Gieryn's work on 'truth-spots' (2002, 2006, 2018). He approaches 'truth-spots' as places where scientific 'truth' is produced and narratives of scientific credibility are generated. According to Gieryn, place has three dimensions: a geographical location (it is "a unique spot in the universe" – 2000: 464), a material form (it has a "physicality" – p. 465), and an investment with meaning and value (it needs to have "naming, identification or representation by ordinary people" – ibid). These particularities of place make it a fruitful concept to understand the production of scientific claims, making Gieryn call for a "place-sensitive sociology" (p. 483) which looks at "what place does […] for social life and historical change" (p. 473), considering matters of power, representations, and interactions.

Following this line of inquiry around the localisation of science, recent scholarship in STS has investigated the *placing* of science, going beyond its mere location or physicality and rather focusing on the third dimension put forward by Gieryn – its meaning, representation, and value. Thus, Lisa Messeri, in her book *Placing Outer Space* (2016), approaches 'placing' as the practices of the planetary scientists she studies to make sense of outer space on Earth. Placing, in this sense, is a narrative tool as much as a way to project terrestrial dynamics into outer space. Indeed, by setting the 'planetary' as a place, Messeri focuses on the "imagination of being on/within/alongside, of experiencing, the planet", which is "an active relationship" (p. 12). Messeri seeks to go beyond the traditional dichotomy between place and space, which she believes is "problematic" as space tends to be associated with the global and objectivity while place is "essentialized

as a local, feminized subjectivity". Rather, she argues, place "is not a static and singular term but is multiple and varied, constantly being made and altered" (Messeri 2016: 13).

Whilst I agree, like many geographers, that place and space ought to be understood together and not against each other, it seems far-fetched to argue that space is associated with objectivity. Space is fluid (Massey 1999), produced (Lefebvre 1974), and does not have, by itself, a materiality – it only exists through specific practices and representations. Although space is an ambiguous concept, which varies between disciplines, *geographical space* is social: it is produced by human groups who organise and develop it. The production of space by societies results from power dynamics between actors – domination, competition, or cooperation. According to David Harvey (2006), space has three conceptions: it is material because it is experienced, it is conceived and represented, and exists *through* representations (the space of sensations, imaginations, emotions, and meanings)[8]. Thus, space exists as long as it is conceived, experienced, and practised, whilst place can be given meanings by societies but is a condition for their existence – societies are always situated somewhere. As philosopher Jeff Malpas writes: "the social does not exist prior to place nor it is given expression except in and through place – and through spatialised, temporalized ordering […] It is within the structure of place that the very possibility of the social arises" (2018: 34). For geographer Tim Cresswell, place has been approached in geography through description of particular entities, as 'social constructions' underlying spatial processes and as political objects (2014). Being situated somewhere, 'in place' or 'out of place' has thus a strong normative and moral component in societies (Cresswell 1996). All in all, while 'places' produce societies, 'spaces' are products of them. Conversely, while societies invest specific places with meanings, they exist within space.

Thus, to go back to Messeri's argument about the necessity to consider place and placing as something more than local and contained to specific, bounded locations; it is equally important to conceive space as more than global, invisible, and boundary-free. As several geographers have argued, scientific activities are fertile grounds to reconsider traditional meanings of place and space. Beth Greenhough, for example, argues that "while scientific practices define particular spaces, they also serve to question pre-existing

[8] This triad concept directly derives from Lefebvre's *Production of space* (1974; Dubiau and Szende 2023).

understandings of spaces and the social relations sustained within them" (2006: 225). She urges STS scholarship to consider the "spatial possibilities generated by and through [scientists'] work" rather than assumptions (p. 226); and, generally, to "take the production of space seriously" (p. 234). This means that the point of a geography of science is not just to focus on where science is, but what kinds of spaces are generated by scientific work. Such a conception signifies that the *meaning*, more than the location, matters if we ought to understand the spatialisation of science. Moreover, scientific work is always moving – it is mobile in space, time, and society.

As such, undertakings of 'placing' scientific activities typically end up turning to the question of movements and mobility. Morgan Meyer, for instance, attempts to delineate the "geography of do-it-yourself [DIY] biology" by analysing the "spatiality and materiality" of the field, in line with practices of 'boundary-work' (Meyer 2013: 119; citing Gieryn 1983). He first asks, "where precisely does do-it-yourself biology take place? Where and how do people share their knowledge in order to build their labs?" (p. 118-119), focusing on two laboratories. By analysing the materiality of these places, he then notices that "we have to include in our analyses – in addition to disciplinary spaces and physical places – the networks and trajectories of material objects" (2013: 128). Indeed, DIY biology does happen in specific places, but this question only matters together with how specific communities imagine, practice, conceive – thus, *produce* – these places as those for DIY biology. Meyer connects it to Gieryn's concept of 'boundary-work', but this idea also largely echoes what Beth Greenhough (2006) argued about the production of spatial possibilities by scientists. In this sense, from 'placing', Meyer '*traces*' DIY biology[9], as its materiality matters as much as its mobility and malleability. In a following chapter written with Susan Molyneux-Hodgson, they argue that "placing a science means constructing a science (a discipline, an activity) and a concrete space where this science occurs, concurrently" (2016: 62). Placing is thus concerned by the "*movement* related to an activity" (p. 63, original emphasis), as it draws from places to places, in space and in time. Taken up by Dumoulin Kervran, Lamy, and Verlin (2024) for scientific infrastructures in postcolonial settings, 'placing' is a useful concept to both consider the localisation of science, the interactions between specific places and their surroundings,

[9] The concept of 'tracing' is further developed in a related paper (Meyer 2012) and relates to focussing on what is left in places and moves across places, in particular through social relations.

and its generative dimension – which they rather approach as *spatialising* (considering centre-periphery dynamics) and *localising* (considering local frictions).

Place, space, placing, spatialising, localised, localising… The spatial dimension of science has led to a large – and sometimes conflicting – vocabulary that seeks to comprehend the paradoxical nature of scientific activities as local and global, fixed and mobile, situated and universal, produced and productive, generated and generative. In this context, place and space are not opposed but make sense together as tools to read through this complexity. This attachment to the idea of place and placing in science studies is interesting, as science is also highly mobile and mutable. As Henke and Gieryn noted, "In an era when the globalization of science has never been more apparent, it seems almost anachronistic for us to suggest that 'place' continues to matter a great deal for the practices and accomplishments of science" (2008: 353). They argue that these features are, in fact, not opposed, but that some places as "authoritative sites for knowledge-construction actually *enable* the mobility of science all around" (ibid, original emphasis). Conversely, I argue in this thesis that (im)mobilities, too, enable the construction of specific places as sites for science.

The geography of scientific (im)mobilities

So far, the geographical dimension of science has largely been approached in STS through the *places* where scientific knowledge is produced and, conversely, through the analysis of how scientific knowledge produces specific places. The movements of science and its mobile nature have mostly been interpreted as a consequence of its fixedness: it is because science happens in places that it ultimately circulates. However, in this dissertation, I propose to look at the production of scientific knowledge from the opposite perspective, taking up Greenhough's argument to focus on the 'production of space' by scientists and how they generate new 'spatial possibilities' (2006). In particular, I argue that scientific (im)mobilities generate sites for scientific knowledge production. In this section, I will thus delineate my theoretical contribution around the geography of scientific (im)mobilities, drawing from geography scholarship to address an overlooked yet major STS inquiry.

The 'mobility paradigm' in STS

After the so-called 'spatial turn' inspired social sciences to explore the materiality and malleability of the relationships between knowledge and power, geography encountered its own 'turn' with what some called the 'new mobility paradigm' in the early 2000s (Hannam, Sheller, and Urry 2006). Having significantly contributed to the notion of a postmodernity marked by "time-space compression" (Harvey 1989: 240), geography began to examine the symptoms of this compression and acceleration of exchanges, capital, innovations, and techniques. "Mobility" and "hypermobility" provided a fruitful lens for understanding contemporary global transformations and the unequal power dynamics generated. Consequently, many geographers within 'mobility studies' emphasised the relational aspect of mobilities: as some parts of the world embrace liberalism and postmodernity, borders disappear, and exchanges intensify across various domains, whilst some communities remain stuck and obstructed, particularly in migratory contexts (Sheller and Urry 2006; Urry 2007; Elliott and Urry 2010). This observation resonates with concerns of STS scholarship, which also seeks to illuminate persistent power dynamics and inequalities in the condition of postmodernity.

Thus, mobility provides a particularly conducive avenue for dialogue between geography and STS as it emphasises the dynamic, relational, and political dimensions of knowledge production. As geographer Tim Cresswell notes, "mobilities research thinks about a variety of things that move, including humans, ideas and objects" (Cresswell 2011: 552).

The interest in movement in STS is strongly reminiscent of ANT, which focuses on describing the 'networks' of translation between human and non-human actants making up knowledge. Through networks, ANT addresses the discontinuities, heterogeneity, and asymmetry of knowledge, which resonates with the 'mobility paradigm' scholarship. However, these networks are not conceptualised in space – Latour insisted that "a network is a concept, not a thing out there", and the logic of networks is relational rather than spatial (Latour 2005: 131; Guggenheim 2016: 3). Still, mobility emerged as an important conceptual tool, particularly around the concept of "immutable mobile" (Latour 1987). Defined later by Guggenheim as "mobile technologies that allow the standardization and reproduction of actions in different places" (2016: 6), these objects

are created by science for dissemination, stabilising socio-technical processes and creating a form of homogeneity upon their diffusion. These immutable mobiles are a fundamental symptom of modernity and emphasise the tension between fixedness and mobility, friction and diffusion. However, again, Latour did not conceive them as spatial objects, even though he associated them with "centres of calculation", places that concentrate the diffusion of techniques. Mol and Law later replaced these diffusion networks in spatial settings, focusing on their "topologies" (1994) and "spatialities" (2001).

Furthermore, while the literature in STS has demonstrated the dynamic and active nature of places and networks in scientific production, it has struggled to conceptualise this dynamism alongside the inherent anchoring of places. A striking example goes back again to Latour, and his refusal to consider the laboratory as a spatial object. In 'Give me a laboratory and I will raise the world', he reflected on labs and their position within societies for the production of scientific knowledge. He considers the questions of "where the laboratory" and "where society" are (1983: 154), but ditches the geographical component of this inquiry, simply because the movements and networks ("displacements") that create labs are impossible to precisely situate in space. However, a laboratory remains a building located somewhere. How to account for that whilst acknowledging the numerous and constant movements that are constantly generating the lab and its contribution to society? Geographers would argue that, simply, employees commute to work everywhere, workers maintain the infrastructure, papers are sent out for publications, they receive equipment, etc. All these daily, mundane, routinised and repeated mobilities and immobilities constantly (re)generate and (re)purpose the lab as a site for science. Otherwise, the lab is not a *place* in scientific knowledge production, but a mere building.

As shown in this critique of Latour, while STS has largely approached mobility as an analytical tool, it has generally underexplored it as an object of study – and immobility even more so. I will further unpack this observation in the following sections.

Mobility, immobility, (im)mobility

Allow me to return to the definitions of 'mobility', 'immobility' and, ultimately, '(im)mobility'. According to geographer Tim Creswell, mobility without *meaning* is

simply movement (or "abstracted mobility") (2012: 2). Mobility, then, is not merely a movement through space; it is a social condition – moving – which assigns meaning and representation into space (Urry 2007, 2012). Thus, "mobility is how geographic movement becomes entangled in the way societies and cultures assign meaning through talk, images and other representations and live out their lives" (Adey 2017: 7; Cresswell 2006). One common way that mobility is interpreted is as a form of power, or even capital. Kaufmann, Bergman, and Joye (2004), for example, propose the notion of 'motility' to encapsulate how spatial mobility shapes social mobility and vice versa. Mobility refers to the experience of movement and the meanings generated, and helps to describe and understand societies.

Similarly, immobility needs to be conceived as more than the mere absence of movement. In the 'new mobilities paradigm' and studies of 'hypermobility', immobility is often thought of as a symptom of domination and power or active resistance against the acceleration produced by science and technology (Smart and Smart 2011). David Morley, for instance, suggested that mobility "is increasingly seen as a social good and immobility increasingly acquires, by contrast, the connotation of defeat, of failure and of being left behind" (2002: 202). However, some scholars have argued that immobility also deserves attention as a meaningful and active experience of (non) movement. One remarkable attempt to move beyond a binary of mobility and immobility comes from geographers David Bissel and Gillian Fuller's *Stillness in a Mobile World*, which introduces the concept of 'stillness' as a "pulse (…) punctuating the flow of all things" (2011: 3). Against the dominant narrative of intensifying flows and compression of time and space, Bissel and Fuller argue for a consideration of what stays *in place* and why.

> (…) curiously, stillness is so often anticipated, more or less, as an aberration and thus a problem to be dealt with. A moment of emptiness or missed productivity, producing a hobbled subjectivity without active agency. In an epoch that privileges the mobilization of mobility, still has been stilled; turned into a stop that is just waiting to go again. Waiting to be re-moved (2011: 3)

They also demonstrate that stillness can be a desire and even "a solution against logic of accumulation and productivity, consumption, movement and activity" (ibid: 6). In articulating mobility and immobility in this way, Bissel and Fuller demonstrate how 'stillness' generates new forms of relations, which go beyond movement. Stillness can be an act of resistance, a disruptive and unruly engagement with the logics of modernity.

Bissel and Fuller's approach is common to geography, which often examines mobility and immobility together, whether as complementing or in opposition. Barry and Iaquinto noticed that "The topic of immobility has been an area of concern since the arrival of the mobilities paradigm" (2023: 37), and Bourlessas states that mobility "should always be seen as dependent on, and in relation to, forms, practices and places of immobility" (2018: 755). Migration studies scholars have proposed contributions approaching the inextricable relations between mobility and immobility. They typically ask, "Who moves freely and who doesn't? How does one's place of residence on the planet frame one's capacity to leave or travel, if one so desires? How does the movement of some rely on the immobility of others?" (Adey 2017; Ahmed 2004). Similarly, Hannam, Sheller, and Urry (2006) develop the concept of 'moorings' as the fixed infrastructures that enable mobilities, such as roads and airports. The entanglement of mobility and immobility thus exists in space and specific places.

If mobility refers to the experience of movement across space, time, and society, and immobility to stillness – the parenthetical construct '(im)mobility' aims to embody the sense that there can be no motion without a beginning and an end, no pause without activity. Thus, mobility and immobility are not relative to a binary form of movement and rather embody that movement is never linear: it is made of pauses, delays, anchoring, and acceleration. (Im)mobility is a relational concept.

I argue that (im)mobility is more than the entanglements of mobilities and immobilities. I noticed that in the literature using '(im)mobility', the writing with the parentheses is not particularly discussed or justified, and is rather a convenient way to use the two concepts together. In this thesis, I aim to use (im)mobility as a fruitful concept of its own. As I aim to look into how scientists generate new 'spatial possibilities' (Greenhough 2006), I argue that (im)mobility is a conducive concept to address the *stability* and *repetition* of mobilities, and the spatial and temporal dimension of scientific practices. In this context, I take up Yi-Fu Tuan's conception of the relationship between place, space, and time:

> (…) mobilities are not the simple aggressor to any chance of meaningful attachment to places. Rather it is the **immobility of their repetition that habituates into a stable investment of meaning**. (...) What is important is the **stability of these mobilities – the repetition which formulates attachment**. (Tuan 1977, in Adey 2017: 93, my emphasis)

In other words, the process of repeatedly moving backwards and forward to the same site creates a sense of place. (Im)mobility thus addresses the need to consider places as dynamic (Thrift 1999), constantly (re)generated through the mobilities of people who access, stay, leave, and return there.

Turning to scientific (im)mobilities

At the start of the chapter, I presented the dilemma faced by numerous STS scholars working on 'placing' scientific activities, in approaching the fixedness and moveability of science. (Im)mobility emphasises the inextricable relations of movements of scientific people, ideas, and activities, with the sites that generate, disperse, and direct these flows. The aim is not just to consider more movements in the geographical study of science, but to pay more attention to overlooked repetitive movements. Instead of being out in space, somewhere in networks, or rigidly fixed in places, I argue that sites of knowledge production are constantly being (re)created, (re)generated, and (re)appropriated through (im)mobilities. This repetition of movement not only maintains a site, but it also gives it a "stable investment of meaning" (Adey 2017: 93) and generates attachments to places. Importantly, it sheds light on the meaningfulness of stability and attachment in light of growing discussions about the 'acceleration' of academic lives, expectations of mobility, and the importance of 'maintenance'. In this section, I will delineate how (im)mobility contributes to both existing and relatively emerging sets of inquiries within the STS literature.

Although the dynamic aspect of places has been addressed in STS beyond the 'localist genre' (Ophir and Shapin 1991), as exposed in the previous section; very few studies have interacted with the idea of (im)mobilities as movements with meaning and practice, and the topic of stability and repetition of movements. Rather, most studies either use mobility as a metaphor (such as the 'immutable im/mobile') or as a descriptive tool. Typically, works engaging closely with the 'mobility studies' field have analysed the dynamics of academic mobilities, describing the movements of scientists across institutions throughout their careers (Allison and Long 1987; Flanagan 2015). They particularly unravelled how international mobilities have increasingly become expectations under 'academic capitalism', in which scientists and institutions compete for

reputation and other forms of symbolic capital in the global market (Hackett 2014; Fochler 2016; Kim 2017). Here, mobility is understood as a factor of success of elite scientists (Azoulay, Ganguli, and Zivin 2017) but also one of discrimination (Ackers 2008) and emotional distress, as junior scientists tend to experience 'homelessness' and lack of attachment to places (Balaban 2018). Starting from the connection between mobility and academic precarity, Sarah Davies opened a conversation on the meaningful and affective dimension of academic mobility (2021). She approaches scientists' international mobilities as 'atmosphere', a concept drawing from geography (Anderson 2009). Davies argues that studies of academic mobilities have given little attention to the "affective regimes" of mobilities and how these impact scientific work conditions. Through discussing their experiences with scientists, Davies noticed the "non-coherence or tension" of mobilities:

> (...) mobility might be simultaneously desired and imposed; permanent and temporary; pleasurable and painful – and [was] imagined as operating at multiple different scales, from the intimacy of interpersonal connections to the global dynamics of research. (Davies 2021: 217)

As 'atmospheres', too, are composed of everyday 'tensions', or 'frictions' (Tsing 2011), mobilities can encompass the desire for some scientists to move or stay, their struggles to settle somewhere while thinking of 'the next move' for their career. It appears surprising, then, that Davies did not consider the immobilities of science and what happens when scientists do not move. To move, one needs first to be still (Adey 2006).

Because (im)mobility entangles spatial and temporal considerations, it also resonates with the existing STS literature on the precarity of academic lives and careers, in which (international) mobility is a growing source of anxiety and tension. A string of literature, discussed in Davies' paper (2021), approached the spatial dimension of academic pressures, along with studies of mobilities, while other scholars have addressed this issue in its *temporal* dimension, discussing the 'acceleration' of academic time (Vostal 2015, 2016). The "heightening tempo of academic work-life" (Vostal 2015: 296) echoes the general 'social acceleration thesis' notably developed by philosopher Hartmut Rosa (2013) to describe the paradoxical situation of societies which are allowed 'free-up time' thanks to technological developments, while these progresses pressure them to live *faster*, with fewer time resources. As Filip Vostal notes, this social condition is particularly reflected in academia:

> The dramatic shifts of funding regimes prompted by neoliberal ideology, the efficiency imperative, output-oriented and performance-based research culture, increasing teaching commitments resulting from massification, pervasive managerial practices and the changing purpose of the university are commonly recognised as the main forces behind such realities (2015: 295-96)

Interestingly, Vostal developed a typology of the 'acceleration experience' faced by academics, to 'resent', 'manage' or 'embrace' this growth of expectations under fewer time resources (2015: 296). This echoes Davies' (2021) argument: academic mobilities can also be seen as sources of strategies to resent, manage and embrace the expectations to move.

In STS, few studies have examined the meaningfulness of staying somewhere and the attachment to scientific places generated by the stability and repetition of accessing them. However, (im)mobility can be a useful contribution to these discussions in STS around the 'acceleration' of academic work-lives, because such pressure resonates with the global urge for innovation (Russell and Vinsel 2018). Against "our era's obsession with 'innovation-speak'" (p. 3), a growing STS scholarship has called attention to the material practices involved to "make things last" (Denis and Pontille 2022: 14). In particular, sociologists Jérôme Denis and David Pontille, within the 'maintenance studies' research agenda, took a closer look into the "background activity *par excellence* that very often does not seem to matter" (p. 16). They reveal that these activities of maintenance and repair of everyday objects and infrastructures enact specific 'careful' relations of attachment, attention, resilience and care. Interestingly, in a 2015 paper, they open up their argument for a deeper study of maintenance practices with the example of "'immobile infrastructures dedicated to mobility" (Urry 2007; Denis and Pontille 2015: 339), such as airports. Indeed, as many geographers have argued, global mobilities could not happen without immobile infrastructures, or 'moorings' (Hannam et al. 2006), which have fixed, material realities that constantly need to be maintained and repaired – taken care of. Turning to scientific (im)mobilities forms part of this larger acknowledgement that, instead of mostly focusing on innovation and socio-technical advancements, STS scholarship can equally unravel how things last. Staying put is not a synonym for passivity; on the contrary, making things last in the long term should be approached as active and even political against the acceleration of social lives. This goes back to geography's turn to stillness after the 'new mobilities paradigm' (Bissell and

Fuller 2011; Cresswell 2012). As Creswell notes, "Stillness in work informed by the mobilities turn, however, is not suggesting a return to a discipline based on boundedness and rootedness but rather to an alertness to how stillness is thoroughly incorporated into the practices of moving" (2012: 648).

Finally, such attention to the repetition and stability of movements in and out of scientific sites echoes another geographical scholarship that has not particularly taken hold in STS, the study of *rhythms*. In line with Henri Lefebvre's *Rhythmanalysis* (2004) and furthered by Tom Mel's *Reanimating Places. A Geography of Rhythms* (2004), (im)mobility acknowledges the spatial and temporal dimension of movements as it is a lived, embodied, and sensorial experience. As Creswell explains, "rhythms are composed of repeated moments of movements and rest, or alternatively, simply repeated movements with a particular measure" (2010: 23). To Lefebvre, rhythms constitute the production of everyday lives and are part of social order. Attending to rhythms is a lens to investigate the production of societies through the ordering of particular movements, stabilities, repetitions, cycles, frictions, and breakdowns. Thus, looking into scientific (im)mobilities is also a consideration for the integration of spatial movements into larger timescales. Scientific places, flux, and networks have their rhythms and tempos, constituted of many (im)mobilities.

In sum, it appears timely to turn to scientific (im)mobilities in STS scholarship. Firstly, mobilities is a common topic and analytical tool across human geography and STS, and both disciplines connect it to broader societal diagnosis of acceleration of time and compression of space in the postmodern era. Second, as geography has also turned to the tension between moving and staying put, flux and anchoring, STS has yet to resolve this tension (Dijstelbloem 2023). However, recent strands of work, particularly along the 'maintenance studies' agenda, have shed light on the necessity to carefully consider maintenance practices and the absence of immediate change as still active and meaningful. In my following analysis of marine ornithologists' (im)mobilities to field sites, I thus investigate the mobilities of scientists to the colonies they study and particularly focus on the meaning of their immobilities on these sites – staying at a single colony and repeatedly coming back over the years is no mundane work.

The geography of (im)mobilities in field sciences

It is clear that geography of science encompasses a multitude of questions and topics, and the specific angle of (im)mobilities also resonates with many fields within STS. In this thesis, I apply the geography of scientific (im)mobilities particularly to field sciences, which, as I demonstrate in this final section, have also been distinctively confronted with the problem of the anchoring and dynamism of science. The literature has been particularly rich in addressing the highly localised dimension of field sciences, but has ultimately paid little attention to the (im)mobilities that produce places for science. In this section, I will go back to how the dynamic-fixed dimension of scientific places has been discussed in the literature. Moreover, the specific case of marine ornithology offers an even broader conception of field sites as constantly (re)generated not only by researchers but also by the (im)mobilities of non-humans inhabiting these places.

Placing field sites?

> The field in this sense is not just 'there'; it is produced and re-produced through both physical movements across a landscape and other sorts of cultural work in a variety of sites. (...) The field is produced *in situ* through a variety of embodied spatial practices. (Driver 2000: 267)

Unlike laboratories, scientific sites *par excellence*, field sites are ambiguous entities to delineate and even more to place. This is because of the nature of these places, which do not exist as scientific sites *per se*, but specific practices of data collection give these sites – inhabited and used by others – a scientific function (Driver 2000; Ezequiel and Martín Valdez 2021). This ambiguity of field sites has particularly interested historians of science who have explored the emergence of field sciences at the turn of the 20th century. For Robert Kohler, the major challenge of field naturalists is to reconcile the expectations of universality and replicability from the laboratory with the inherent locality of data collection in the field. He theorised this as the 'lab-field border', a concept that initiated a tradition of STS studies defining the field not for itself, but always in resonance with the laboratory (Kohler 2002a; Golinski 2005; Gieryn 2006; Vetter 2012; Adler 2014; Bont and Lachmund 2017). Although Kohler rightly showed in his book *Landscapes and Labscapes* that this distinction between the lab and the field was important for the first

generation of field naturalists, one might legitimately ask if such a distinction still prevails for 21st-century field ecologists.

The concept of the 'lab-field border' encapsulates the high permeability of the field, which is only a field when practised as such by researchers. This aspect is well expressed by Latour, who described the fieldwork of botanists and soil scientists in the Brazilian Amazon. He then demonstrated that their work consists of constant back-and-forth exchanges between the forest they study and the laboratory (1999). Latour argues that the field is not solely confined to the forest but remains and exists through the circulation of references – samples collected for laboratory work, which will guarantee the standardisation and credibility of fieldwork. In addition to these broad circulations, Latour also draws attention to the smaller-scale movements in the field that turn the place into data (ibid: 23). This description of the field as a highly permeable entity constituted of a reverberation of movements echoes his former conceptualisation of 'centres of calculation', which relates to the processes by which knowledge is moved from peripheries (such as field sites) to metropolitan centres (such as laboratories) (Latour 1987).

Thus, the field appears to be an inherently (im)mobile object: it is constituted by the mobilities of researchers accessing it, and their immobilities to remain and collect data. Studies of field science have already faced the issue of the field's anchoring and dynamism. Initially, when launching their programme for a better account of field sciences in STS, Henrika Kuklick and Robert Kohler highlighted this dynamic dimension:

> We must attend to the exigencies of getting to and staying in the field; to the affective aspects of natural places; to the heterogeneity of field science workers and tasks; and to the chronic issues of status and credibility that derive from the social and methodological tension between laboratory and field standards of evidence and reasoning (1996: 3)

They conceptualise the field as a porous spatial and symbolic entity, generated by researchers' access, their affect toward the natural places they study, their relationships with local inhabitants, and their struggle to make these sites legitimate and authoritative for science. However, Kohler later interprets this porosity as the sign that fieldwork matters first and foremost as a *place*, and that "field practices are not the placeless practices of labs but practices of place" (Kohler 2002b: 192). For him, 'place' is the central concept to analysing field science, as the field initially emerged in opposition to the 'placelessness' of the labs, and researchers must balance the particularities of places they study to produce universal scientific facts.

> The most obvious strategy for field biologists to achieve credibility – but difficult, because of the places where they work and the things they work on – is to become more like laboratory scientists. The trick is to assimilate elements of laboratory practice and make them appropriate to field conditions, to seek out natural places that resemble laboratories in some way. Another strategy is to do what lab worker cannot: namely, use the very particularity of nature to create knowledge that is true of nature generally (Kohler 2002a: 11)

The term 'place' rather than 'space' is important for Kohler, "to underline the physicality and reality of these places where border culture is experienced and lived" (2002a: 6). To counterbalance the symbolical and cultural dimension of border-work between the lab and the field, Kohler seeks to focus on the material reality of researchers' movements across this 'border' which long led to the field being seen as a form of recreational and less credible science. However, these movements clearly show the relevance of considering the (im)mobilities of the field. Kohler himself compared researchers to 'transhumant pastoralists' who change fields with the seasons (p. 19). Despite acknowledging the importance of (im)mobilities in and around the field – sometimes mentioned as "circulations", "paths", or "motion" – Kohler refuses to view the field as a 'produced space'[10].

Subsequent studies of field sciences have blended this anchored conception of the field as a place and fieldwork as 'practices of place' with the recognition that the field is primarily a *space* produced by researchers' practices and representations. Because it can be located anywhere, the field is always generated by researchers, developing particular 'spatial possibilities' (Greenhough 2006), 'geographical imaginations' (Gregory 1994; Hennessy 2018) and practices to *inhabit* these places (Geissler and Kelly 2016). Adler, for example, defines the field as "a type of space in which scientific knowledge is produced" (2014: 339), and De Bont and Lachmund argue, in *Spatializing the History of Ecology* that "scientific work (…) is simultaneously spatially situated and productive of space" (2017: 7).

One way the field is spatially produced is through domestication by field scientists. Geissler and Kelly proposed a special issue in *Social Studies of Science* to explore how scientists turn field sites into 'home' through field stations (2016). Guillaume Lachenal, for example, describes how the Lamto field station in the Ivory Coast was turned "both a

[10] In line with traditionally Lefebvrian ideas. This refusal to consider field sites as spaces is even more developed in a commentary published in 2012 (Kohler 2012).

home for science and home for France (…) [and] a scientific home for ecology" (2016: 878) through investigating the "material and affective life of the station" (p. 889). To Geissler and Kelly, the domestication of field sites as 'homes for science' refers to the "function of the station as a residence for scientists, a shelter from the perils of the wilderness and indigenous inhabitants, and a sanctuary from trouble metropolitan worlds" (2016: 798). They acknowledge that these representations of field sites are not only materialised in places, but they also happen in time and are evolutive.

The natural spaces scientists study are mutable, especially under the environmental crisis, changing political situations (in particular, post-colonial times) and, importantly too, (broken) academic tempos (Tousignant 2013). Isabelle Arpin and Céline Granjou argue, in that sense, that "temporal issues appear to be crucial to the relationship between life scientists and their field-sites, and to the making of science in the field" (2015: 238). They thus call to consider fieldwork as "practices of place *and time*" (ibid, original emphasis).

Such a conception of field sites as generated through scientists' representations and practices, in time and space, calls us to pay closer consideration to their (im)mobilities. Indeed, field sites are generated by scientists' (im)mobilities. On the one hand, doing fieldwork entails mobility to access sites, "going out into a cleared place of work" (Clifford 1977: 186). Clifford defines the field as a "distinctive cluster of travel practices (…) [which are] more or less voluntaristic practices of leaving' home' to go to some 'other' places" (p. 196-197). On the other hand, field sites can be turned into a home for science (Geissler and Kelly 2016). Because scientists stay and 'domesticate' natural environments to collect scientific data, field sites are also produced by scientists' immobility. These movements and experiences of accessing, staying, leaving, and returning to field sites are, in all, what produce these places as sites for science. In addition, these movements relate to specific imaginations, experiences, and tempos (Greenhough 2006; Tousignant 2013; Arpin and Granjou 2015). Thus, field sites can be physically bounded to specific places[11], such as field stations, but the literature has well demonstrated that these are primarily produced spaces by scientists.

[11] Some papers have described cases of physically mobile sites, such as boats (Adler 2014) or expeditions (Dritsas 2005; Faugère 2019).

More-than-human (im)mobilities in field sites

However, because field sites are primarily inhabited by others, human and non-human, they are not solely produced by scientists. Amanda Rees notes, in the case of field primatology, that the unruly mingling of scientists and primates' practices made, in fact, some sites valuable for science:

> (…) field sites were irregular places that were not easily accessed, which rarely possessed defined boundaries, and whose populations (human, animal and plant) and the relationships between them could fluctuate erratically and unpredictably. Yet, it was precisely this irregularity, these fluctuations and the lack of clear boundaries between functioning systems that drew the field researchers. (2006: 312)

Thus, field sites should not only be conceived from the practices and (im)mobilities of researchers, but also integrate those of the organisms they study, and generally of all inhabiting these places. This is generally what makes them attractive and invested by field biologists, as Rees has, for example, described.

This calls back to another convergence of geography and STS that draws attention to the critical role of non-human actors in the trajectories of human societies[12]. Among this growing literature, 'animal geography' has, for instance, focused on describing how certain places are defined *for* animals and how animals can transgress these spaces (Philo and Wilbert 2000). Christielle Gramaglia (2002), for example, describes territorial conflicts in southern France between various local actors and colonies of gulls. She shows how each group of actors projects and assigns the 'right' place for the gulls – where they should belong. In her case, local groups of ornithologists themselves select certain groups of gulls to kill, to protect other bird species, thus choosing which has the right to occupy the space. 'Animal studies', therefore, extensively describe how the spatial practices of animals are conditioned, in more or less forceful ways, by humans.

Conversely, Timothy Hodgetts and Jamie Lorimer emphasise animals' experiences of being entangled with humans, suggesting approaching them through the perspective of their mobilities. They propose to develop a study of 'animals' mobilities'[13] which

[12] In STS, actor-network theory critically addressed such inquiry. In geography, Sarah Whatmore (2002) introduced 'hybrid geographies' borrowing from ANT, more-than-human theories and animal geography.
[13] Hodgetts et Lorimer use the word 'mobilities' to encompass "movements and stillnesses that are socially shaped, experienced (by human actors, in most accounts), and that have meanings for those involved" (2020: 6). They thus also approach (im)mobilities, under the generic term 'mobilities'.

"extend the concept of mobilities to animals by first asking how animal movements are shaped by human actions [...] how movement (or its lack) is experienced by animals themselves" (2020: 5). This contribution shows that (im)mobilities are fruitful for exploring the multiplicity and entanglement of lives that practice and produce spaces.

Among these co-produced spaces, the field must also be considered, as Isla Forsyth proposes developing 'more-than-human geographies of field sciences'.

> However, so far, there appears to have only been peripheral attention paid to the multiple and myriad nonhuman animals that are present in the field. The field is a site where animals have been the object of study, provided transport, companionship, sport and food, but their presence within the history of field science is conspicuously absent. (…) field science is a process of learning with and from nonhuman animals, yet so far, the more-than-human relations in the field where places, lives, performances and knowledge become knotted together in a process of mutual transformation have been underexplored. (2013: 527-528)

She defines the field as "a space shaped by the more-than-human relations that take place within and produce it" (p. 536) and thus proposes to approach the geography of field science through "how animals, alongside diverse technologies, can become enrolled in the doing of field research, and influence knowledge and practice" (p. 528). This call resonates with Martin Mahony's suggestion, a decade later, that geographies of science and technologies should interact further with the literature of care, which has particularly emphasised the entanglements of humans and animals in the production of science (Puig de la Bellacasa 2017; Friese 2019; Mahony 2023). In the laboratory, Carrie Friese, for example, argues that, as they work closely together in local settings, lab technicians and mice develop "intimate knowledge" (2019). She shows that local entanglements in scientific settings are entirely conducive to the production of scientific facts. In the field, Jamie Lorimer describes the affective practices – embodied skill, emotion and ethical sensibility – towards the birds the surveyors study (2008). In particular, he shows that, to produce knowledge in the field, surveyors must "learn to be affected" (p. 397) and develop an "ethical sensibility or ethos of engagement that field scientists bring to their interactions in the field" (p. 398). Such studies demonstrate very well that field sites should not only be approached as places, but as spaces of representations and emotions, co-produced by scientists and the animals they study.

This furthers the argument for taking into account not only *scientific* (im)mobilities in the field, but also how these interact, are shaped by, and produce *more-than-human* (im)mobilities. As I will show in the case of marine ornithology, we cannot

understand the movements of seabird scientists without attending to those of the seabirds.

Conclusion

To conclude, although 'geography of science' has been discussed for several decades, there are still many gaps in the dialogue between human geography and STS. This area of academic inquiry contributes to understanding how, beyond being situated in space and society, science is a hybrid activity, both dynamic and static, anchored in places yet always in motion. In this context, (im)mobility is a conducive angle to take part in STS scholars' effort to 'place' science while considering its generative, produced and representational aspects. It shows that geography of science can enact typical STS inquiries with a geographical sensitivity beyond traditional questions of 'place', 'space', 'placing', and 'spatialising'. Whilst addressing this 'dilemma' of placing scientific activities into space, (im)mobility is useful to embrace these points altogether.

Essentially, I demonstrate that, while science can occur in certain places, scientists produce spaces through their acts of accessing, staying, leaving, and returning. Through the lens of (im)mobility, I aim to consider these scientific movements and stillnesses, along with the experiences and emotions they generate. I particularly apply the geography of scientific (im)mobilities to the field site, which is fundamentally shaped by the practices, representations, and emotions of researchers, as well as the animals they study. Within this framework, (im)mobility allows us to envision the field as a space in continuous (re)construction, (re)configuration, and (re)negotiation. It is the stability and repetition of researchers' (im)mobilities that transform and sustain these places as a 'home for science'.

In the next chapter, I will thus outline the methodological approach I deploy to address these scientific (im)mobilities in the case of marine ornithology. To grasp those, I attempt to 'follow those who follow seabirds', between colonies and the open ocean.

Chapter 3

Following those who follow seabirds

Methodological accounts

If someone, unfamiliar with my field of study, asks me what my thesis is about, I tend to reply, with a touch of irony, that I "observe those who observe seabirds"[14]. If this may appear abstract, I mostly try to suggest that I am acting as a mirror, researching those researching seabirds. Such expression can be reciprocated in many ways: observing those who…, studying those who…, following those who… I believe the word 'follow' better embodies my approach, which I will explain in this chapter.

In the social sciences, 'following' is not a mundane word. It commonly refers to the method popularised by anthropologist George E. Marcus of 'multi-sited ethnography' (Marcus 1995; Hine 2007), whose principle is to carry out fieldwork and subsequent observations in several places identified for their representativeness and differences, to gain a better understanding of the practices of the community being studied. In his seminal paper, Marcus exposes the principles of multi-sited ethnography, and what it can "follow": the people, the thing, the metaphor, the plot, the story or allegory, the life or biography, and the conflict. For marine ornithologists, 'following' has a different dimension. It can be a synonym for 'monitoring', closely observing a population of birds over time, to assess potential changes. 'Following' also refers to challenging methodological decisions as seabirds are species characterised by their propensity to breed in places inaccessible to men (or at least, perceived as such), and to spend most of their lives in the open sea. "Following seabirds" is thus a difficult endeavour, and

[14] It is also how I presented my study to the marine ornithologist community during my talk at the 16th International Seabird Group Conference. Similarly, Dan Podjed, in his study of Slovenian ornithologists explains his position as "an observer of observers" (2013).

"following those who follow seabirds" is all the more so. In this chapter, I shall present my methodological approach, which, as the previous paragraph has instilled, has a strong 'auto-ethnographic' and at least, reflexive dimension. Studying the field practices and choices of marine ornithologists, I also have my own practices, methodologies and choices, which I will explain here.

Thus, in this chapter, I situate marine ornithology and explore what it means for researchers to 'follow seabirds'. I also present the methodology I developed to 'follow' marine ornithologists. As I argued in the introduction, the study of birds involves encounter and attention, anywhere and everywhere (Bonta 2010; Despret 2021). However, in the case of seabirds, this encounter must be carefully negotiated in specific locations, which, I will demonstrate, fosters a strong epistemic culture that values fieldwork. In this sense, I suggest that fieldwork at seabird colonies generates numerous narratives that help shape what it means to be a marine ornithologist. Additionally, I will demonstrate how, as a geographer of science, I approach the hybrid nature of field sites as both fixed and fluid entities, created and practised through scientists' (im)mobilities. As a trained geographer, my initial aim was to map field sites in seabird research, to produce a clear and compelling illustration that some colonies attract more research than others. However, in this chapter, I explain why I realised this approach could not fully capture the realities of field sites as hybrid and dynamic entities that cannot be simply pinpointed on maps. Instead, I propose to 'map beyond maps' by focusing on the practices and representations of fieldwork – how scientists conceive where it *should* be rather than where it is. My study, therefore, is based on biographical narratives, semi-structured interviews with marine ornithologists, and multi-sited participant observations. Through qualitative data collection, I examined the narratives within the seabird research community and how they perceive and negotiate access to colonies, transforming them into field sites. Consequently, I studied fieldwork *with* fieldwork, enabling critical reflection on what engaging in fieldwork means for someone following seabirds – and someone following those who follow seabirds.

Unravelling narratives and practices of seabird colony fieldwork

In this section, I describe the scientific community of marine ornithologists I follow in this study, and then explain *how* I follow them. Fieldwork at the colony reveals specific issues and practices that must be addressed to inform my methodological choices. In the following, I will argue that the slow and proximate observation of birds in the field is a relatively recent development in ornithology. In marine ornithology, this issue is even more difficult to negotiate. Because of these challenges, the study of seabirds is particularly relevant for examining fieldwork as a multifaceted set of practices and narratives.

Situating fieldwork in ornithology

At first glance, defining marine ornithology seems rather straightforward: it is the science that studies seabirds. On closer examination, however, marine ornithology is a heterogeneous community of professional scientists and amateurs whose research questions and scientific practices lead them to study seabirds. Setting the boundaries of the scientific study of seabirds is not so straightforward, and ornithology could be described as a 'classic' case of Thomas Gieryn's boundary-work theory (1983). Upon reviewing the STS literature, I observed that ornithology has been predominantly approached as an activity, with most contributions discussing ornithology in terms of birding or birdwatching – observing birds (see, for example, Law and Lynch 1988; Lynch and Law 1999; Lorimer 2008; Toogood 2011; Podjed 2013). The delineation of ornithology as an activity or a science remains blurry, and the literature generally little considers the study of birds beyond birdwatching. In the history of science literature, ornithology has been a focus for its seminal moments, such as the extinction of the Great Auk (Lorimer 2014; Kalshoven 2018; Pálsson 2024) and the ultimate searches for the Ivory-billed woodpecker in the first half of the 20th century (Barrow 1998; Lynch 2011; Hunter 2023; Hunter and Searle 2024). Some publications also explore the disciplines' connection to military and surveillance realms (MacLeod 2001; Macdonald 2002; Greer 2008; 2009). The literature approaching the study of birds is, of course, much broader, as I will showcase in this thesis, but I noticed how little ornithology is considered beyond the activity of birdwatching. And despite the inspiration from seabirds that is starting to

take hold in STS, marine ornithology has barely been discussed either (notable exceptions are recent publications such as Blair 2022 or Hartman Davies 2024). This strong focus of the literature on ornithology as birdwatching also emphasises how the study of birds relates to bodily and sensorial practices. Law and Lynch (1988), for instance, describe the 'descriptive organisation of seeing' of ornithologists sighting birds, which can also be materially transcribed into inscriptions such as field guides and lists. Beyond 'organizational seeing', Ellis (2011) attended to its embodied and tacit dimension, exploring the 'jizz' of naturalists able to recognise a species only from a remote glimpse. Similarly, MacDonald (2002) explored the role of the birdwatcher as a skilled observer and the controversies within ornithological associations in the UK regarding the nature of ornithology as a science. Lorimer (2008) focused on surveyors 'becoming corncrake' as they must count the birds based on sounds, not sight. Likewise, Hunter (2023) focuses on the 'sonic geography' of searchers trying to find the presumed extinct ivory-billed woodpecker through sounds.

In fact, fieldwork in ornithology remains a relatively recent practice. Until the early 20th century, ornithologists generally did not conduct direct observations of birds in their natural environments. Ornithology as a science only emerged towards the second half of the 19th century, following Darwin's ground-breaking theory of evolution, based on observations and expeditions. This introduced the idea that field observations could reveal underlying ecological and behavioural mechanisms. Coincidentally, naturalists encountered the first modern extinction of a species, which they thought would never disappear: the Great Auk (*Pinguinus impennis*). Heavily hunted for its feathers, flesh, and eggs, this seabird species breeding along the coasts of Canada up to Scotland presumably became extinct in 1844 on Eldey Rock in Iceland (Kalshoven 2018; Pálsson 2024). This loss was pivotal for the ornithology community, which, for the first time, faced the extinction of a charismatic bird caused by human activity (Lorimer 2014; Kalshoven 2018; Pálsson 2024). It also prompted them to reflect on their own practices and relationship with the birds (Chansigaud 2012). Indeed, ornithologists at the time were mostly explorers travelling to shoot and collect bird specimens, using their feathers for display and their bodies for collections (Moss 2004; Chansigaud 2012). The primary tool of ornithologists was not the binoculars but the rifle, and the main sites were museums rather than the field (Despret 2021: 13).

Upon the witnessed disappearance of birds in the 19th century, and moral debates on the role of naturalists in shooting specimens[15], practices of ornithologists shifted toward the 20th century. Indeed, scientists not only noticed the worldwide decline of bird populations, but they also understood that these were accelerated by human activities (Chansigaud 2012). Seabirds played a particularly important role in sensitising and even mobilising scientists, as they were heavily hunted during the breeding season. In 1869, ornithologist Alfred Newton launched the first public campaign in the press to denounce seabird hunting practices in England, leading to the Sea-Bird Preservation Act the same year, forbidding the killing of about thirty seabird species during the breeding season. Along with these political debates around the tragic fate of (sea)birds, some ornithologists defended another way of studying them: in their natural environment (see, for example, Raby 2015: 813, on the case of ornithologist Frank Chapman).

Thus, at the turn of the twentieth century, two ways of practising ornithology overlapped: "the first is predatory and only considers birds as future trophies, and the second is looking to observe them in their natural environment, conscious of not disturbing them" (Chansigaud 2012: 100). In this context, doing fieldwork was a novel way of studying birds, and even a political act aimed at casting ornithologists as protectors of nature rather than accomplices in the decline of bird populations. The development of fieldwork as a scientific method is not unique to ornithology and largely developed across the second half of the nineteenth century, in biology and ecology (see Kohler, 2002a; De Bont, 2015b). In ornithology, it was across the early twentieth century that observing birds in their natural environment, rather than in controlled and experimental laboratories, gained popularity among researchers and amateur naturalists. This led to radical changes in the practices, culture, and social settings of the discipline (Chansigaud 2014). Birdwatching, in theory, is accessible to anyone paying attention. Numerous amateur ornithologists, from their gardens or familiar environments, developed theories about bird behaviour that still hold momentum today. Vinciane Despret (2021), discussing the proliferation of ornithological studies aimed at making sense of birds' territories in the first half of the century, revealed that most were carried out by amateur birders. For example, Henry Eliot Howard, observing reed bunting (*Emberiza schoeniclus*) in his home region of Worcestershire, wrote a foundational study

[15] In 1888, Joseph Asaph Allen estimated in *Science* that ornithologists account for 500,000 killed birds in the USA over the century. In comparison, millinery accounted for 5 million birds over a single year.

on birds' territorial practices, *Territory in Birds* (1920). According to Chansigaud (2014), ornithology in the first half of the twentieth century was uniquely structured as a pyramidal scheme of nationwide networks of observations, arranged by naturalist organisations such as the Royal Society for the Protection of Birds (RSPB) or the British Trust for Ornithology (BTO), in the United Kingdom. These networks consisted of 'home-based' observation spots, such as gardens and familiar grounds, as well as dedicated observatories, including lighthouses and stations (de Bont 2015a). The increasing pool of professional ornithologists relied on an even more growing pool of local birders able to regularly observe and recognise birds. This became all the more crucial for the study of migration, making ornithology into what historian David Allen described as a "permanent cooperative enquiry" (Allen 1994: 212; cited in De Bont 2015a: 175).

Ornithology thus developed not only as an intimate knowledge of birds and their behaviour, but necessarily as an intimate knowledge of places – often observers' own homes. Vinciane Despret (2021), for example, noted how ornithologist Margaret Morse Nice gained a much deeper understanding of territorial interactions within a group of birds she was studying near her home in Ohio, thanks to her bird banding techniques. By attaching a ring and a unique identifier to each bird, she developed a personal intimacy with each one and spent hours observing them. Despret adds that "intimacy can only be achieved as a result of hard work" (2021: 24). It is on this principle that numerous studies of bird behaviour (ethology), seasonal migrations (movement ecology), and population dynamics (population ecology) developed across the twentieth century. Ornithology has become both a science of birds and an art of negotiating intimacy, in space and time[16].

An epistemic culture of fieldwork in marine ornithology

If the development of ornithology as a scientific discipline occurred at the intersection of familiar places and dedicated observation sites, this spatial structure was necessarily different for marine ornithology. Seabirds primarily breed on colonies selected for their distance from human threats and other predators, often on isolated rocky islands or cliffs.

[16] This is inspiringly demonstrated throughout Despret's book *Living as a Bird* (2021). She discusses the entanglement of ornithologists' theories about the territorial practices of birds and their social anchoring. Notably, she shows that the understanding of birds' behaviour developed through a sensible attentiveness to birds with long-term and close observations.

Thus, in the literature dealing with the history of ornithology, I noticed that few fundamental studies are mentioned that arise from observations of seabird colonies. Yet, as noted in the previous section, the vulnerability of seabirds was observed early on, with the extinction of the Great Auk and the intensive collection of their eggs in the 19th century (Barwell 2014; Kalshoven 2018). Seabirds are symbolic of species disappearance in the Anthropocene era, as I mentioned in the introduction (van Dooren 2014; Lorimer 2014).

The study of seabirds, more than other birds, relied in the 20th century on prolonged observations of colonies[17]. As Oscar Hartman Davies noted, "Seabirds are easier than many other bird and indeed vertebrate groups to study as populations, owing to their coloniality and relative accessibility of their colonies" (2024: 82). Though, as I will show throughout this thesis, the 'relative accessibility of their colonies' is very complex and covers many dimensions; the seasonal fidelity of seabirds to certain sites has enabled numerous fundamental studies in population monitoring and bird behaviour. Notable references in ethology are based on seabird population monitoring, such as Nikolaas Tinbergen's monograph *The Herring Gull World* (1953), or George Dunnet's long-term study of Northern Fulmars in Orkney, Scotland (mentioned in Birkhead, Wimpenny, and Montgomerie 2014). Another seminal work is Ronald M. Lockley's displacement experiments on Manx shearwaters (*Puffinus puffinus*) on the Welsh island of Skokholm. He took a bird, Caroline, to Devon, some 224 miles from its nest, and surprisingly noted that she was back on her egg about nine hours later, demonstrating the bird's navigation abilities (Lockley 1942). According to ornithologist Michael Brooke, this work in the 1940s is still fundamental for the understanding of seabirds, noting that "it is remarkable how little was known [on seabirds] just a human lifetime ago" (Brooke 2018: 13).

The study of seabirds was built around prolonged observations, sometimes repeated for decades, and captured in numerous monographs that remain significant today. Thus, marine ornithology could be said to have a strong *epistemic culture of fieldwork*. I am relying on Karin Knorr Cetina's seminal work on epistemic cultures, which she defined as

[17] This has to be distinguished from 'sea-watching', the branch of birdwatching dedicated to the spotting of seabirds from the coast or on boats (in general carried out by amateur birders to identify migrating individuals). According to ornithologist Philippe Dubois, this activity, consisting of looking at the sea for hours in the hope of spotting some flying birds, is reserved for 'cracked' people (2019: 142).

"the amalgam of arrangements and mechanisms – bonded through affinity, necessity, and historical coincidence – which, in a given field, make up how we know what we know" (1999: 1). Thus, beyond disciplinary divides and internal homogeneity, science is also structured through cultural differences and alliances. Morgan Jouvenet similarly noted that fieldwork forms an integral part of the epistemic culture of ice core science and is a critical "transformative experience" for scientists (2022: 61–62). He argues that, therefore, he deployed an "interpretative anthropology of fieldwork focusing on the meaning scientists give to their activities on ice sheets, and opening up the analysis to the emotions they attribute to them" (2022: 61). Fieldwork is not just a set of practices, but also interpretations, meanings, stories, and emotions.

In this sense, fieldwork in marine ornithology is both a scientific practice and a culture. It forms an integral part of how scientists relate to each other and perceive their work, which is embedded in monographic narratives, where scientific accounts and life stories closely intertwine. For example, going back to Ronald Lockley and his decades of fieldwork on Skokholm Island, his accounts of field practices are both rigorously explanatory and heroic, even novelistic. This is particularly striking in his description of his method for catching Atlantic puffins (*Fratercula arctica*) with a wired hook:

> Handsome he certainly is, and shrewd-looking, as he stands there, staring at the advance of the wire rod. But his behaviour suggests that he is not particularly intelligent by human standards. Otherwise he would show greater alarm; he would not peek inquisitively, idly, at the hooked tip of the rod as it is pushed close to his legs. Even when the hook is slipped over the flat scaly keel of his foot he is not greatly perturbed; he side-steps neatly, and once more pecks at the wire.
>
> There is now only a distance of twelve feet between the hand of the human being and the bird. The nine-foot-long bamboo rod with its three feet of wire bridges the gap. So long as you crawl over the ground gently and push the rod very slowly, inch by inch, you can get very close to the puffins. And it needs very little practice before you acquire the art of hooking and holding them. […] You may decide from his behaviour that the puffin is stupid. And looking at him closely you begin to see that the bird really resembles a clown. Apparently he is not only mentally stupid but he actually dresses like a clown, even to the false eyebrows, cheek, smears, and big, red, false-looking nose! Surely he must be abysmally dull-witted to permit himself to be captured by so simple and obvious a contrivance? (Lockley 1953: 1–2)

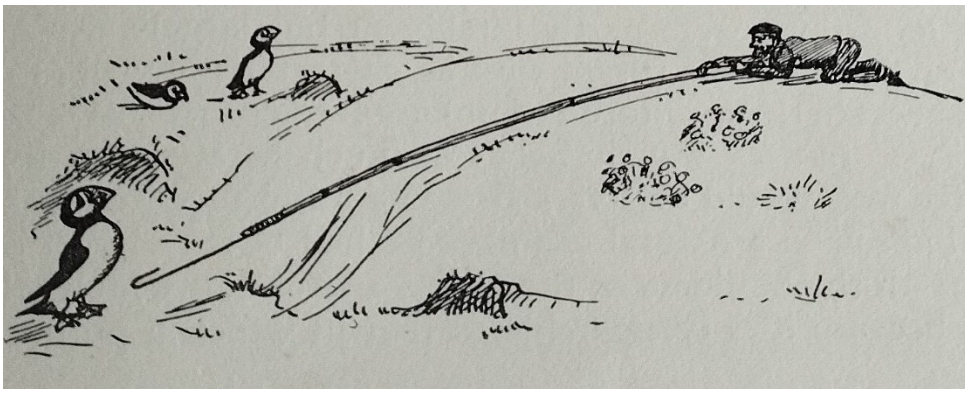


Figure 2. Illustration on the method of catching puffins from Lockley (1953)

Because they provide essential insights for researchers into the adaptations required for working at seabird colonies, these monographs are valuable sources for my study of marine ornithologists' fieldwork. In the tradition of Lockley's novelistic descriptions of field experiments, I noted that numerous other scientific monographs have been published throughout the twentieth century, and continue to be produced today (see, for example, Birkhead 2010; Kress 2015; Grémillet 2021; Weidensaul 2022). These sources are important for shedding light on field practices and the culture in which researchers operate. Although inevitably biased and romanticised, these accounts contribute to an understanding of the ideals and representations of fieldwork, perceived as a learning experience full of challenges. This 'heroic' aspect of fieldwork (which also needs to be reconsidered – see Benson 2022) produces numerous narratives that must be examined to understand how researchers select the colonies they study and work in the field. Similarly, Hayden Lorimer (2003), in his study of a geographic field expedition in the Cairngorms Mountains in 1951, demonstrated that 'small stories' and personal accounts of field experiences are valuable resources that need to be taken seriously to understand the relationships between scientists and the field. More recently, Robert Kohler published a book entirely based on 'stories from the field' (2019). He argues that:

> (…) narratives are a true and proper means of understanding human and natural worlds: they may be faulted on facts or logic, but they cannot be dismissed as untrue just because of their narrative form. For most of the long time in which histories and natural histories have been written, that was the accepted view. (Kohler 2019: 19)

He adds that narratives "are not lived but told; are art, not knowledge" (p. 21). Telling narratives "is not a description of things that already exist, but takes shape in the making of those things in the first place. It is, in other words, 'a mode of being before it is a mode of knowing'" (p. 22). Thus, echoing Kohler, I argue that because fieldwork is a generated

space of representations (see Chapter 2), field narratives should not be ditched, but, on the contrary, used to understand what fieldwork ought to be for the research community. Inspired by Lockley, Michael Brooke, for example, recounted a similar experience with catching puffins:

> There I learnt the truth about puffins. They may draw tourists by their clownish appearance and ability to grasp tens of sand eels in a single beakful. But they are horrible to handle. The beak is strong and sharp, as are the claws. It is all but impossible to hold them in a way that leaves one's hand safe from biting beak or scratching claws. (2018: viii)

Brooke contrasts with the general attraction to Atlantic puffins. Like Lockley, he shows, with a touch of humour, that he has acquired an intimate knowledge of birds in the field, beyond the appearances that give puffins a friendly look; he knows that they can be fierce. This deep, intimate understanding is crafted through *manual* contact with birds, another notable dimension of fieldwork in ornithologists' accounts, which I will further discuss in Chapter 6. Selen Eren and Anne Beaulieu note that this has even become a genre of its own in ornithologists' social media, where they post photos of themselves holding birds: "In these photos, ecologists display important moments in their knowledge production practices, and capture the achievement of turning individual anonymous birds into sources of data' (2023: 2). Thus, I also take into account narratives found on blogs[18] or social media (especially X, formerly Twitter) in the study of the culture of seabird fieldwork, where researchers share their impressions, feelings, photos, and anecdotes in real time. Although I will mostly not directly discuss these references in my study, they strongly informed my subsequent analysis and data collection, especially in the first year of my research, when I was learning about the marine ornithology community.

The narratives of ornithologists about their fieldwork hold a prominent place in this thesis. As my research questions suppose that the field is a constructed, represented, and practised space, constantly produced and renewed by researchers through their (im)mobilities, I am particularly interested in their vision of what the field *should* be, alongside what it actually is. This approach has posed challenges related to geographical representations, as I will explain in the following section.

[18] For example: Jens-Kjeld Jensen on the island of Nólsoy, Faroes Island: http://www.jenskjeld.info/UK_side/indexuk.htm.
David Steel, warden of the Isle of May, Scotland: https://isleofmaynnr.wordpress.com/.
Bethany Clark on Grassholm, Wales and Iceland: https://bethanylclark.wordpress.com/.
Jude Lane on Bass Rock, Scotland: https://gannetresearch.wordpress.com/.

Figure 3. Example of a blogpost: "Gannet-catching Viking Style" (source: Bethany Clark 2016)

"Geographers draw maps"?

In *What Would Animals Say If We Asked the Right Questions?*, Vinciane Despret (2016) is rather surprised that some French geographers are investigating a legal case of zoophilia in the United States. She wonders, "what does geography have to do with this case?". She asks her colleague, the Swiss sociologist and biologist Alain Kauffman, "how geography is different from anthropology today, [and] he responded with a smile: geographers draw maps" (p. 204). This answer satisfies Despret; she indeed noticed how different some recent geography papers she consulted are: they include maps[19]. Taking upon this assumption, that geography is anthropology *with maps*, I will present in this section how, as a geographer of science, I understand and represent in this thesis the spatial distribution of seabird colonies as field sites *beyond maps*. Although numerous studies in geography do not necessarily include maps, I started this thesis aiming to provide a comprehensive mapping of the localisation of field sites in marine ornithology, which would uncover hotspots and gaps. I will first discuss the spatial dynamics of mapping marine ornithology, a field deeply concerned with the issue of mapping. Then, I will

[19] Although I deeply enjoy Despret's work, I found it surprising that she showed such little awareness of what geography is. In one of her last books, *Living as a Bird* (2021), she demonstrates a strong sensitivity towards geographical ideas of 'territories' or space as a rhythmic and produced process rather than a fixed and delineated entity; without necessarily engaging with the geography literature.

delineate how a geography of science methodology does not necessarily need to engage with Euclidean mapping and instead, propose ways to 'map beyond maps'.

Marine ornithology: everywhere, anywhere, somewhere

As discussed in Chapters 1 and 2, seabirds and marine ornithology offer insightful opportunities to think about the relations between fixity and dynamism, being anchored in places and travelling through spaces; in short, it conveys a striking example of (im)mobility. Because of the great mobility of seabirds, marine ornithology must rely on the places where they loyally come back to.

Geographer and ornithologist Mark Bonta noted that arranging 'encounters' with birds is much of the thrill of ornithology. He interestingly argues that ornithology does not just rely on the observation of birds; it matters as an encounter *somewhere.*

> It is never just about birds; the fact is, birds make any landscape far more interesting than it would be otherwise. […] Every place we visited was of paramount importance because it contained birds, but all the landscape in between was also noteworthy for the same reason […] The only landscapes that most participants seemed to judge negatively were those that appeared to have no birds whatsoever (Bonta 2010: 141-143)

According to Mark Bonta, ornithologists do not necessarily choose where they go, but aim to follow the spatiality of birds. What matters is creating the conditions for encounters[20]; thus, ornithology can happen *everywhere* and *anywhere*. For amateur birders, the challenge is to balance mere luck, presumably letting the birds decide when and where to appear, with the acquired experience of *expecting* where these birds are likely to be observed. The negotiated encounter with birds is therefore a situated practice. To increase the chances of bird encounters, ornithologists have developed a myriad of mapping tools, such as field guides and atlases, in books or online (such as eBird – Sullivan et al. 2009). Ornithology is thus well-acquainted with geographical representations.

I noted that in marine ornithology, mapping seabird colonies is an emerging scientific concern. Since seabirds generally do not nest in familiar human locations, it is hard to know where they are beforehand. The scientific community is concerned about how this creates scientific biases and leads to some areas being more studied than others. For

[20] Several contributions in the literature note the asymmetrical power dimensions that such 'more-than-human encounters' hold (see, for example, Wilson 2017; Isaacs and Otruba 2019; Eren and Beaulieu 2023).

example, Bernard et al. (2021) produced an analysis of the distribution of seabird tracking studies. They argue that there should be a "global strategy of seabird tracking", noting the unequal distribution of tracked seabirds. Indeed, despite the concentration of seabirds in polar and tropical areas, most tracking studies take place in more temperate locations, around Europe and North America. They highlight an unbalanced distribution of studies and biases toward areas where scientists are concentrated, and seabirds are dispersed. Similarly, Clairbaux et al. (2024) propose a review to optimise the location of Black-legged kittiwakes (*Rissa tridactyla*) monitoring sites in the Arctic. They also show that some areas are more studied, while some are underrepresented, and propose to include further local collaborations with Indigenous communities, unravelling how such spatial gaps are closely related to social matters.

Ornithology thus relies on the controlled unpredictability of encounters. This delicate balance between observing birds *anywhere* and *everywhere* makes mapping their distribution crucial, extending beyond assessments of population dynamics worldwide. In marine ornithology, although the study of seabirds needs to happen *somewhere*, on precisely delimitated colonies to which birds return each year, the community noticed that some biases led to some areas being more studied than others – without yet being able to understand *why*.

Mapping seabird colonies as field sites…beyond maps

It is to contribute to these concerns, to which marine ornithologists still do not have answers, that I initially proposed in this thesis to map the distribution of field sites[21]. In the early stages of my doctoral research, I conducted an exploratory mapping of the studied seabird colonies based on a small set of publications from the open-access journal *Marine Ecology Progress Series* (MEPS), which publishes seabird studies, and the seabird-related research programme SEAPOP[22]. I spent a significant amount of time building up a dataset of marine ornithology papers, as a way to set out *where* science is done, beyond the traditional places of publications (Maisonobe 2020). However, I soon realised that

[21] As explained in Chapters 1 and 2, I mostly took inspiration from the work of the project ANR Geoscience (2010-2013), mapping the international distribution of science based on publications from the Web of Science.
[22] Which I will further describe and explain in Chapter 6.

mapping field sites is a nice tool to raise questions on the localisation of science, highlighting concentration or deconcentration of scientific research (Maisonobe et al. 2017), but it does not explain *why* science happens *there*. Moreover, as my research questions focus on the negotiations, in space and time, to turn seabird colonies into sites for science, a Euclidean 'fixed' mapping of field sites as dots on a map turned out to be limiting for my argument. Producing a geography of science does not have to rely only on maps, and in my study, maps are rather tools than results.

Rather unexpectedly, I fell into the trap of Vinciane Despret's comment on geography being about "drawing maps". Progressively engaging in the first years of this research with the marine ornithology community, I used mapping as an attractive and easy-to-comprehend argument to reach out to researchers, and even presented some maps at the International Seabird Group Conference in September 2024[23]. As a geographer of science, mapping was an appealing tool to access seabird researchers, already concerned with the issue of the spatial distribution of their work. I also used it to identify particular colonies that seemed to appear frequently in publications, and subsequently contacted several researchers who published studies based on fieldwork in these sites (I will develop my sampling strategy in the next section).

However, maps do not necessarily have to be mere Euclidean representations; in fact, as they always represent *a certain view* of a spatial phenomenon, they are great tools for addressing representations and narratives (see, for example, Brunet 2024; Commenges 2024; Medby et al. 2025). Throughout the following empirical chapters, spatial representations are never absent; in particular, in Chapter 4, I try to tackle the issue of representing ornithologists' field (im)mobilities, overlapping sites' meanings, interactions, and temporalities in the careers of researchers. Thus, I use maps to illustrate the intimate relationship between the sites and the colonies they study, their representations of what it is to be doing seabird fieldwork, and my own spatial representations, from sketches drawn in the field. Maps in this study are tools to illustrate some of the geographical dynamics I am exploring. In the research process, they also served as tools of communication with the marine ornithology community and to identify relevant participants for interviews and fieldwork.

[23] These were maps of scientific co-authorship of papers on the 'Atlantic puffin' from the Web of Science using VoS Viewer and Netscity.

Engaging with those who follow seabirds

Geographers do not only 'draw maps'; they also do interviews and fieldwork, which is even considered 'new orthodoxy' (Crang 2002) or a 'presumptive rite of passage' (Guasco 2022: 468) in human geography. These methods of data collection are also widely shared in STS inquiries (Hine 2007). The following empirical chapters draw from semi-structured interviews and a series of ethnographic observations on seabird colonies. In this section, I will unfold the process of collecting stories and representations among the marine ornithology community to understand what is at stake in fieldwork on seabird colonies.

Semi-structured interviews

Between March 2022 and October 2024, I conducted thirty semi-structured interviews with twenty-nine marine ornithologists – professional scientists or naturalists specialised in the study of seabirds. These conversations relied on a flexible grid of questions to gather ornithologists' depth of view on a range of topics (Clark et al. 2021): how the scientist ended up working on seabirds, where they did fieldwork and why there (for at least one or two sites mentioned), their usage and perspective on tracking technologies, and their scientific collaborations. The rest of the conversations were based on specific aspects of the scientists' biographies and careers, which I picked up on throughout our conversations. These interviews aimed at recreating what David Livingstone described as "life geographies" or "spaces of biography" (2003: 182). In *Putting Science in Its Place*, he argued that geography or science should also consider the effect of specific places on the 'self', how one's identity is shaped by the places they go or live in. He added that

> (…) a greater awareness of the spaces of biography, of the places of identity, or the geography of selfhood, would enormously enrich our understanding of the mutual making of science and scientist. (Livingstone 2003: 183)

Thus, the interviews aimed at grasping how marine ornithologists make sense of the places where they have been doing fieldwork (how they ended up studying a specific seabird colony, maintaining or not this study and/or moving to another field site), how they position themselves in the broader scientific community, how they perceive these

field sites have shaped their careers and how their research practices might have evolved over time. As such, I focused on delineating marine ornithologists' (im)mobilities to field sites through their careers and scientific trajectories, which I particularly discuss in Chapter 4. I also aimed at gathering their narratives of what it is like to study seabirds and do fieldwork on seabird colonies. The interviews thus recreated the 'epistemic culture of fieldwork' in marine ornithology by collecting stories, narratives, and representations. Through these discussions, I could construct and follow researchers' (im)mobilities in and out of seabird colonies throughout their careers. The interviews provided stories and representations, helping to produce a better understanding of the challenges and stakes involved in conducting fieldwork with seabirds. I used these as generators of conversations and ideas, and to understand the important considerations for scientists studying seabirds in the field.

I started the interview process by reading scientific monographs, identifying two senior seabird scientists who could introduce me to a scientific community I knew little about. For the pilot interviews with Philippe[24] and Michael P. Harris, I prepared a grid of questions related to their academic trajectories, field experiences, vision of the field of seabird science, collaboration practices, and relationships with the seabirds they study. Because of their senior position and contributions to the scientific community, these two interviews opened doors to further interviews with scientists who know and esteem them, as colleagues, friends, and former students. Knowing that they gave some of their time to answer my questions motivated some researchers to do the same, and it was with this expectation that I designed my sampling strategy[25]. As I decided to focus on the broad North Atlantic and Arctic area, I narrowed my interviews to people who conducted fieldwork at these sites, either found from scientific papers (from the preliminary mapping described on p. 66), conferences (see next subsection), or recommendations. Thus, the twenty-nine participants all did fieldwork and are established in the North Atlantic and Arctic regions (although this did not have to coincide). My sampling strategy also targeted scientists doing fieldwork on sites I was considering for my ethnographic fieldwork. Indeed, the more interviews I did, the more I noticed that field access is based

[24] Based on a consent form I presented to all interview participants, I will anonymize the interviewees who did not wish to be identifiable or who did not formally express that they wished to be identified. In this case, I use a fake first name. Real names comprise the first and last names of the participant.
[25] Generally described as 'snowballing' technique (see Clark et al. 2021).

on personal encounters and acquaintances. Interviews, being flexible conversations, acted as moments to build trust and identify whether I could ask the interviewee if they would consider letting me join them in the field.

I should also mention that the interviews were conducted in English and in French, which I will indicate in footnotes when sharing quotes. Of the 29 people I interviewed, 10 were French speakers[26], which was not something I specifically targeted, but which might have been a bias when I received recommendations from colleagues to interview or when I got contacts at conferences.

As Oscar Hartmann Davies noted in his thesis (2024), the seabird science community is small, and most people are familiar with one another. " Cultivating *good judgment* in the course of encounters" (Thrift 2003: 107) was necessary to know whether to invoke another participant's name and reference a conversation[27]. For instance, when a PhD student mentioned a conflict with a senior colleague with whom I also did an interview, and vice versa. Some other difficult decisions were related to hearing about traumatic experiences in the field. For ethical reasons, I decided not to approach these in my study, although I want to stress that gender-related abuse and violence remain a pressing matter in the field[28].

The table below summarises the interview participants and their main characteristics. One participant, Pauline, was interviewed twice, in August 2022 at the Seabird Group Conference, and in August 2023, to make up for not being able to have me join the field because of unforeseen circumstances (which was the content of our second interview). One other participant, Charles, was not formally interviewed, but we exchanged several rounds of emails between 2023 and 2024 in which he answered my questions. These interviews were mostly conducted online, using Microsoft Teams and its automatic recording and transcription tool (n= 25), via phone call (n= 1), in person (n= 3), or via email exchanges (n= 1). Efforts were made to engage with diverse representations of gender, career stage, and geographical context as reflected in Table 1. The interviews,

[26] Out of the ten French interviewees six are based in France, and only two mostly do fieldwork on French seabird colonies.

[27] Many interviewees were curious about my research project and asked who I had talked to before. As I mentioned previously, I also used the names of Philippe and Michael Harris to get some trust from the participants.

[28] In this matter, a special talk was held at the Seabird Group Conference in September 2024.

lasting between forty minutes and two and a half hours, were subsequently recorded and transcribed with the consent of the participants[29]. Finally, I wish to acknowledge that although not all of the interview participants are directly quoted in this thesis, all of the discussions I had with seabird researchers were crucial for grasping the community's broader representations and practices of fieldwork on colonies.

Table 1. List of Interviews

Participant's name or pseudonym*	Research position	Main field site(s)	Institutional location	Gender (Male/ Female)	Date
Philippe*	Biological oceanographer	Greenland, South Africa, France	France	M	29/03/2022
Michael P. Harris	Retired seabird biologist	Isle of May (Scotland)	United Kingdom	M	08/06/2022
Adele*	Seabird ecologist	Norway	Norway	F	23/08/2022
Pauline*	Post-doctoral researcher	Greenland, Ireland	Ireland	F	23/08/2022 07/08/2023
Tycho Anker-Nilssen	Senior research scientist, seabird ecologist at NINA	Røst (Norway)	Norway	M	06/09/2022
Bernard Cadiou	Ornithologist at Bretagne Vivante	Molène (Brittany)	France	M	07/09/2022
Hugo*	PhD candidate	Scotland	United Kingdom	M	19/09/2022
Mark Newell	Field technician at UKCEH	Isle of May (Scotland)	United Kingdom	M	23/09/2022
Alice Edney	PhD candidate in seabird ecology, University of Oxford	Svalbard, United Kingdom	United Kingdom	F	26/09/2022
Martin*	Marine ecologist	Norway	Norway	M	07/10/2022
Morten Frederiksen	Seabird ecologist at Aarhus University	Greenland	Denmark	M	11/10/2022
Bethany Clark	Seabird Science Officer at BirdLife International	Falkland Islands, Iceland, United Kingdom	United Kingdom	F	01/11/2022
Ingrid Pollet	Seabird ecologist	Canada	Canada	F	03/11/2022
Annette Fayet	Seabird ecologist	United Kingdom, Norway	Norway	F	04/11/2022

[29] All interviews and subsequent ethnographic observations have been conducted in accordance with the University of Edinburgh ethical guidelines. All interview participants were given a participant information document with a clear overview of my research aim and scope, and a consent form to sign ahead of the interviews, with the notable option to be anonymised and to review the interview transcript. In accordance with the General Data Protection Regulation and the University of Edinburgh data protection policy, personal data was stored securely. I submitted ethics forms to the School of Social and Political Science for conducting a series of interviews, updated for ethnographic fieldwork, which have been approved.

Charlotte*	Seabird ecologist	Norway	Norway	F	10/11/2022
Clotaire*	Ornithologist	France	France	M	24/11/2022
Aline*	Marine ecologist	France, polar regions	France	F	05/12/2022
Lewis Fisher-Reeves	PhD candidate, University of Oxford	Skomer (Wales)	United Kingdom	M	23/03/2023
Sébastien Descamps	Seabird ecologist, Norwegian Polar Institute	Svalbard	Norway	M	24/03/2023
Olivia*	PhD candidate	United Kingdom	United Kingdom	F	14/04/2023
Johannis Danielsen	Seabird biologist	Faroe Islands	Faroe Islands	M	19/04/2023
Juan*	PhD candidate	Antarctic	United Kingdom	M	20/04/2023
Françoise Amélineau	Spatial ecologist, seabird specialist	Arctic	France	F	11/09/2023
Erpur Snær Hansen	Seabird ecologist	Iceland	Iceland	M	08/02/2024
Stephen Hurling	PhD candidate	Iceland	Iceland	M	09/08/2024
Charles*	Marine ecologist	Polar regions	France	M	06/09/2024
Amanda*	Seabird ecologist	Canada	Canada	F	24/09/2024
Sofie*	Seabird ecologist	Norway	Norway	F	03/10/2024
Katarzyna Wojczulanis-Jakubas	Behavioural ecologist	Svalbard	Poland	F	07/10/2024

Conferencing

To a smaller degree, my understanding of the stakes of conducting fieldwork at seabird colonies comes from participatory observations at two major seabird conferences. This practice, often described as 'event ethnography', has increasingly gained momentum in ethnographic methods following Brosius and Campbell, noting that "there has been a surprising lack of ethnographic attention to 'the meeting' as a field site" (2010: 247). The COVID-19 disruptions forced many social scientists to develop creative strategies to engage with their objects of study and expand what they traditionally conceive as 'the field' (Howlett 2022; Keen, Lomeli-Rodriguez, and Joffe 2022). Even if my doctoral research was not directly affected by these disruptions, I incorporated academic conferences as part of marine ornithologists' engagement with field sites, spaces where they would likely share the results of their fieldwork, but also their stories. In the following chapters, I will rely on several occasions on anecdotes from the field shared by scientists presenting at these conferences.

Figure 4. 'Souvenirs' from fieldwork shared during a presentation (Coimbra, 05.09.2024)

In August 2022, I attended the 15th International Seabird Group conference in Cork, Ireland. There, I participated in a workshop, listened to the presentations, and, more importantly, engaged in conversations with ornithologists during breaks. This gave me a better sense of important topics and questions for the seabird research community. For instance, I noticed how recurrent presentations based on tracking were. Crucially, this conference was a 'space of encounter' (Thrift 2003), not only with the marine ornithology community but also with specific individuals. Coffee breaks and other moments of social

gatherings were key to discussing and meeting with potential participants of my study. Indeed, fifteen interviews I conducted over the fall of 2022 resulted from encounters with scientists at the conference. Two of these were conducted during the conference, right after we met and being introduced to my project.

Two years later, in early September 2024, and as I was starting the last year of my research, I attended the Seabird Conference again in Coimbra, Portugal. This time, my presence was less to get new contacts for interviews – although I subsequently interviewed four scientists I met there – but to present my research to the scientific community and get feedback and reactions. Like two years ago, my goal was to get a sense of the important topics and research questions and compare them with the previous conference I attended. For instance, I noticed how tracking technologies were still major, but more criticised – one presentation, for example, shared a 'failed' experiment based on tracking. Other technologies, such as AI, became important points of conversation, whereas they were barely mentioned at Cork. The emotions and ethics of doing fieldwork were also discussed, such as witnessing the disappearance of seabirds, maintaining long-term studies, and facing difficult living conditions in the field (which will be particularly discussed in Chapter 5).

Multi-sited participant observation

Because my research focuses on fieldwork practices of marine ornithologists, it was crucial to observe and, more importantly, feel and participate in fieldwork at seabird colonies. Ethnographic observations stem from a tradition of focused, bounded, and intense presence among a studied community. Tim Ingold, however, warns against the confusion between *participant observation* and ethnography, which means "*writing about the people*" (Ingold 2014: 385, original emphasis). 'Ethnography', he writes, is "a judgment that is cast upon [encounters] through a retrospective conversion of the learning, remembering and note-taking". It thus corresponds to the retrospective analysis of what should instead be called 'participant observation'. He argues that anthropologists[30] should

[30] I consider that his argument is also relevant for disciplines familiar with ethnography, in particular geography and STS.

> (…) *attend*: to attend to what others are doing or saying and to what is going on around and about; to follow along where others go and to do their bidding, whatever this might entail and wherever it might take you (ibid: 389)

I subscribe to Ingold's argument that ethnographers should rather be cast as 'participant-observers', or should I add 'followers'. In my case, 'following' meant that I joined, observed, participated, lived with, waited with, and experienced with the seabird researchers wherever and whenever they would do fieldwork. Thus, my approach necessarily had to be 'multi-sited', as I study the (im)mobilities of marine ornithologists to the field site – I *follow those who follow seabirds*. I aimed to gather various situations and practices at seabird colonies, and how fieldwork is practised and experienced. Interviews proved useful to learn about a variety of field sites, but these were also limiting in understanding the emotions and precise practices at stake when doing fieldwork. Indeed, my lack of field experience on seabird colonies meant that my questions were not targeted to get such descriptions from the interviewees, but also that the interviewees felt less inclined to share such an intimate perspective. What is more, seabirds breed in a variety of places and fieldwork frequently spans multiple sites in a single project, making a multi-sited ethnography approach even more acute.

Over the seabird breeding seasons (April-September) 2023 and 2024, I assisted several seabird research fieldworks, sometimes as a sole observer, sometimes as a participant-observer. I gathered ethnographic notes, photos, sketches and recordings to capture the routine practices and unexpected decision-making, negotiations, emotions and tensions that make up seabird fieldwork.

(1) In May 2023, I spent ten days on the island of Skomer, Wales. Skomer is a nature reserve and the biggest Manx shearwater colony in the world, as well as one of the biggest Atlantic puffin colonies in the UK. It is thus an important research site and a tourist destination. I was hosted in the accommodations of the Wildlife Trust of South and West Wales (WTSWW) with the long-term volunteers. My daily activities involved sharing time with the staff on the island, welcoming tourists and short-term visitors, who would spend a few nights in the hostel; and observing the work of three research teams studying several bird colonies on Skomer. I spend most of the days with Lewis Fisher-Reeves, a PhD researcher, and two field assistants monitoring a colony of Manx shearwaters, checking for eggs in their burrows. I also joined a researcher monitoring a puffin colony

and another monitoring a Common Guillemot (*Uria aalge*) colony. My fieldwork mostly consisted of observations, although I helped take some notes and record bird sightings with binoculars and scopes on a few occasions.

Figure 5. The "North Haven" colony of Manx shearwater, and the building accommodating the warden, most researchers and the Skomer library (06.05.2023)

(2) In July 2023, I assisted two naturalists from the Groupe Ornithologique du Nord, an association based in the North of France, to protect its biodiversity. I joined the counting of Black-legged kittiwake (*Rissa tridactyla*) chicks in the harbour of Boulogne-sur-Mer, the biggest fishing port in France. The kittiwakes breed in a wasteland surrounding the harbour and many fishing warehouses. It is one of the only increasing colonies of this species in Europe; however, because the area is under a renovation plan, the future of the colony is under threat. Twice a year, a group of naturalists counts the kittiwakes breeding all over the harbour and writes a report. I joined and helped in the counting for a day, and spent the next two days observing the work of volunteers surveying another kittiwake colony in a nature reserve, and running a stand at the annual "Sea Festival" of Boulogne-sur-Mer.

Figure 6. A naturalist counting kittiwake chicks on the 'Tour PP3', in the old maritime train station of Boulogne-sur-Mer (12.03.2023)

(3) In June 2024, I joined the Icelandic Puffin Monitoring Programme or 'puffin rally', as a scribe. Instead of observing and sometimes helping with the counting of birds like in the previous field sites, I was a full member of the research team – although my job was still to take notes. The 'puffin rally' is a research programme run by Dr. Erpur Snær Hansen from the South Iceland Nature Research Centre to monitor thirteen puffin colonies across Iceland. Each year since 2010, in June and July, Hansen and three field assistants travel by car and trailer to visit these sites for between two hours and three days. In June 2024, the goal was to check about 70 burrows in each colony and mark whether the puffins had laid an egg. Because we had to postpone our departure due to bad weather, I spent a total of a month in Iceland, along with Hansen and his two field assistants, Sam and Ugo[31].

[31] As for the researchers' anonymity procedure (see footnote 24 p. 70), all fieldworkers mentioned are given other names (indicated only with a first name).

Figure 7. Erpur Snær Hansen checking puffin burrows with a "burrow camera" on Drangey, Iceland (13.06.2024)

(4) In August 2024, I spent a week in the Vestmann archipelago to observe the monitoring of three species of petrels for Stephen Hurling's PhD research project, a student of Hansen. Hurling's project aims at setting up a population survey for three species of petrels (the Manx shearwater, the Leach's storm petrel *Hydrobates leucorhous,* and the European storm petrel *Hydrobates pelagicus*) on the island of Elliðaey, which has never been carried out before, despite the ecological importance of these species. Because the island is primarily used by puffin hunters, the research team instead resides on the proximate island of Heimaey (the only inhabited island of the Vestmann archipelago) in Hansen's house, which is turned into a 'field station'[32] throughout the seabird breeding season. Because of bad weather conditions, we only spent a day on the studied island, Elliðaey, and I spent the rest of the week on Heimaey observing the 'puffling rescue'. The 'puffling rescue' activity, conducted by locals and tourists alike, aims to spot, catch and release baby puffins that left their burrow surrounding the small town of Heimaey and mistook the city lights for stars, crashing onto the urban buildings.

[32] In Hansen's own words.

Figure 8. Fieldworkers checking a storm petrel burrow on Elliðaey, Iceland (30.08.2024)

Finally, I returned to Heimaey in the first week of August 2025 to participate in the filming of a documentary, "The Archipelago", focusing on seabirds in the Vestmann archipelago. As this happened three weeks before the submission of this thesis, I will not draw on this experience except in the concluding chapter. This returning experience contributed to strengthening my connections with the research team based in Heimaey over the summer, getting information on how the field season 2025 has gone in comparison to the previous year, and sharing and receiving feedback on the outcomes of this work.

Thus, in the course of my research project, I have visited, for varying lengths of time, some fifteen study sites, ranging from a nature reserve in Wales to an industrial town in Northern France and the wild landscapes of Iceland. Giving an account of this diversity of field sites (mapped in figure 9, p. 84) while maintaining an analysis focused on common dynamics is tedious. What is more, each field site had its own logic, defined by researchers and birds. Multi-sited participant observation makes it possible to account for a variety of situations and how they are connected, but also imposes methodological challenges.

Studying fieldwork *with* fieldwork

As I will return to in the next chapter, defining 'the field' requires reflexivity, especially as my approach was to understand how marine ornithologists do fieldwork by doing

fieldwork with them. According to Tim Ingold, doing fieldwork has been wrongly systematically conflated with ethnography and corresponds to a particular space and time, defined and delimited by researchers based on 'encounters' (2014: 386). In my case, defining and delimiting 'the field', especially whether I was operating as someone doing fieldwork, was a constant concern. This issue is particularly intrinsic to fieldwork on mobility, which "has to be actively and reflexively created by the researcher", noted geographer Julia Verne (2012: 563). The research field, she added, is not simply an area on a map, but "a set of relations in which the mobility of actors, things and ideas and their connectedness over space and time have to be acknowledged" (ibid).

In my case, the field was not confined to what the ornithologists I followed call 'the field' – which I will discuss in the next chapter. The field, for me, existed when I was in 'co-presence' with the seabird researchers, whether they were doing what they call 'fieldwork' or not. Anne Beaulieu (2010) proposed to extend the consideration of ethnographic fieldwork beyond 'co-location', being located in a delimited space with the people observed, to 'co-presence', primarily constituted of social interactions. While she developed this concept to tackle laboratory ethnography challenges, this also applies well to my experience following marine ornithologists in their field sites. Indeed, positioning whether I was doing ethnographic fieldwork, seabird fieldwork, or having an 'off' time was a constant concern and negotiation.

The challenge of navigating my position presented itself as soon as I did the interviews. During interviews, my position as a social scientist meant that the respondents sometimes 'simplified' or 'oriented' their answers with the expectation that I did not have expert knowledge of seabirds. Conversely, because of my non-biological background, my questions could sometimes lack a precise vocabulary and understanding of seabird science – although I felt more comfortable with such topics after having conducted ethnographic field visits. However, my own interest in birding and ornithology gave me opportunities to find ways to be 'useful' in the field. I have been a member of the University of Edinburgh Birding Society and have been birdwatching since childhood, so I have been asked on several occasions to help spot birds (particularly ringed birds) while conducting ethnographic fieldwork. However, I do not hold any professional certification, such as a ringing permit[33].

[33] Which guarantees not only the ability to ring birds, but to catch and hold them safely, a crucial practice in ornithology, especially with seabirds (Isaacs 2019; Eren and Beaulieu 2023).

Such a matter of positioning myself toward the marine ornithology community was even more acute when conducting participatory observations at the Seabird Group Conferences and ethnographic fieldwork on seabird colonies. In particular, I was living in the field constantly with the research teams I was following, which meant that I was not only observing how they study seabirds but also shared many social moments that are supposed to be 'off-work'. It was challenging to know when I was working for my thesis, or just asking personal questions out of sympathy and curiosity. Especially during the 'puffin rally' across Iceland, I had to navigate between being a social scientist and observer, a member of the research team, and a friend to the people I spent four weeks with.

For example, an event that happened during my second visit to Iceland in August 2024 represents the challenge of navigating between identities during such a peculiar experience as fieldwork on seabird colonies. I was supposed to come for a week to observe the work of Stephen Hurling and his assistants on Elliðaey, in the Vestmann archipelago. However, because of bad weather, the team was stranded on the main island, Heimaey. This week without fieldwork was both a moment of frustration for not being able to collect data and a welcome break after intense field sessions. But for me, it was *my* fieldwork: with or without being on the seabird colony, I had a week booked on Heimaey to observe and gain knowledge on what it is like to do seabird research. So, when we were all sitting at a café, chatting, for the research team, this was a break, and for me, this was fieldwork. One day at a café, Hurling casually mentioned to another research team, working on orcas, the number of tracking loggers they wished to deploy in the next fieldwork session. I asked him to repeat while I grabbed my notebook – Hurling seemed uneasy and joked that he had forgotten I was doing fieldwork when we were simply having a coffee, "It's so weird, right?". He added, explaining who I was to the orca team, "Mayline takes note of everything I say, it's like she's studying gorillas and we are the gorillas!". After this, I was thinking twice before taking out my notebook when chatting with team members. It was all down to *good judgement* (Thrift 2003; Greenhough 2007) and, I should say, good memory and accepting that I would leave much information out. If we were in a setting where they were off work and sharing information relevant to my knowledge, I would try to remember and note it down later. If we were all working, then I understood it was socially acceptable to write notes, which they would even dictate to

me. But even with these precautions, the suspicions remained. After the (only) day at the seabird colony, when we were all chatting on the couch – and this time, I was truly enjoying a break – I was typing on my computer, checking some personal emails. Stephen was sharing some anecdote about his fieldwork, stopped and laughed, "Mayline, are you still taking notes?"[34].

This anecdote is worth mentioning because it embodies much of my field experience and introduces my argument in this dissertation. Fieldwork is a strong emotional business (Thrift 2003), especially in remote seabird colonies. It required a lot of *good judgment* and a lot of letting things go – not taking any notes, because of a lack of time or social comfort. Fieldwork was as much about observing how scientists work on seabird colonies as sharing social time, cooking, playing board games, sharing a meal at a restaurant, and sitting quietly in the car, with music in the background. Throughout the empirical chapters, I also invoke my own research trajectory across field sites, and (im)mobilities, as I studied those who study seabirds in the field, by also studying seabirds in the field. Studying fieldwork *with* fieldwork, I saw many connections between my practices and the practices of the researchers I was following. As Vanessa Manceron, who followed amateur naturalists in England, writes, "How better to say that both anthropologists and naturalists are part of what they observe? And to realise this, it is important to observe them observing" (2022: 27).

[34] Although he was not completely wrong here since I did remember this conversation and include it now in this thesis.

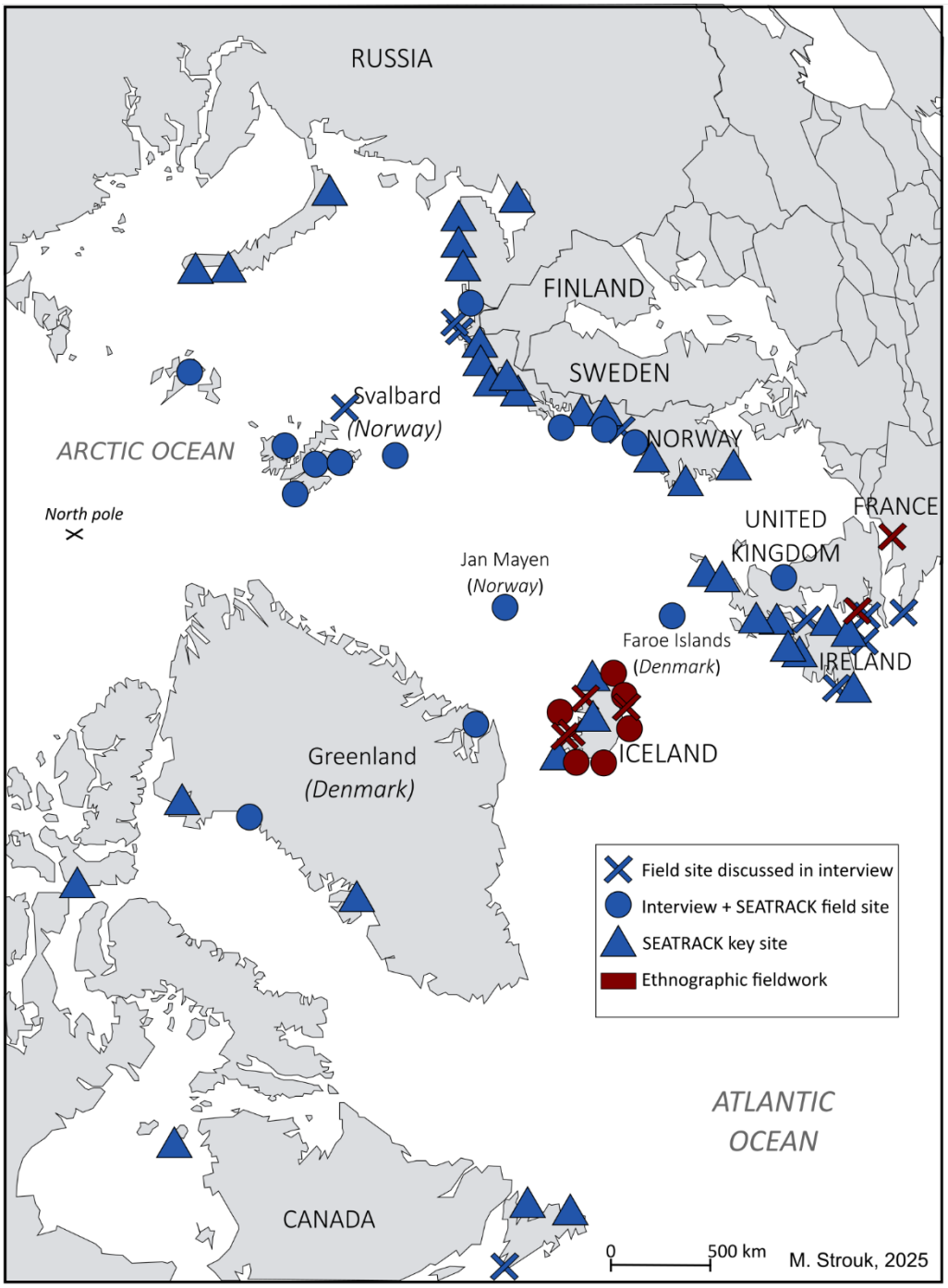


Figure 9. Map of field sites discussed throughout this thesis (source: author's own).

Chapter 4

Following seabirds?

Field (im)mobilities in and out of seabird colonies

In the previous chapter, I articulated that my aim throughout this research is to *follow those who follow seabirds*. While I have explained what it might mean to 'follow' in the context of my study, to 'follow seabirds' also needs to be further unpacked. This chapter examines *where* scientists go to study seabirds and, more importantly, *why there* rather than elsewhere. I argue that marine ornithologists do not just go where all seabirds are, but rather select specific sites suitable for the study of seabirds. Moreover, they actively transform these seabird colonies into field sites. Thus, this chapter explores how scientific sites are constructed: I argue that to do so, marine ornithologists turn seabird colonies into their *territories*. This is important to understand why some field sites are particularly attractive and renowned, shaping scientific communities, while some are ignored, never come into being or are abandoned before they appear in publications. Ultimately, I argue that by investigating what field sites mean for marine ornithologists' identities, positions, and career trajectories, it is possible to unravel how the production of knowledge on seabirds is spatially structured and how this may influence the content of that knowledge.

Indeed, in scientific publications, marine ornithologists typically provide information about where they collected data, but superficially approach why they have decided to conduct their study *there*. Take Fayet et al. "Local prey shortages drive foraging costs and breeding success in a declining seabird, the Atlantic puffin" (2021). The five co-authors demonstrate that demographic declines in puffin colonies can be explained because the adults need to forage farther from the colony. Their findings are based on GPS-tracking data, camera traps and DNA barcoding conducted across four colonies in the North

Atlantic, which the authors describe as the breeding range of Atlantic puffins. These four sites are Skomer, in Wales; Heimaey and Grímsey, in Iceland; and Røst, in Norway – all provided with precise geographical coordinates. Now, why did the authors select these four specific sites among all the puffin colonies in the North Atlantic? If we take a look at the researchers' affiliations, we get a glimpse of why they might have chosen these sites – each is located in an author's respective homeland[35]. But, then again, this does not answer our question: why, among all the puffin colonies in the United Kingdom, Iceland and Norway, did the authors choose these four? From the paper, we also learn that Røst was once the world's largest puffin colony, with its population declining by 81% between 1979 and 2019; now overtaken by Heimaey in the Vestmann Islands, where the puffin population is also experiencing significant declines. Thus, two of the four sites appear to be important puffin breeding colonies, with declining trends. It seems reasonable to assume that this is why they were included in the study. But what about the two other sites, Grímsey and Skomer? Are these the only reasons for including Røst and Heimaey in the study? Finally, we are being provided a last clue: "we compare the foraging ecology of chick-rearing puffins at four colonies across the north-east Atlantic with contrasting trends in population growth and breeding success, ranging from a growing population with high breeding success to a fast-declining population with low breeding success" (p. 1153-54). Again, could this not also be applied to other puffin colonies? This geo-'sceptical' approach (Latour 1987) could well be applied to most publications in marine ornithology and, presumably, to a vast majority of publications involving mobility to collect empirical material.

In the case of Fayet et al. (2021), as it turned out, I interviewed three of the five co-authors[36] and conducted fieldwork on three of these four puffin colonies[37]. The reasons behind the choice of these four sites go beyond the contrasting breeding performances of puffins.

[35] Accordingly, we can also assume that the five co-authors did not collect all the data and might have shared that task. For example, it is said that Gemma Clucas, based in the U.S., did not participate in the fieldwork. On the contrary, the authors indicate in the acknowledgements that "Many people helped with fieldwork, especially Cecile Vansteenberghe, Nancy del Carro (Skomer), Eldur Antonius Hansen (Grimsey), Peter Hoyer (Heimaey), and Calum Bachell, Håvard Eggen and Terje Landsem (Hernyken)" (2021: 1161).
[36] Annette L. Fayet, Tycho Anker-Nilssen and Erpur S. Hansen.
[37] Skomer in May 2023, Grímsey in June 2024, Heimaey in June and August 2024 and August 2025.

Selecting a field site is neither straightforward nor trivial, as it plays a crucial role in shaping scientific trajectories. The topic of trajectories has been a core question throughout the STS literature, interrogating how scientists become scientists (Bourdieu 1984; Shapin 2010a), how they choose a certain topic or research question (Latour 1993; Knorr Cetina 1999; Gläser et al. 2002), and how they circulate between scientific institutions (Davies 2021; Davies and Pham 2022). Fieldwork often holds an important status for scientists, as an educational and emotional experience that shapes their research questions, legitimacy, and broader positioning within the scientific community (Calbérac 2015; Gieryn 2018; Waquet 2019). Thus, for some scientific fields, fieldwork is an important source of prestige (see, for example, Calbérac 2015 and Guasco 2022 in the case of geography). This means that field sites act as 'truth-spots' for scientists (Gieryn 2006, 2018) and should also be considered part of their "spaces of biography" (Livingstone 2003: 182). Consequently, scientific careers and trajectories are inherently interwoven with the places where fieldwork is conducted. Exploring the rationale behind these trajectories to field sites may contribute to a broader discussion on the biographies of researchers and scientific fields and the spatial distribution of scientific sites.

In this chapter, I examine scientific trajectories to the field site, focusing on the decisions or circumstances that lead researchers to work at specific colonies. To do so, I will first discuss the importance of conceptualising field (im)mobilities as part of scientific trajectories. I argue that ending up in a field site is never purely coincidental or a matter of chance, nor should it be reduced to a simple process of choice. Importantly, field sites need to be distinguished within scientific trajectories, and I propose a typology based on the (im)mobilities of scientists to access these sites. Some forms of fieldwork are more valued for scientific careers and do not entail the same degree of decision-making. Crucially, I then argue that accessibility drives the trajectories and (im)mobilities of scientists to field sites, which needs to be distinguished between epistemic, relative, logistical and social accessibility. Finally, I discuss how, in practice, marine ornithologists turn seabird colonies into sites for science: specifically, I show that they must appropriate them as territories, which hold a particular value in the context of a moral economy of fieldwork.

Conceptualising (im)mobilities to field sites

Making sense of the "life geography" of a scientist (Livingstone 2003: 182) is a complex task, as it requires reflecting on a series of decisions, such as selecting a field site. This involves unpacking what it means to do fieldwork and what field sites are. This also involves considering what making a choice means. In this section, I identify a set of three core principles guiding marine ornithology (im)mobilities to field sites throughout their careers, distinguishing several types of sites and contingencies to select them in the first place.

Defining field sites in marine ornithology

How should we define fieldwork and field sites in marine ornithology? The short answer could be that field sites are seabird colonies, and fieldwork is the time spent on seabird colonies to collect scientific data. Reality is more complex, as Martin, a marine ecologist I interviewed in the early stages of my research, pointedly reminded me. As part of my early semi-structured interviews strategy, I included a question which prompted reactions from several respondents – "Can you list the places where you have been doing fieldwork throughout your career?". With Martin, I even dared to add: "Be as precise as you can". He did not like that formulation:

> Can we say 'Svalbard' as Svalbard, or do you want to have all 50 or 60 different places? You ask difficult questions. Various places around the archipelago of Svalbard. Various places around the island of Iceland. Those are the two main areas I have done fieldwork. My counter question is, what do *you* define as fieldwork? Is fieldwork like an afternoon somewhere? Or does fieldwork have to have a minimum time period? Is fieldwork only something you do for a month, or is fieldwork something you can do for two hours in the afternoon, where you just walk there or drive for half an hour?
> (…) It's difficult for me to list what kind of fieldwork and where I've done fieldwork in the last 10 years because, honestly, I don't remember all of it. And there were quite a few places… Some of the fieldwork is also not as much locality-based. For example, if you go and monitor polar bears, you know, you travel around until you find a polar bear. Each position where you find the polar bear: is it your fieldwork site, or is it the general area where you try to search for it, which might be half of the island? [38]

This interaction yielded several learnings and intuitions. First, fieldwork is both a spatial *and* temporal entity (Arpin and Granjou 2015; see Chapter 2), which I would need to define with the respondents, as that understanding is not always straightforward.

[38] Interview on 07.10.2022.

Fieldwork can be as much an extended trip in a remote area as a few hours spent close to home. Second, I would have to similarly be attentive to grasp, in the researchers' answers, what they mean by 'fieldwork' and whether that impacts their answers to this very question. As Martin pointed out, fieldwork can be anecdotal – it can be an afternoon somewhere, or even two hours. It can be something he forgets because he has done it a lot already. And finally, he raises an important point: who defines fieldwork? Is it the researcher, or is it determined by the space-time realities of the object of study? As Martin explained, if you wish to observe a polar bear, is the whole time and journey until you find a polar bear part of the fieldwork, or solely the moment when you can observe it? As I exposed in Chapters 2 and 3, field sites are spaces produced, practised and represented by scientists (Driver 2000; Greenhough 2006). This means that planning fieldwork and analysing field data is also fieldwork. This also means that the selection of a site is important because it is *already* fieldwork.

The interview question "Can you list the places where you have been doing fieldwork throughout your career?" was quite a good lesson, not only to know about the spatial distribution of field sites – its initial purpose – but also to grasp the meaning of fieldwork and field sites. Annette Fayet, a seabird ecologist based in Norway, whilst listing her field sites, shows a complex itinerary to seabird colonies throughout her about fifteen-year career.

> Well, I will do this chronologically. During my thesis, it was mainly Skomer, but I also worked on Copeland, in Northern Ireland, and Rúm, in the Hebrides, Scotland. I think that is all I did in my thesis. And then, during the five years I was a Junior Research Fellow at Oxford…I went to Iceland, to several colonies in Iceland, in the south, on Vestmann Islands and also in the North, on Grímsey. I went to Norway, to Røst, where I work now – actually, I went there at first for a study. And then I worked…I went to Maine, on the island of Matinicus Rock in North America, and Machias Seal Island, but these were really quick visits; it was more to train researchers, teach them some things. So yeah, there you go. And then, I also went to Japan and worked on Awa-shima, in the Sea of Japan. And I worked in the Seychelles, on the island of Aride, in the Inner Seychelles, so the Seychelles, where everyone goes, where everyone lives. And also, I worked on Aldabra, in the Outer Seychelles, much closer to Madagascar. And that is it, I think that is all. Well, these are my 'seabird' field sites, and otherwise, just before that, I went to the island of Tiritiri Matangi in New Zealand for six months, but it was on terrestrial bird species. And I did fieldwork in Oxford and Cambridge on tits, like close to the university. I think that is all.[39]

Although Annette Fayet presents a somewhat fixed understanding of a field site as a place she has "worked" on (sea)birds, her response – and our subsequent conversation –

[39] Interview on 04.11.22. Translated from French.

reveals that not all field sites hold the same significance, depending on the purpose, context, and duration of fieldwork. There are sites where Fayet conducted her doctoral research: "mainly" Skomer in Wales, and two other locations in the UK. She continued collecting long-term data and conducting experiments on Skomer during her five years at Oxford, before moving to a new position in Norway, where she now oversees the monitoring of the puffin colony at Røst. She also lists several collaborative sites, which she visited only occasionally, in Iceland, the U.S., and Japan. Lastly, she mentions two sites in Seychelles that she established during her fellowship at Oxford as part of her effort to "have a non-Skomer project". These sites reflect her aim to develop a new long-term monitoring site outside her usual focus area and to collaborate with local scientists, to avoid reproducing "parachute science"[40]. Indeed, sites do not carry the same significance within a researcher's career. As Martin pointed out, and as we can see from Annette Fayet's response, field sites differ in terms of the amount of time spent at each colony and the work conducted there. Additionally, Martin and Annette Fayet seem to be particularly mobile researchers. In the roughly fifteen years she has worked on seabirds, Fayet has been to eleven colonies, sometimes returning annually, other times only visiting once. Some sites have been crucial in shaping her career, while others are more anecdotal; even Martin admits he cannot recall all of his field sites.

In contrast, other researchers I interviewed have mostly devoted their careers to a single site. Katarzyna Wojczulanis-Jakubas, an ecologist based in Poland, has only ever studied seabirds in Svalbard, particularly around the fjord of Hornsund. When asked about her career path, she explains how she initially joined her supervisor's expedition in Svalbard and, from the knowledge she gained there, managed to continue conducting fieldwork there for the remainder of her career.

> (…) the professor who was my supervisor already had some experience in polar research. And while I was doing my master's, he was about to relaunch his project on seabirds. And apparently, based on my performance during the master's, he invited me to participate in the very first expedition in Hornsund. And this is how it started. It wasn't my choice at all. It was simply random. I was driven by chance. And then once I went there, I thought I really, really would like to continue my work. I knew I wanted to do a PhD, but I didn't know what I was going to go for. I thought maybe I'll be continuing my master's project. It wasn't because of my interest. It was mostly because of my knowledge, which I, you know, obtained so far. When I was exposed to polar environments, then I thought that's actually a great, great environment I would like to work in. (…) So, yeah, I came back from

[40] Quote. 'Parachute science' is a growing concern raised by ecologists from the Global North conducting fieldwork on places in the Global South they do not belonging to, reproducing post-colonial dynamics. Instead, they propose to engage with local scientists (Asase et al. 2022; de Vos and Schwartz 2022).

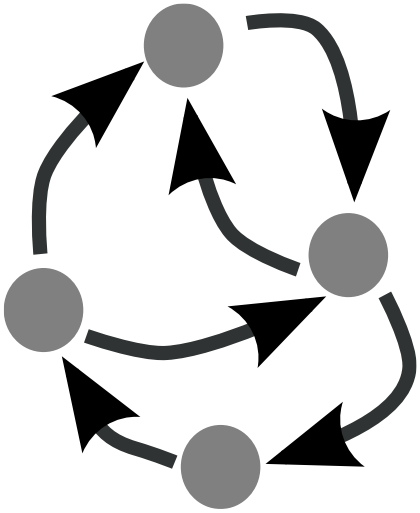
> the first expedition, and then we started to write applications, and it turned out to be successful. So, we could go for the next season. After a while, we realised that indeed I'll be able to do a PhD out of this. And this is how I started.[41]

Since that initial expedition, Wojczulanis-Jakubas has been conducting fieldwork in Svalbard for twenty-one 'field seasons', seventeen of which were at the Hornsund colony.

Based on these examples, it is apparent that marine ornithologists have varying degrees of (im)mobility: Fayet has been (im)mobile across several field sites, and Wojczulanis-Jakubas has mostly been bound to a single area of fieldwork in her career. Accordingly, researchers have different (im)mobility practices, but this does not necessarily mean they spend more or less time in the field. Importantly, some field sites they go to are part of long-lasting and intensive fieldwork, whilst others are punctual visits.

Thus, before exploring what shapes these contrasting (im)mobilities to field sites, I am setting out three key principles that I identified:

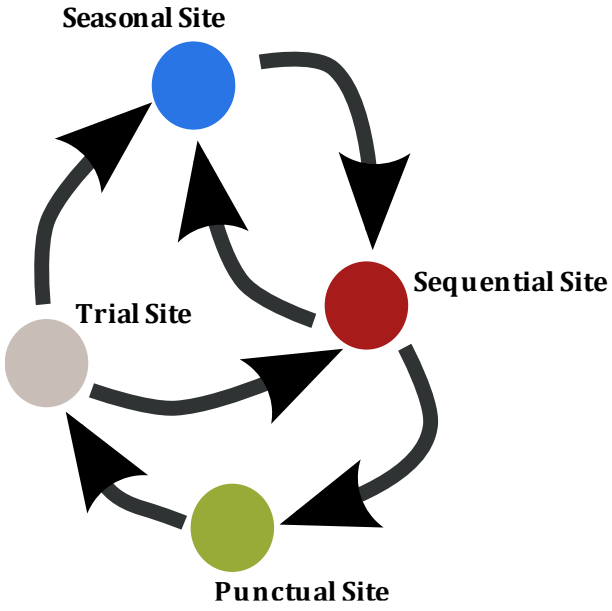
1. **There are different kinds of field sites, and they do not have the same value in a researcher's career.** Throughout their career, researchers have a messy field trajectory, with sites they go to each year, sometimes for several weeks or months, and sites they only go to once, and for only a day.



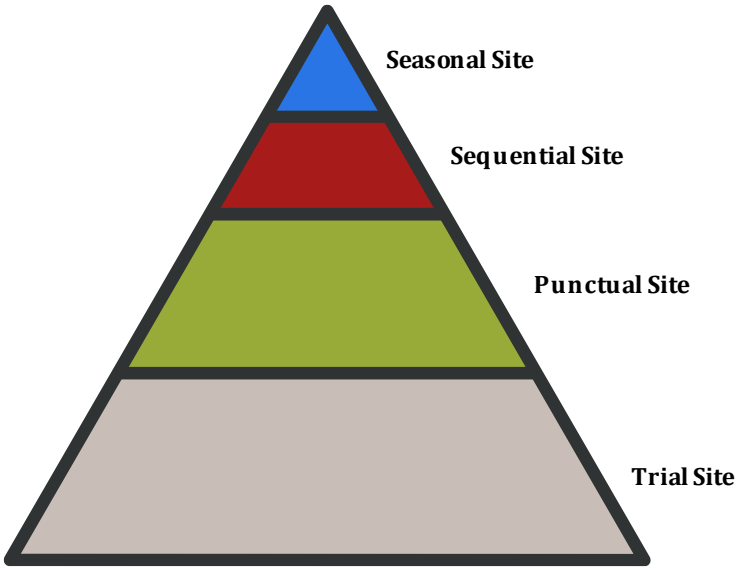
2. **Field sites can be divided into four main types**. **Seasonal sites** are locations where scientists can spend several months, often the entire breeding season, such as Hornsund for Wojczulanis-Jakubas or Skomer for Fayet. **Sequential sites** are where scientists return repeatedly throughout the breeding season, but they

[41] Interview on 07.10.24.

usually only stay for a few days or weeks at a time. This applies to Fayet's sites in the Seychelles islands, which are part of a long-term programme. **Punctual sites** are involved in routine inspections, where researchers typically cannot stay long but may visit annually, sometimes multiple times during the breeding season. As I will shortly detail, this includes the puffin rally. Lastly, **trial sites** are used for one-off field visits, primarily to gather data, and are not revisited. These usually arise from circumstantial opportunities, such as doctoral research projects or academic collaborations. They also encompass sites that, for reasons I will discuss later, are abandoned.



3. **Researchers do not have the same capacity to be (im)mobile.** Within the marine ornithologists' research community, there are many trial sites and, conversely, only a few seasonal sites. Setting up a trial site does not require the same resources as establishing a seasonal site. As I will explore in Chapter 5, being able to establish and maintain seasonal sites is subsequently highly valued in the marine ornithology community, as they facilitate long-term population monitoring studies and showcase scientists' capacity to be (im)mobile.



Building on these three principles and the typology of field sites, I propose a schematic representation of the geography of marine ornithologists' field (im)mobilities throughout their academic careers. I have divided Annette Fayet's career (figure 10a) into three stages (PhD, postdoctoral fellowship, and permanent position) and included the field sites she attended during each stage. Skomer was Fayet's seasonal, long-term site, but became a punctual visit when she secured a position to work on Røst throughout the breeding season. Now, instead of several months, she can only attend Skomer for short visits. Røst shifted from being a trial site she attended as part of a collaboration project to a seasonal site after she obtained a permanent position in Norway. It is interesting to note that, despite changing country and position, Fayet remained committed to accessing Skomer and conducting fieldwork there. Additionally, it appears that as Fayet secured a permanent position, her field (im)mobilities became devoted to sequential and seasonal sites instead of trial sites. This could indicate that her time and resources are rather targeted for 'secured' and long-term work, rather than prospective and collaborative opportunities.

In the case of Katarzyna Wojczulanis-Jakubas (figure 10b), her field (im)mobilities appear compartmentalised between her PhD position and permanent position, although both were from the same institution and involved the same site, Hornsund. The main difference is that, by acquiring a permanent position, she has been able to extend her (im)mobility to a new site, Magdalenafjorden, which she occasionally attends in addition to her seasonal site.

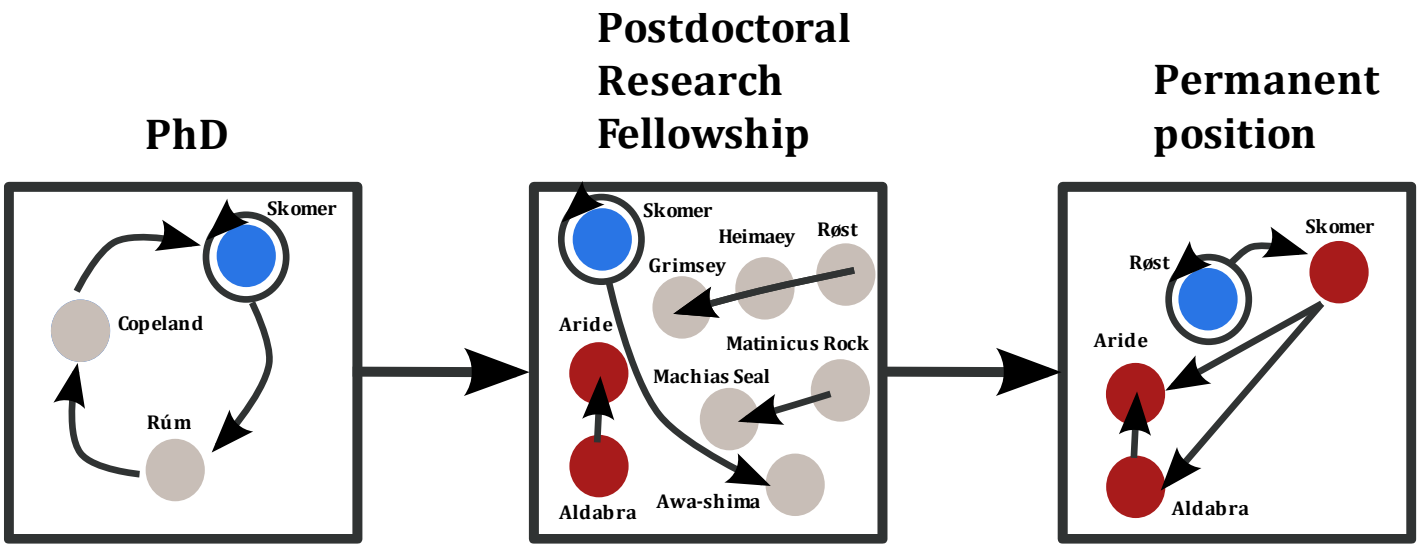


Figure 10a. Annette Fayet's field (im)mobilities throughout her career[42]

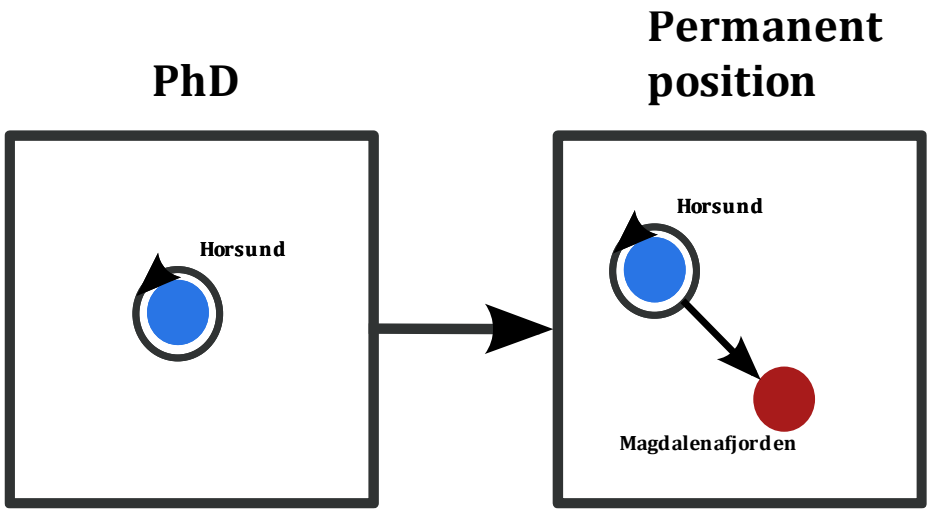


Figure 10b. Katarzyna Wojczulanis-Jakubas' field (im)mobilities throughout her career

I have thus shown that marine ornithologists' (im)mobilities to field sites are complex. The sites they visit throughout their careers can be numerous or virtually unique; in all cases, they are produced by field (im)mobilities – the comings and goings of researchers to these sites. Whether it is a seasonal or a punctual site, the challenge of accessing a site is the same. What differentiates field sites is the time spent, the ability to *stay there*. This leads me to explore further what drives researchers from one site to another through their careers – what brought them *there* at that particular moment.

[42] The arrows represent the direction of (im)mobilities. Thus, a turning arrow around Skomer indicates that Fayet accessed it repeatedly times during her PhD, and same during her postdoctoral position. In her permanent position, she now repeatedly accesses Røst.

Scientific trajectories to field sites

I have argued that not all field sites are equivalent; their meaning evolves according to researchers' ability to access them and, above all, stay there. Field sites are, therefore, spaces constructed and produced through researchers' (im)mobilities. How does this production of space begin? What leads researchers to conduct fieldwork *there* in the first place? These questions are complex as they touch on deeply personal matters: scientific trajectories, steeped in myths of opportunities, luck, and serendipity (Merton and Barber 2004; Daston 2004; Davies and Pham 2022).

The literature on fieldwork offers contrasting perspectives on what might influence researchers in choosing specific sites. In the case of the Naples and Wimereux marine stations, Raf de Bont notes that their founders respectively "explicitly elaborated upon the reasons why they chose Naples and Wimereux as locales for their marine stations" (de Bont 2009: 208). Notably, Alfred Giard established a station in the small town of Wimereux due to its diverse local species along the coast and its proximity to Lille, which enabled scientists to commute by train. Anton Dohrn selected the metropolis of Naples to attract tourists. Alternatively, in other instances, "the sites of research may not be of the scientists' own choosing", writes Stephen Bocking. "Instead, they are often located amidst complex, nearly intractable ecological and social conditions" (Bocking 2012: 711).

In my study of marine ornithologists, too, the selection of a field site also elicited contrasting responses and reactions. Not all researchers have the same ability to *choose* their field sites. For some, they did choose their sites, while others feel they merely seized opportunities prepared by others. For example, Katarzyna Wojczulanis-Jakubas describes her career path as shaped by luck, emphasising that "it wasn't [her] choice at all", and that it was "random" and "driven by chance" that she ended up working on Svalbard (see p. 90). By distancing herself from the decision-making process for selecting Hornsund, she considers that she did not have the *power* to make that decision. She followed her supervisor, who had previously chosen this site during an expedition. Although she may not have initially chosen the site, she decided to continue working there, securing funding and transforming what was once a 'trial site' into a 'seasonal site'. She took advantage of a field station to establish a long-term monitoring study of the colony.

This issue of power dynamics was quite transparent throughout my discussions with the researchers – many of whom emphasised that they did not *choose* their field sites.

> I'm still adamant that you don't necessarily choose your field site. You go where you can get funding if you are a researcher, and if you are a student, you go where you think it's fun. And where actually someone says 'yes' (Martin, seabird ecologist based in Norway. Interview on 07.10.2022)

> It was more that the field site chose me rather than me choosing that long-term field site where I have worked now for four years. (…) So yeah, I can't say I chose the field site; it was more by coincidence. It was free, I took it, and I'm very happy with it. (Adele, seabird ecologist based in Norway. Interview on 23.08.2022)

> Well, it was basically from…I didn't make that decision. But it was from looking at what the options are and which ones seem to be where the work that was being planned would be possible. And this one [field site] seemed the best option, so we tried it. (Morten Frederiksen, seabird ecologist based in Denmark. Interview on 11.10.2022)

To Martin, even when researchers may choose their sites, they are actually driven by funding (echoing Laudel 2006, which I will discuss further in Chapter 5); otherwise, they are driven by other people's approval. Similarly, Adele argues she has been working on a seabird colony in Norway "by coincidence": simply, "it was free, I took it". In her sense, she worked on that site simply because it was available. Finally, Morten Frederiksen did not decide, although he also mentions that the field site "seemed the best option". Thus, scientists appear confused about distinguishing what led them to a particular site and determining specific reasons.

This confusion is all the more prevalent as it tends to hide behind the idea of 'luck'. For example, Françoise Amélineau did a postdoc in Norway and had the "chance that there was a postdoc position which opened up just when I was looking for a job there, and I was also lucky to be selected"[43]. This is not surprising and echoes Davies and Pham's (2022) conclusion that luck is often used by scientists as a narrative for 'success' in their careers. They argue that luck comes with a paradox: "It is by definition a chance event, but is constantly subject to effort to control, or prompt its appearance" (2022: 289). In this sense, luck is a narrative and reflects how researchers try to "make sense of trajectories that were framed as incremental and uncertain, whilst presenting oneself as pleasingly modest" (p. 293).

In contrast, Lewis Fisher-Reeves, a PhD student working on Skomer, explains how his supervisor has the power to choose his sites, while students typically take on those he

[43] Interview on 11.09.2023. Translated from French.

is less interested in: "I suppose he gets to pick and choose which ones he wants to. Because, obviously, he's the boss and nobody tells him otherwise. (…) So, I think they then serve as a good training ground for students while he handles the more intense sites or the more remote sites"[44]. The selection of a site is tightly linked to the position of researchers, which determines both their ability to choose and whether they can acknowledge *how* they choose. The tension, then, lies in what I will further discuss throughout this thesis: the selection of a site is not mundane and plays an important role in the career trajectory of a marine ornithologist. Thus, as much as researchers seem confused about how they selected their sites, this question remains fundamental for their own career trajectories.

Since I challenge the researchers and make them reflect on their decisions, it is only fair and insightful to turn the question back to myself and reflect on my own scientific trajectory. In Chapter 3, I outlined the four "field sites"[45] I visited during this research: Skomer in Wales, Boulogne-sur-Mer in France, the 'puffin rally' in Iceland, and the Vestmann Islands in Iceland too. Thus, turning the question back to myself: did I choose these sites, and if so, how? There are two answers. The first is the answer of the confident researcher presenting their methodology – typically in publications. In this case, I could claim that yes, I did choose these sites because they represent different realities: a seasonal site, with a field station and a long scientific tradition (Skomer), a sequential site in an urban setting (Boulogne-sur-Mer), an expedition across thirteen punctual sites (Iceland) and a trial site, also in Iceland (Elliðaey). The other answer, however, is that I did not choose my field sites – I simply went where I was allowed to go. Yet, I did make certain choices and had some control over my itinerary.

Starting this research project, I had a vision I believed to be clear and realistic: I would have two field sites, one fairly accessible, with mild conditions and representative of the North Atlantic, and the other more challenging, harsh and remote, which would be for the Arctic. For the first, the ideal candidate seemed obvious: the Isle of May, just off Edinburgh, where I was based. It was accessible by two ferries and even had accommodation. As for the second, I was less certain but knew it had to be in Norway,

[44] Interview on 23.03.2023.
[45] If we consider that the 'puffin rally', encompassing thirteen colonies across Iceland, counts as one field site.

where I had previously conducted fieldwork in Tromsø during my master's, hoping this prior experience would open doors. At this stage, several factors guided my potential fieldwork trajectory: accessibility, my research questions, and my previous experience.

However, several things would thwart my plans. First, the staff on the Isle of May were too busy to welcome a social scientist, especially when the avian flu outbreak hit the island in 2022. More broadly, being an inexperienced fieldworker closed many doors in the course of my field site prospecting. For researchers, it was already complex enough to organise their fieldwork to also have to consider an additional, untrained person taking the place of someone who could have been more useful and who, on top of that, is going to demand attention.

Allow me to focus only on the sites where I was finally able to do fieldwork:

- **Skomer**: It was a recommendation from Annette Fayet, who told me in March 2023 that I could not join her and Tycho Anker-Nilssen at Røst, in Norway. Since Røst is located within a nature reserve, securing access was too difficult to obtain. She suggested Skomer as an "easier" site for me, where she had previously worked. I then reached out to Lewis Fisher-Reeves, a PhD student doing fieldwork there over the breeding season, who directed me to the warden. The warden agreed, provided there was an available bed. As it happened, there was a spot in early May, and I was able to stay for ten days.
- **Boulogne-sur-Mer**: I met Sylvain Poisblaud 'by chance' at the Cork Conference. I did not know there was a colony of black-legged kittiwakes in this city, which, as a French person, I knew at least by name. After arranging an interview, I told him I would be interested in observing this kittiwake counting the following summer for a few days, which he agreed to.
- **Iceland ('puffin rally')**: This was a great surprise. As I approached my final year for fieldwork before writing up – and still had no options for Arctic sites – I went through a list of potential contacts and reached out to Erpur Snær Hansen, based in the Vestmann Islands, Iceland. We conducted an interview in February 2024, during which he mentioned the 'puffin rally' project. While he could not guarantee a spot on his team, I noticed he might need a 'scribe' – someone to take notes. I do not have any experience handling birds, but as an ethnographer, I do know how to take field notes – if that could be considered a technical skill. In April, I followed up, and bingo, he confirmed he needed a scribe.

- **Vestmannaeyjar (Heimaey and Elliðaey)**: During the 'puffin rally', Hansen mentioned another fieldwork project led by his PhD student, Stephen Hurling, running through the summer on an island in the Vestmann archipelago, Elliðaey. He suggested that I could return in August to observe Hurling and his team as they worked with storm petrels and Manx shearwaters, believing it would interest me. With Hurling's approval, I arranged to come back for a week in August 2024 and subsequently in August 2025.

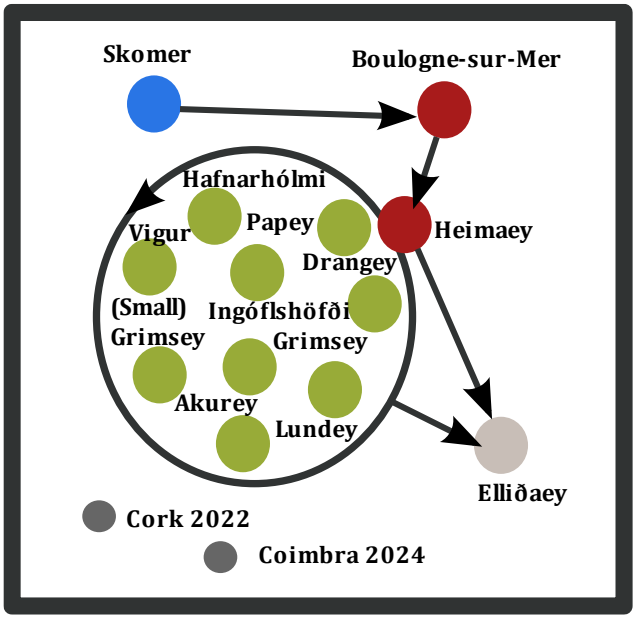


Figure 11. My field (im)mobilities throughout this thesis[46]

The common dynamic between my field trajectory and that of marine ornithologists is that the 'choice' of these sites was mainly based on opportunities – which researchers choose to seize or not. The question, then, rather should be: *what opportunities prompt researchers to select a seabird colony for their study*? In the following section, I thus approach what makes field sites suitable for science; mainly, some sites are particularly conducive to being *made accessible*.

Making a site accessible

[46] The colour coding given to sites is not directly based on what they represent for my career, as they could all be 'trial sites' then. Rather, it is based on their meaning for the researchers I followed. I also included my participant-observations during the two editions of the Seabird Group conference, in Cork in 2022 and Coimbra in 2024. Although these do not matter as field sites for the ornithologists, they did for me (see Chapter 3).

According to traditional scientific discourses, and particularly according to my discussions with marine ornithologists, each researcher has unique reasons and contingencies that led them to a specific field site. As I explained in the previous section, researchers otherwise tend to invoke the role of chance – which they were able and willing to seize. However, I argue that beyond these unique contingencies or chances, certain factors make some sites attractive for the study of seabirds. I demonstrate that this attractiveness is linked to the possibility for researchers to *make the field site accessible*. Accessibility, I argue, is complex and never absolute: it is constructed and constantly negotiated. Thus, while researchers have ideals regarding the choice of their field site – scientific relevance and balance between connectivity and remoteness – they must also, and above all, negotiate the accessibility of these sites, which crucially depends on logistical resources and social networks.

Epistemic accessibility: the place that answers questions

In the world of 'ready-made' science, following Latour's depiction (1987), field sites are typically selected based on the scientific questions researchers wish to answer. This is what Fayet et al. (2021) explain in their paper and is generally what scientists bring up; an orientation that even the STS literature has tended to adopt. Robert Kohler, for instance, has examined how scientists developed specific practices to turn nature into lab-like places (Kohler 2002a, 2011, 2019). Because fieldwork is a practice of place, he argues, "skills of selecting and using places are what it takes to operate effectively in the field, as skills in creating constant, placeless environments, are for those who work with standard animals and instruments" (2002b: 205). Under this model, researchers formulate scientific questions in their office and test them somewhere in the field. Conversely, from scientific observations in the field, they would be able to ask the *right* question (Kohler 2002b; Rees 2006). In the case of primatologists, Amanda Rees shows how scientists primarily seek to find "a place that answers their questions" (2006: 312), driven by a certain "idealized notion of the field site as the natural place" (ibid). This aligns with Thomas Gieryn's concept of truth-spots (2002; 2006; 2018): the field site is a place where scientists' legitimacy is built upon their capacity to produce trustworthy science. The field site is perceived and constructed by scientists as a place of epistemic authority.

In this thesis, I aim to move beyond the notion that field practices are primarily shaped by epistemic considerations. However, it is undeniable that research questions significantly influence the choice of a research site. Throughout my interviews with marine ornithologists, several highlighted local considerations that directly impact the suitability of a site for specific scientific inquiries. A notable case is Michael P. Harris, a prominent British ornithologist known for his long-term study of seabird populations on the **Isle of May**[47]. When I asked him about initially choosing the Isle of May in the 1970s, he explained his rationale:

> The initial locations were chosen because I was given a problem. (…) The Isle of May was chosen because I was looking at puffins in Scotland. It was not chosen for me. My research problems sort of guided me to where I work.[48]

After some experience as the warden of Skokholm Island in Wales and a postdoctoral position in the Galapagos, Harris secured a position at the Institute of Terrestrial Ecology near Edinburgh in 1972. He was hired to develop a research program on Atlantic puffins, largely declining across Scotland, particularly in St Kilda, which used to be the biggest colony and had fast-dropping population numbers. In comparison, Harris observed that the Isle of May, located on the opposite coast and close to his Edinburgh office, had a stable or even increasing puffin population. Thus, he set up a monitoring study of these populations, which continues to this day on the Isle of May. While the research problem initially guided him, this alone did not account for the longevity of the study, as I will explore further (see also Chapter 5). The sites' proximity to Edinburgh and logistical accessibility also played a significant role in his decision and in sustaining the research over time.

The island of **Bjørnøya**, situated between Svalbard and northern Norway, is not as accessible, yet it remains an important site for the study of seabirds. To get to Bjørnøya (or Bear Island), researchers must travel by boat or helicopter, and due to the heavy logistics involved, most typically stay on the island for several months – making the field site a seasonal site by default. As Martin, who conducted fieldwork on Bjørnøya,

[47] Since I started writing this thesis, Michael P. Harris sadly passed away. I hope this thesis showcases his work on seabird colonies and generosity in participating in my study in 2022, when I was still only conducting preliminary fieldwork and interviews.
[48] Interview on 08.06.2022.

summarises, "Bjørnøya is freaking expensive but still done because it's a very important colony"[49]. Seabird population monitoring on the island began in 1986 under the Norwegian Polar Institute. While multiple factors may have contributed to the initiation of this study, Bjørnøya's unique location – between the Polar Front and the warmer North Atlantic – creates conditions that make it particularly valuable for seabird research. In particular, the island is home to one of the largest populations of Common guillemots (*Uria aalge*) and Brünnich's guillemots (*Uria lomvia*) and is a rather unique site where many different species of seabirds co-exist[50]. Beyond its ecological importance, Bjørnøya is also recognised as a 'truth-spot' within the scientific community. Martin, reflecting on the significance of fieldwork on Bjørnøya, references a pivotal scientific discovery made there in the early 2000s (Bustnes et al. 2000; Verreault et al. 2005):

> It is one of the biggest colonies in the Northern Hemisphere. Like aggregation of seabirds, just sheer numbers, there are a lot of them there. So, of course, whatever happens there would be good to know. I mean, Bjørnøya is the field site where we learnt for the first time that pollutants are bad for seabirds because Glaucous gulls were cracking their eggs while incubating them. Because the eggshell was finer. That's Bjørnøya. That is, as far as I know, one of the first clear examples of direct pollutant effects on wildlife. For example. Bjørnøya is just important in various different instances, so it has to be monitored.[51]

Even Robert E. Kohler (2002b) mentioned Bjørnøya as an interesting case where the remoteness of the island has not prevented scientific research. He writes, "One solution to the problem of place is to select natural places that are already lab-like – places with fewer variables to contend with than most, or with less variability. In this way field biologists turn the particularity of natural places to their advantages" (ibid: 195). Drawing on Charles Eton's work on animal communities, conceived from observations on Bjørnøya, Kohler highlights how the site, despite its local challenges, was "the ideal place to see these patterns because very few kinds of animals and plants live there" (ibid). Thus, because of this geographical isolation, Bjørnøya became an attractive and interesting field site.

Islands, more broadly, are often praised in ecology for this very reason (Hennessy 2018), motivating many studies of seabirds in remote locations (Birkhead 1993). Bjørnøya is isolated, and accessing it might be challenging, but once there, researchers can stay in cabins located just outside the bird colonies. According to Françoise

[49] Interview on 07.10.2022.
[50] At least it is how the SEAPOP project, in charge of the seabird monitoring on Bjørnøya, describes it: https://seapop.no/en/activities/key-sites/bjornoya/.
[51] Interview on 07.10.2022.

Amélineau, who conducted several field seasons there, this proximity to the birds makes Bjørnøya more "comfortable" than other field sites she attended. She adds:

> The difference at Bjørnøya is that we live at the foot of the colony, and there are two of us in a hut. So, there are very few logistics involved in getting to the colony; we are already there, so we can monitor the colony much more closely. (…) In the Bjørnøya study area, the number of nests is actually quite small, so we know all the nests and we know all the individuals nesting in the study area. And that is something I haven't found in other little auk colonies where I have worked. Here, it's a combination of the setting, how the colony is arranged and the logistics. The fact that we are on-site means we can make a much greater observation effort than if we had to travel by boat and hike to get to the colony.[52]

The proximity to the birds allows researchers to get a deeper understanding of the colony and consequently, collect more data – which might also allow them to produce more studies and ask more research questions. However, this is possible because of the logistical infrastructure that supports research on Bjørnøya. The Norwegian Polar Institute provides a cabin and funding. Amélineau insists on how that provision of resources and support explains why she had a good experience there and what makes it a field site she "likes compared to other field sites". She could spend more time observing the birds because the logistics were taken care of.

Accordingly, while some researchers may be attracted to certain field sites for their ecological characteristics, access to birds, and scientific relevance – what can be described as epistemic accessibility – this is never the *only* reason. The *right* place to answer questions is only if researchers can access it in the first place. But accessibility never simply relates to a geographical location.

Relative accessibility: balancing connectivity and remoteness

The choice of a field site is closely linked to its perceived accessibility; whether the preference is for proximity or, conversely, isolation. In most cases, however, a site's accessibility matters for its balance between connectivity and remoteness.

In geography, 'remoteness' has two dimensions: "One is the absolute, geometric dimension, related to distances as measured on parallels, meridians, and over altitudes. The other is a relative, geographic dimension, subject to scale, and to connectivity rather than distance" (Bocco 2016: 178). Accessibility, however, is never truly absolute but always defined from a starting point. It is a situated perspective. The same applies to sites

[52] Interview on 11.09.2023. Translated from French.

of knowledge production (Latour 1987; Dumoulin Kervran, Lamy and Verlin 2024): since scientific research operates through networks, accessibility and remoteness are always structured in a centre-periphery manner. The literature on field studies has also highlighted the crucial role of accessibility in the connectivity of sites for fieldwork. In line with my previous argument, historical case studies demonstrate how accessibility is *constructed* (Aubin 2009; Heggie 2016; Vetter 2012).

Indeed, field stations and other scientific infrastructures are essential to the connectivity of sites[53], as they allow scientists to spend more time in the field, such as on Bjørnøya. For instance, Jeremy Vetter describes how Central West America was turned into "domestic field sites" in the early twentieth century (2012: 592). He emphasises how advancements in transportation, such as the railroad, made the region attractive for scientific study (Vetter 2004, 2012). Since field stations acted as "deeper extensions into the environment of the university campuses that established them" (Vetter 2012: 588), their location along transportation lines was a key consideration. Vetter identifies how early field stations were purposely located along railroads (2004) and roads (2012) when the automobile was later developed. The accessibility of field stations attracted many students, teachers, fieldworkers and technicians, which required building appropriate housing. However, he also shows that as these stations grew in popularity, some were relocated to more remote locations, to preserve an ideal of wilderness and the perception of environments as being "untouched by man" (2012: 598). A degree of remoteness is often necessary to uphold the perceived 'authenticity' and 'reliability' of field studies – an issue closely tied to the 'lab-field border' (Kohler 2002a; Vetter 2012). This illustrates a central tension in the location of fieldwork: while accessibility is important, excessive connectivity is not desirable. Similarly, Raf de Bont describes how the location of Rossitten as a bird observatory was decided based on the site's isolation, desirable for its supposed controllability, lower cost of living, and romanticised imaginary (de Bont 2015: 156).

The attractiveness of a field site thus crucially resides in a delicate balance between connectivity and remoteness. Isolated sites, too, need to be accessible, as

[53] Even if the presence of a field station might indicate that the field site already exists, it does not tell us for *whom* it exists. Field stations are built *a posteriori* of the selection of a site, but greatly influence the selection by other scientists thereafter (see, for example, Strouk and Maisonobe 2024)

described by David Aubin in his study of the Mount Faulhorn observatory, built in 1823 in the Swiss Alps (Aubin 2009) and later discussed by Vanessa Heggie (2016):

> (…) on closer investigation it is clear that the Faulhorn does not nearly echo the story of isolation: the mountain was popular not because it was isolated but because it was accessible, and it had a hotel at the summit serving hot drinks and offering warm beds. Given the vastness of the Alpine region where scientific work could have been done in perfect isolation, the fact that a peculiar concentration of scientific men passed over the Faulhorn suggests that its connectedness had some particular appeal. (Heggie 2016: 814)

While the Faulhorn observatory had to be located far from human settlements to act as a site for scientific observations, it also had to be connected and accessible: "Neither too remote nor too easy to each, it offered exceptional conditions for observation and the promise of reaping original results" (Aubin 2009: 371). Still, as Heggie (2016) describes, a narrative of isolation often remains emphasised. Additionally, isolation can be geographical, but it is rarely social. Remoteness plays a role in the heroic, glamorous, and gendered storytelling of fieldwork (Oreskes 1996). The idea of isolation was strategically important for the Silver Hut's status as an appropriate 'home for science' (Heggie 2016:824). She adds: "Without its high-altitude location, without its access to mountains and its localization somewhere that would suit Yeti hunts and climbing expeditions, it was not worth funding and could not claim a special status as a maker of knowledge about altitude" (ibid). Thus, the remoteness of the Silver Hurt participated in its appeal.

This relative accessibility, invoking a delicate balance between connectivity and remoteness, particularly matters for marine ornithologists' motivations to study a specific bird colony. However, as the case of **Skomer** highlights, the ability to determine the degree of remoteness is highly related to researchers' career positions.

Skomer is a Welsh island off the coast of Pembrokeshire. According to the researchers I interviewed who have conducted fieldwork there, its popularity stems largely from its accessibility, which takes multiple forms. First, Skomer is located less than a mile from the coast and is reached via a fifteen-minute boat ride operated by a private company. The island is not only a site for scientific research, home to more than a million seabirds, but also a tourist destination, receiving about 250 visitors per day between April and September. In addition, personnel from the Wildlife Trust of South and West Wales (WTSWW) and around fifteen overnight visitors stay at the island's accommodations. Moreover, the fact that I, too, was able to access Skomer and reside

among WTSWW volunteers highlights its accessibility. Skomer is far from being a place of social isolation – at least during the seabird breeding season[54]. The map below (figure 12) schematically represents the organisation of Skomer and clearly shows the accessibility of seabird colonies to accommodations. Most researchers are housed in a cabin on North Haven, shared with the warden and located within a Manx shearwater colony. They have access to electricity, hot water most days, fresh food, and private rooms (which they generally have to share).

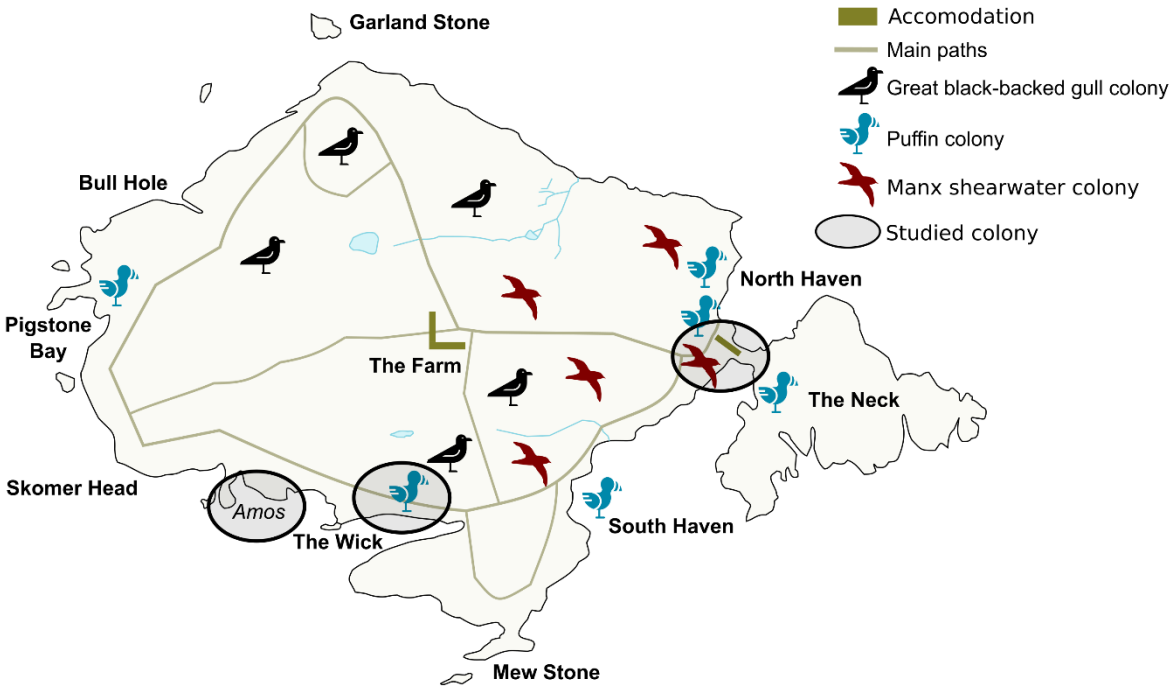


Figure 12. Map of Skomer and its several seabird colonies (source: author's own)

These living conditions contribute to Skomer's attractiveness as a seasonal site for the long-term study of Manx shearwaters, a project initiated in 2006 by Tim Guilford from the OxNav research group. However, nearly two decades after the study began, Guilford himself no longer conducts much fieldwork on Skomer. Instead, he supervises students and fieldworkers who collect baseline data and carry out their own experiments. While Skomer remains a convenient site, he prefers to focus on developing trial sites and collaborative studies in more "exotic" and "fun" locations, as Lewis Fisher-Reeves, a PhD student at OxNav, explained:

[54] Here, I draw on my interviews with Annette Fayet, Lewis Fisher-Reeves and Olivia, as well as my ethnographic experience on Skomer in May 2023. Likely because I was there to observe the researchers, I did not experience any sense of social isolation. On the contrary, my experience aligns with discussions I had with scientists about the lack of privacy and intimacy, as well as the social pressure of seabird fieldwork, where researchers spend weeks or even months isolated together.

> What I meant with Tim is if you enjoy fieldwork – which he clearly does – and what I defined as that remoteness beforehand, it is *real* fieldwork. When we go to the Faroes, to Majorca, where the Balearic shearwaters are, it's sort of completely remote. So, when I went to the Faroes, we flew obviously to the Faroes, and then we had to get a boat to one of the smaller islands. And then, from where the boat landed, we had like a five-hour trek through the mountains to the other side of the island, which was uninhabited. We were camping in tents and had to carry all our food with us. So, that was the *real* fieldwork, I guess. Like, that's as intense as fieldwork gets.
>
> And I guess Skomer is different in that, yes, it is remote and you are on an island, but there are boats every day except for Mondays. So, if you were really hating it or something went wrong, you can leave. The options are there, and there are other people on the island, there are staff and volunteers, and there is a community. It's a comfortable living situation. You have a nice bedroom and a shower, and a kitchen. It is an intense field site, and it feels very intense when you're there, but then, in terms of the grand scheme of fieldwork, it's still a very intro level. As opposed to what you could be doing in sort of the Faroes or other more remote locations. And I suppose to him, if he's used to all these big adventures, Skomer feels too easy for him! Even when he comes to Skomer, he sleeps in a sleeping bag in the middle of the colony. He won't stay in the house! …And you know, he's a huge climber and hiker and paraglider. He has a real sense of adventure. So, I think he enjoys those more challenging aspects of fieldwork.[55]

Interestingly, Fisher-Reeves makes a distinction between Skomer, with its "comfortable living situation", and sites like the Faroe Islands, which he considers "real fieldwork". To him, "real fieldwork" is defined by remoteness – having to trek, camp and being unable to leave easily. Guilford's "real sense of adventure" draws him to more "challenging sites", and even on Skomer, he prefers sleeping among the birds rather than in the comfort of the station. It is worth noting how imaginaries and narratives around fieldwork shape researchers' field trajectories. Remote sites, such as Bjørnøya or the Faroes, are perceived as more 'prestigious' field sites, as Lewis Fisher-Reeves added during our conversation.

While Skomer is attractive due to its accessibility, it is not necessarily the most *fun* or *intense* site. Senior researchers like Tim Guilford and Annette Fayet tend to try and extend their (im)mobilities to other sites that might appear more challenging. For example, after completing her PhD, Fayet decided to set up a project "*not* about Skomer", in the Seychelles:

> What interests me is the question, not necessarily a specific species or environment. If you look at studies of what we know about seabirds globally, it is much centred on temperate and polar zones, while we know far less about tropical regions. This is mainly because wealthier Western countries are located further north, so people first focused on nearby birds and then went to the Arctic and Antarctic[56]. The more tropical zones tend to

[55] Interview on 23.03.2023.

[56] This analysis, based on a recently published paper at the time of our conversation (Bernard et al. 2021) is interesting in regards to the common narrative of polar areas as margins of scientific study. Conversations initiated by Geissler and Kelly (2016) show how tropical areas can also be incorporated into that narrative of remoteness because they have been widely ignored in science, whereas some Arctic sites

> be countries with fewer resources, so there have been fewer studies. So, for me, it was exciting to go to the Seychelles and truly explore. It felt a bit like what it must have been for someone studying seabirds in the UK in the 1950s – there is so much to discover.[57]

Fayet chose the Seychelles partly to move beyond the accessibility of Skomer and to work in a largely unexplored area. She likens herself to early seabird scientists in the United Kingdom, as briefly described in Chapter 3, demonstrating how the imagery of discovery and remoteness still influences fieldwork today. The case of Skomer emphasises that while accessibility is critical, it must be balanced with a certain degree of remoteness – which varies for all researchers.

Logistical accessibility: the capacity to access

Accessibility is merely about geographical proximity: it is constructed and needs to be negotiated. Typically, Skomer may appear accessible, with only a fifteen-minute boat ride. But if the weather conditions deteriorate, the island is isolated. Thus, the choice of a site does not just matter for its perceived connectivity or remoteness; it also needs to be *made* accessible. Logistical capacities and associated funding support are crucial, as Martin explained: "fieldwork usage is all about accessibility. And how you get funding to do it. That's how I see the main drivers behind *any* fieldwork"[58].

In the few cases where researchers acknowledged their own role in the selection of a field site, accessibility as a capacity emerged as the primary driver – out of necessity rather than choice. Philippe, for example, is a senior researcher based in France. While he was driven by research questions at the beginning of his career, logistical matters eventually shaped his field trajectory.

> I think that at the start, I had an approach, I would say intellectual, to research questions. I had hypotheses and knew where and how I could test them. But then, some things are more or less feasible from an administrative and logistical point of view. I think I set the bar quite high – working on seabirds in remote areas is complex, expensive and time-consuming.[59]

like Svalbard are integrated into networks of international science (Roberts and Paglia 2016; Strouk and Maisonobe 2024).

[57] Interview on 04.11.2022. Translated from French.

[58] Interview on 07.10.2022

[59] Interview on 23.03.2022. Translated from French.

Philippe initially sought to establish a study site for little auks (*Alle alle*), a cliff-breeding seabird, in **East Greenland**, where no previous studies had taken place. In this sense, his research question first led him to a broad geographical area.

> So, initially, I had hypotheses that I could test in the short term, meaning I could work for one or a few years on a study site before evolving my questioning and changing species and study areas. That's part of the answer. The other thing is that I've always had an exploratory approach, intellectually. And so, I've always said to myself: 'it's good to go and work where there's a lack of knowledge and not necessarily in places where things are already very well defined'. So, I think it was also a search for originality. Initially, I think that explains to some extent the diversity of my field sites. Now, I've moved on and I am much more interested in long-term monitoring.

As he explains, "it is much lighter" to go to trial sites, where he does not necessarily plan to return but to test some research questions. However, in Greenland, he aimed to set up a long-term study of little auk populations, requiring a reliable site. In 2004, he organised a "prospective mission" with a student and two Danish colleagues to the fjord area of Scoresby Sund to find the *right* colony for the study.

> It was really nice – the Danish had a bit of money to prospect, so they tested two sites. The first was not right, but fortunately, the second was, and that is where we have been working for almost twenty years. So, in this case, there was some prospecting, and there was a scouting phase.

I asked how they ultimately selected the second site in Scoresby Sund. He explains:

> (…) if from a logistical point of view, it's viable, if it's not going to be too dangerous, expensive, complicated, exhausting. Whether or not it's actually possible to have access to the birds. That's all. Whether it's financially viable or whether it's so far away that we will never be able to pay for transport, which is always very expensive in Greenland. […] We are dropped off by helicopter because, at that time of year, when there is not enough sea ice to go around on a snow scooter, but there is still too much sea ice to go by boat. It is a site along the coast. So, as it is not accessible by snow scooter, boat or on foot, we're being dropped off by helicopter. And that's why, financially, of course, we're only a quarter-hour helicopter ride from the airport, and we can barely afford that. But if we were two hours away by helicopter, for example, it would be impossible.

Thus, the logical infrastructure and available funding capacity greatly determined what made the site accessible or not. Here, because of the funding limitation of Philippe's team, the other colony they attended was abandoned and never became a field site. Accessibility, therefore, is not so much related to localisation as it is to the accessibility to material resources.

Accessibility as capacity matters differently depending on the type of field site. Fieldwork on a trial site, which needs to be accessed once, obviously does not require the same

resources as seasonal sites, conceived for decades-long studies. But even for trial sites, accessibility remains a decisive factor.

Aline, a marine scientist based in France, explains how she selected her two field sites in **Norway** for her PhD research. Like Philippe, she began with a research question – studying Northern gannets (*Morus bassanus*) in Norway, a rather overlooked species in the country. She thus had a broad geographical range for her fieldwork. With only four gannet colonies in Norway, Aline initially planned to conduct fieldwork at all of them. Initially, she was driven by the research question to establish trial sites. She describes this first prospective expedition:

> The colonies were monitored in terms of numbers, but that was it. So, the information we had on accessibility was a bit hearsay. For example, we had a tent, and my mother sewed what we called 'skirts', to hold the tents up, as there is a lot of wind, and they added large pieces of fabric on the sides. Your tents were planted with pegs in the ground. And to make sure you didn't get your tent ripped off in a storm, we put stones on the skirts. Well, the tent couldn't tear if you wanted, but that was an extra safety feature compared to the little pegs. We had a few photos [of the islands], but not even that, you know! I was told 'Yeah, well, in Lofoten, there will be stones, there's no ground, there are stones'. So, we had some skirts sewn, and when we got there, there were no stones, but just a massive rock. We asked the guy who dropped us off to give us a boot, and we tried to hang our tent as best as we could with a little rope in the crevices! (*laughs*) Accessibility was an issue, yes. But we managed to adapt, in fact, where we could catch the birds, even if we had to climb or go over a crack… […] So, in that case, it was: where are the birds? And finally, where can we work? For 'Where are the birds', we tried all the places. And then we said, 'Well, it would maybe be more reasonable to restrict a bit to have more time to do telemetry at this place and this place. So, first of all, the first constraint is where you can find the species you want to study. The feasibility. Because clearly, in the two colonies where we stopped working, it was not possible.[60]

Despite her precautions and resilience to adapt to the unexpected challenging conditions of the site, she eventually decided to drop two of the four sites she visited during her first field season. What she defined as accessibility – the ability to pitch the tent and access the birds – made the other two sites convenient for fieldwork, and she returned twice more in the following years of her PhD. Interestingly, because she was the only researcher who conducted fieldwork on these sites and even though she eventually moved on to other topics, she is still contacted by colleagues for advice on how to access the birds: "I told them 'I will go back whenever you want me to! If you need a guide to make things easier for you the first year, I will come with you!'". Managing access and the capacity to mobilise adequate resources thus seems to guarantee recognition within the marine ornithology community.

[60] Interview on 05.12.2022. Translated from French.

Social accessibility: negotiating with local gatekeepers

Considering the social infrastructure behind field sciences necessarily requires examining the role of people even before fieldwork begins, particularly in the process of accessing and selecting a field site. The literature on field sciences has emphasised the role of social communities outside of the scientific realm in the conduct of fieldwork. Field sites are always embedded in broader social environments, which Kohler, for example, refers to as the "social complexity of nature" (2002b: 193). In the case of the Rocky Mountains, Jeremy Vetter mentions the "social infrastructure of the station" (2012: 605), without which these stations simply could not function. Similarly, in her account of British naturalist Alfred Russel Wallace's field tribulations, Jane Camerini describes the "collective nature of fieldwork" and the "complex human infrastructure entailed in carrying out fieldwork" (1996: 47 and 49). This case highlights the crucial role of local informants in gaining access to bird specimens. In short, the places where Wallace ended up depended upon access provided by his human relationships. However, as Rees (2006) and Heggie (2016) argue in their respective cases, the significant role of local populations and social interactions in field sciences is often overlooked.

Returning to the paper by Fayet et al. discussed in the introduction, it is interesting to note that their acknowledgements mention several individuals who are not co-authors but who "helped with fieldwork", with specific reference to the sites where they have helped (2021: 1161). It has been widely observed in scientific practice that certain kinds of work and people "are rendered invisible while others are extolled" (Star 1999). Interrogating researchers on what prompted them to select a field site might obscure the role of people and "social network" (Rees 2006: 323), which are relegated to 'coincidence', 'opportunities' and 'chance'. Bernard Cadiou, for example, has been working on the island of **Molène** in Brittany, France, since the late 1990s. When asked how he came to conduct fieldwork on that colony, he attributed it to mere luck and coincidence:

> It all happened by chance. When I arrived, one of the association's volunteers asked me if I wanted to go with him to the island of Molène to redo a survey of storm petrels that had not been done for years. So, I went with him, and that's when I discovered the territory, the species, and the monitoring that had been carried out years before. Upon this

> discovery, realising that there was something we did not know before, I suggested we conduct a more in-depth study.[61]

While Cadiou describes his introduction to Molène as a matter of *chance*, it was in fact facilitated by a volunteer who invited him to join. In other cases, the role of certain individuals as gateways to field sites is even more pronounced. In Greenland, before working on little auks in the Scoresby Sund, Philippe conducted a study on cormorants. His field site was decided solely on the advice of a trusted local ornithologist.

> I met a Danish scientist, David Boertman, who is a living encyclopaedia of nature in Greenland. It was through this meeting that I arrived at my study site on cormorants in West Greenland. He knows everything about Greenland; he has been everywhere. So, when I mentioned 'the great cormorants in Greenland', he gave me a GPS point and said 'there' (*laughs*). And that's how it happened. […] Because he is an exceptional naturalist, he has been going to Greenland since the 1970s…he is a living library, recognised by everyone. He really is a great sage. It's like having a great sage to consult on research options – he gives an opinion, you follow it, and it's fruitful. So that's what it is all about, meeting people.[62]

Philippe relied on Boertman's expertise for the best site to access cormorants, highlighting the value placed on such local knowledge within the marine ornithology community – similar to Aline, who is still contacted to advise on accessing gannets in Norway. Likewise, Philippe described how a later study he conducted in Russia on little auks, to compare with his Greenland site, was entirely based on his meeting with a local scientist: "The gateway, it was her. It all was down to this meeting". Thus, scientists rely on a network of trusted colleagues, esteemed for their local knowledge.

Sometimes, the gateway is permitted by residents outside the scientific community. Robert Kohler describes this as 'resident knowledge' (Kohler 2011, 2019): while scientists become temporary residents, their presence is often only periodic. They thus have to rely on locals to get a situated understanding of the field. In the case of ecologists Herbert Stoddard and Paul Errington, Kohler writes: "[their] field practices were both situated and situating: quails were studied in their natural environments, by observers who were either resident or as good as" (2019: 216). In particular, he shows how Errington's site was chosen based on the presence of residents with whom he wished to collaborate to gather observations:

> Human residents on the study area were nonetheless essential to Errington's project. Since the land was privately owned, researchers were legally trespassers and depended

[61] Interview on 07.09.2022. Translated from French.
[62] Interview on 23.03.2022. Translated from French.

> for access on residents' interests and goodwill. […] study sites should be chosen not just for their natural advantages but also for the prospect 'for sustained interest and cooperation on the part of human residents'" (Kohler 2019: 200)

A similar dynamic persists in marine ornithology, where researchers often rely on landowners – whether individuals or organisations – to access field sites. Such openness to the study of bird colonies determines the particular choice of a site. For example, seasonal and long-term sites such as the Isle of May or Skomer are attractive due to the support they receive from nature organisations which own and manage the islands. In **Ireland**, Pauline, a postdoctoral researcher, explained the challenges of working across multiple field sites, particularly when dealing with private landowners:

> For example, the fieldwork I do on Little Saltee, an island in Southeast Ireland…these islands are privately owned! So, we need to contact the owner of the island […] and they accept or not that we come. For me, on Little Saltee, there is a man who is very professional for our studies, and he lets us come as much as we want; he is very chill about it and even helpful, we don't have any issues. But you see, this is a collaboration we know is likely to come to an end one day. If he were to pass away, there is no guarantee that the next one is going to be so nice about it. We try to maintain these collaborations, which also means being on good terms with the people who own these islands. On the other hand, […] we are going to try to do fieldwork in September on an island called Scarriff, also owned by a landowner, but he had said 'no, I'm not keen, legally speaking, I'm not sure I'll be covered if anything happens to you on my island. Like if you trip down on the rocks, who is responsible for that?'. We got the university's legal department involved, but that means there is another level of constraints that we scientists are not prepared for; we are not lawyers. […] We also do fieldwork on an island called Skellig Michael, which is managed by the Irish National Park Wildlife Service and there, they have the power of the collaboration we have with them. So, sometimes there are moments when it's not convenient for them to have us around, and so, hop! [the fieldwork] gets sacked[63]

Thus, her field (im)mobilities around Ireland are largely determined by the access granted by local gatekeepers, who may be more or less cooperative. Pauline is very conscious of the fragility of access over time: landowners can change their minds, islands can change owners, and schedules and priorities can change too.

In some cases, local cooperation for access involves residents with conflicting interests in seabirds, such as local hunters. Johannis Danielsen, a seabird ecologist in the **Faroe Islands**, explains the role of these local informants:

> I always try to look for places, and the main criterion on the Faroes is just getting access. When can I get access to 20-30 fulmars or common guillemots? Because they will sit in places that are very hard to get access to by humans, because humans are the main predators. So, I ask all over the country, people who are hunters and go collecting eggs and stuff like that.[64]

[63] Interview on 23.08.2022. Translated from French.
[64] Interview on 19.04.2023.

Seabird hunters share local understandings of the birds and how to access them; however, their agenda is, of course, much different from the scientists'. In the Faroes, Danielsen maintains cordial relationships with hunters who may even possess cabins with access to the colony. This is also crucial on the island of **Elliðaey**, in the Vestmann archipelago, in Iceland[65]. There, the 'loneliest house in the world'[66] is owned by a local family practising puffin hunting in the summer. Marine ornithologists' ability to access the island and sleep in a house or camp outside depends on their willingness, which is particularly fragile as they hunt puffins, while the ornithologists wish to protect them[67]. The role of local gatekeepers is particularly critical in **Iceland,** where the community is small: on some sites, such as Elliðaey or most islands of the 'puffin rally', only one family or one boat has access or residence. The itinerary of the 'puffin rally' (figure 13) across thirteen colonies has been built on the representativity of each site, but also on the relationships Erpur Snær Hansen had cultivated over the years with local farmers, ornithologists, island owners, tourist guides or rescue teams. Access to each of these sites is uniquely reliant on specific gatekeepers who provide their boats or accommodations. For example, to access the island of Papey, Hansen depends on a local captain who personally knows one of the two families living on the island; without this captain, Hansen could not visit Papey, which is closed to the public. The island of Grímsey (the northernmost) is accessible to anyone with a daily ferry connection; however, Hansen and his team need to reside in a friend's accommodation, the house of a local captain, as there are no camping grounds on the island. Finally, to access Drangey, Hansen resides in his brother's house in a nearby town and then pays a local guide to take him and his team on a boat to the island, otherwise inaccessible.

[65] This is not the same Elliðaey as the one in the 'puffin rally'. Similarly, there are two different islands named Grímsey included in the rally.

[66] Many rumours surround this house, as this sensationalist newspaper article can testify: https://metro.co.uk/2024/11/06/worlds-loneliest-house-a-remote-island-94-miles-nearest-city-21940519/.

[67] I cannot go into details on the controversy between researchers and puffin hunters for ethical and privacy matters, but can mention that scientists used to be able to rent the house, which is no longer the case in 2025.

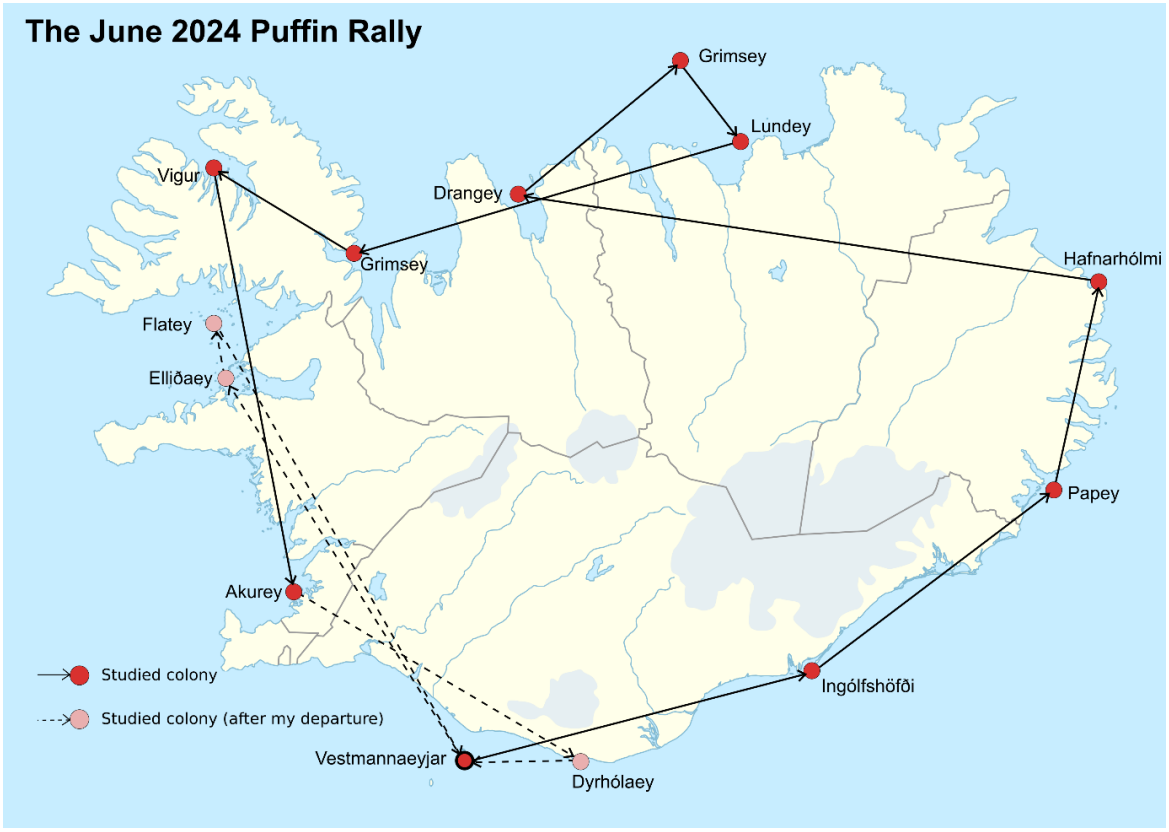


Figure 13. The June 2024 'Puffin rally' itinerary across Iceland (source: authors' own)

One anecdote from the 'puffin rally', for example, illustrates how changes of landowners can impact the continuation of the study. The island of **Vigur**, located in the Westfjords, was owned by eider farmers until 2019, when a new family purchased the land. This shift meant that Hansen had to renegotiate access to the site. The challenge was not just getting permission to visit the island but also securing the ability to stay for multiple nights to collect blood samples for a new collaborative project with a Canadian team. Unlike previous years, when he had only spent a few hours there, the study now required an extended stay. In June 2024, when I joined the rally, Hansen was unsure how the new landowners would respond. They were already quite open to the idea of studying Vigur's seabirds. When we arrived, they were in the middle of hosting their son's birthday party. As a gesture of cooperation, Hansen invited the children to participate in puffin monitoring, allowing them to look through the burrow cameras (figure 14). Meanwhile, I was in charge of the groceries – naively assuming we would be sharing meals with the family, I bought too much food, only to realise we were expected to eat separately. In the end, we had to ask them to share that impressive amount of food, and all gathered for a barbecue after the birthday party. This helped strengthen our relationship with the family: instead of staying just for the night, we remained on the island for three days. Not

only was Hansen able to collect the necessary blood samples, but the landowners themselves became involved in the study, assisting with the research even after we left.

Figure 14. Children queuing up to look into burrow cameras on Vigur (19.06.24)

Discussion

The choice of a colony to study deeply depends on the access that researchers can construct and negotiate. Accessibility is a complex concept with multiple, sometimes paradoxical, dimensions for marine ornithologists. Crucially, I have argued that selecting a colony first means defining criteria for accessibility. The research question (*epistemic* accessibility) is the main argument put forward by scientists, but it also conceals the reality of *relative* accessibility: where the colony *should* be located, not too far yet not too close either. This clearly shows that the choice of a field site is a matter of resources and that considering these resources, both material (*logistical* accessibility) and social (*social* accessibility), also depends on the researchers' academic position. The selection of a site then depends on the researchers' ability to endure certain conditions, such as Aline, who camped on rocky islets in Norway during her thesis, or Tim Guilford, who prefers to leave 'easy' sites to his students. Furthermore, the experience gained in the field helps to strengthen local networks, attract funding (see Chapters 5 and 6), and build reputations, which also critically shape marine ornithologists' field (im)mobilities. Students such as Aline stand out by setting up a new site, subsequently abandoned due to a lack of resources. Others follow the footsteps of their mentors or supervisors – in this case,

standing out, such as Annette Fayet, means being able to establish new sites later. All in all, scientists' (im)mobilities refer to their ability to construct and negotiate access to seabird colonies. As I will show in the next section, they must also be able to transform what is a 'home for seabirds into a 'home for science' (Geissler and Kelly 2016), and make it into their territory.

Turning seabird colonies into territories for science

Choosing a colony as a field site based on its multi-dimensional accessibility necessarily involves transforming this 'home for seabirds' into a 'home for science'. In this final section, I explore this transformative process as *territorialisation*. This parallels ornithology's own fascination and struggle to define and understand what territories might mean for birds (Despret 2021). The classic definition of 'property' being inapplicable to the avian world, ornithologists prefer the idea of 'any defended area' or 'process' (p. 15–16). Vinciane Despret instead shows that the concept of territory is much more porous than ornithologists conceive it: "the same space, the inhabited space, can be a territory at times, and not at others. Territory imposes a rhythm on space" (p. 53). Her understanding of bird territory greatly echoes my conception of marine ornithologists' (im)mobilities, which I defined in Chapter 2 and described in this chapter. Some places are periodically transformed into seabird colonies, which are also periodically transformed into field sites, when researchers access them to collect scientific data. This transformation involves a process of territorialisation: appropriation of a site as a scientist's or research team's own. This can lead to conflicts, not only with locals but also between researchers. This further illustrates the individual nature of field sites, which become currencies in a moral economy.

Home for seabirds, territories for science

Selecting a field site entails a form of spatial appropriation: a seabird colony is transformed by researchers into a site for science. When questioning the choice of a field site for researchers, it may be tempting to essentialise these locations primarily as *scientific* sites. However, they are primarily *seabird* colonies, appropriated as such by the

birds for several months a year, during which they occupy burrows or sit on cliffs, breeding a chick or prospecting for future seasons. It is only during this prior occupation by seabirds that some of these colonies are periodically accessed by marine ornithologists to collect scientific data.

Conceptualising seabird colonies as territories for scientists is not merely provocative; it follows upon historian Megan Raby's (2019) call for greater attention to *land*, rather than just *place*, in the history of ecological sciences. Raby argues that ecological fieldwork should be understood as a form of land use, situating her case of an expedition in the Amazonian rainforest within a broader web of economic and political incentives that shape the conduct of science. She notes that while Kohler (2002a: 18) acknowledged the tension between conducting fieldwork and claiming a certain form of land use, he largely treated it as a metaphor. Taking up Raby's call, Erika Milam examines a case of field site selection in behavioural science, framing it as a process of "scientific place-making". She demonstrates that fieldwork is, in essence, a process by which land is transformed into "places for the generation of scientific truths" (2022: 122). This literature from historians of science is fruitful in showing how scientific fieldwork operates within a broader context and that, as such, turning a place into a field site should be understood as a form of territorial appropriation.

By designating a colony as a scientific field site, marine ornithologists make it *their* territory. Throughout my interviews, I noticed that the sense of remoteness and adventure I discussed in the previous section is accompanied by a feeling of *ownership*. Being so remote, surrounded by seabirds, gives scientists a sense of unique privilege. Pauline, for instance, reflects on her experience at a remote field site in Greenland:

> Sincerely, I had the feeling of being a princess on my island. Honestly…it's your island. No one ever comes there; you act like a queen in her domain, and you go and equip your birds. When you leave the Arctic, you have the feeling that whether you had been there or not, life and nature would have carried on without you anyway. You see, it's like entering a sort of sanctuary.[68]

Pauline's account reveals a tension between researchers' territorial appropriation – "like a queen in her domain" – and nature's ultimate territorial re-appropriation. When she departs, the colony becomes just a seabird colony again. In another discussion, rather than using the language of kingdoms, a researcher described her field site as "almost your

[68] Interview on 23.08.2022. Translated from French

baby"[69]. Katarzyna Wojczulanis-Jakubas similarly reflects on how her relationship with **Hornsund** evolved over the years:

> It was just an adventure at the beginning. I was very much excited about that. And then later, I was excited to go back to the place. Then I felt quickly, you know, as at home, very comfortable. Nowadays, I think it's maybe time for a change. It feels like I'm going to one of my places in this world. It's like, you know, this is my place. This is my territory.[70]

In her case, the territorialisation of Hornsund is reflected through her own sense of comfort. She adds: "I'm getting even quite picky about the bed I'm going to have, which I think is quite dangerous because at the station you don't really have that much space for negotiations". Her feeling of ownership extends to the very selection of her bed, but also importantly to the nests in the colony she studies and how to access them and reach the birds. She explains how, to her, "it's obvious, like *this* chamber is pretty special. And then, you need to, while going in, twist your hand *this* way [shows the hand gesture, twisting her wrist]". Territorialising a colony as a field site thus encompasses a broad range of actions, from setting up one's comfort to having precise knowledge of how to access specific birds.

One of the most obvious ways of appropriating the colony as a field site is through visual and material means. For example, building a research station, which will remain scientific even when researchers and birds have left. As such, Geissler and Kelly (2016) noted that field stations often play a crucial part in the affective appropriation of a place as a field site and feeling like a 'home for science'. However, many studied colonies do not have stations; researchers either camp there or reside elsewhere and access them periodically. During my ethnographic field visits, I noted that what endures researchers' absence and durably marks a colony as a 'scientific territory' is the marking of bird burrows with posts, each being a unique identifier. Posts are critical for scientists as they are often the only 'trace' they will leave on the colony, differentiating *scientific* burrows from others. As ornithologists cannot identify ringed birds from outside, they need to search within their burrows; and need to know which burrows to look inside. Although in the 'puffin rally' all posts are marked with numbers, on **Skomer** Island, I noticed that the naming of burrows truly embodies the scientific territorialisation of the site. All posts are named with a combination of letters and numbers based on the localisation in the colony, or

[69] Interview on 10.11.2022.
[70] Interview on 07.10.2024

featuring the researchers' initials (figure 15). As such, burrows integrated into the colony's monitoring during Annette Fayet's work are marked with 'AF', while some others are given initials in tribute to a deceased researcher. However, the two students I followed preferred to use the initials 'HG' for new burrows in their study, in connection with rapper Megan Thee Stallion's fanbase ('Hot Girls'), as they did not wish to use their own names – "you don't own nature"[71]. Naming burrows is as much an essential mnemotechnic device as a 'marker of relations', as Candea (2010) also noticed in the Kalahari Meerkat project[72]. On Skomer, it is also a way for researchers to leave material and durable traces of their presence, whether with their names or not. This might relate to Skomer as a trial site for most doctoral students working under Tim Guilford's long-term project. After their thesis, wherever their (im)mobilities take them next, some posts with their initials, or initials of musicians they enjoy, remain on the colony.

Figure 15. Two marked burrows on Skomer (06.05.2023)

Territorialisation occurs through material and visual cues and practices, leading researchers to claim a field site as theirs. The question, then, is how do marine ornithologists manage to claim a territory so effectively that it is recognised by the entire scientific community? Although this question is highly complex, I found that the concept of a 'moral economy' helps to understand the unwritten rules of territorial appropriation and the sharing of field sites within the seabird research community.

[71] Field note from Skomer, 05.05.2023.

[72] "The 'animals' names might thus reflect the volunteer's taste in music, books or film, their favorite historical characters, or in some cases, members of their family." (Candea 2010: 250)

A moral economy of fieldwork?

Firstly, I should mention that acquiring a scientific territory does not come without 'geopolitical crises' within the research community. While seabird colonies are primarily bird habitats, they can also be privately owned, as I described in the previous section. In such cases, as Pauline explained in Ireland, territorial conflicts can arise, preventing researchers from using the colony as a scientific field. At times, territorial disputes also emerge between researchers themselves. Charles[73], a seabird ecologist based in France, conducted many studies across the polar regions. In the late 1990s, he established a long-term study of Black-legged kittiwakes in **Northern Norway**. His choice of this site was driven by the factors outlined in the previous section. First, he was aware of the "excellent work conditions of this island through publications" – like Bjørnøya, this site was a truth-spot where he could answer his research questions. Second, a French colleague based in Norway recommended this site for his study. In particular, Charles engaged in a scientific interaction with Norwegian researchers, writing a commentary on a study they published, in which he was critiquing their research design. "(…) This allowed me to realise that the field conditions would be ideal there to implement an experimental approach"[74]. Finally, this accessibility of the site and birds was confirmed by the comparison with another site in Canada where he conducted a prospective expedition: "this site (Gull Island in Witless Bay, however exceptional too) was less perfect/practical, but this shows well that I had to prospect to find a site". Given the advantages of the Norwegian location, Charles contacted the team already conducting fieldwork there, and they agreed on a spatial division of the island:

> We needed a series of 'plots' (small pieces of cliff where black-legged kittiwakes bred), and we were able to choose these in different areas around the island, making sure, in the field with the biologists already working there, that we did not encroach on their study areas. The areas of our manipulations were therefore distinct from the areas monitored on a long-term basis by [the Norwegian team].

[73] It is worth mentioning the context in which I know this story. I contacted Charles in April 2023 as I was seeking to conduct fieldwork in Norway. The Norwegian team I was in touch with were not responding to my follow ups but I noticed that a French team had been publishing data collected on the same island. I contacted Charles in order to propose an interview, and mentioned that I was seeking to conduct fieldwork on that island – which I would rather not name here in order not to contribute further to the territorial dispute. In the email exchanges that followed, he explained to me how I could not join his team in the field, simply because he himself lost access to the site several years ago.

[74] Email on 16.09.2024. Translated from French.

For nearly twenty years, the two teams coexisted on the island, sharing boats and accommodations. However, a conflict arose when the Norwegian team observed a major decline in the birds they had been monitoring.

> My project was recently evicted from [the site] precisely because of competition between research groups. It was a tough battle, and we lost. (…) The team we had been working with for twenty years lost all the birds in their study area on the island and decided to move into ours, thereby expelling us[75]

According to Charles, whereas the two teams had previously submitted a common ethics application for two decades, the Norwegian team unilaterally submitted their own that year, resulting in the rejection of the French team's application. Consequently, Charles relocated his research to other field sites, and the project on the Norwegian island never resumed. However, this case remains an outlier within the broad range of cases I encountered during this study. Very few seabird colonies are shared among multiple research groups. Some sites, such as Skomer, are occupied by three different teams across the island (figure 12), but each is responsible for different species and distinct research questions. On Charles' Norwegian site, even though a territorial agreement had initially been established, the spatial distinction between study areas was not so clear.

If I were to map the trajectory of a seabird colony as a scientific site in the same way I mapped researchers' field trajectories at the beginning of this chapter, there would rarely be more than one connection – typically, between the site and a single research team. Each colony is the territory of a specific researcher or research group. When new field sites are established, they are usually located in seabird colonies that have not yet been designated as sites for science; or it needs to be a collaborative project on a trial site. Returning to Fayet et al. (2021), the four sites Annette Fayet visited during her fellowship position were already the territories of her colleagues. Erpur Snær Hansen, for instance, resides on Heimaey and monitors a puffin colony only a few minutes' drive from his home. Grímsey, a site he had included in the 'puffin rally' for several years, allowed him to host Fayet, as he could rent the house of a local fisherman he knew. Fayet thus joined him for several stops along the 'puffin rally'. Similarly, Tycho Anker-Nilssen has been monitoring the puffins on Røst since the 1980s. Having already negotiated access to the site, he hosted Fayet for a short period so she could conduct her experiment. Finally, Skomer was

[75] Email on 06.04.2023. Translated from French.

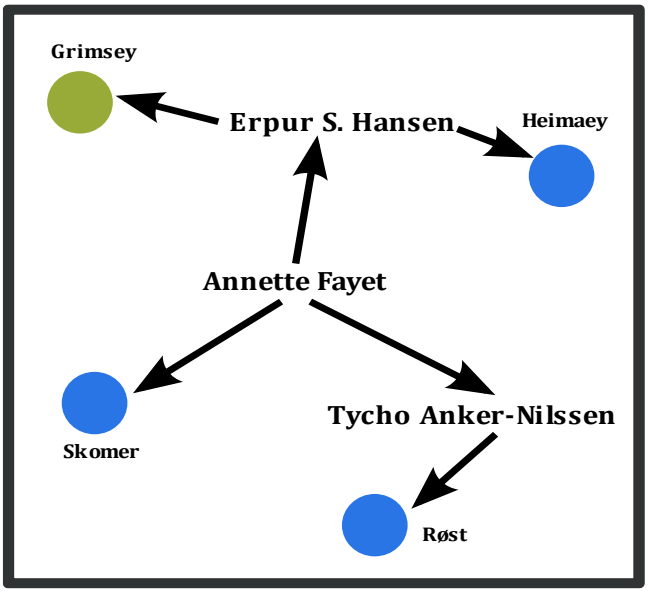


Figure 16. Field (im)mobilities in Fayet et al. (2021).

a site where Fayet had already been working for several years. Figure 16 illustrates the field (im)mobilities that shaped the research behind Fayet et al. (2021). Each colony was a researcher's territory, and rather than a share of field sites, these collaborations functioned more as diplomatic visits. This form of territorial gatekeeping is not unique to seabird research. Amanda Rees similarly describes such dynamics in primatology, in a footnote which crucially indicates that *certain* field sites are associated with the prestige of *certain* people:

> The importance and significance of particular places is reinforced by the ways in which many of the interviewees spoke of how tricky it was to get access to an established field site, referring in particular to the reluctance of pioneer figures to allow strangers in. One primatologist observed, 'joining an existing field site has its own problems [...] It's almost as if the amount of space they have makes them territorial'. (Rees 2006: 322)

This individual dimension of field sites as scientists' territories largely echoes the concept of 'moral economy', popularised in science studies by Robert Kohler (1994) for the community of fruit fly (*Drosophilia*) geneticists established by Thomas Hunt Morgan in the United States in the early twentieth century. This community was shaped through a 'moral economy' valuing the wide sharing of mutant stocks with the expectation of reciprocal sharing – "no trade secrets, no monopolies, no poaching, no ambushes" (Kohler 1994: 254). Strasser (2019) generally defines moral economy as "the system of values that underlies the exchange of scientific knowledge, with particular regard to how knowledge is tied to issues of property, privacy and priorities".

In marine ornithology, the challenge of accessing seabird colonies reinforces both the values of data sharing (which I will further explore in Chapter 6) and the gatekeeping of field sites. Researchers are expected to invite others to their field sites, but often do not share them; it can lead to conflicts, such as in the case of Charles. This situation arises not so much from a lack of willingness to share, but from a pragmatic logic. As one researcher

explained to me during an informal conversation at a Seabird Group Conference, it was already quite complicated to access her own site, let alone visit others. However, as I will describe further in the next chapter, this territorial gatekeeping also relates to the prestige associated with having privileged access to specific field sites.

Conclusion

In this chapter, I tried to answer an apparently simple question: *Why do researchers go where they go to collect scientific data?* which uncovered an even more challenging question: *What does it mean to select a field site, and how do researchers choose them?* Behind contingencies and luck, I demonstrated that the selection of field sites is not mundane. It is shaped by the multi-dimensional matter of accessibility: epistemic, relative, logistical and social. Accessibility, I have argued, is constructed and negotiated by researchers who do not have the same resources at hand. Thus, I have noted that senior researchers tend to prioritise epistemic and relative accessibility, whereas early-career scientists are more often constrained by logistical and social access. Similarly, whereas the research questions are central to the selection of trial sites, logistical and social resources are particularly influential in the choice of long-term, seasonal sites. This is important to note as setting up seasonal sites is more prestigious within the seabird research community. Ultimately, selecting a field site is major for a researcher's career trajectory. Not only does it relate to the data, analysis and publications they may produce, but it also shows their resilience and capacity to construct and negotiate access to often challenging and remote sites. Such challenge participates in processes of 'territorial appropriation' of colonies as scientific field sites: each colony, it appears, belongs to a scientist or research team.

Understanding the processes driving marine ornithologists to specific seabird colonies is important, as it may explain why certain sites are more attractive and studied than others. Conversely, it uncovers sites that are abandoned or simply never come into being. This also shows that the temporalities of these field (im)mobilities are not straightforward: scientists set up field sites, access them once, might come back, or never return. Along the way, some sites appear, others disappear. Indeed, once they have secured access and turned a colony into a field site, ornithologists then seek to maintain

it, and annually access it, leaving and returning to study the same group of birds, the same part of the colony. Negotiating (im)mobility, being able to maintain access to colonies in the long term, is a crucial concern for marine ornithologists, as the next chapter will promptly discuss.

Chapter 5

Long-term commitments

Maintaining (im)mobilities at the seabird colony

It was the fifth day of the 'puffin rally'. Erpur Snær Hansen, Sam, Ugo, and I were seated in an elegant restaurant by the harbour of Husavík. It was already 4 pm and we were having lunch after hours of driving from Egilsstaðir. We were taking our time; the rescue team meant to take us to the small island of Lundey, was no longer available for the day, and we would have to return the following week. We still had several hours to drive to our next stop, at Hansen's brother in Hólar, so we truly relished this break. As we discussed his collaborations and how he is collecting data for international colleagues during the 'puffin rally', Hansen wondered what would become of all his undertakings when he is "fed up with doing the rally" – perhaps in 10, 15 years, who knows? I asked if he planned to find a successor. "Impossible", he said. The 'rally' should both begin and end with him. To lead the 'rally', you should be Icelandic, speak Icelandic, and know Icelandic people[76]. "People behave differently if you are not Icelandic", he noted. And the people are key to the success of the 'rally'. For instance, Hansen's wife knows one of the homeowners on Papey, who allowed us to camp by her house and hosted me for the night when I was unwell. Hansen is also friends with the fisherman who took us to Papey, owns a small house on the island, and is flexible with the rally's frequent 'change of plans!'. He concluded, "You need to know a lot of people, who to call, and whom to ask if you need anything".

Although it plays an invaluable role in monitoring Iceland's puffin populations, the 'rally' seems likely to end once Hansen retires or chooses not to commit any longer. The 'rally' requires considerable effort and personal dedication: months in advance, Hansen

[76] It is important to mention that the seabird research community in Iceland is very limited and very international; Sam, for instance, is Spanish, and so was his predecessor on the puffin rally.

must find at least three people to join him in the field. He recruited Sam as a new field assistant in April, invited me as a scribe later that month, and hired Ugo as the drone pilot just weeks before we started in June. He also maintained the Lunar cruiser, the off-road vehicle, and the trailer tent essential for travelling across Iceland, where we sleep. This year, he undertook extensive renovations that involved trips to Reykjavik and hours of manual work, such as replacing mattresses, updating electrical systems, and repairing furniture. We all gathered at the end of May to depart on June 1st, but postponed due to a predicted snowstorm – the largest in northern Iceland in a century. In the meantime, Hansen coordinated with various contacts each day, including the boat captain to Papey, the resident of Papey, the Husavík rescue team, his brother in Hólar, and the homeowner in Grímsey. He had to constantly reconfirm the infrastructure of the people who make the 'rally' operate; yet, we encountered 'system failures', such as arriving that day too late in Husavík, where the rescue team had already finished for the day.

The 'puffin rally', somehow, has run like this since 2010, for about 15 years, in Hansen's hands[77]. Despite his name, "rally", and organisation – "quick and dirty", as Hansen calls it[78] – the program is part of a long-term monitoring initiative. Its goal is to collect information on the breeding population of Atlantic puffins in Iceland. In June, Hansen and his team first visit a set of puffin burrows (generally around seventy) in several colonies spread across the country, and use a burrow camera (figure 17) to assess incubation and nest occupancy – basically: is the burrow occupied? how many puffins are present? is there an egg? He returns in July to compare the first round of data to the same observations: is the burrow still occupied?

Figure 17. Hansen inspecting a puffin nest with a burrow camera on Vigur, Iceland (19.06.24)

[77] However, I do not want to make it into a personal affair: the 'rally' has also been running through the field assistants joining throughout the years. Erpur has been the sole 'lead' of the rally, and created it.
[78] Interview on 08.02.2024

did the egg become a chick? Towards August, he thus has information on the breeding success of puffins in Iceland. He then writes an annual report describing the health of the puffin population, based on the accumulation of data from past years of the rally; all these reports describe a worrying decline in the populations of puffins in Iceland (Hansen and Martinez Catalan 2024).

Long-term monitoring is often portrayed as a 'scientific ideal' in ecology (Mauz et al. 2012), providing critical insights into long-term environmental processes and being vital for predicting future changes (Magnuson 1990; Hughes et al. 2017). Ecology has produced numerous studies, books, and programs underscoring the importance of collecting comparable and replicable data at singular or networks of sites to develop robust understandings of the past, present and future of ecosystems (see Magnuson 1990; Lindenmayer & Linkens 2010; Strier 2010; Hughes et al. 2017). In today's context of environmental disruptions – characterised by the Anthropocene era (Crutzen and Stoermer 2013), the Sixth mass extinction (Ceballos et al. 2017), and global warming – acquiring ecological information over extended periods is particularly valued. As seabirds are intertwined in these ecological disasters (Dias et al. 2019), long-term monitoring is a crucial scientific practice (Birkhead 2014).

In the previous chapter, I articulated what choosing a field site means for marine ornithologists and demonstrated that it is importantly related to negotiating accessibility and claiming a territory. Selecting a field site involves more than choosing a prime location for answering research questions; it is also a strategic career choice that determines researchers' academic trajectories. In marine ornithology, what matters is not just accessing the colony once, but being able to return – this is also how colonies become territories for researchers. The temporality of fieldwork, accessing and returning to the same colonies for sometimes decades, is a crucial concern for seabird scientists.

This point is important to consider as it provides a better understanding of the very nature of field sites: how they are set up, maintained, and passed on, and under what conditions. Arpin and Granjou, drawing on Kohler, emphasise that fieldwork is constituted of 'practices of place *and time*' (2015: 239, original emphasis). They add that "considering the longevity of research sites might therefore be key to analysing the knowledge produced on these sites as well as the field scientists' relationships with local users and political engagement" (ibid: 242). In their study, they identify various 'practices

of time' among field scientists, particularly concerning researchers' investment in field sites. Some sites are central to researchers' expertise, while others are part of broader networks, involving minimal time investments – which echoes my distinction between *seasonal* and *trial* sites.

This chapter is thus concerned with the temporal dimension of seabird fieldwork. How are the ornithologists able to *return* to the same colonies? How are these seabird colonies *maintained* as field sites? What does it *feel* like to maintain in the long term and spend decades on it? Finally, how does long-term monitoring *end*? Long-term monitoring of seabird colonies, akin to field ecology, is an ideal, a vision (Mauz et al. 2012), and as I introduced it with Hansen's story, is also a *commitment*. Seabird fieldwork is not only a matter of selecting or ending up in a specific colony. As this chapter discusses, these endeavours are most meaningful to marine ornithologists when sustained access to birds is negotiated over the *long term*. Hence, the chapter addresses the (re)configurations and challenges of maintaining seabird colony studies for long-term monitoring. I explore scientists' (im)mobilities driven by the desire to maintain colonies as 'home for science' (Geissler and Kelly 2016) and 'home for seabirds' amid contexts of changing funding landscape and Anthropogenic climate change. Researchers aim to monitor sites to track population changes – a narrative of significant seabird declines. However, the (im)mobilities of researchers and birds do not always align. Ornithologists confront a profound tension: to advocate for sustained colony monitoring, they must demonstrate substantial population changes – often declines – even as they care, and wish, for these colonies to thrive.

I will first discuss the challenges of long-term monitoring in ecological field sciences approached in the literature, around three *temporal paradoxes* that researchers have to navigate. Most of the literature addressing the work of maintaining a long-term study draws from big ecology; instead, I focus on little stories of big commitments at specific seabird colonies. Next, I will introduce the narrative ideal of long-term monitoring in the seabird research community as a *lifelong commitment*, beyond personal resilience and dedication. This commitment to the long-term maintenance of field sites is all the more critical to negotiate as scientists are working through major disruptions: the gradual decline of seabird populations and the shifting values of commitment within the research community.

Three temporal paradoxes in ecological field sciences

> For scientists, change in the field sites is the name of the game, but too great a change and these sites cease to be relevant at all (Ribes and Jackson 2013: 158)

This quote nicely illustrates the inherent paradoxes of ecological fieldwork. The challenge marine ornithologists face in maintaining long-term monitoring of specific colonies is not unique to seabird research. In this section, I propose a review of the literature which emphasises three temporal paradoxes in ecological field sciences: producing systematic and standardised observations in a constantly changing environment; predicting the future based on the past; and sustaining long-term observations with short-term funding. These paradoxes I have identified serve as a framework for understanding the anxieties and challenges of long-term seabird colony studies.

The paradox of ecological changes

First, ecological scientists must produce systematic and replicable data from an ever-changing environment[79]. This paradox is thoughtfully explained in a chapter by David Ribes and Steven Jackson in their study of stream chemistry in the Baltimore region on "the work of producing, preserving, and sharing data" (2013: 147). They challenge common understandings of 'raw data' collected in the field by illustrating the extensive effort to make environmental data comparable against constantly evolving organisational, technological, and cultural contexts. The stream chemistry case resonates with broader challenges of keeping data 'the same' when everything else changes:

> Sites where samples are collected are transformed over the years, becoming polluted by industrial growth and then purified as emission standards take effect. The academic cycle brings in new teams of graduate students (the laborers of scientific data production) and each such change threatens to tweak the delicate rituals of collection. New sensors promise automation and objectivity while subtly changing baseline readings and the accompanying human routines of collection and upkeep. What results is a complicated ontological choreography, as scientists and technicians work to make data "the same" in a changing ecology of technologies, organizations, field sites, and institutional rearrangements (ibid: 148)

[79] This is the nature of *monitoring* and distinguishes it from *surveying* (Aronova 2015) or *recording* (Manceron 2013).

Indeed, researchers operate a "delicate balancing act", whose rationale is that: "Data only become longitudinal if they measure the same thing week to week and year to year. And yet it is also differences in those field sites over time that are of greatest interest to scientists. When are changes the right kind of changes?" (p. 153). Ribes and Jackson's insightful analysis reveals how local practices contribute to large-scale and long-term ecological research. To assess changes, scientists must produce systematic observations over decades, ideally centuries.

In line with Ribes and Jackson, most of the literature on temporal matters in ecology primarily engages with infrastructures, particularly focusing on the transition from (local) field observations to data stored in (large-scale) infrastructures. Scholars have highlighted temporal challenges, especially those related to aligning short-term research practices with long-term scientific visions (Karasti, Baker and Millerand 2010).

The Long-Term Ecological Research (LTER) network has remarkably inspired infrastructure ecology scholars to think about matters of time and ecological change. The LTER program was officially launched in 1980 under the National Science Foundation, connecting a vast array of sites, people and institutions across the United States. It is perhaps the most successful case of a sustained program for the long-term study of specific sites, resulting in a comprehensive understanding of ecosystem changes in North America (Hobbie et al. 2003). For STS scholars, it illustrates the temporal contrasts between data infrastructures and environmental shifts. Here, long-term spans not just years or decades but centuries (Ribes and Finholt 2009; Edwards 2010; Karasti, Baker and Millerand 2010). Scientists are thus cautiously navigating between the construction and maintenance of large-scale and long-term infrastructures, and environmental changes – which they must integrate into these very data infrastructures.

Besides, long-term monitoring enables understanding ecological changes, but too big a change can also hinder these studies. In the restoration of the Columbia River Basin, Shana Lee Hirsch mentions that "Temperatures, streamflows, and tide levels are becoming more variable and extreme, and some restorationists have been forced to abandon long-term monitoring sites altogether: climate change effects have rendered some comparisons impossible" (2020: 48). Ecological change is essential for long-term studies; otherwise, there is no meaning for "monitoring" (Aronova 2015). Similarly, in the case of animal research and primatology, Amanda Rees notes how the study of the same group of primates over decades is vital, but inherently biases the data collected, as the

animals habituate to the humans and change their practices (2006: 323). Thus, ecologists need to work *with* the changes they study, knowing that these changes only make their research more difficult to arrange and maintain because of their inherent unpredictability.

Finally, Rees (2006) and Ribes and Jackson (2013) point out in their respective studies that the academic landscape also changes, making it challenging to study long-term ecological issues that extend well beyond the lifespan of scientists. "Gathering data on a primate lifetime reproductive success, for example, is a project that can last as long as the lifetime of the primatologist", notes Rees (2006: 324). As I will further discuss in this chapter, this issue is also critical for marine ornithologists: how to maintain a robust, comprehensive and objective study of a seabird colony beyond a scientist's life?

The paradox of temporal orientation

Long-term monitoring is centred on ecological change. To assess this, researchers must collect data from the past in the "invisible present" (Magnuson 1990) to predict and understand potential future changes. Field ecologists contend with various temporalities and rhythms – of the environment, their own (hi)stories, the data they produce, and the orientation of this data. Consequently, field-based ecological research faces the paradox of its "temporal orientation" (Whitney 2019): field biologists look to the past when making arguments about the future. Whitney discusses how shorebird specialists in the U.S. struggle to advocate for bird protection measures until a clear decline is evident, often only when "the population reaches zero" (2019: 279). Because they are unable to foresee the future, the scientists must rely on a form of *intuition*, based on the available knowledge in their hands, such as bird population declines. Whitney highlights how field scientists intertwine three historical temporalities: their own "history of seeing population crashes as a wildlife biologist", "the history of wildlife and fisheries management more generally", and the "shorebird populations [they know] are in decline" (p. 279).

Ecological field sciences are rooted in the tradition of natural history, seeking patterns and trends in past monitoring data. In *Landscapes and Labscapes* (2002a), Robert Kohler examines how the 'new natural history' developed as a legitimate discipline in the early 20th century. He explores how, to legitimise field-based science,

field ecologists blurred the 'lab-field border' and transferred laboratory-like practices into the field. Credibility was vital for scientists developing robust environmental knowledge based on temporally and spatially situated observations. Kohler describes fieldworkers' strategies to "use the very particularity of nature to create knowledge that is true to nature generally" (2002a: 11). Making credible, 'true to nature' knowledge posed challenges as field ecologists transitioned from natural history to experimental science. This endeavour relied on hybrid lab-field instruments, protocols and practices to accumulate rigorous, replicable observations. Megan Raby adds, from the case of the long-term ecological site of Barro Colorado Island (BCI), Panama, that "practices on BCI went beyond reconstructing a place's past to include the ongoing surveillance of the life and environment of the island into the future" (Raby 2015: 802). This means that while scientists worked around BCI's ecological past, they also needed to develop specific place-based practices to ensure its maintenance. However, maintaining a site, she notes, means modifying it so it stays 'accessible and observable', rather than leaving it unchanged. The BCI need to be both an 'ark', an attractive site for its ecological diversity, and an 'archive', a scientific object and long-term living data repository.

As such, Lorraine Daston (2012) conceptualised scientists' "archival" practices as those with a "historical consciousness", such as making and maintaining spatially and temporally large-scale records of observations. The concern for such "science of the archive", Daston argues, is "storing up material for future investigators". This poses again a paradox of temporal orientation as Raby notes: "In contrast to the stereotype of scientists' amnesia regarding their own history, those working in such fields must not only scrutinise the work of past practitioners but also consciously store up material and observations for future researchers" (2015: 803). Thus, scientists, and particularly ecological field researchers, need to work under different temporal orientations and their articulation. As the local and situated environments they study change inexorably, ecologists are working to 'freeze' these changes in databases that will endure into the future – without knowing how these infrastructures themselves will last.

The paradox of funding temporality

Both temporal paradoxes – ecological change and temporal orientation – are problematic because they clash with the temporality of academic funding. The long-term nature of

ecological monitoring conflicts with modern timescapes of science. Isabelle Arpin and Céline Granjou highlight this major temporal tension for field scientists:

> the rise of project-based funding motivates life scientists to respect often tight deadlines, while on the other hand they are also strongly encouraged to predict how living beings and ecosystems might respond to long-term global changes. So, more than ever, they must seek to reconcile two apparently conflicting requirements: being fast knowledge producers, and attending to the specific temporalities of the living beings and ecosystems they are interested in, in the context of climate and other global changes. (2015: 238)

While long-term monitoring holds significant value for ecological studies, it is predominantly short-term funded, with decreasing allocated resources. An article written by a group of ecologists reaffirms the importance of long-term ecological studies for understanding and managing nature (Hughes et al. 2017). "Ironically" (p. 273), as long-term programmes have proven crucial for the understanding and decision-making over the environment, dedicated funding has largely decreased. The main issue is that the timeline for such programs does not align with the short-term nature of grants. Even the LTER program in the US, often cited as an example of successful integrated long-term monitoring, does not *really* run on a long-term temporality. Involved field sites are re-evaluated every six years for continuation or renewal of funding.

While fieldwork requires significant resources, in both time and money, particularly in remote locations such as seabird colonies, it is not given much consideration in scientific funding policies, which provide critical support for research projects. A group of field ecologists notably recently published a call in *Nature*, claiming that "Institutions and funders should develop policies and funding mechanisms that recognize the time and resources required for field-based studies and expand evaluation metrics to evaluate researcher contributions to their disciplines beyond publication metrics" (Rafiq et al. 2024: 856).

STS literature has largely discussed this discrepancy, emphasising how funding systems prioritise innovative, result-driven projects, impacting research content (Gläser and Laudel 2016; Franssen et al. 2018; Smith, Schäfer and Bernstein 2023). This affects the 'long-termness' of research (Laudel 2006). Scientists often value rapid publications, which conflict with long-term ecological data collection, as they may not even provide any results within their lifetimes. Nevertheless, publications based on long-term data are highly valued in ecology (Hughes et al. 2017). Securing funding is a critical "art" (Laudel, 2006) for scientists who develop adaptive strategies to obtain resources for the research

they wish to conduct. While science policy does not impact the content of science in an unidirectional way, scientists also find strategies to turn their ideas into "do-able problems" (Fujimura 1987). As several scholars suggest, following "the money trail" is crucial to understanding specific research decisions and practices, especially in contexts of funding scarcity and constant threats of interruptions (Andersen, Bek-Thomsen and Kjærgaard 2012; Gläser and Laudel 2016; Reinecke 2021). Ecological field sciences, such as marine ornithology, particularly reveal the misalignment between long-term perspectives and funding policies. Besides, as scientists adapt to these funding conditions, more and more voices are advocating for the consideration and valuation of *slowness* in research as a matter of care for the environment they study (Puig de la Bellacasa 2015).

Thus, scientists must develop strategies to align their 'environmental vision' (Benson 2012) of long-term monitoring with funding agendas. Amanda Rees notably pointed out in a footnote this crucial practice from primatologists, who rely on seemingly 'new' ideas and projects to maintain their long-term field sites: "This pattern of seeking short term grants to bolster up a long term project is one that is common in the development of long term research sites" (2006: 324).

Similarly, I wish to emphasise in this thesis how marine ornithologists must navigate the clash between their 'environmental vision' (Benson 2012) of long-term monitoring and the short-term nature of the funding they use to return to seabird colonies over sometimes decades. Throughout my interviews with marine ornithologists, unsurprisingly, many raised the paradox of funding temporality for long-term monitoring. Martin, a marine ecologist in Norway, argues that long-term monitoring is inherently almost impossible to fund. Thus, marine ornithologists, like the primatologists Rees observed, find ways to align short-term funding with their long-term vision.

> (…) monitoring is always poorly funded. Because monitoring is a long-term investment. […] no one wants to commit to like "okay, for the next thirty years, that one is paid!" […] if you use the word 'monitoring', you can be sure that it's not going to get funded. People don't want to fund monitoring, but if you twist and turn "Oh and this innovation! And this new thing…!", and you know, you just have the monitoring while you are anyway there, that works. But you can't just say "I need funding for monitoring". No one funds it.[80]

[80] Interview on 07.10.2022.

Bernard Cadiou, a seabird ecologist monitoring a colony in Brittany since the 1990s, further explains the challenge of securing long-term funding, as it is inextricably based on speculations:

> Long-term monitoring demands a huge investment. Because from the moment we start, we need to try and maintain it every year. So, there is the issue of funding and always being able to justify the interest in having this study. That's why there are so few of those. Because at some point, you are asking for recurring funding without necessarily being able to provide anything new. That's because you are doing routine work: ring the birds, recapture the birds, ring-spotting with the scope, following breeding success… Every year, we are roughly doing the same thing, which is the baseline of long-term monitoring. But we will not necessarily bring anything new every year, every two years or every five years. And for a funder, in France or abroad, it is difficult to understand the value of this annual monitoring, which does not bring anything new. Which does not bring anything new, but which, we know, is going to be a baseline for ten, twenty, thirty years, and one day, if anything happens, this baseline will be the reference for a new evolution. But when we start the study, we cannot know that. […] When we do long-term monitoring, that's what we have to provide, that's what we do: a baseline study, which could help highlight some major changes if anything happens. But maybe nothing will happen at the scale of our lives.[81]

Thus, long-term monitoring is speculative and uncertain, conducted to *potentially* detect changes arising in the Anthropocene. For marine ornithologists, this necessitates visiting the same colonies annually, collecting data that may or may not be useful, but which *must* be there to make sense of any study conducted. Funding remains a constant concern and with it, the maintenance of (im)mobilities to seabird colonies.

Lifelong commitments

Maintaining a field site is both a major scientific concern and a logistical and financial challenge for researchers. The literature emphasises the strategies scientists need to find to align their long-term vision of fieldwork with the short-term aims of funding policies. This is especially notable in marine ornithology, which values the long-term study of seabird colonies to observe their evolution under increasing threats such as climate change. In this section, I argue that long-term monitoring for studying seabirds is even more crucial since fieldwork on the same colony for decades is seen as a 'lifelong commitment'. The literature I previously discussed generally overlooks the experiences and feelings involved in spending days, months, and years in the same location, studying

[81] Interview on 07.09.2022. Translated from French.

the same environment or population. In marine ornithology, the personal stories and careers of scientists conducting long-term studies on remote and challenging seabird colonies form part of a collective imagery of resilience and dedication, inspiring the scientific community. This collective imagery is part of the 'epistemic culture of fieldwork' in marine ornithology, which I introduced in Chapter 3. However, I add that it tends to overlook other factors beyond personal dedication and raises the standards of what it means to be a marine ornithologist.

Inspirational figures of resilience

On October 7, 2024, the PacificicSeabirds newsletter shared a story from the *Anchorage Daily News* (Wohlforth and Holmes 2024) about American seabird ecologist George Divoky's "half-century of research on the Black Guillemots of Cooper Island". "Recent years, unfortunately, document the gradual demise of the colony due to global warming", wrote the seabird scientist sending the story. A colleague later remarked, "Yes, it's an excellent article – a nice portrayal of George's decades of work and commitment – and a moving commentary on what the loss of this one small colony indicates, in the big scheme of climate change". Indeed, the story of George Divoky's long-term study of the Black Guillemots (*Cepphus grylle*) of Cooper Island reflects commitment amidst loss and illustrates the affective ties in maintaining a seabird colony study. Such commitment forced the admiration of the seabird research community for Divoky's career.

Divoky, age 78, has spent his summers for fifty years among the Black Guillemots on **Cooper Island**, a small gravel islet off Alaska's north coast, living in a tent and later in a small hut he built – or "weather-beaten plywood shack, which is no larger than a lawn shed", writes the journalist. The colony is in serious decline due to climate change and polar bears. The article describes Divoky's experience of loss for the bird he has been studying for several decades, regularly attacked by hungry polar bears: "And here were pieces of a bird he thought of as an old friend. He had checked its nest and measured its young every summer since 2002". Divoky risks losing not only his long-time avian friends but also his fieldwork. The journalists write that "perhaps this summer would be his last extended stay. After surveying all the nests, he found that the bears had destroyed half of them. Only 10 remained with eggs. And four adults had died out of only 40 still nesting". Indeed, Black Guillemots nest on the ground and do not bother digging burrows. They

Figure 18. A group of Black Guillemots on the beach on Vigur Island, Iceland (20.06.24)

find a cavity, a hide, or a rocky area to lay their eggs if they deem the area safe from predators. This picture (figure 18), which I took on the island of Vigur during the 'puffin rally', shows a group of Black Guillemots nesting outside our tents, on the rocky beach[82]. On Cooper Island, the guillemots also decided to breed on the ground instead of their usual rocky cliffs. They took advantage of wooden debris from a U.S. Navy operation boat spread across the rusty red gravel island. Initially thriving with over 600 nesting birds in 1972, Divoky sensed the colony was threatened by climate change from the start. He navigated his study amidst attachment and anxiety for the guillemots. "There are birds out here that are over 25 years old that I've known since they were a nestling", he explains in the article. Divoky even maintained his study despite the paradox of funding temporality, and when he lost his funding in 1981:

> Divoky kept his study alive. Long-term data is critical for tracking change in the environment, and he was already seeing change […] Without funding, Divoky slept in a tent on hard, frozen gravel, bundled in layers of vests and parkas against frigid, foggy winds that rarely cease and produce constant noise. (Wohlforth and Holmes 2024)

Divoky eventually secured funding again and never stopped feeding his data series on the breeding behaviour of guillemots, slowly witnessing incontestable changes. What is now jeopardising Divoky's long-term study is not funding (it never really was), but the arrival of polar bears, driven by climate change. Despite replacing vulnerable nests with wooden and plastic boxes, bears learned to open them, leaving the guillemot 'colony' arguably not one anymore. The article portrays Divoky's resignation to possibly leave Cooper Island and end his lifelong study. Yet, he eventually plans to return to Cooper Island the next year; he decided not to stop his study of the colony, even if few birds remain.

[82] They were also nesting underneath the owner's wood terrace, on the stone wall and behind the tractor's wheels.

Such resilience in maintaining long-term studies against all odds commands the respect of the seabird science community and inspires researchers faced with the temporal paradoxes of ecological fieldwork. For Divoky, the decline in the guillemot population confirmed his intuition and the undeniable impact of climate change on the High Arctic. He persevered despite funding cuts and, like the greatest adventurers, endured extreme conditions to continue collecting data. These types of stories form part of the marine ornithology epistemic culture of fieldwork. Inspiring heroic figures like Divoky highlight the resilience of seabird scientists working on remote colonies, in precarious material conditions, and who have devoted decades of their lives and careers to studying companion birds[83].

Another figure remarkably profoundly inspired Canadian seabird research. At the Seabird Group Conference in September 2024, Ingrid Pollet presented over sixty years of Leach's Storm Petrel data from **Kent Island**, New Brunswick[84]. She asked the crowd, "I know many of you are a young audience, but those of you who were there at the conference in 2016, do you remember the motto? It's never too late to start a long-term study. Whilst I agree with that, I myself started a long-term study in 2010, and I think it is important to analyse the data from previous long-term studies. Let me introduce you to Chuck Huntington". Charles (Chuck) Ellsworth Huntington was a biology professor at Bowdoin College and directed the Kent Island Field Station from 1953. He noticed that the island was home to a large colony of Leach's Storm Petrels and started to collect data on these birds in 1955. "He did not know at the time that it would become a *very* long-term study, still ongoing seventy years later", added Pollet. Huntington had been going every year to Kent Island until his passing at 98 in 2017. He collected data on burrow occupancy, egg laying and hatching success from 1955 to 2017, except during his sabbatical in 1977. Such extensive data, proving a serious bird population decline due to climate change, earned colleagues' admiration. Pollet expressed pride in working with this data after Huntington, which had been little published. His obituaries also

[83] Jouvenet (2022) makes a similar observation in ice core science, where some of these inspiring heroic figures are also public, appearing in the media, and publishing appraised books describing their adventures in the poles. This also recalls some of the books published by marine ornithologists, such as Ronald Lockley and Tim Birkhead, that I discussed in Chapter 3.

[84] I. Pollet "Adult survival in the seabird Leach's storm petrel *Hydrobates leucorhous* covaries with the Atlantic Multidecadal Oscillation over the past six decades". Presentation at the 16th International Seabird Group Conference, 5th September 2024.

emphasised his resilience and dedication, trekking to Kent Island every summer for over sixty years. His successor described the perilous journey to the island that Huntington cherished:

> If the tides and weather cooperate, it is a lengthy journey from Brunswick to Kent Island—including a five-hour car ride, a two-hour ferry, and a one-hour ride in a lobster boat—before transferring to a skiff and walking 20 minutes across the muddy, algae-covered intertidal, around a tidal basin, and through woods and fields for another quarter mile. Chuck relished every moment of that trip and every trip he took to Kent Island. (Wheelwright and Mauck 2018)

Huntington's dedication reminded me of my first visit to the Isle of May in May 2022. Together with my supervisors, we were trying to find seabird researchers working on the island to plan future interviews. We were chatting with a Master's student when he froze suddenly as an old man walked in our direction. He was wearing ripped clothes and had a notebook coming out of his pocket – surely, an ornithologist. I collected the pieces of information together: this was no other than Michael (Mike) P. Harris, who initiated the long-term study of the Isle of May in the 1970s, another highly praised figure for the seabird community. At least, I could tell so with the student's reaction to Harris approaching. George Divoky, Chuck Huntington and Mike Harris share many similarities: they are all men, coming from the field naturalist tradition (Kohler 2002a; Chapter 3) and established long-term studies in the 1960s-1970s. The longevity of their monitoring seems to be the result of their commitment, bravery and resilience against all odds. But are these stories of devotion representative of the long-term monitoring of seabird colonies, or is it the exceptional resilience of these individuals that makes them such an inspiration to the research community?

The exception that proves the rule?

Attributing the longevity of a long-term study solely to the sheer will of an individual would be simplistic. As demonstrated in Chapter 4, many factors make a site attractive for seabird research. Similarly, many conditions contribute to the maintenance of these studies. For example, Mike Harris is renowned in seabird research for his study of puffins on the **Isle of May**. The site was often mentioned in my interviews as a model for monitoring seabird populations. Hugo, who completed his PhD there, spoke about "the privilege to be able to work there. Because since the project started in the 1970s with like

Mike Harris and Sarah Wanless, it's an iconic place to do seabird work"[85]. Morten Frederiksen, who worked on the island before returning to Denmark, shared a similar sentiment about its reputation:

> (…) that was a total dream job… Being a seabird ecologist, it was clear to me that this was the most comprehensive and interesting long-term study of seabird ecology in Europe. (…) I would not hesitate to say, at least in Europe, it is *the* most well-known and most comprehensive single-site study of seabird ecology. I cannot speak for how the younger people in the field feel about this, but I would still think that it has an extremely strong reputation.[86]

Like Chuck Huntington on Kent Island, the Isle of May study was not initially intended to be long-term. During our interview, Harris explained that the maintenance of the monitoring in the first decade initially relied on individual dedication:

> It was just one or two people. And I mean, one or two people for the first five to ten years. Sarah Wanless came along in the early 1980s, and she has been working there ever since. It's been a relatively small research group, and it is now much bigger than it ever was. Because there was no accommodation on the island initially. We managed with the research money to keep the long-term study going.[87]

Indeed, after almost a decade, Harris was joined by Sarah Wanless, whom he married. Together, they never stopped going to the island, which is why I met Harris there in 2022. Although no longer involved in research projects, he was still collecting background data essential for long-term monitoring. While Harris and Wanless demonstrate personal dedication, the study's continuation is due to several advantages, such as accessibility. Philippe, who did a postdoc on the island in the 1990s, explains:

> On the Isle of May, the small boat is quite expensive, but you just need to take the shuttle to go to the island. It's simple. By the way, when Sarah Wanless and Mike Harris set up these long-term studies, I think they did so because, on the logistical side, it was not too difficult. I guess that is why they have been doing it for almost half a century, whereas we in Greenland have been doing this for 20 years, and we are already exhausted and wonder if we are going to hold out![88]

Philippe's comment thus shows that accessibility does not just play a critical role in the very selection of a site (Chapter 4), it is also crucial for its maintenance in the long term. On top of its accessibility, the Isle of May has a functioning field station managed by NatureScot[89] providing accommodations for researchers. Additionally, Harris and

[85] Interview on 19.09.2022.
[86] Interview on 11.10.2022.
[87] Interview on 07.06.2022.
[88] Interview on 31.03.2022. Translated from French.
[89] The Isle of May is one of Scotland's National Nature Reserves, owned and managed by NatureScot. It has a bird observatory and accommodations for rotating researchers, wardens and volunteers.

Wanless' lab, UKCEH, employs a full-time field technician, Mark Newell, who described his role as "ensuring that standardised monitoring continues from one year to the next. And then, all the other projects that happen out there, might be long-term or short-term, or students or whatever: how it all complements that long-term work"[90]. As he explains, long-term studies are performed by an infrastructure of people, in more or less short-term positions. Newell has been employed for about two decades, but the long-term monitoring relies on shorter-term studies, most often students' projects who only stay on the island for a few summers. Jeremy Vetter (2011) similarly noted the importance of skilled field assistants in sustaining long-term field sites, allowing senior scientists to maintain fieldwork at a distance. This indicates that while long-term monitoring is a source of prestige and tends to value strong figures in the community, it is critically performed by a collective of people, and most often early career researchers or students. This recalls Skomer, where the long-term study of Manx shearwaters led by Tim Guilford is passed on throughout doctoral projects of PhD candidates such as Lewis Fisher-Reeves (see Chapter 4). On the 'puffin rally' too, Erpur Snær Hansen tends to hire Master students who receive fieldwork experience and are more flexible with the design of the project, particularly prompt to unpredictability[91].

These stories thus contribute to a *situated* narrative of resilience, echoing Naomi Oreskes' description of the "ideology of scientific heroism" (1996: 90), particularly significant in field sciences[92]. Marine ornithologists *sacrifice* their time, and it appears, their life, to spend several months on a remote colony every year, for decades, ideally until their passing. However, this has to be situated. Oreskes notes that such heroic achievements often obscure contributions from women scientists and neglect their responsibilities, like family care. As I noted, it also neglects the role of temporary, more precarious students and research staff. This issue emerged in my conversations with marine ornithologists and will be further explored in the last section of this chapter. Yet, the Isle of May

[90] Interview on 23.09.2022.
[91] In my experience on the 'rally', the departure was delayed for over a week, we were stranded from accessing several colonies for a few days in Reykjavik due to a breakdown in the vehicle, without mentioning multiple 'change of plans!' each day.
[92] See also Benson 2022 discussing the role of 'heroic' narratives of fieldwork as ways for scientists to navigate the expectations of adventure in the US post-wars context. Benson urges historians of science to take "fieldwork seriously but not too seriously" (p. 116), paying further attention to the role of legacy in crafting scientists' own image and expectations of fieldwork. In short, researchers also like to *perform* fieldwork.

represents a unique case of long-term monitoring in Europe. At the 2022 Seabird Group conference, the 50th anniversary of the long-term monitoring of the Isle of May was celebrated. These 'success stories' serve as inspiration amid challenges researchers face in maintaining seabird colony studies. On closer inspection, the realities of such longevity are complex, with cases such as the Isle of May being rather exceptional. This is why this single site has been mentioned in so many of my interviews, often used to compare the difficulties encountered by scientists in establishing long-term sites, as Philippe.

These stories also contribute to the 'prestige' of fieldwork, in particular as a unique and long-term site in an ornithologist's career. This underscores a form of devotion to the study of seabird populations in decline, and to enduring sometimes extreme working conditions. In this context, seasonal sites, where researchers can spend the entire breeding season, are even more valued and prestigious, as they further reinforce the image of the researchers knowing *their* seabird intimately. Fieldwork at the colony, in those narratives, is a matter of patience and time. However, these stories from the field are sources of inspiration for the scientific community, but also distinction, defining the expectations of the 'true' field marine ornithologist and overlooking the role of women and early career fieldworkers.

Affective matters of long-term monitoring

These stories of commitment inspire researchers because they reflect the importance of long-term monitoring amid the increasing and inexorable disappearance of seabird colonies in the Anthropocene era. George Divoky, for example, has not given up on returning to Cooper Island, even though only a few birds remain. This commitment to returning to the colony and maintaining (im)mobilities faces internal forces within academia (the three temporal paradoxes I have presented) and external forces, such as climate change. The constraints and difficulties of long-term colony monitoring also highlight the deeply emotional and affective stance of fieldwork, particularly when it spans several decades. This deserves more attention, as the focus of long-term seabird populations monitoring has shifted from documenting the state of bird populations to documenting their demise. In this section, I will first attend to matters of *care* for ornithologists witnessing the decline of seabird colonies over the long term. Second, I will

attend to the apparent tension of such decline as a source of grief and motivation for researchers. Finally, I will discuss further another matter of loss at the colony: the loss of motivation to do long-term monitoring, and the weariness of such a commitment.

Long-term environmental care

The literature has already touched upon the affect of doing fieldwork, especially with wild animals, and how it requires practices attuned to the environment. Lorimer (2008), for example, famously described the practices of 'becoming corncrakes' from the corncrake field surveyors, and Alcayna-Stevens (2016) discussed how primatologists become 'habituated' to the primates. Seabird research is, too, an affective and care-ful science. When taking *time* into account, such matters of care and affect are even more acute (Puig de la Bellacasa 2015). It is clear that spending several decades on the same colony and repeatedly collecting data on the bird populations each year, sometimes for several months a year, is an intensely emotional experience, even more so when researchers can only witness the decline or disappearance of their study colonies.

The story of Signe Christensen-Dalsgaard particularly moved the scientific community at the Seabird Group Conference in September 2024[93] . The seabird ecologist at the Norwegian Institute for Nature Research (NINA) presented a photographic and audio exploration of the gradual disappearance of breeding birds on the cliffs of several colonies in Norway. Instead of numbers, she explained, photos and recordings offer an edifying testimony of the extinction of seabirds: "What is, really, 80% of breeding kittiwakes that have disappeared? It is a total silence of bird cliffs in Norway". Christensen-Dalsgaard arrived from Denmark in the early 2000s and immediately fell in love with the landscapes and seabirds, she explained. Like many other visitors, she did not notice that the cliffs were not supposed to be silent. During her talk, she compared pictures and video recordings made on the Norwegian island of **Røst** of packed bird cliffs in 1968 to contemporary landscapes. And while these show the pristine and stunning views over the Lofoten, we can only notice the quietness of the video and that all these birds are gone. By talking to colleagues who had been studying these colonies in Norway

[93] S. Christensen-Dalsgaard, "Silent bird cliffs. A photographic journey through shifting baselines". Presentation at the 16th International Seabird Group Conference, 4th September 2024.

Figure 19. A comparative photograph of Runde in 2023 (left, photo: S. Christensen-Dalsgaard/R. Barrett) and in 1982 (right, photo: R. Engvik). All the white dots in the right picture show kittiwakes. Screenshot from 'Silent birdcliffs' website.

since the 1960s-1970s, she realised the extent of the decline. For instance, in the colony of Runde, where she has been doing fieldwork for five years, more than 5,000 pairs of European shags (*Phalacrocorax aristotelis*) have disappeared. "In the last count this summer, there were 30 pairs left and none of them had chicks." And for the kittiwakes, the number goes up to 100,000 pairs of birds that are now gone (figure 19). The once-called "seabird metropolis of the Arctic" is mostly silent. Christensen-Dalsgaard collected hours of recorded conversations with the previous researcher in Runde, Rob Barrett, and her colleague on Røst, Tycho Anker-Nilssen, who has been working there for more than 40 years. She also collected pictures and videos from the archives of documentaries shot on these islands in the 1960s, to compile them on a website and tell the story of these "Silent Birdcliffs" (Landrø et al. 2024).

This process has been emotionally challenging for Christensen-Dalsgaard, who mentioned during her conference presentation how "eco-grief and eco-depression have been a part of everyday research". During a subsequent conversation, she added that she experienced eco-grief as "this paralysing feeling of not being able to do anything because it's just going to hell"[94]. Long-term monitoring amplifies such feelings: "We need to acknowledge the people behind the research being done and how it impacts us. I was a bit surprised, actually, that the presentation in Coimbra got so much attention. Because for me, these are things that everybody knows rationally, just like I know this rationally – because we work with these declines and long-term data series". This case indeed also illustrates the long-term emotions and care of monitoring seabird colonies; especially when such monitoring documents dramatic declines. Signe Christensen-Dalsgaard

[94] Interview on 03.10.2024.

gathered Rob Barrett and Tycho Anker-Nilssen's stories of witnessing thriving colonies becoming silent, and on the website "Silent Birdcliffs", she entangles their life trajectories with that of the colonies. She describes the "overwhelming" feeling of Barrett joining her 50 years after starting his study in 1975 on Runde and witnessing that most birds are gone – 90% of kittiwakes throughout Norway. The website also emphasises their emotions and resilience to the birds' disappearance:

> When Signe is out in the bird cliffs and experiences mere glimpses of what her colleagues describe from their first years in trade, she has the best job in the world. But sometimes she feels more like a doomsday prophet, who only brings tidings of bad times. […] Just like Rob Barrett and Tycho Anker-Nilssen half a century ago could not imagine that life in the bird cliffs would one day come to an end, it is difficult for today's younger researchers to imagine anything else.

Spending decades at a seabird colony and witnessing its decline is thus also part of the narrative of long-term monitoring. This storytelling of the *Silent Birdcliffs* project illustrates the commitment of researchers and the overwhelming feeling of witnessing – or even discovering – that the birds are gone. The story of Christensen-Dalsgaard, Anker-Nilssen and Barrett on Norwegian seabird colonies is also a matter of 'environmental care' (Schönbauer 2025). In the case of marine science, also very concerned by rapid environmental changes, Sarah Schönbauer documents the emotional relationship of care for scientists with the environment they study. She defines it as the

> emotional attachment that researchers have with their place of research and their research objects; their perceived responsibility and efforts to protect environments and species; the attention and concern for environmental changes they enact in research and protest and their experience of being troubled and worried about environmental changes (2025: 6)

Interestingly but unsurprisingly, she shows that such care is exacerbated when scientists do fieldwork, especially when they undertake building long data series. Long-term monitoring enhances their sense of care and commitment to the ocean. Schönbauer shows how care is situated in time and space, and how scientists even reorient their research questions and careers based on environmental changes. She touches upon the concern this creates as scientists remain entangled in credibility and research success issues. Thus, she argues that 'environmental care' is not innocent and that normative underpinnings apply, which necessitate situating the analysis in specific contexts of knowledge production.

Between care and strategic motivations

Schönbauer's contribution is a useful reference point for tackling my next argument on the disappearance of seabird colonies in the Anthropocene era. Marine ornithologists are emotionally affected by the declines of seabird populations, but such declines are also the very drivers of their engagement and the funding support they receive to conduct long-term monitoring.

Let me revisit Martin and Bernard Cadiou's arguments in the section on the paradox of funding temporality: long-term studies are scarcely funded due to the uncertainty of their results. However, massive and rapid declines in seabird populations *are* a clear and compelling outcome. In his argument, Martin referenced the case of ornithologist Tim Birkhead as a "success story"[95]. Indeed, in 2014, Birkhead's funding from the Welsh government to monitor the Common Guillemots (*Uria aalge*) on Skomer Island was withdrawn, and he published a commentary piece in *Nature* calling for support. He promptly launched a crowdfunding platform for the public to participate in, which gained so much popularity that it has supported his research ever since. In this piece entitled "Stormy outlook for long-term ecology studies", he highlights the longevity of his long-term study on Skomer and the vulnerability of seabirds to climate change to garner support:

> For more than 40 years, I have studied populations of guillemots on Skomer Island, off the coast of Wales. My research has revealed, for example, that the birds now breed two weeks earlier than they did in the 1970s, probably owing to climate change. This kind of research is not easy. It has taken four decades to accumulate the data necessary to understand how the population works because to do so requires accurate measures of how long adult guillemots live, how many chicks they produce, how old they are when they breed, what proportion of young birds survive to breed and so on. No more. Funding for the project has been axed. (…) It is frustrating that officials chose this moment to terminate our funding, when we have such an important opportunity to assess the vulnerability of seabirds to climate change. (…) There is a feeling that conservation and monitoring is low quality science and should be cheap; there is also a feeling that monitoring does not matter. For all those biologists who start what turn out to be long-term studies, continuity of funding is a major problem. (…) When my study started in the 1970s, climate change was barely on anyone's radar. The main benefit of long-term studies is that they allow researchers to address problems that no one else has yet imagined.

Birkhead did not expect to collect data on how climate change impacted the guillemots of Skomer when he started his study, yet that turned out to be his main finding, and the

[95] Interview on 07.10.2022.

motivation to continue the work despite funding cuts. Vanessa Manceron (2013) describes this shift from documenting the state of bird populations to documenting their demise as a move from *recording* to *monitoring*, and from a practice of *care* to a practice of *surveillance* (Manceron 2013). It is interesting to note that long-term studies are no longer a matter of solely collecting data but aim to describe declines (or, more rarely, increases) in seabird populations. This evolution is also apparent in the story of "Silent Birdcliffs" in Norway: Rob Barrett started to count the kittiwakes of Runde for the sole sake of *recording*, as he explained to Signe Christensen-Dalsgaard. Forty years later, she is *monitoring* the disappearance of the colony. Thus, the justification and motivation to study seabird colonies in the long term are entangled with the very disappearance of colonies against climate change. I must add that I analyse this as a tension, but the researchers I have met did not express a particular concern over this. On the contrary, as Christensen-Dalsgaard argued, marine ornithologists are so embedded in the massive declines and threats to seabirds that they would not even think to collect data for the sole sake of documenting them anymore. Under climate change, monitoring turned into the surveillance of seabird population declines.

The weariness of long-term monitoring

Although the disappearance of seabird colonies provokes emotions of grief, loss and care, it also conveys feelings of boredom and weariness. The weariness does not come from a defeatist attitude of researchers against climate change, but is mostly a reaction against the temporal paradoxes I discussed and the challenges, commitments, work and emotions to maintain (im)mobilities on seabird colonies over decades.

Throughout my interviews and when we discussed their practices of long-term monitoring, researchers were much more open to sharing their weariness over the amount of work required to maintain the study of a colony rather than the affect of witnessing massive population decreases. As Signe Christensen-Dalsgaard mentioned, researchers do not necessarily associate the dramatic numbers they produce with their feelings of grief and loss. In a study of climate scientists' emotions toward climate change, Head and Harada (2017) also described several coping strategies and emotional management tools the researchers developed.

Emotions are an increasingly important aspect of scientific practices that the STS literature has taken upon (Barbalet 2002; Shapin 2010b). Specifically in the context of long-term ecological research, we should attend to the positive and negative feelings of hope and loss, but also boredom (Gabillet, Arpin, and Prévot 2020). In their study of two environmental monitoring programs, the authors argue that it is crucial to attend to emotions to understand how participants maintain long-term studies. They identify two main sets of emotions, hope and boredom, and that participants navigate between the two realms. In particular, they comment on the participants' "weariness, as the programmes struggled to reconcile short-term gains with a long-term scope" (ibid: 3). For some participants, this led to strategies to find hope and motivation; for others, the weariness made them quit the long-term study. Weariness mostly comes from a lack of funding support, which is also the case for marine ornithologists. It also relates to exhaustion over the repetition of tasks, especially when the results of the study do not come immediately.

This echoes, for example, my conversation with Erpur Snær Hansen, which I mentioned to introduce this chapter. He indicated that the 'puffin rally' will end when he is "tired" of doing it. Indeed, the 'rally' comes with many tasks and responsibilities every year: recruiting fieldworkers, collecting and maintaining the equipment and the trailer, and ensuring he can access the same thirteen colonies again. This creates a lot of exhaustion, which Hansen expressed on many occasions during the 'rally'. Similarly, Philippe, a seabird ecologist based in France, insisted on his weariness over the administrative and logistical process of maintaining a long-term study. Philippe has been monitoring a little auk colony in **East Greenland** for over twenty years. As we were discussing his long-term monitoring study, he revealed he is considering terminating it:

> That is something I'm questioning again now, but more for logistical reasons. In fact, that's a bit of the reason why I am late today, because it takes a lot of energy to maintain all this, and I have the impression that [his institution] does not support me in this very arduous task. (…) At the moment, I'm trying to do a bit of everything, which exhausts me, and so I'm thinking…Well, if it's really so hard, shouldn't I give up long-term studies and go back to a lighter way of working? (…) For example, the fieldwork in Greenland (*sight*)…every year it's a nightmare all over again! (*laughs*) No matter how much we already know exactly what we want, how to do it and all that…every year it is still a massive effort.[96]

Philippe struggles with an aspect of long-term monitoring often left out of narratives but critical: planning for the field season ahead. This takes time in his already important

[96] Interview on 31.03.2022. Translated from French.

research responsibilities, and he had to book flights and cover some of the costs with his personal money, because his institution changed its internal system, causing some issues with his logistical partners.

Fieldwork is thus an intense, affective and emotional experience before, during and after being on a seabird colony. In the context of long-term monitoring, researchers must constantly think about the future: not only the colonies they study, but also what would happen if they have to stop monitoring them or retire.

Commit or not? Legacies of long-term seabird studies

All the cases I have presented describe researchers committing to study seabird colonies despite funding cuts, environmental change, grief and exhaustion. Except when they pass away or retire, they simply do not stop the monitoring study. What happens in this case? Scientists' (im)mobilities to the colonies might stop, but the seabirds and the scientific relevance of studying colonies remain. In this last section, I explore the legacy and continuation of long-term monitoring studies beyond the researchers' lifelong commitments. After introducing the topic of 'field legacies', I will discuss how commitments at the colony are evolving as a new generation of seabird researchers comes into play, with different expectations of what fieldwork should be.

Field legacies

Despite discussing how fieldwork is an affective, intimate and personal practice, the literature on field sciences has little approached the topics of continuation and legacies. Yet, this is crucial, especially when scientists build up long-term studies and generally appropriate colonies as their territories. In the introductory vignette of this chapter, Erpur Snær Hansen expressed that *no one* would be able to take over the rally after him. Throughout my research, however, I have encountered many cases where the scientists who set up a long-term study retired and found someone to replace them. This comes with adjustments, transfers, negotiations and sometimes, conflicts, especially as long-term monitoring must be based on robust and reproducible data. The literature from

infrastructure studies and maintenance and repair studies provides further ground for understanding the stakes of such transfers of field sites.

Indeed, as the literature on infrastructure has thoroughly described, infrastructures are made to *last* and have a lifetime of their own (Karasti et al. 2010; Ribes and Finholt 2009). Infrastructure technicians design and work along the idea that it needs to last beyond their own temporal scale and life cycle. Interestingly, in a case where the infrastructure is supposed to end, I found an inspiring parallel to my study of seabird colony fieldwork. Marisa L. Cohn (2016) describes the end-of-life of a large-scale and multi-decade technological infrastructure built to support a space science mission. She discusses the work of engineers to maintain the spacecraft in orbit around Saturn to collect scientific data. Started in the 1980s for a launch in the late 1990s, the mission was supposed to end in 2010. Cohn's fieldwork in the laboratory explores the extension of the last mission phase up to 2017 and the consequences of this unexpected longevity of the infrastructure. She describes the negotiated practices of technicians to work along with the ineluctable decay of the spacecraft. The maintenance of the spacecraft was conducted *along* with its decay, rather than *against* it, to "decay gracefully" (Cohn 2016: 1512). This case illustrates the affective practices that shape the maintenance of long-term scientific programs. Denis and Pontille (2022) add that it is a good example to explore the *stubbornness*[97] of scientific maintenance. The lifetime of the spacecraft exceeded the scientists' expectations and careers. Thus, until the end of the last mission, several teams of scientists and technicians succeeded in maintaining the infrastructure, which led to tensions, reorganisations, and transformations of technical skills.

Similarly, seabird colonies generally live beyond the scientists' lifetime, meaning there should also be situations of knowledge transfer, loss, re-organisations, transformations and tensions as the monitoring study gets passed on. Approaching maintenance as *stubbornness* also embodies the affective matters at stake when transmitting a field site, touching upon the level of commitment I have discussed throughout this chapter. I argue that, as seabird colonies as field sites are scientists' own territories, transmitting them is a matter of *legacy*. "Field legacies" encompass altogether the legacy of the researcher, data and fieldwork practices.

[97] In the original French version, they call this "obstination".

Legacy is also an important concept in the study of infrastructure time (Star and Ruhleder 1996) and has been more recently discussed in the literature. Hirsch et al. (2022) developed the concept of 'sedimentary legacy' to describe scientists' struggle to keep the LTER data infrastructure consistent when new layers of knowledge and practices come into play. They approach it as "how researchers adapt infrastructure to support the investigation of new research objects, even while operating under constraining legacies" (p. 561). Sustaining the legacy of infrastructure requires specific designs, decisions, and practices. The authors importantly describe that these never disappear, even when new people participate and new practices are adopted. The work of maintaining infrastructure is thus geological, new 'layers' or 'strata' are added, which sediment over time: "Consequently, even as new 'strata' of data and specimen collections are added, older strata continue to exert persistent and consequential influences for how a research infrastructure is able to adapt to support novel investigations" (p. 564). The matter then is to ensure a continuation.

In marine ornithology, field legacies are not just a matter of transferring specific practices, although they are crucial to ensure the continuation of long-term monitoring. I am more interested in the process of creating a legacy for a long-term monitoring study, and how this comes with transformations, tensions and re-organisations. Like in the spacecraft case, the longevity of seabird colony monitoring often exceeds the expectations of scientists.

Shifting commitments

First of all, being able to commit to studying a seabird colony for several months a year and several decades involves a strong level of dedication (and *stubbornness*), which needs to be situated (Haraway 1988). Indeed, lifelong commitments at the seabird colony are gendered and fall within the heroic narrative of field sciences (Oreskes 1996). Most of the stories of long-term monitoring I have described in this chapter are those of men, which is not surprising given that these were started in the second half of the 20th century, in a specific context for ornithological studies (see Chapter 3) and in the general context of invisibility of women in science (Traweek 1988; Oreskes 1996; Ekerholm 2015). However, the realities of long-term seabird colony monitoring are now different as more women do fieldwork, and this generation of pioneer researchers is retiring, replaced by

a more feminine and younger generation with a distinct vision of what *commitment* should be.

In the story of 'Silent birdcliffs', I briefly mentioned Tycho Anker-Nilssen, who started monitoring the birds of **Røst** in the early 1980s. His own story of long-term monitoring started with a tragic legacy. Anker-Nilssen was then a Master's student in biology in Oslo and a volunteer at a Bird Ringing Centre. His colleague (and mentor), the zoologist and nature photographer Gunnar Lid, invited him to join and help study birds on an island at the southern tip of the Lofoten archipelago. The study of Røst seabirds started in the late 1950s when the Swiss zoologist Beat Tchanz initiated the ongoing data series for common guillemots. He was followed by wildlife researcher Svein Myrberget, who set up a field cabin on the surrounding island of Hernyken in 1964, to be closer to the bird colonies. In 1970, Gunnar Lid succeeded Myrberget and organised the monitoring of seabirds on the island: by the 1980s, he had launched a national seabird project with funding from the Norwegian Directorate for Wildlife and Freshwater Fish. It is in this context that he invited Tycho Anker-Nilssen in 1981 to help support his newly born monitoring program. The first years of monitoring had documented dramatic declines in the puffin populations, and Lid published several pieces alerting that a "bird tragedy" was ongoing on Røst[98]. Another tragedy occurred some years later, this time involving the research team. In 1983, Lid drowned while he was doing fieldwork off Hernyken and Anker-Nilssen, still a student attached to the University of Oslo, took over the seabird monitoring work on Røst. He was "his natural successor to carry the project forward", as later wrote a blog post from the Fram Centre dedicated to his career (Framsenteret 2018). During our interview, Anker-Nilssen also explained this 'succession' as somewhat natural, and his commitment to long-term monitoring:

> And then, I came to Røst, and the next unexpected thing to happen was that my predecessor drowned in a boat accident in the colony at Røst in 1983, and I was still a student, but I took over the project. I moved up there to Trondheim from Oslo, where the Directorate had moved meanwhile, and I got a job at the Directorate, then continued the studies. (…) People thought, "Okay, now you're taking your PhD, what do you want to do in your afterlife?". And then I said: "I want to continue doing the same thing". Which was surprising to some people, but we started to realise the value of these long data series.[99]

[98] He was a regular contributor to the local newspaper *Lofotposten*, where he published annually the results of his seabird counts.
[99] Interview on 06.09.2022.

In 2022, when I interviewed him, Anker-Nilssen had been spending his summers on Røst for over forty years, and was looking to retire: "I'm trying to slowly lower at least my fieldwork efforts every year. Because I've been in Røst for two months every season, over 42 years, that means I've spent six years of my life if you add everything together. So, I can't continue doing that forever, obviously!"[100]. To continue monitoring the birds of Røst, his institution, NINA, advertised a new position. Tycho Anker-Nilssen selected Annette Fayet, a seabird ecologist in her late 30s, whom he already knew from past collaborations on puffins[101] and so had a sense of trust towards her. His vision of the transmission was that they should overlap for a couple of field seasons so she could learn his methods and practices and replicate them when he retires. While Fayet told me she enjoyed getting the position and learning from Anker-Nilssen's experience, she does not share the same vision of the *commitment* it should be.

> Because, as Tycho was saying… the employer can't say that they are looking for someone to take over Røst for 25 years, you can't ask that of someone. That's not possible! But he said he hoped that it would be a long-term thing, and I told him, "Well, we'll try, but I can't guarantee that I'll stay there until I retire". (…) I understand that. When you are doing fieldwork at a site, you learn, some things work at the site that don't work on others, and so it takes time to get things to work. So, it's true that if people were changing every two years, it would be very difficult to keep it all going. (…) But at the same time, I think that this model is going to disappear more and more because I think society is changing and these sorts of sites where people keep…Well, I think there will be fewer of them. For example, if you look at NINA, the people they hired in the last years to do seabird monitoring, we are mostly women, the new ones, and we're my age, between 30 and 40 years old. I don't know if any of us want to stay on the same island all the time, every year, until we retire.[102]

Annette Fayet believes she is not the only woman who does not want to spend summers at the same site until they retire, which is a more 'old-school' field practice. Indeed, I discussed with several other female seabird scientists, in Norway and beyond, who also expressed that they did not want the level of commitment for long-term monitoring that their predecessors had.

However, it would be wrong to interpret this change of commitment as a sole gender issue. Two dynamics are concomitant. First, there are indeed more women in the seabird community – I do not have specific statistics to argue that, however, throughout my study, I did speak to many women who started working more recently, towards the late 1990s

[100] It is interesting to put that quote in perspective with the stories of Chuck Huntington and Michael Harris that I described.
[101] In particular the paper by Fayet et al. 2021, which I discussed in Chapter 4.
[102] Interview on 04.11.2022. Translated from French.

and 21st century[103]. The societal pressure for women to have caring responsibilities also played a role, especially when they started a family. Sofie and Amanda, two seabird ecologists respectively in Norway and Canada, explained that they did less fieldwork when they got kids. As their children are now older, they wish to do more fieldwork again[104]. Being a mother clashed with their fieldwork commitment, but they still much value spending extensive time in the field. Conversely, men had less caring responsibility, which favoured extensive field seasons. To Annette Fayet, this is what explains Anker-Nilssen's commitment to Røst:

> Tycho has been working at Røst for 42 years and has spent all his summers there. And so, I asked him, when he got kids, how did he do? Well, his wife took care of the kids at home. Fortunately, this model works less these days. But he indeed spent all his career there. He spent all his summers there, and I am supposed to get this site from him when he retires. Honestly, I don't know if I will spend the next thirty years of my life there. What you can do is to have students come; you don't have to be there all the time. I love being in the field, but it's true that it's a sacrifice. Sometimes, it is difficult to leave your family behind, even when you don't have kids. I have a husband, and it's sometimes difficult to leave for two months. And it's not even being there in person, but you have terrible schedules, so it's difficult, you can't say "I'll call you every day at 8 pm", because your schedule changes all the time. So, it's difficult, and people do what works for them. Some want to do this all the time, in any case. And some others find solutions. For example, one of my colleagues has young kids and also has a similar monitoring site to take care of. So, she only comes half the time; they hired a technician to cover when she's not there.[105]

From her description, the commitment to fieldwork is not just a question of gender, even if that plays a role, especially when considering previous generations of researchers. It is also a matter of personal decision, spending so much time doing fieldwork on a remote bird colony. It is also about having resources, as her colleague was able to hire someone to share the responsibilities.

I also encountered male early-career researchers who did not share this perspective of lifelong commitment either. Lewis Fisher-Reeves, for example, was a second-year PhD student when we discussed his upcoming second field season on Skomer Island. I asked him about the balance between doing a field season and having a personal life.

> This year, I feel a bit more conflicted with it. I think last year, I was really excited. And this year, I'm still excited, and I still love the work, and I'm still looking forward to going back. But (…) I guess I have FOMO (Fear Of Missing Out), like I have a fear that people are gonna forget me, or I'm gonna miss out on fun experiences in Oxford. (…) the younger generation, there's definitely an expectation from the supervisors that we're okay with doing it. And I am okay

[103] Specifically, among the 29 people I interviewed, 13 are women. The more 'senior' started research in the late 1990s, and the more junior in 2020. For the men, the more senior started in the 1970s. I am also considering my fieldwork experiences, where many women worked as fieldworkers.
[104] Interview with Sofie on 03.10.2024. Interview with Amanda on 29.09.2024.
[105] Interview on 04.11.2022. Translated from French

> with doing it, obviously. But I think they don't necessarily have… they don't quite grasp these concerns we have, in the same way for social life and things like that, because they're obviously either much more established or they're past that, sort of.[106]

Juan, a PhD student doing fieldwork in Antarctica, shares a similar perspective on the generational *gap*, rather than shift, on the level of commitment that seabird monitoring requires:

> (…) this is the famous sentence of like "Oh, I haven't seen my son in two weeks. – Oh, really, I haven't seen mine in two months!". And it's like, well, you're shaming me for wanting to live my life. And at the same time, you're showing me that you don't care about yours. (…) not with my supervisors, thank God, but other researchers have been like 'Oh, but you cannot complain because it used to be worse in my day'. And shouldn't you be happy that I don't have to go through worse things? Because if that change has happened, it is because through your lifetime you have made conditions improve, you should be proud of the improvements that you've brought to the field, and not lecture me on how hard your life was and why I should be working harder.[107]

Both Lewis Fisher-Reeves and Juan, however, insisted on the importance of having some fieldwork experience and committing to extensive field seasons, as the community still generally values long-term fieldwork. The transmission and legacies of field sites are thus an important topic, encompassing many societal and political issues for the marine ornithologist community. Specifically, it emphasises an inner shift in the narrative of prominent figures of lifelong commitments, male scientists who famously devoted their lives to studying declining seabird populations. Now, a younger and more diverse generation of scientists is moving away from such a level of social sacrifice. In addition, this new generation does not necessarily value spending the whole fieldwork season at a single colony. I encountered many cases of scientists looking to set up monitoring on different sites, sharing the responsibilities with other colleagues. Annette Fayet, for example, is still doing fieldwork on Skomer with students and is training local fieldworkers in the Seychelles islands to start a monitoring study. Thus, it is also important to consider the appointment strategies of scientists taking over monitoring responsibilities, whether they are appointed as the 'heir', continuing the work as it was, or if it becomes a shared mission across several colleagues. For example, after Chuck Huntington, the task of collecting Leach's storm petrel data was spread across several teams in Canada, under the coordination of Ingrid Pollet. On the Isle of May, when Harris

[106] Interview on 23.03.2023.
[107] Interview on 20.04.2023.

retired, a full team of fieldworkers, students and scientists was also collecting data on the bird populations.

Conclusion

In this chapter, I approached the crucial practice of conducting long-term monitoring studies in seabird research. Although it is scientifically critical to understand the declines in seabird populations under climate change, researchers must navigate temporal paradoxes to maintain their studies. I described the value, practices and evolutions of (im)mobilities to the field site, by focusing on the temporalities of seabird research. This chapter has drawn attention to the field practices of time to maintain access to the birds across decades. In particular, I described narratives and storytelling practices of 'heroic researchers' who dedicated their lives to the study of seabirds. Beyond these figures of commitment, I have demonstrated that long-term monitoring is a matter of accessibility, funding support and a network of sometimes underrepresented and precarious fieldworkers. The study of seabird colonies across decades is also a matter of affective practices of maintenance and difficult emotions of grief and weariness. The maintenance of colonies as field sites is a deeply emotional practice, as it involves extensive time in the field and witnessing the disappearance of seabird colonies. Finally, I described a shift in the commitment to long-term monitoring, as a new generation of researchers challenges the level of personal sacrifice and dedication.

Through this chapter, I contributed to the argument in support for long-term monitoring studies (Hughes et al. 2017) and ongoing research in Science and Technology Studies on the valorisation of mundane yet fundamental maintenance practices (Denis and Pontille 2022). Maintenance is not just a set of practices; it is also a general concern for ornithologists, particularly under climate change and rapid and result-driven science. The stories I told highlight the disappearance of seabirds under climate change and the ecological importance of recording these. These 'heroic' stories of lifelong commitments, whether Divoky, Harris, Huntington, Barrett, or Anker-Nilssen, illustrate the need for the scientific community to narrate the value of such an engagement, which requires time, financial, logistical and emotional efforts, with often little support. However, the affect and emotions of long-term fieldwork are not commonly discussed, even if new

undertakings, like the 'Silent birdcliffs' project, are changing that. Thus, I argue that the shift in the commitment to long-term work illustrates that the relationships to the field sites are changing, as the (im)mobilities (their frequency and length) are changing too. The ideal of spending months over decades on a remote colony seems to be challenged. This is not only a question of generational shift, but other reconfigurations are at play in seabird research. The development of remote sensing devices challenges long-term (im)mobilities on seabird colonies and reinforces collaborative practices, which allow the sharing of personal, lifelong commitments.

Chapter 6

Capitalising (im)mobility

Tracking technologies and the reconfigurations of fieldwork at the seabird colony

Fieldwork is fundamental to the study of seabirds but is threatened, or at least, reconfigured by the growing demands for efficiency and commitment required of researchers – while using the least time and resources possible despite the critical decline of seabird populations worldwide. In this final empirical chapter, I aim to address another crucial reconfiguration of marine ornithologists' fieldwork, which can appear as another disruption but is mostly perceived by scientists as a potential 'fix' to the challenges of long-term monitoring. This reconfiguration involves the development and miniaturisation of tracking devices, which, when attached to the birds, enable marine ornithologists to follow their movements at sea beyond the sight of the colony.

Although I have demonstrated how fieldwork is constitutive of researchers' practices and identity, the development of remote sensing technologies, such as tracking loggers, has generally sparked a debate in ecology over the future of accessing field sites. Are tracking technologies separating ecologists from the field? In the broad debate that pits technological developments against human affective and manual practices (Agar 2006; Edgerton 2006; Joly 2015), the increasing use of remote sensing devices to study wild organisms is a growing focus. Accordingly, in a 2010 review, the biologists Mark Hebblewhite and Daniel Haydon express their concerns about the use of GPS tracking data in ecology, identifying the "divorcing of biologists from the field to be a growing problem" (2010: 2303). They acknowledge that a "new revolution" is underway, so much so that "today, ecologists sitting at their desk can check the movements of even the most difficult to study species" (ibid). However, because of the great amount of knowledge and, in turn, the "slavish addiction" (ibid) of biologists toward these technologies, they argue

that the benefits and problems these devices pose for the field need to be examined. This critical review came almost a decade after a major technological development in the study of wild animals. Miniaturising tracking loggers enables ecologists to follow animals' movement at an increasingly precise scale, for an increasingly long time, and over an increasingly wide array of species. Such devices, like GPS or geolocator (Global Location Sensor, or GLS) systems, can be directly attached to animals and left untouched to collect data for up to a few years. The ecology literature, particularly marine ornithology, often recalls this technological advancement as the 'revolution of biologging', the emerging discipline specialising in the study of animals' movements (Börger et al. 2020; Amélineau et al. 2021: 128). Opportunities to provide high-profile knowledge are even more significant for animals that can only be observed in a few specific places. As seabirds mostly breed in remote locations, technologies like tracking loggers have become a crucial means for researchers to gather knowledge about their trajectories at sea beyond the colony (Bernard et al. 2021). Along this overwhelming narrative of a 'revolution', however, some biologists like Hebblewhite and Haydon fear that these opportunities to create knowledge about wild animals may be a "blessing and a curse" (2010: 2306). They argue that:

> Instead of getting an important biological 'feel' for what drives animal ecology, ecologists now spend increasingly less time in the field becoming acquainted with their study species and the landscapes they dwell in.

These complaints about the development of remote-sensing technologies and animal-borne devices are recurrent in many disciplinary contexts. Unsurprisingly, STS scholars have explored how these technologies reconfigure the relationship between scientists and their objects of study (Benson 2016a; Gabrys 2019), be it the ocean (Lehman 2018), the forest (Gabrys 2020, 2022), or marine animals (Fish 2022). In addition to concerns about the abstraction of environments and animals into data (McCormack 2012; Benson 2016a; Lehman 2018), processes of 'doing fieldwork' and the 'embodied encounter' (Lehman 2018: 58) of the studied environment and organisms are also being reconditioned through these technologies. The 'biological feel' (Hebblewhite and Haydon 2010: 2306) that researchers get from the field seems to be profoundly renegotiated through remote technologies in the field: what can a researcher *feel* through the screen of their computer for an animal they have not observed in the wild? What does this say about the role of fieldwork in marine ornithology? In this chapter, I explore how the

'revolution of biologging' reconfigures fieldwork at the seabird colony. I argue that it actually reinforces the role of fieldwork and the (im)mobilities negotiated to specific sites and birds: the colony becomes a *capital* for marine ornithologists.

The literature on the development of remote-sensing technologies illustrates how fieldwork is becoming less and less crucial for the identity-making of researchers and disciplines. In the case of oceanography, for example, Jessica Lehman discusses the "implications of [the] shift away from ship-based research, done by scientists at sea, to observations taken by robotic or remotely operated sensors" (2018: 58). She identifies several reconfigurations, amongst which is the 'embodied encounter' with the ocean and ship-based research gradually becoming less of an essential component of being an oceanographer. In philosophy of science, Rose Trappes (2023) identifies reconfigurations around four 'epistemic values' in the study of animals, making tracking technologies highly attractive for scientists, owing to the variety, efficiency and robustness of the data collected. As a result, the expertise of ecologists no longer necessarily comes from the field, while other 'ways of knowing' (Pickstone 2000), such as modelling ecology, complement – or compete with – the collection of data in the field (Mauz and Granjou 2013). Mauz and Granjou show in this study of collaborations between 'field naturalists' and 'modelling ecologists' that such cooperation also implies a profound identity crisis for those whose ways of knowing derive from the natural history tradition, "based on collecting, comparing and computing" (p. 319), as they feel "downgraded to the status of mere data providers" (p. 327). Similarly, in marine ornithology, the development of tracking studies could undermine the experience and associated affect of fieldwork at the seabird colony.

Beyond practices, remote sensing technologies thus reconstitute the affective commitments of researchers toward the organisms they study. In this regard, social science literature, following Hebblewhite and Haydon, has been critical of these developments, invoking the Foucauldian vocabulary of 'surveillance' and 'biopower' (Foucault 2004). In short, tracking technologies create new modes of attention – in the form of surveillance and care, whether manifesting through renewed sensitivity, or violence (Bergman 2005; Reinert 2013; Whitney 2014; Hinchliffe 2016; Isaacs 2019; von Essen et al. 2023). Some articles, based on ethnographic studies, approach tracking technologies as a form of oppressive surveillance which would impose violent gestures

of capture and control (Reinert 2013; Isaacs 2019). The field *without* tracking would then be an opportunity for a 'real' affective experience of animals, for instance, described by O'Mahony, Corradini and Gazzola about the monitoring of wolves in Romania, based on sensory practices such as "walking, looking, smelling and listening" (2018: 117) instead of using tracking devices. Other approaches offer a more nuanced interpretation of these practices, emphasising the 'collaborative' (Gabrys 2016: 83) and 'relational' (Whitney 2014: 84) dimensions of wildlife sensing.

In this chapter, I explore how the 'revolution of biologging' reconfigures fieldwork at the seabird colony. I argue that the general assumption that it separates scientists from the field is more complex in marine ornithology. Indeed, I show that tracking technologies actually reinforce the role of fieldwork and the (im)mobilities negotiated to specific sites and birds as the colony becomes a *capital* for marine ornithologists. Instead of a shift away from colony-based research, the development of tracking studies transforms the conditions and meaning of seabird fieldwork. Tracking is used to reassert the legitimacy of fieldwork and its meaning for the identity of seabird scientists. The 'revolution of biologging' emphasises the challenge faced by marine ornithologists to "articulate" (Fujimura 1987) the injunctions and values of the community, between the ideal of adventure and territorial dimensions of field sites; and producing knowledge that fits in the trend towards 'infrastructural globalism' (Edwards 2006).

Thus, in this chapter, I will describe and analyse the complex articulation of tracking as a tool to reassert the meaning of fieldwork, whilst reconfiguring practices at the colony. Tracking does not question the value of doing fieldwork, because it cannot happen without being at the colony, to capture, equip, and recapture the birds. As I will show, it even reinforces the interweaving of scientists' (im)mobilities with specific birds, which I approached as 'shared (im)mobilities'. Tracking also enables scientists to gather and standardise collected data from their respective colonies, to produce large databases within 'big data biology' (Aronova, Baker, and Oreskes 2010), and attract funding. I will demonstrate how tracking allows researchers to respond to the incentives for rapid, result-driven science, whilst fitting in with their epistemic culture of fieldwork. However, if fieldwork remains essential, it becomes more intense and fragmented, which I approached as 'fractionated (im)mobilities'.

Tracking technologies and seabird fieldwork

In this first section, I delineate the so-called 'revolution of biologging' for the study of seabirds and its integration into the epistemic culture of fieldwork in marine ornithology. Although scientists generally praise this technological development, it is clear that they separate it from traditional practices and representations of what working on seabird colonies should be. More than collecting new data, I argue that tracking technologies form part of ornithologists' attempts to align their vision of fieldwork with the pressure for rapid data collection.

The 'revolution of biologging' in marine ornithology

Although field ornithology is a relatively recent practice (see Chapter 3), it has been profoundly transformed in only a few decades after its democratisation, with the increasing use of remote sensors in ecology. The narratives used by seabird scientists in the marine ornithology literature reflect how 'revolutionary' they perceive tracking loggers to have been for the field. Seabird ecologist David Grémillet, for example, recounts in his blog when he found out, in the late 1990s, that GPS loggers had been miniaturised enough to be potentially used on birds: "That day at the station, I immediately knew that my life as a seabird ecologist was about to change radically" (2016: 1).

Following animals' trajectories is far from new in ornithology: since the early 20th century, birds have been ringed with the intention that they will be re-sighted somewhere else through a world-network of observers, and their movements consequently deduced (Newton 2010). Over the following decades, several technologies were developed to monitor *individual* animal movements without direct observations and at a distance. One of these technologies, the radar, stems from military advancements and, according to ornithologist Ian Newton:

> revolutionised the study of bird migration because it made observations almost independent of flight altitudes and weather, totally independent of light conditions, and hence fully comparable by day and night. It has taught us much about unseen migration (2010: 25)

From the 1960s, animals could be equipped with VHF radio transmitters, emitting a signal that can be received by radio receivers positioned somewhat close to the animals' mobile area, to triangulate their position. This technique was not only time and labour-

intensive, but particularly inaccurate (Urbano 2015). From the 1970s and mostly the 1980s, the development of the Argos satellite tracking system and Ultra-High Frequency (UHF) tags allowed attaching devices to animals and mapping their long-distance movements (Benson 2012). Thus, the understanding of animals' mobilities extended considerably; however, it remained with a rather low accuracy of several hundred meters to kilometres, and was highly expensive (Newton 2010; Benson 2012; Grémillet 2016). In addition, due to their weight and size, these radio and satellite devices were primarily employed on large animals such as grizzly bears (Mitman 1996; Benson 2010), with relatively limited application in ornithology, particularly marine ornithology. Even on larger seabirds like penguins, these devices looked like bulky backpacks and impacted the foraging performances of birds (Wilson et al. 1997, 2002; Phillips, Xavier, and Croxall 2003) (figure 20, left). It was not until the late 1990s that Argos satellite transmitters became sufficiently light to be used on a broader range of seabirds. Yet, because they could only be employed within close proximity to researchers (holding satellite receivers), the trajectories of seabirds beyond the colony, during their winter migration, remained largely unknown (Grémillet 2016).

The so-called 'revolution of biologging' for seabird research (Amélineau et al. 2021: 128) really took off after the 2000s and the twin invention of the geolocator by marine biologist Rory P. Wilson (figure 20, right) and the miniaturisation of GPS devices (Grémillet 2015, 2016). With these new types of devices, researchers were able to gather a wealth of novel knowledge on the distribution, migration routes and activities of seabirds during their winter migrations and foraging trips, across an ever-expanding array of species as devices became smaller and cheaper. Despite initial concerns, the community has largely adopted the GLS, a light-sensor which must be attached to the leg of a bird to calculate an approximate[108] location, left throughout winter migration, and retrieved the following breeding season to download the data. In parallel, GPS devices are more precise and do not always need to be retrieved[109], although, because of their higher price, most GPS-based tracking studies involve recapture. Tracking technologies, and in particular GLS and GPS devices, thus unlocked new possibilities for understanding the

[108] The preciseness of geolocators is rather low (sometimes several hundred kilometres) but satisfying for seabird winter migration studies (Grémillet 2015).
[109] However, GPS devices have a much shorter battery capacity. Thus, geolocators tend to be used for migration studies, while GPS is used for foraging ecology, studying the movements of seabirds at sea during the breeding season.

trajectories of seabirds beyond the colony and direct observations. Despite significant progress in the past fifteen years (Börger et al. 2020), there remain substantial gaps in the collected knowledge, in particular a bias towards bigger species, and polar and subpolar areas (Bernard et al. 2021). Nevertheless, there has been an 'explosion' of tracking studies in marine ornithology with nearly 700 studies covering over 28,000 individuals from 216 species (out of nearly 300) (ibid). The idea of a 'revolution' in the literature thus mostly refers to the expansion of knowledge and understanding of seabirds' behaviour, especially outside of the colony.

Figure 20. Left: A radio backpack fixed on a Gentoo penguin in 1972 (source: National Geographic). Right: A geolocator attached to an Atlantic Puffin (Grímsey, 14.06.2024).

Throughout my discussions with seabird scientists, the narrative of the 'revolution of biologging' was also prevalent. In fact, the opportunities to use tracking technologies to unravel the 'mysterious lives of seabirds' (Brooke 2018) were often mentioned as a motivation to study seabirds and embrace a career in the field:

> I chose to study this species [Atlantic puffins] because I was interested in the migration of birds, and when I started my PhD, I thought it was amazing that we had no idea where puffins were migrating! Some people tried really hard to find where these millions of puffins migrate in the winter, and they never found them. And I thought it was incredible that it is such a famous and charismatic species – everyone knows what a puffin is – and yet we did not even know about eight months of their lives every year. I thought it was fascinating, and that's why I started to work on puffins.[110] (Annette Fayet, seabird ecologist based in Norway)

> (…) when I started working on seabirds, we could go and work with them in the colony, and we could look at them, catch them, and release them. And then, they would fly off to sea and sometime later they would probably come back. We didn't know essentially

[110] Interview on 04.11.2022. Translated from French

> anything about what they did when they were out at sea – very, very little. And so, there was a nice mystery about it as well, which of course has changed dramatically! But I still think it's very, very interesting the way they cross the border between land and sea, and they come home and tell us a lot about what's going on at sea.[111] (Morten Frederiksen, seabird ecologist based in Denmark)

> My PhD project was looking at the foraging ecology, so tracking the birds at sea and looking at their behaviours at the colonies (…). And that really hooked me for what I've done since! I changed from marine mammals to seabirds, and there was no going back for me. We could get our hands on these birds, we could put trackers on them, different devices that we could understand their behaviour at sea and their exposure to different threats. That was very appealing to me. (…) Tracking has been a constant for all the different research questions that I've tackled across the years. Tracking has been a really important tool for that. (…) It's just been an explosion of tracking studies and expertise, and analysis of tracking data.[112] (Amanda, seabird ecologist based in Canada)

Thus, tracking is an integral part of the seabird research communities' epistemic culture of fieldwork and collective narrative. From scientists' accounts, tracking enabled understanding seabirds' trajectories at sea beyond direct observations, while also requiring manual practices of capturing, as Amanda explains. What is at stake in the tracking 'revolution' is not the end of fieldwork but what doing fieldwork means.

'Quick and dirty' fieldwork?

The development of remote-sensing devices in biology and ecology provokes debates around the reconstitution of fieldwork practices, between proclamations of a 'revolution' and sceptical accounts (Hebblewhite and Haydon 2010; O'Mahony et al. 2018). In the case of the digitalisation of offshore oil production, Eric Monteiro (2022) emphasises that a precautionary approach is necessary for any account of 'revolutionary' technological advancement, challenging the narratives of a new paradigm or 'business as usual'. He proposes a compromising approach to "balance a healthy skepticism of proclamations for revolutionary or radical change against an empirical, phenomenon-oriented openness to interestingly different aspects of the new and the old" (p. 4). In marine ornithology, the use of tracking technologies similarly sparks a nuanced discussion. While they became constitutive of the narrative of the community and generate general enthusiasm, they also profoundly reconstitute the conditions of fieldwork, toward more intense and rapid visits to the colony.

[111] Interview on 11.10.2022.
[112] Interview on 24.09.2024.

For example, Philippe explains that the increasing use of tracking devices means more and more ornithologists study seabirds *without* fieldwork.

> [tracking technologies] changed the way we worked, because during my PhD, for example, I was doing radio tracking of cormorants. And so, for radio tracking, the cormorant is wandering with a VHF transmitter, as was done a lot on the Isle of May. There are several antennas to listen to the VHF signal; therefore, we need someone to listen to it. Well, there are recording systems, but they were not very developed when I started my PhD 25 years ago. So, we needed someone all the time, from sunrise to sunset, at each antenna. So, sometimes during my PhD, we were twelve in the team, which, socially speaking…it's a big machine, and it took a lot of time and energy. But socially, it was amazing. But with the loggers now… Actually, there are marine ornithologists who do very little fieldwork because there are big databases and they work with that. Typically, master's projects – they don't do fieldwork now, almost never. They work on existing data, so it changes a lot of things. And as fieldwork teams, we have much smaller teams when we use loggers. So, technology changed the whole social dimension of fieldwork[113]

Thus, as Philippe describes, tracking reconstitutes both the conditions in the field and the scientific specialisations of the community. On the one hand, there are fewer tasks needed for on-site staff, and on the other hand, the sheer volume of data collected with tracking devices means that an increasing number of research projects without resources for fieldwork are possible. Students' research projects, usually transferred into trial sites (see Chapter 4), thus tend to become digital. Fieldwork might then become a fragmented and specialised practice in seabird science, in line with Jessica Lehman's (2018) observations in oceanography. However, as I will show, (im)mobility at the colony remains fundamental in the narrative and collective imagery of the scientific community.

The challenge of tracking falls within its integration with the methods traditionally associated with field ornithology, such as observation at a distance (Law and Lynch 1988; Mitman 1996; Garlick 2019). Throughout my interviews, while most ornithologists acknowledged the usefulness of these devices, they also insisted on the need to distinguish them from the traditionally 'manual' practices of field ornithology, stemming from the naturalist tradition. Tracking should not replace the traditional imagery of field ornithologists, with their notebooks and binoculars. This reasoning is well reflected by Mark Newell, field technician on the Isle of May. To him, the fallibility of tracking devices is rather positive, as this means that human expertise is irreplaceable:

> The technology is wonderful, but I still see a lot of the fallibility of it, the failure of it. The devices, they're never quite what they say they should be, you know, you just plug them in, tell them what you want to collect, stick them on the birds, and off it goes. And variably,

[113] Interview on 23.03.2022. Translated from French.

> there's so much more checking of the devices, whether they're working properly and preliminary stuff before you deploy them. That does not seem to have got any better! (…) you still have to catch birds, and quite a lot of times, we still have to catch the birds again the following season. And it's reassuring that, actually, there are bits of fieldwork where there is still some pace to just go out yourself, with a pair of binoculars and a notebook, and write things down rather than relying on remote cameras and devices, or whatever. Personally, I think that they *add to* rather than *replace* basic fieldwork.[114]

Newell thus values the integration of tracking with the traditional practices of field ornithologists, namely "reading the rings" and "go[ing] out yourself with a pair of binoculars and a notebook". Similarly, Michael P. Harris explained that as he retired, he stopped being involved in tracking studies and rather went "back to the old-fashioned days"[115]. According to Charlotte, a seabird ecologist based in Norway, tracking technologies can never replace traditional practices associated with fieldwork:

> I think technology will solve things that we are not able to do ourselves. Like this basic thing of catching birds and putting rings on them. Of course, you need to do this; for example, with this geolocation technology, you need to catch them to put these little geolocation devices on. (…) But researchers love being outside and reading the rings on their legs to identify them. So, I have never heard of anyone using this technology that you would automatically get who comes back. But I mean, this would be a huge time-saving thing! (…) you would be removing something that I think seabird researchers love to do. (…) I think we will try to keep doing what we do and be efficient, more efficient, maybe in some ways, but not stop doing like the classic fieldwork. (…)
>
> I'm not just saying that because people love to be outside, but you gain a lot about the behaviour of the birds, social behaviour and things, and just these like…*feelings*. You speak to guys who have been working for many years, and they know so much which is maybe not published. Maybe you can't get it if you have a drone flying over or something like that. This real experience there is so valuable. So, it's important, I think, also to keep going there and doing this hands-on work.[116]

For Charlotte, beyond efficiency, the love of "being outside" and observing birds means that there would always be a complementarity of methods between using technologies and "classic fieldwork". For one thing, then, the development of technologies in the field reinforces the meaning and value of fieldwork as a "real experience": developing "feelings" for the birds and their behaviour.

If fieldwork might not immediately disappear with tracking technologies, I note that there are more and more endeavours that integrate colony-based monitoring and intense data collection with technologies. In contrast to the decades needed to produce significant data on the population trends of a colony, based on observation and nest monitoring, the

[114] Interview on 23.09.2022.
[115] Interview on 08.06.2022.
[116] Interview on 10.11.2022.

use of tracking technologies guarantees a form of productivity and immediate attractiveness, as Rose Trappes (2023) has also observed. The 'puffin rally' is a characteristic case of such integration of technologies into long-term colony monitoring. During our first exchange in February 2024, Erpur Snær Hansen described this monitoring programme as "quick and dirty" fieldwork:

> (…) you can call it 'quick and dirty', but I think it's not that dirty. It is the maximum information for the least amount of effort (…). That's the joke, I call it ICEPOP[117]. And I make fun of the Norwegians because they have this dedicated team of a few people in every key colony, as they call it, and I go to it 'quick and dirty'. They spend almost the whole summer, they are working with many species, they are checking rings, and they are ringing a lot, and they are checking so many things. It's a massively admirable programme they have running there. (…) We have a lot of seabirds in Iceland; it's roughly 25% of the biomass in the North Atlantic. Somebody calculated that one time. But there are very few people studying them, hardly very few have a full-time job.[118]

Because of the lack of resources in Iceland to study seabirds, Hansen designed the 'puffin rally' to "maximise" his time and collect as much information in the least amount of time.

> This rally thing takes us two weeks to go through these twelve colonies. It's sometimes two per day, and that's a *lot* of driving! We basically drive between 2500 and 3000 kilometres in two weeks and visit the twelve islands. So, it's a bit strenuous! (…) We spend most of the time in the rally on the road. Sometimes, we only spend a couple of hours in the colony, we just check our 75 burrows, and we're gone. (…) It's more like a roller coaster, and it's over before you know it. You never have time to let the pleasure, in particular places, seep in. It's more like going through a photo!

As I experienced it, the intensity of the 'rally', however, is not particularly due to the use of tracking devices, which only adds to the monitoring of burrows on two colonies, Papey and Grímsey. There, instead of the few planned hours, we had to stay overnight to secure two days among the birds (see next section). Because tracking needed us to select, capture and equip the birds, I would even argue that those practices were the only opportunities we had to develop a sensitivity and connection to the colony. As I demonstrated in Chapter 5, it is rather the growing time and resource constraints for fieldwork and particularly long-term monitoring that made the 'rally' such an intense endeavour.

The 'puffin rally' is a rather extreme but striking example of how scientists use technologies to industrialise the collection of data in the field. Indeed, in addition to tracking devices, it relies on the inspection of bird burrows using a camera which Erpur Snær Hansen designed with the help of a friend plumber, his brother-in-law (a retired

[117] In reference to the Norwegian SEAPOP program, which monitors seabird colonies across the country since 2005.
[118] Interview on 08.02.2024.

ATM engineer) and a photographer. When Hansen moved to the Vestmann Islands in 2010, he met a local plumber and former puffin hunter, Marínó Sigursteinsson, who had used a pipe camera to look inside puffin burrows, wondering about their behaviour underground. With a few improvements to turn it into a scientific instrument over the years, Hansen has since used the 'burrow camera' to monitor puffin breeding all over Iceland in the rally (figure 21). This unique instrument showcases how technologies are used by researchers to align their visions of fieldwork with resource constraints.

Figure 21. Erpur Snær Hansen using a burrow camera on Hafnarhólmi (11.04.2024)

Shared (im)mobilities: tracking in practice

While tracking technologies have profoundly transformed ornithologists' understanding of the trajectories of seabirds at sea beyond the colony and without direct observations, I have shown that they do not change the nature of fieldwork. Namely, ornithologists still need to access the colonies, at least to equip the birds. Plus, most loggers are not remote downloads, so researchers must catch the bird again to retrieve the data. Rather than erasing contact and creating distance between researchers and birds, tracking technologies reinforce their interdependence. What is more, they reinforce the interweaving of researchers' (im)mobilities with *specific* birds. In this context, marine ornithologists must find strategies to create what I call *shared* (im)mobilities with the

birds: the trajectories of the researchers and the birds aligning at the colonies in different configurations. To make tracking a successful endeavour, researchers need to physically engage with specific birds to equip them with loggers and, crucially, to capture them again to retrieve the data. This is a major reconfiguration of ornithological fieldwork – instead of engaging in the field with *a population* or *a colony*, researchers need to coordinate their (im)mobilities with particular individuals. Through several configurations of colony fieldwork, I discuss the many adaptations that tracking seabirds require from ornithologists, negotiating with specific birds as they become carriers of data, which they can give back or not.

Reconfigured affective and physical proximities

The idea that bird navigation studies, and subsequently tracking, create nonhuman individualities is not new but has rarely been a focus of attention. Many scientific contributions, from the ecology or social sciences literature, however disclose stories of specific animal's trajectories, such as 'Caroline', the Manx shearwater which ornithologist Ronald Lockley famously displaced in his Skokholm navigation experiments (1942), or 'Amelia', the albatross whose biography was written by Carl Safina in *Eye of the Albatross,* an award-winning book in 2002. Ethnographic and STS-affiliated accounts also discuss stories of named birds' trajectories, like 'Aldo' the White Stork, which Jennifer Gabrys (2016) follows across the Animal Tracker App. Hugo Reinert also discusses the "curious, remote blow-by-blow intimacy of satellite tracking technologies" (2013: 13) and the movements of 'Imre' the Lesser White-fronted Goose until it got shot in Russia, his device retrieved and placed on another goose.

Despite its ethical and political stances, naming is first and foremost a tool to acknowledge an organism's participation in research and distinguish individuals (Benson 2016b). It also undeniably participates in the construction and marketisation of wild animals as human-like characters, to create attachment and engagement (Candea 2010). Most interestingly for my case, the naming of tracked animals shows how tracking "enable[s] a novel and instantaneous proximity, a kind of 'sticky' surveillance", as Reinert puts it (2013: 15). Indeed, tracking reconfigures how humans interact with organisms. Von Essen et al. (2023) note how it involves a series of relational paradoxes, highlighting tensions between care and control, proximity and distance, and authenticity and

artificiality of animal lives. Animals are transformed from bodies to 'bodies in motion' (Benson 2016c: 138) and 'data' (Bergman 2005), or even 'becoming sensor nodes and parts of extended sensor networks' (Gabrys 2016: 99). Their lives are so abstracted that they become arguably living organisms but tracks on a map, or sequences online (Benson 2016c). In this context, the materiality of tracking as it happens in the field has been scarcely approached or described as a set of violent and inconsiderate practices.

I note that the literature has largely adopted a critical approach to the development of wildlife sensors. Tracking is often described as a way to violently control animals by capturing them, attaching loggers without their consent and getting an intimate sense of their lives, collecting data and taking governance actions upon it (Reinert 2013; Gabrys 2016; Isaacs 2019; von Essen et al. 2023). Tracking technologies seem to substitute direct observations and the natural history competencies of field biologists, whilst creating new forms of care, between intimacy and violence[119]. They both enlarge the physical distance between biologists and animals and reinforce their affective proximities, between care and control.

However, I argue that analyses of tracking from the field depict a more nuanced configuration of spatial and affective entanglements with seabirds. Kristoffer Whitney notably critiques the over-reliance of the Foucauldian vocabulary of 'biopower' and 'surveillance' when discussing tracking studies. From the case of shorebird conservation in North America, he rather argues that "it has also kept alive older forms of natural history rooted in 'collecting', life histories of species and individual animals, and observational (and often phenomenological) ethology" (2014: 85).

Following this nuanced approach called for by Whitney, I describe in the following three configurations in the field of 'shared (im)mobilities' between ornithologists and seabirds, in the process of tracking: (1) grubbing, or capturing, birds to equip them; (2) observing birds at a distance to spot logged ones; and (3) routinely looking for logged birds during long-term monitoring. I show that tracking creates asymmetrical relations, in which birds can be captured, but mostly in which researchers need to be acutely attuned to the (im)mobilities of *specific* seabirds.

[119] According to von Essen and colleagues, "care can also form the basis for an almost pathological form of control" (2023: 690), based on literature analysing other forms of digital engagements with wildlife, notably Candea's discussion of the *'Meerkat Manor'* reality show involving meerkats at a biological field station (2010).

(1) Capturing. Becoming a scientific bird

To become a tracked bird, one carrying a logger collecting their movement data, seabirds must be captured and, most generally, recaptured. Capturing seabirds, often described as 'grubbing', holds many forms and involves the scientists aligning their (im)mobilities with specific birds, which must be present and accessible at the colony. Grubbing, which I approach here as 'immobilising' birds, is a forceful practice turning a mundane bird into a scientific object, rather than a subject. What matters is not the bird itself, but its (im)mobility: that it is there, that it will travel, and mostly, that it will come back. My experience on Grímsey during the 'puffin rally' and the interview with Pauline provide two insightful accounts of the spatial negotiations at play to immobilise specific seabirds.

On **Grímsey**, grubbing puffins for tracking was an intense experience[120]. We had three capture-recapture sessions planned to inspect sixty burrows with cameras, retrieve logged puffins and equip about twenty puffins with double loggers, and three with simple loggers[121]. What is normally an achievable goal for the rally was then very ambitious, as Erpur Snær Hansen was the only team member with experience tracking puffins. Instead of a few planned hours in the afternoon, we had to work until late evening and still did not meet our tracking goal. Each of our practices had to be cross-verified by Hansen, whose experience or instinct – it is hard to tell which – determined whether the captured puffin could be used for tracking or if it risked skipping breeding. Decisions included whether to double or simple-log the bird, or just colour-ring it. These hours at the colony felt like a court for puffins. If a puffin happened to be in its burrow at the right (or wrong?) time, it could become a *scientific bird* (again). Each of us had a precise role in the judging process. As the scribe, I identified burrows with potential logged puffins[122] and informed Hansen and Sam, who checked if the bird was present and with an egg, and if they could spot the logger. If yes, they would capture the bird. If not, they would often capture the bird anyway to make sure it really does not have a logger. If the bird had a logger, we

[120] This vignette is based on my participant-observation fieldwork during the puffin rally as a scribe in June 2024.
[121] The tracking procedure I am describing for Atlantic puffins during the 'rally' is rather unique, as capturing puffins is otherwise generally conducted using mist nets. Instead of grubbing the birds from inside their burrows, scientists cover many nests in the targeted area – with tracked birds – with a large mist net. As they try to leave or go inside their burrows, puffins get entangled in the net, easy to capture.
[122] Because they had been logged in previous years, as indicated by the data sheet I carried.

could retrieve it and generally replace it with a new logger. If the bird did not have a logger, we assumed from the ring that it was the partner and equipped it regardless. In such cases, we removed the previous ring and gave the bird a new identifier, thereby making it a scientific bird. In all scenarios, the bird was placed in the 'rocket-like' tube, measured, weighed, and so was its egg – and ringed if not already (figure 22).

Figure 22. A puffin grubbed from its burrow and placed in a tube (Grímsey, 14.06.2024)

Throughout this laborious process, the birds had no choice but to participate in the study if Hansen deemed it suitable. They had ways to express reluctance, such as hiding deep in the burrow, out of reach, or trying to escape, biting our hands when captured[123]. One bird was even recaptured only to find its logger missing, which greatly frustrated Hansen – we equipped it with a new one, and it became a scientific bird again.

This experience of tracking birds at the colony is very different if we move from a burrow configuration to rocky islands and cliffs. In this case, it is not about reaching out inside and grubbing a bird, but 'fishing' it from above or below a cliff, as explained by Pauline, a postdoctoral researcher based in **Ireland**. This particular configuration, using a noose, a long stick with a cord at the end to grab the bird by the neck (figure 23), emphasises how tracking is a matter of creating fragile, shared (im)mobilities with birds.

[123] This painfully reminded me of Brooke's (2018: viii) comment on puffins' fierce character (see Chapter 3, p. 64).

Figure 23. A fulmar caught with a noose (Source: SEAPOP, 2025)

Pauline conducts fieldwork on several colonies throughout Ireland, during the seabird breeding season, typically spanning from May to August. Her fieldwork involves prolonged stays of several weeks at individual colonies. In Ireland, many of these colonies are located on privately owned islands and access, even for scientific research purposes, is contingent upon the goodwill of the landowners (see Chapter 4). This can sometimes restrict research time in the colony, adding a challenge to existing funding and logistical constraints. For instance, Pauline's time in the field became restricted in 2023 as the island with the Northern gannet colony, which she and the team study, was only open to visitors and researchers for 3.5 hours a day. Since the colony is about a 30-minute walk from the dock, they could only stay for up to 2.5 hours among the birds. Because of this time constraint, they decided to "randomly capture birds"[124], she explained, hoping they would be back within the two-hour window or the next day. In previous field seasons, the team would catch a breeding gannet when about to swap with their partner to go out foraging and subsequently would wait several hours for the bird to return to the colony. This way, they acquired hours of data about the bird's movements at sea, while also having time for observations of the colony. In contrast, in 2023, they had much less time to identify the right gannet and wait for it to return. They also only used devices that needed to be retrieved to read the data, which meant they were even more reliant on the bird coming back. Consequently, Pauline said that "it was a very bad field season" as out of the twenty-one birds they equipped, they could only recover nine, "which is extremely

[124] Interview on 07.08.2023. Translated from French

low for a gannet season". In comparison to the season before, "the recapture rate for gannets was 90%. Now, we are not even at a third". During our interview, Pauline explained the frustrating process of capturing and recapturing gannets. On top of the time constraint, the birds were not cooperative.

> I have never seen anything like this in my life. We had individuals that we saw; they had come back, but they were such scaredy-cats. In general, to catch them, you use a long fishing rod with a hook at the end. The fishing rod is 10-13 meters long, so you don't get too close because if you do, they will push each other off, and you will really disrupt the colony. So, you try to get close but not too close, and then you try with the fishing rod to catch the individual you want – you are playing duck fishing, right?

In 2023, the gannets seemed to remember the 'fishing rod' and would fly off as soon as Pauline approached them. Another reason for this unsuccessful recapture rate could be that, because they randomly equipped the birds, some might not have been breeding, but simply sitting near a chick – "juveniles that were perhaps a bit more cowardly and had no intention of being caught", Pauline explained. On top of that, the team tends to capture birds on the periphery of the colony, which is less ideal for breeding, and these areas are mostly occupied by weaker birds that cannot compete for a prime spot. Due to the avian flu in 2022, these birds might have been replaced by more fierce ones, including some not habituated to being captured for scientific research.

Pauline's efforts to capture birds show how tracking technologies do not necessarily increase the affective distance between researchers and birds. On the contrary, Pauline needs to engage with the birds and access the colony to get data. The loggers can provide much more data, but also nothing, as the bird, according to Pauline, can 'choose' not to let itself be caught again, out of fear. Her frustration was all the more as some of the loggers she uses are very expensive, and she would never retrieve them again, not to mention the data they contain. The story of Pauline is rather a case of a 'bad' field season, with a low recapture rate and little data collected in light of the effort to access and stay at the colony. The ability to be (im)mobile at the colony, and to create shared moments of (im)mobility with the birds, is crucial to the success of a tracking study.

My experience on Grímsey and Pauline's account both illustrate that tracking involves a particular spatial configuration at the colony. It is about choosing and capturing the right bird to carry the logger and become part of the scientific study. Grubbing, whether from burrows or cliffs, involves getting access to the colony and staying with the birds long

enough to retrieve the logger or implement one, on the right bird. This process not only involves the researcher's capacity to be immobile at the colony, and immobilising the birds. It also creates an interdependence with the (im)mobility of the birds: will they stay still and be (re)captured, or will they fly off? What is more, even if technologies supplant the researchers' eyes beyond the colony, they reinforce the interdependence within the colony between the researchers and *specific* individuals who carry the loggers.

(2) Observing. (Im)mobility at a distance

The problem of selecting the right bird – accessible, breeding, and somehow habituated (see Rees 2009; Candea 2010) – is a major concern in tracking. At a distance, too, tracking exacerbates the need to create shared (im)mobilities with specific birds, making sure the right individual returned to the colony, and at a place where it could be recaptured.

Francoise Amélineau did several seasons of fieldwork on **Bjørnøya** (Svalbard), as part of the SEATRACK project, staying in a cabin set up in the middle of a little auk colony. Throughout the breeding season, her challenge was to identify individuals suitable to be equipped with tracking devices and to find those already equipped that had returned to the colony after some time at sea. From inside her cabin, Amélineau spent hours observing the little auks coming and going through her scope, in the hope of spotting specific individuals she had equipped with loggers.

> Birds with loggers need to be recaptured when they are there, so we spend a lot of time looking to see if they are there, but we also spend time looking at the coloured rings. We don't spend time specifically observing those with loggers (...), but let's say that in our 80% of observation time, there is also time when we are going to spot an individual with a logger, and then the remaining 20% is the time spent trying to capture these individuals (...).[125]

Amélineau chooses the birds to capture in the first place based on their accessibility, so she can maximise the chances of getting the loggers back. "Above all, it is the accessibility of the birds, and that we can see the nests easily from our observation points, so that we can recapture them later. The idea is to have birds that we can recapture", she explained.

Amélineau's description shows that in tracking, observing is never just about looking and maintaining a distance from the birds. Observing matters to spot the right individual bird, accessible to be captured and recaptured. When she scans the colony, she

[125] Interview on 11.09.2023. Translated from French.

Figure 24. Can you spot the logged bird? (Source: SEAPOP, 2025)

collects information on the birds, their attendance to the nest and their behaviour, but she always remains attentive to the pop of colour of the ring that marks a logged bird (figure 24). The literature approaching ornithological practices often describes observation as a form of negotiation, involving the observer as much as the observed (Lorimer 2008; Reinert 2013; Garlick 2019). For example, in the case of osprey conservation in Scotland, geographer Ben Garlick (2019) describes how observing the birds has impacted the nature reserves' wardens, who learned to see their surroundings differently. Observation heightens all the senses, and they look for osprey by sight as much as by sound. Observation is also an affective encounter, as Beth, a field assistant on Skomer, told me: "The more you watch something, the more you get attached and the more you admire it"[126]. Despite her frustration with the gannets, Pauline also considers the wait for the right bird to be back on its nest as a positive and learning experience:

> The phenology is really important, and there is another aspect that you don't always control, which is that we actually depend on living animals. So, if that day they decided they were not going to be on the colony, too bad for you! That's for everyone – days of waiting for a bird! This particular bird decided that it wasn't going to come because it might have already seen you and you're scaring it, because it might have already gone back to its nest and you haven't seen it, because the weather might be nice today and it decided it's going to leave…You depend on a living animal, on what it's doing, and that's what fieldwork is all about. It taught me patience, really! But for the best![127]

Because tracking is not about observing any bird, but the *right* bird, observation is an active moment of suspension (Bissell 2007), to wait and look for the logged bird to show up. Waiting is not passive and inactive; on the contrary, Amélineau is actively looking for birds to be static so she can read their rings, check whether they have a logger and assess

[126] Field notes, Skomer, 07.05.23.
[127] Interview on 23.08.2022. Translated from French.

if they can be (re)captured. Waiting and moments of suspension at a distance only serve to eventually break the physical distance to the birds and immobilise them. In this sense, tracking not only still involves crucial practices of field ornithology, like distant observation, but it also takes time. It is not opposed to the narrative of slow and attuned fieldwork I described previously, and can also involve hours-long observations of birds at a distance.

(3) Monitoring. Long-term spatial entanglements

However, the capacity to create these moments of stillness and observation depends on the resources for researchers to negotiate and maintain (im)mobility with the birds at the colony. In the case of the 'puffin rally' and Pauline's fieldwork in Iceland, observation at a distance was barely possible. It mostly takes place, I noticed, in configurations of seasonal sites, which is the case for Françoise Amélineau. Having a field station among the birds at the colony made it possible to stay for hours observing the birds in the warm comfort of the cabin. Whilst Pauline and her team needed to leave the island after a few hours, we were only supposed to stay for a couple of days at most on site during the 'rally'. Thus, tracking as a field practice is very different for seasonal, sequential, punctual or trial sites. Even more, and as I will discuss further in the following section, tracking can create opportunities to turn punctual sites into seasonal ones or to maintain seasonal sites. In this case, fieldwork at the colony is never just about tracking; tracking is rather integrated into long-term monitoring.

This entanglement of tracking and monitoring was prevalent on **Skomer** (Wales), where the OxNav team specialises in studying the navigation of Manx shearwaters. However, their schedule was never just about tracking, which was instead integrated into the routine of checking about two hundred nests in the North Haven colony, finding eggs and measuring them to monitor breeding success. Like Françoise Amélineau, their cabin is located at the foot of the colony, but because Manx shearwaters breed inside burrows and even socialise at night, observation for (re)capture is not an option. Researchers must crawl between burrows to find eggs and capture the birds (figure 25). This 'art of crawling' as Lewis Fisher-Reeves described it, is a critical practice for tracking and illustrates a form of delicacy and carefulness, more difficult to set in the cases of

sequential field sites I described. Navigating among the burrows so as not to damage them was as much a critical skill as being able to twist the arm and grab the birds inside them.

Figure 25. A researcher touching a Manx shearwater from its burrow (Skomer, 05.05.2023)

Such careful practice of tracking was also prevalent on **Elliðaey** (Iceland), where the sensitivity of storm petrels to noise made it very important to move quietly and even whisper when approaching a nest with a potential logged bird. I observed that otherwise, our movements were not particularly attentive. Only when approaching a few meters from a tracked bird, we needed to behave according to the bird's pace and be careful of its sensitivity. This shows that tracking technologies, even if they extend the gaze of researchers' eyes beyond the colony, do not abstract their bodies as a mere 'presence' with the birds (Despret 2013). On Skomer and Elliðaey, researchers' bodies and their ability to crawl delicately and quietly between burrows is as much a 'research tool' (Calkins 2020) as Pauline's fishing rod or Hansen's burrow cameras. This sensitivity and carefulness for the birds is also heightened by the nature of these studies. Whilst on Grímsey, the birds have a full year to recover and potentially forget the stressful encounter with the researchers' grip; in cases of seasonal sites like Skomer, nests are checked on an almost daily basis. The encounter and shared (im)mobility with the birds thus needs to be constantly negotiated, echoing Tuan's conception of (im)mobility as stable and repeated mobilities and encounters (1977; Adey 2017; see chapter 2). This idea that the repetitiveness of burrow visits creates more careful practices was nicely

expressed by Elisa, a field assistant on Skomer: "You have some duty of care with them. They are just living their life, and by accident, they are in your study"[128].

On Skomer, where the team studies birds' navigation, tracking represents a marginal amount of the field schedule. This is especially true as I joined the team in the early stages of the breeding season in the first week of May, when Manx shearwaters lay their eggs. During this time, tracking mostly means checking burrows and marking potential eggs. The team did a first round of checks in the morning, and if they found an egg[129] (which means that there is also a bird, and more importantly, that the bird is willing to be in its burrows), would do another round later during the day to verify by touch if the bird had a logger[130]. If it did, the team discussed and figured out whether the bird was worth recapturing to change the logger, according to a procedure they had defined at the beginning of the season (figure 26).

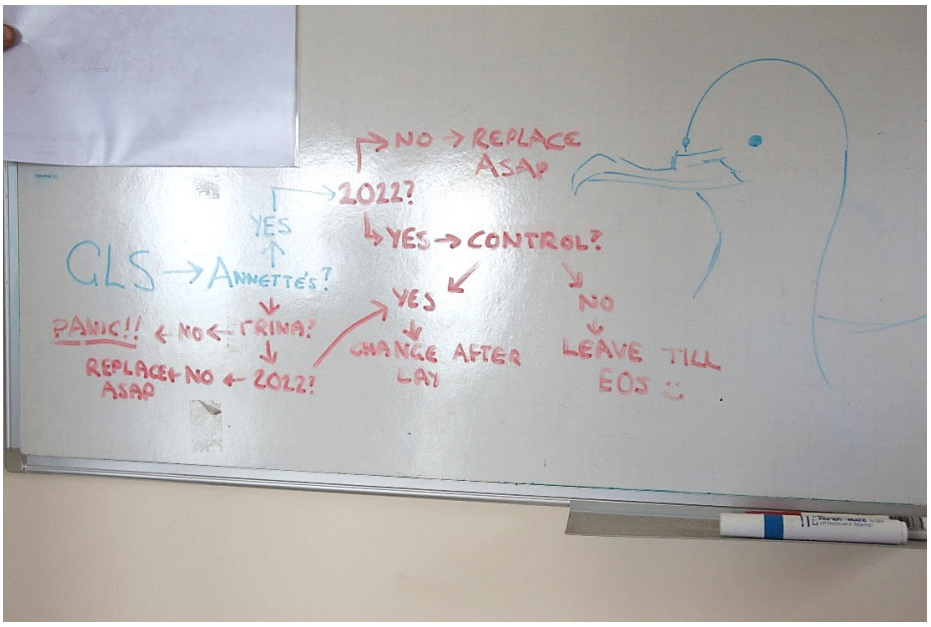


Figure 26. Panic? OxNav's decision-making procedure to capture and change loggers (Skomer, 05.05.2023)

In addition to this entanglement of monitored and tracked burrows, a whole area of the colony, the 'clock-shift', was solely dedicated to tracking experiments. When they had

[128] Field notes, Skomer, 05.05.2023.
[129] Each day, they found only a handful of new eggs.
[130] Unlike on the 'rally', they thus avoid capturing to verify the presence of logger. This is mostly related to their different pace of fieldwork: they had more time available to spend at the colony and they needed to interact again with the birds several time during the breeding season. Thus, each capture had to be carefully considered.

finished their routine checks, and if the weather allowed, Lewis Fisher-Reeves and the field assistants inspected these burrows to set up a crucial displacement experiment for his doctoral research. There, the goal was to find "good burrows", based on two criteria: the incubating partners needed to have just swapped[131], and the bird accessible by hand. In this case, too, tracking is deeply intertwined with monitoring and birds' breeding, which creates particular sensitivities to specific birds' lives. For example, one day in the field, Fisher-Reeves felt frustrated as he was checking burrows with supposedly logged birds, which he could not retrieve: "It's like a tease because there are lots of birds with GLS around, but we have to wait for them to lay to retrieve them"[132]. About a specific burrow he was checking, without eggs yet, he added: "It feels like a gamble, but I'm sure they will lay, they have been very successful breeders in the past"[133]. On another burrow he checked later that day, DB27, Fisher-Reeves was quite upset and sad as he found no bird, nor an egg – he expected them to be there this year, as they have been successful breeders since 2010. When he shared his discovery with Olivia, a PhD colleague, she also became visibly upset by the absence of the birds – "After what happened with DB27, I don't believe in anything!".

Discussion

To summarise, even with remote tracking technologies, researchers must access the colonies and the birds to catch and equip them. These different field accounts illustrate how seabird tracking fieldwork implies a great deal of chance, randomness, frustration and care. The loggers allow for collecting a broader range of data and gathering more knowledge on the previously unknown trajectories of seabirds at sea – but because they still need to be attached and detached from birds, the researchers are dependent on access to specific individuals. Although this access is carefully negotiated through routine inspections and observations, it ultimately implies the (stressful) immobilisation of birds, which are turned into scientific objects.

[131] Manx shearwaters 'swapping' schedule (or 'stint time') is five days. So, if they displace a bird when the partner is supposed to come back soon to the nest, the bird may not find it worthwhile to return to their nest too and rather directly leave on a foraging trip. The team had to come back every day and mark birds with white paint, to know when it was a different bird they were touching. In this sense, they avoid having to capture the birds every day, which would stress them and compromise the study.
[132] Field notes from Skomer, 09.05.2023.
[133] Ibid.

Through these accounts, I have also shown that the participation of birds is collaborative – researchers and birds need to *share* (im)mobilities, being together at the right place and moment. As Isabelle Stengers puts it: "the construction of an experimental device [in no way] ensures that the being we wish to mobilise will agree to show up" (2011a: 362). This is prevalent in both cases of 'sequential' and 'punctual' field visits, where the presence and accessibility of logged birds are unpredictable, and in 'seasonal' sites, where repeated visits to nests mean that researchers need to be particularly careful not to stress the birds. Beyond the care of birds as living organisms, tracking turns birds into scientific objects and carriers of data, creating an interdependence between the (im)mobilities of birds and researchers. These affective connections are not new to field ornithology, but tracking reinforces the awareness of specific birds' (im)mobilities. In particular, it makes the field site valuable *only if* specific birds return, and all the more reinforces the need to maintain access to the colony.

Tracking is a meaningful entry point for understanding how researchers work together with the birds at the colony, facing external circumstances that determine their (im)mobilities to the field site – their capacity to access, stay, and return. Tracking technologies thus reconstitute practices and the affective distance with specific birds at the colony. It does not erase the need to attend the colony and do fieldwork, but reconditions what it means to be doing fieldwork and be in contact with the birds. More importantly, it sheds light on the contrasting conditions of fieldwork, between rapid and intense field endeavours such as the 'puffin rally' or Pauline's work in Ireland, and long-term, slow and repetitive sites, like Skomer and Bjørnøya.

Fractionated (im)mobilities: The SEATRACK system

Tracking reconstitutes the interweaving of researchers' (im)mobilities with the seabird colonies as field sites. Yet, as I have demonstrated, fieldwork remains a crucial practice for the conduct of tracking studies, and even reinforces the local expertise of scientists, to ensure that they can access the right bird. For example, without his negotiated access to Grímsey for almost twenty years, Erpur Snær Hansen would not have been able to grub logged puffins from their burrows. Based on this principle that local knowledge ensures the success of tracking studies, the international programme SEATRACK was developed

in the last ten years. In this section, I discuss how tracking connects local field sites through a large-scale collaborative system. I will demonstrate that through this 'scaling-up' of fieldwork, SEATRACK helps scientists to attend to the injunctions for rapid, result-driven data collection while maintaining their ideal of long-term monitoring. Instead of *shared* (im)mobilities among researchers, this collaboration relies on *fractionated* (im)mobilities, as fieldwork at the colony gets limited in time and space. I show that SEATRACK, and tracking in general, is used by ornithologists to 'articulate' their vision of long-term fieldwork with the incentives for short-term science.

Creating a global infrastructure

SEATRACK is a collaborative project that stems from SEAPOP, a monitoring network across Norway. SEAPOP was developed in the late 1980s, as three ornithologists monitoring distinct colonies all noticed "a period of poor productivity for a number of species and decreasing populations"[134], explained Tycho Anker-Nilssen, one of the project's founders. After several meetings and exchanges comparing their observations, Anker-Nilssen and his colleagues managed to transform this rather informal endeavour into an official monitoring program funded by the government and several offshore energy companies (which I will come back to). SEAPOP involves today about thirty "key sites" across Norway, with a gathering and standardisation of observations through regular meetings, publications and reports. Such an extensive "counting complex" (Stokland 2015) is "unique", or even an "anomaly" for seabird scientists I interviewed. It is also the foundation for the idea that coordination and standardisation of fieldwork ensures long-term funding support, as Sébastien Descamps explains below:

> So, SEAPOP is the program coordinating seabird monitoring in Norway. It is quite unique; I have never heard of something similar in the world. I have colleagues quite envious of this type of system, in Canada or elsewhere. We have this sort of system coordinating what many researchers do on seabirds. We have very close relationships, specific projects together, and it is a more or less long-term, guaranteed funding. Which is very rare these days – we have funding for one, two, three, four years and in general, it ends, and we have to run against money to continue our work. With SEAPOP, we have the luxury of being able to plan things in the long term.[135]

Martin, a leader of the programme, adds that despite its scientific interest and 'luxury', SEAPOP is arguably a long-term programme: "[It] is an anomaly. It is, and it was, really,

[134] Interview on 06.09.2022.
[135] Interview on 24.03.2023. Translated from French.

really hard work to get that going. And every year, they have to see if they get funding again"[136]. If from the surface, SEAPOP appears as a long-term monitoring programme, like the other long-term initiatives I have described in Chapter 5, it in fact relies on a regular renewal (with uncertainty) of funding. Still, Martin explains that SEAPOP plays a crucial role in maintaining these monitoring sites in Norway: "researchers find strategies to carry on monitoring under the umbrella of long-term projects like SEAPOP".

The idea of gathering forces, through large-scale coordination and standardisation, is far from unique in biology, particularly in field sciences (Vermeulen, Parker, and Penders 2013; Jouvenet 2022). Jouvenet even argues that "the specificities of polar fieldwork call for an important coordination and international planification, which brings ICS [ice core science] closer to the 'big science' model" (2022: 309). Marine ornithology faces a similar issue, as a group of Arctic seabird scientists put forth, calling for a better coordination of fieldwork given its high cost (Mallory et al. 2018). The concept of 'big science' in field biology emerged in the 1960s, notably to gather collections of specimens around the world and get a comprehensive understanding of large ecological systems, which they could not know on their own (Vermeulen 2013). As such: "In field biology, the geographic dispersion of research materials continues to be one of the most important reasons to collaborate" (Vermeulen et al. 2013: 167). It is thus quite surprising that, in this context, an initiative like SEAPOP appears so unique for seabird scientists. I would interpret this lack of general large-scale coordination for the monitoring of seabirds in connection with Henke and Gieryn's observation that "globalised science is at the same time emplaced science" (2008: 353). Similarly, in the case of Argos telemetry in the 1980s, Etienne Benson (2012) describes the "global environmental vision" of wildlife biologists as being a complex and delicate balance between local observations and practices, and standardisation for the global understanding of the environment. As I have discussed in Chapter 4, marine ornithologists seek to turn seabird colonies into their own scientific territories and thus privilege sharing the data collected from the field, rather than the field itself.

The imperatives of securing funding to guarantee maintained access to seabird colonies, such as SEAPOP, inspired an even bigger programme in 2014, SEATRACK. Unlike

[136] Interview on 07.10.2022.

observations and note-taking, which make up long-term monitoring, tracking (providing everyone uses the same devices and software), is easily standardisable. The SEAPOP Norwegian consortium reached out to international colleagues across the Arctic and North Atlantic region to propose a deal: SEATRACK sends dozens of geolocators to scientists already conducting fieldwork so that they equip birds and retrieve the loggers the following year; in return, SEATRACK gathers all the collected tracks, analyzes them with a dedicated team, and guarantees high-impact publications.

The programme is first supported by a consortium of Norwegian research institutions. According to these two scientists based in Norway, tracking is more attractive than monitoring.

> In terms of communication, too, showing a map of bird migration is something that speaks to the general public, to the ministry, to whoever. Showing a 15-year time series on reproductive success is a little less…sexy to communicate![137] (Sébastien Descamps)

> The way research is currently funded does not make it easy to finance long-term projects, so we put forward short studies, also thanks to biologging, to get funding. It is perhaps sexier to say 'Look at where our birds are going' than say "Well, I want to see if my bird comes back next year' – if we have ringed birds, for example. It is perhaps easier for someone who does not know much about it to be seduced by tracking than by just long-term monitoring[138] (Françoise Amélineau)

Thus, tracking allows for conveying clear-cutting and attractive visualisations of seabirds' movement (see figure 27), in line with public fascination with the migration of birds[139]. In addition, tracking is particularly attractive for private funding resources, namely the offshore energy industry. SEATRACK is funded by a consortium of eleven organisations, nine of which are related to oil and gas, or offshore wind farms[140]. The interests of these companies lie in the use of tracking data to produce Environmental Impact Assessments (EIAs), defining foraging areas and monitoring the consequences of their activities for wildlife (Parmiggiani and Monteiro 2016). Such a strategic dimension of tracking data is well discussed by James Blair in the case of the Falkland Islands (2022). There, penguin tracking data is integrated into a "new geographic data infrastructure in the South Atlantic" (p. 60). Martin, a scientific leader within the SEATRACK programme, put upfronts a similar argument to explain the reasons for its funding support:

[137] Interview on 24.03.2023. Translated from French.
[138] Interview on 11.09.2023. Translated from French.
[139] The number of popular books published on birds' migration is a testimony to this public fascination for tracking birds. Some examples are *Eye of the Albatross* (Carl Safina 2002), *Migrations* (Charlotte McConaghy 2020), *A World on the Wing: The Global Odyssey of Migratory Birds* (Scott Weidensaul 2021).
[140] Norwegian Oil and Gas Association (Offshore Norge), Equinor, Vår Energi, ConocoPhillips Skandinavia AS, Aker BP ASA, Wintershall DEA, Neptune Energy, Lundin Norway, Spirit Energy.

> (…) there was hard work and lobbyism. And it works because Norway is rich on oil, and the oil companies need something to greenwash their web pages. (…) the idea is that you can define better areas that need a lot of protection – on the flip side, you define areas that don't, and these areas are free for grab.[141]

This "context of motivation" for seabird tracking helps understand "what set of circumstances led to these particular questions being asked and answered"(Oreskes 2003: 700). Remarkably, that the 'explosion' of tracking studies in seabird science, in particular around the Arctic and North Atlantic (Bernard et al. 2021), is crafted around a strategic collaborative complex and global infrastructure which ensures the distribution of funding – SEATRACK.

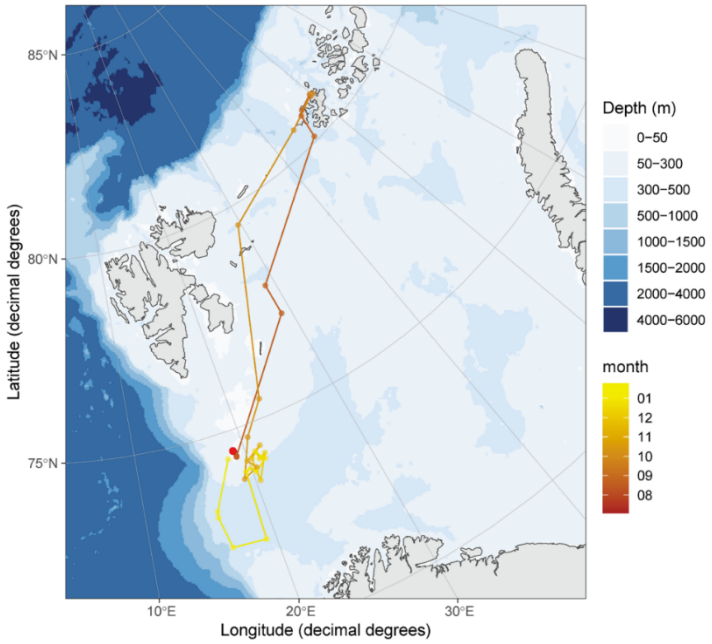


Figure 27. "Track of a glaucous gull instrumented with a leg-mounted GPS at Bjørnøya in July 2022, ending mid-January 2023" (source: SEATRACK 2023 Annual Report)

According to its most recent annual report, SEATRACK involves around 28,200 loggers deployed and around 13,700 retrieved from around 5,900 individuals belonging to 16 seabird species. This corresponds to 4.5 million datapoints, covering more than 13,000 birds' years (SEATRACK 2025). The programme gathers 70 scientific partners from 14 countries, working on more than 90 breeding sites in the region (figure 28). Only in 2024, about 170 field expeditions were conducted during the breeding season, on about 70 colonies (ibid). However, the programme does not directly fund any of these expeditions, providing at most some complementary support for its "scientific partners".

[141] Interview on 07.10.2022.

It instead relies on already negotiated access and local knowledge of a network of marine ornithologists who overcame logistical and institutional challenges to work on these often-remote seabird colonies. Many scientists I met through the course of this study are part of the SEATRACK programme; they explained how this system works and how it benefits them:

> What SEATRACK pays for is all the logistics and data handling, and all the tracking devices. SEATRACK buys like 5000 loggers every year, and then sends them out across the North Atlantic, and people put them out and get them back, and then SEATRACK handles the data management side again. Which is not an easy task. It uses the fact that people already have some – often sporadic – monitoring. You know, some of these people go to their colony every third year, can put some loggers out and then, have a look for years later if it's back.[142] (Martin, SEATRACK project leader based in Norway)

> It works in the way that SEATRACK pays for the loggers, so they supply us with all the devices. They also take care of the data processing, so we sent them either the data files we have downloaded from the loggers, or sometimes also the loggers themselves if they are not sufficiently high-battery to be deployed again. And then, they also give us support towards the cost of fieldwork.[143] (Morten Frederiksen, SEATRACK collaborator based in Denmark, contributing from two sites in Greenland)

In return for deploying loggers on their respective colonies, scientists are guaranteed a rapid productivity – since 2014, the SEATRACK project has led to more than 60 publications, 16 reports and 13 theses[144]. This productivity, contrasting with the slow performativity of long-term monitoring data, ensures that these scientists do fieldwork and respond to their academic expectations by regularly publishing data. Erpur Snær Hansen thus explains how the tracking data he collects during the 'puffin rally' provides him with rather straightforward publications. In contrast, the monitoring data he collects from the burrow camera is tedious and long to analyse.

> There is only so much time you have in winter, you have to run the lab, and you have to write up the results and reports, and applications, grants and *whoop!* the winter is gone, and you haven't done much exciting paper writing. That's one of the good things in SEATRACK, in particular. I mean, in 2021, we had 10 papers out with my name on them, and I just did the fieldwork! I did not do much of the analysis.[145]

Thus, SEATRACK makes use of the negotiated (im)mobility of scientists to produce strategic data for the energy industry and conservation (such as Clairbaux et al. 2024). Importantly, I noted that while it is used by the scientists to respond to their academic expectations of productivity, it is also used for their ideal of 'long-term commitment'.

[142] Interview on 07.10.2022.
[143] Interview on 11.10.2022.
[144] https://seatrack.net/publications/.
[145] Interview on 08.02.2024.

Figure 28. SEATRACK field sites (red dots)[146] (source: SEATRACK 2024 Annual Report)

Articulating short-term tracking and long-term monitoring

Tracking supports scientists with funding opportunities, but more remarkably, it supports their 'environmental vision' (Benson 2012) of long-term monitoring, which is typically not funded. Many seabird scientists described how they use tracking to ensure the continuity of their long-term study and assert the importance of fieldwork.

> They utilise the fact that people go there for their monitoring work anyway, no matter how they got that funding. And SEATRACK itself actually helped by existing. You know, people could use it as a leverage, saying "Look, I'm part of this gigantic program, can your local government or whatnot, chip in, pay my monitoring, so we can be there and – you know, prestige". So, it actually had a positive reinforcement effect just by virtue of existing.[147] (Martin, SEATRACK project leader based in Norway)

> This is the beauty of the kind of work we do. With seabirds in general, what is difficult is getting access to the colonies, and that's what's going to be expensive. But once you are in a colony, you can collect lots of different types of data. If we have funding to deploy loggers and monitor migration, once we are on-site, we can do other things too, so it opens the

[146] Russian sites (white dots) have been abandoned since 2024 but were included in previous phases of the programme.
[147] Interview on 07.10.2022.

> door to other studies.[148] (Sébastien Descamps, SEATRACK collaborator based in Norway, contributing from three sites in Svalbard)

> In 2015, I think, we joined SEATRACK. That was a big step for us, because for a long time we were quite isolated. It probably happened by chance, we got in touch about loggers, and we said to SEATRACK that we can deploy these loggers. 'If you send them to us, we've got birds, we've got good access to the nests'. And then, we show them the data we are collecting there. They thought that was actually a good idea. (…) That's a very big thing for us, because it makes us part of the big international network, which I think is very important.[149] (Katarzyna Wojczulanis-Jakubas, SEATRACK collaborator based in Poland, contributing from two sites in Svalbard)

As these scientists describe, SEATRACK "helps by virtue of existing", it is a "leverage" to be less "isolated", get "prestige" and is relatively easy to contribute to because "once we are on-site, we can do other things too". Sébastien Descamps, for example, takes advantage of the SEAPOP and SEATRACK-related funding he receives to conduct some colony monitoring in East Svalbard, a remote site for which he believes he would not have received support otherwise. Descamps works in Norway, and this system is even more valuable for scientists located within institutional landscapes with few resources to fund seabird fieldwork, and in particular, long-term monitoring. Katarzyna Wojczulanis-Jakubas, based in Poland, explains that if she had not joined SEATRACK ten years ago, she would not have been able to maintain her monitoring study, started in the early 2000s.

> Because long-term monitoring does not have a finite date, and each project has to have clear objectives. And you need to complete the project and achieve these objectives. If your objective is like to continue collecting data, you won't be able to conclude. (…) If you really want to keep doing research, like collecting data for this monitoring, we need to go to the field. And for that, we need to find an excuse. But if you want to look at the long-term data and make a project out of it, then it will be a very different project, I would say, maybe not necessarily with going to the field. And we may even get funding, but maybe not for the expedition, but for the, I don't know, post-doc, to work on this data.[150]

Thus, Wojczulanis-Jakubas' fieldwork is maintained but *fractionated* through tracking studies. Each year, she submits new research proposals relating to new scientific questions, "find[s] an excuse" to ensure her presence at the little auk colony of Hornsund, which she has been monitoring for over twenty years.

Marine ornithologists, therefore, articulate short-term, tracking-related funding and their vision of long-term monitoring. This echoes existing observations from the STS and

[148] Interview on 24.03.2023. Translated from French.
[149] Interview on 07/10/2024.
[150] Ibid.

sociology of work literature. Following Fujimura (1987, 1996), "articulating work"[151] generally relates to the 'tinkering' strategies scientists mobilise to align their research agendas with external socio-organisational contexts. For example, Julien Barrier, studying the impact of project funding on the work patterns of scientists, noted that "researchers mobilise in parallel a large diversity of funding to support their research agenda" (2011: 10). Remarkably, he emphasises that the broad uncertainty of project funding encouraged scientists to even enlarge their portfolio of funding (p. 11). Scientists articulate their research activities between the opportunities and costs of collaborating with the industry. Similarly, Granjou, Mauz, and Daccache (2013) emphasised the articulation work of biodiversity scholars as experts to value their work (notably through major publications) and gain public recognition. Thus, the STS literature generally emphasises the adaptive nature of scientists to shifting environments to secure funding (Lam 2010: 335). Reinecke and Bimm even describe how Martian exobiologists manage to "maintain their research programs in the face of not finding anything" (2022: 201), calling for more attention towards "discipline sustainment under unfavourable conditions (p. 220).

Similarly, I argue that marine ornithologists use their negotiated (im)mobility on specific seabird colonies as a "valuable asset" (Pinel 2021) to articulate their vision of long-term commitment with the injunctions of academic productivity. They must work along two timelines and "environmental visions" (Benson 2012): tracking through the SEATRACK project, and long-term monitoring. However, this articulation work impacts the (im)mobilities to seabird colonies.

An economy of fractionated (im)mobilities

Tracking studies thus allow researchers to "find an excuse" and receive funding support to maintain their fieldwork in the long term. In this sense, tracking helps legitimise fieldwork. It leaves us to ask what kind of fieldwork is maintained? I argue that SEATRACK embodies the tendency of researchers' (im)mobilities to seabird colonies to become *fractionated* in time and space. In time, as researchers experience a growing workload without necessarily having more time in the field. In space, as scientists are

[151] "Articulating consists in creating strategies by which researchers juggle, balance and meet multiple, simultaneous demands at multiple levels of work organization" (Fujimura 1987: 275)

responsible for conducting fieldwork on a larger number of sites and sharing the data collected; which does not necessarily translate into cooperation in the field.

SEATRACK relies on the existing negotiated access of scientists to seabird colonies, but this does not mean that tracking is a straightforward endeavour, as I have shown in the previous section describing tracking practices. In addition, because barely any of these field sites are solely based on tracking, participating in SEATRACK appears mostly as a workload increase in the field. Amanda, collaborating from Canada, explains that "It is a significant increase in our workload"[152]. Whilst she is very positive on the impact of SEATRACK for her scientific visibility and the robustness of the data produced, she feels that the project changed her work schedule. This workload is not only reflected during fieldwork, but also in the time to seek short-term support, sustain this international network and the mental pressure to combine these temporalities.

> There's definitely a balance that you need to strike between the time and effort that you put in your long-term monitoring and then these more short-bursty-project-based questions. There's a balance! (…) I hope to be able to keep those long-term monitoring data sets going despite being pulled in a lot of different directions for flavour of the day. Yeah, you have to make an effort, for sure, to keep them going.

Indeed, in many cases of large international collaboration described in the literature, the collaborations tend to increase the analytical and administrative burden of the partners (Vermeulen 2015). In the context of collaborations based around technologies in the laboratory, Ribeiro et al. (2023) even advance the idea of a 'digitalisation paradox' – while technologies allow simplifying some tasks, they also lead to amplifying and diversifying the workload of lab workers. In the case of SEATRACK and largely tracking studies, the collaborative model allows for reducing the analytical part, as the project employs dedicated personnel to process and analyse the data, while the research partners are expected to focus on collecting data in the field. This implies that the fractioning of (im)mobilities to the field affects scientists' specialisation, as Morten Frederiksen, a seabird biologist in Denmark, notes:

> I don't see fieldwork really changing to become less important. I think we will probably see more people, more individuals who don't go to the field. We already have quite a few of those because there are lots of people working with all the data that we collect. The work is so much more data-heavy than it used to be! Which also means that there's much more time spent in front of computers trying to understand the data. But there's still the need for somebody to actually go out there, so that's not going to go away as I see it.[153]

[152] Interview on 24.09.2024.
[153] Interview on 11.10.2022.

Morten Frederiksen has been conducting fieldwork in Greenland with his colleagues for several years and has included his field sites in the SEATRACK network, integrating logger deployment during his two-week field expeditions. In his case, participating in SEATRACK did provide him legitimacy to maintain his fieldwork, but he did not benefit from additional funding to spend more time in the field. Instead, he needs to include tracking in his existing routine. In addition, he feels restricted to his sites in Greenland, which feed strategic data for SEATRACK and the Greenlandic mining industry. He explains:

> I've had a dream of a specific site in Denmark where I would like to have both a long-term and in-depth study. (…) It's easy, reasonably easy to access. There are buildings there that we would be able to use, and maybe they would need some renovation, but they're there. (…) at my career stage, I'm not looking at something terribly exotic. This would be more of a domestic site, but actually filling some knowledge gaps, some stuff would be really interesting. But so far, no one has seemed to show any interest in funding any work there

Like Barrier (2011) noticed that project funding tends to orient research towards low-risk and consensual questions, Frederiksen's case indicates that tracking also contributes to 'grounding' scientists to specific, strategic colonies. He adds that the only way he foresees getting funding to work in mainland Denmark is through the windfarm industry:

> (…) it's been *extremely* difficult to fund any seabird work here in Denmark, which actually I would really like to do. But that is changing now with the large expansion of offshore wind in the North Sea. Now, they start to think "we actually need to know something about how the birds use these areas". So, I think in parts of the world where offshore wind is developing, this is a major expansion in the funding opportunities for seabird research.

Similarly, the ornithologists from the Groupe Ornithologique du Nord I followed through their monitoring of kittiwakes in Boulogne-sur-Mer, explained to me that they started a small cooperation with scientists to track a few birds, in the hope that the data would demonstrate that they cross prospective wind farm areas. In this case, they would receive support from energy companies and local governments to monitor and track the growing population of kittiwakes in the region. Again, Morten Frederiksen well summarises the dilemma marine ornithologists are facing: "Should we try to aim for establishing long-term studies or should we aim more for quick and short-term projects that aim at addressing a specific issue that's of interest right now?".

Conclusion

In conclusion, tracking technologies are not 'divorcing' scientists from fieldwork, nor distancing them from the birds. In their analysis, scientists are eagerly embracing the advancements of tracking, where social scientists have tended to critically assess the affective and ethical reconfigurations of fieldwork with wild animals. Throughout this chapter, I have discussed the many levels of disruptions of work practices that tracking technologies bring to the study of seabirds. However, I noted that the core nature of marine ornithology remains and is even reinforced: accessing colonies and creating 'shared' (im)mobilities with specific birds. Rather, I argued that tracking technologies mostly change the temporality and spatiality of seabird fieldwork, as access to specific colonies is an asset and capital for researchers contributing to large international programmes such as SEATRACK. I have shown that to ensure their vision of long-term monitoring and in line with the strong epistemic culture of fieldwork in marine ornithology, scientists articulate short-term tracking studies with long-term data collection.

While tracking undoubtedly introduces new configurations, it also largely serves to reinforce and extend existing dynamics. This chapter, therefore, is also an attempt to consider what researchers strive to maintain in a context of epistemic 'revolution', as this reveals what they value. Namely, seabird scientists do not envisage abandoning fieldwork, which remains the foundational practice underpinning their identity and status within the scientific community. Moreover, they value the stability and repetition of their (im)mobilities to seabird colonies and use technological developments to value their access to field sites in the long term.

Fieldwork remains central – but not for everyone, and not under the same conditions. As my discussion of tracking in practice has shown, the ability to access, stay at, and return to colonies is unevenly distributed, and this significantly shapes field practices. This capacity for (im)mobility at the colony constitutes a form of *capital* within the marine ornithology community. For instance, Erpur Snær Hansen has built the 'puffin rally' around his unique access to a network of colonies across Iceland, enabling him to participate in international collaborations. To strengthen his own value, he does not simply collect data at a single site or rely solely on his expertise in deploying and

retrieving geolocators. Thanks to his burrow camera and the intensity of the 'rally', he conducts monitoring at a national scale, which he compares to the scope of SEAPOP in Norway, and provides tracking data from three colonies integrated into his existing fieldwork. Like him, many other ornithologists layer tasks in the field: access to particular sites gives them a strategic position, allowing them to participate in multiple projects and increase their visibility and value in the community. Through their ability to access colonies, researchers can join large-scale, prestigious projects like SEATRACK, which, in turn, helps sustain that access.

(Im)mobility and access to seabird colonies must also be considered over time. Tracking may help maintain fieldwork; in turn, it is becoming increasingly *fractionated*. Within the broader seabird community, some manage to conduct fieldwork while others – often students or early-career researchers – work with already collected data. This can easily be considered a concern, given the value placed on field experience within the seabird science community. At the same time, academia generally tends to reward publications as the true form of capital, in the Latourian sense (Latour 1993), for researchers. It is telling to recall Hansen's case: in a single year, he contributed to ten publications and "just did the fieldwork"[154].

Thus, tracking sheds light on the role of fieldwork as a (fragile) capital among researchers. Fragile, because ornithologists accumulate commitments in the field to maintain these sites, which leads to fractioning the distribution of field sites in space and in time, and contracting fieldwork. As such, tracking legitimises long-term monitoring of bird populations, but within increasingly short and compressed timeframes.

[154] Interview on 08.02.2024.

Chapter 7

Conclusions

Negotiating (im)mobility at the seabird colony

> My work has mostly entailed studying the birds ashore, and remaining frustratingly ignorant of the birds' activities at sea. Only over the last 20 or so years have modern electronic devices begun to reveal the details of those activities. The revelations are astounding. They have enhanced the wonder of seabirds. (…) It feels as if seabird enthusiasts have suddenly found the long-sought key to the door that allows an escape from dark ignorance to a new vista of wondrous knowledge.
>
> Michael Brooke, *Far From Land. The mysterious lives of seabirds* (Brooke 2018: ix)

At the 2022 Seabird Group conference, Annette Fayet, an ornithologist specialising in the movement ecology of Atlantic puffins, shared the story of a group of British ornithologists who flew over the Atlantic Ocean more than a hundred times in the 1940s, in the hope of spotting flocks of puffins. A hundred and eleven times, they embarked on a plane to understand where these charismatic birds had been disappearing for over half a year. After all those trips, they found five birds. Decades later, after equipping them with geolocators, Fayet and colleagues revealed that British puffins migrate to the High Arctic, along the Canadian coasts, and even into the warm waters of the Mediterranean (Guilford et al. 2011; Fayet et al. 2013). Now that researchers know where the birds are going, crucial questions remain unanswered – why are they going *there*, and how do they *return*?

This anecdote reveals marine ornithologists' obsession with understanding the meanings of movements. Tirelessly, scientists tried to follow the birds, even adopting their modes of motion, by flying, without yet knowing where they were actually going. Ultimately, it was not out at sea, but from the colony that seabird researchers "found the long-sought key to the door that allows an escape from dark ignorance to a new vista of wondrous knowledge", as ornithologist Michael Brooke puts it (2018: ix). Like the researchers, I aimed in this thesis to understand the meaning of movements, in and out

of seabird colonies, or what I have called (im)mobilities. My interest, however, has not been in the (im)mobilities of seabirds; but in those who study them.

In this concluding chapter, I synthesise my findings on the conceptualisation of (im)mobility. I have argued throughout this thesis that field sites are not fixed locations but fluid, constructed, and maintained spatial entities, influenced by the recurrent and often unstable movements of scientists who access, stay, leave, and return. These (im)mobilities, as I term them, are negotiated by researchers in various ways. In the first section of this chapter, I will revisit these negotiations through the three crucial concerns of marine ornithologists I have discussed throughout this thesis: following, maintaining, and capitalising. I will then explore how (im)mobilities, as understood in this thesis, can contribute to a different reading of geography of science. I argue that seabirds and seabird scientists offer different 'spatial possibilities' (Greenhough 2006) to conceptualise what the geography of science does to science, beyond 'placing' or 'spatialising' it somewhere. Instead, I propose three other spatial possibilities which emerged from my fieldwork and thinking with (im)mobilities: interweavings, territories, and rhythms. Finally, having argued throughout this thesis for the consideration of scientific movements to access, stay, leave, and return, I reflect on my own (im)mobility at the beginning of my academic career and as I return to one of my field sites.

Negotiating (im)mobility: following, maintaining, capitalising

This thesis aimed to address a question that has rarely been directly explored in STS: where do field researchers go to collect scientific data, and why there? The first part of the question relates to the distribution of scientific field sites, while the second concerns the motivations behind this distribution. I suggested that the locations of science reveal that spatial distribution logics are not uniform. Some areas attract more data collection, whereas others are less studied. Applied to fieldwork, this suggests that certain sites are privileged and that specific features make them favourable for scientific knowledge production. Throughout this thesis, I explored and unravelled the entanglement of social processes in space and time that drive marine ornithologists to specific seabird colonies, showcasing that it is the very movements and stillnesses to access, maintain, and return

to these sites that turn them into scientific fields. I argued that understanding these (im)mobilities reveals the contrasting meanings of field sites and fieldwork practices for researchers. Scientists' (im)mobilities produce field sites, and these field sites themselves shape scientific trajectories.

To emphasise the dynamic dimension of scientific activities in space, I proposed developing a geography of field sites that goes 'beyond maps' (Chapter 3). I argued that, as researchers need to create, transform and maintain seabird colonies into field sites, it is important to consider how this (re)generation unfolds. I proposed that (im)mobilities capture the movements and experiences of researchers who appropriate a seabird colony and create field sites (Chapter 2). Seabird colonies as field sites are not just there; rather, they are continuously being negotiated by researchers as they access, stay, leave, and return. Throughout this dissertation, I have described this active process of negotiating (im)mobility to seabird colonies. This negotiation unfolds across three major concerns for marine ornithologists: following, maintaining and capitalising.

Following

> There are, Lorenz explains, two kinds of field ethologists: the hunter (like Tinbergen) and the cattle-breeder, like himself. The hunter follows the animals in their own field, and observes them. The cattle-breeder keeps them with him, and tries to provide them with the most natural conditions. (Despret 2004: 129)

Vinciane Despret (2004) describes the strategy of early field ethologists, such as Lorenz and Tinbergen, to observe and understand the behaviour of wild animals and distinguishes two approaches: hunting and breeding. Observations in the field thus relate to a form of insatiable hunting to follow specific animals and gain insights from them. Fieldwork, in this sense, is about following. I have argued throughout this thesis that following the birds was a central and constantly negotiated concern for the marine ornithologists. It involves selecting specific sites to study seabirds, monitoring them in the long term, and understanding their movements beyond colonies.

Following something or someone, I argued, always involves a process of selection. In Chapter 3, the process of selecting interviewees and field sites meant that I was following *some* of those who follow seabirds. Similarly, marine ornithologists are not able to 'follow' and study all seabirds. Rather, as I argued in Chapter 4, *Following the seabirds?*, they

determine privileged places to access them, selecting colonies which they turn into sites for science. I have shown that researchers do not necessarily follow the birds but rather follow constraints, strategies and opportunities. They follow, for example, their research supervisor or apply to existing projects. Moreover, the study of researchers' field (im)mobilities reveals that their trajectories vary highly, with some regularly changing sites and others studying the same colony throughout their careers.

However, in Chapter 4, I demonstrated that researchers mainly follow the contrasting logics of accessibility. Beyond the scientific discourse that essentialises the selection of a site to the research question, I showed that marine ornithologists negotiate with a variety of constraints related to the different dimensions of accessibility to field sites: epistemic, relative, logistical, and social. Therefore, seabird colonies should not only be geographically close, but researchers must also mobilise logistical resources to access them. These sites should not be too accessible either, as this contradicts the ideal of isolation sought by researchers craving adventure. Additionally, accessibility is constantly challenged by local gatekeepers, such as island owners who may restrict or enable access to the birds. Consequently, 'following' requires active participation from researchers; they do not simply go where the birds are, but organise the best conditions to ensure access to the birds.

In Chapter 5, *Long-term commitments*, I showed how following seabirds also needs to be negotiated in the long term, to conduct population monitoring studies over decades. I explained that long-term monitoring is seen as scientifically vital but is heavily influenced by disruptive factors such as lack of funding, climate change, or the shifting affect and aspirations of the scientific community. Indeed, given all the effort it demands, following seabirds is seen as a *commitment* for marine ornithologists to study colonies throughout their career. This commitment indicates that following is not straightforward but a continuous negotiation, not only with the birds but also with local and global disruptions.

One such major disruption, the technological development of biologging, strengthens scientists' ability to follow seabirds, especially to *track* them. Chapter 6, *Capitalising (im)mobility*, described what has been called the 'revolution of biologging' throughout the latter half of the 20th century, which involves the miniaturisation of tracking devices. With GPS or geolocator loggers, marine ornithologists can follow seabirds beyond the colony through direct observation. At the start of the chapter, I noted

that while this could mean that some technologies mediate researchers' capacity to track birds and potentially replace fieldwork for such tasks, because they must be captured and recaptured; tracking actually enhances researchers' attention to the movements of birds in the field, reinforcing fieldwork. I used the concept of 'shared (im)mobilities' to encapsulate the focus on *specific* birds' movements, both in and out of the colony, and to show how tracking studies underline the importance of fieldwork. Tracking occurs at multiple scales, from migratory routes to movements within colonies, up to the process of grubbing birds from inside their burrows and 'duck-fishing' them from cliffs to attach or remove devices from them.

Following is thus a crucial concern for the marine ornithologists I have myself 'followed' throughout this thesis. In the study of seabirds, scientists are concerned with selecting the right places to be with the birds, which involves specific negotiations of accessibility and territorial practices to turn the colonies into sites for science. This concern is all the more a 'commitment' as it ideally involves, for marine ornithologists, following seabird colonies in the long term.

Maintaining

> (…) most objects in the human world do not last. They decay, decompose, wear out in different ways and for different reasons. They must therefore be maintained, or they disappear. (Denis and Pontille 2022: 11)

In the book *The Care of Things*, Denis and Pontille (2022) discuss practices of maintenance in everyday lives and emphasise their importance for the production of knowledge. In this thesis, I have aimed to shed light on the role of maintenance for fieldwork, arguing that field sites exist through continued investments. Maintenance, in the case of marine ornithologists, is not simply a set of practices, but rather a constant concern. In chapter 4, for example, I demonstrated that the value of field sites varies based on the time researchers spend there. Seasonal sites, where researchers stay throughout the breeding season, are perceived as more prestigious than punctual or trial sites, where researchers can only access the birds for a few days or even hours. Indeed, the capacity to negotiate access to a single colony and collect data throughout the breeding season enables researchers to claim it as their territory. Field sites embody their identities in the scientific community. For example, Michael P. Harris and Sarah Wanless

are immediately associated with the Isle of May. In Chapter 5, I argued that what really matters to marine ornithologists is the ability to *return* to the colonies throughout their careers, enabling long-term population monitoring. Temporal dimensions thus count as much as spatial ones, and are deeply entangled when it comes to the maintenance of field sites.

Consequently, marine ornithology's 'epistemic culture of fieldwork' values dedicated figures within the community – researchers who have built their careers around a single site. Access only matters when it can be repeated and maintained over the long term; what mostly counts is not just accessing the birds once, but being able to return across decades, sometimes even beyond the lives and careers of the researchers. In Chapter 6, I demonstrated that the local knowledge scientists developed through such long-term engagement is also transferred into short-term projects, such as tracking studies. Returning to the same colony to access a specific bird is especially important for equipping birds and retrieving tracking devices the following year.

Throughout this discussion of maintenance work, I argued that field sites are not just places for data collection but *territories* that shape ornithologists' scientific identity. In chapter 4, I showed that gaining access to the field depends on researchers' ability to mobilise and maintain resources and local connections. This brings to mind the anecdote that I began Chapter 5 with: the 'puffin rally' depends on the negotiation efforts of Erpur Snær Hansen, initiated about fifteen years ago, or even earlier if we consider his existing friendships with many people who provide access to housing, boats, and other services on colonies across Iceland. According to Hansen, the 'puffin rally' is intrinsically tied to him; without him and after him, it cannot exist, as access to the colonies ultimately relies solely on the connections and resources he has gathered. This very personal aspect of fieldwork turns the 'rally' into his territory.

Maintaining also raises questions about the future. If field sites are territories maintained by researchers, what happens when they can no longer sustain them? As I discussed in Chapter 5, various internal and external constraints can separate ornithologists from their sites. For example, colonies may vanish due to climate change, or researchers might retire. In both cases, the future becomes particularly difficult to manage. I have recounted stories of researchers, such as the American ornithologist George Divoky, who continued

working on a guillemot colony even when the population shrank from four hundred to just a handful. This case illustrated the culture of devotion within the seabird science community and highlighted the strong emotional connection to the field. Through long-term access efforts, researchers develop a deep relationship with colonies, especially when they are threatened by the environmental changes they are documenting. Maintenance is then, crucially, also a matter of care.

Personal resilience to maintaining field sites, particularly amid climate change and funding cuts, is part of a communal narrative and matters for career paths and academic distinction. However, I have also observed that maintenance and long-term access reveal power dynamics that extend way beyond the colony sites. Indeed, female researchers shared the difficulties of committing to long-term fieldwork while managing family care duties. In contrast, men, particularly in past decades, could rely on their wives to care for their families. Maintenance is thus subject to various inequalities, including those based on gender and academic status. In chapter 4, I noted that young researchers often work on trial sites or join their supervisor's projects. Their workload and progress depend on their ability to maintain and territorialise field sites. For example, Annette Fayet joined an existing monitoring programme on Skomer for her PhD, but then also developed other projects, such as in the Seychelles. Her capacity to negotiate access to field sites led Tycho Anker-Nilssen to select her to succeed him in the long-term monitoring of the Røst colony (Chapter 5). However, Fayet does not value such a deep personal connection to the site, achieved at the expense of personal life balance, and instead aims to share some of the fieldwork, both in the Seychelles and Røst.

Maintenance of field sites is thus a constant concern for researchers, both as a scientific interest (documenting declining bird populations) and a community value (gaining recognition). Although it is highly valued by marine ornithologists, it remains largely underfunded, as it does not align with short-term-oriented funding cycles. In Chapter 6, I explained how researchers work to articulate their long-term ideals with short-term constraints. Notably, tracking technologies enable producing short-term results and publications, and are used by researchers to maintain and legitimise their field sites. From the SEATRACK case, I demonstrated that tracking studies are leveraged for funding while collecting long-term monitoring data. However, I argued that scientists also need

to constantly manage their time and resources, adding tasks in the field and adapting to what is financially strategic. I also highlighted how tracking tends to be funded by offshore energy companies, which threaten birds' lives while helping to maintain their study. Tracking, therefore, tends to concentrate work on certain sites that hold more strategic importance for funders, and which are perhaps less valuable and strategic for maintaining scientific inquiries.

Maintaining sites is a major concern for marine ornithologists. I have mostly outlined this in chapter 5 as a matter of 'long-term commitment', discussing how scientists perceive and practise maintenance as a valued skill and culture, despite disruptions such as the future of colonies and field sites. This issue was also emphasised when discussing the selection of sites in Chapter 4, as accessibility is not just a spatial, but a temporal concern. Finally, the case of tracking discussed in Chapter 6 revealed how researchers balance economic incentives with their vision of maintaining long-term fieldwork.

Capitalising

> Pierre is a capitalist – in credibility capital –, and a wild one he undoubtedly is, since he is ready to move all his assets at a moment s notice to reinvest them wherever he feels their profitability is highest. The more famous he becomes, the more mobile he is. (Latour 1993: 108–9)

In a paper based on an interview with biochemist Pierre Kernowicz, Bruno Latour (1993) describes scientists as 'wild capitalists' whose aim is to amass capital. Remarkably, he notes that such capital is converted into mobility. Throughout this thesis, I have shown that not only mobility but also (im)mobility matter as forms of capital for marine ornithologists.

As I have discussed, the selection of field sites and the ability to negotiate access – and even more, to appropriate them as territories – depends greatly on researchers' positions. Those at the highest career levels have greater access to birds, as they have accumulated logistical resources and local connections. However, while one might expect that career progression would separate researchers from doing fieldwork, I showed that the opposite is often true for marine ornithologists. For example, Tim Guilford, a professor, prefers to delegate easier' field sites to doctoral students in charge of experiments and long-term monitoring, while he focuses on more adventurous sites. This

means that accessibility is an accumulated capital: researchers negotiate access to sites, which they can decide to keep for themselves, share, or delegate. In particular, in chapter 5, I noted that the seabird community s inspirational figures are researchers who built their careers around a field site, sometimes returning to it for the rest of their lives. Finally, in Chapter 6, I emphasised that even though tracking technologies allow researchers to spend less time in the field and potentially delegate data collection, programmes like SEATRACK reinforce the need to be at the colony. Erpur Snær Hansen, for example, explained that this collaboration brings him publications, prestige, but also ties him even more to the puffin rally' – he is only asked to collect tracking data in the field, not doing any of the analysis. As such, access to specific colonies is the capital of researchers, their value to stand out in the research community. Capital is not just symbolic or economic; it is also geographic. Indeed, being localised in a remote and 'closed' environment like Iceland brings Hansen opportunities to be integrated in an attractive and productive international programme like SEATRACK. As he noted in Chapter 5, he believes that only an Icelandic person is able to conduct the 'puffin rally' because of the local connections it requires. At the same time, Icelandic funding would not be sufficient to support his monitoring programme across the country. He thus relies on his unique access to colonies like Papey and Grímsey to equip and retrieve loggers for SEATRACK. With the international support and publications that he receives through this international programme, he legitimises the existence of the 'puffin rally'.

In Chapter 5, I described how long-term monitoring does not fit funding agendas, while it is a crucial research activity for marine ornithologists to collect background data for other studies and to understand seabird population declines. In Chapter 6, I showed that ornithologists instead mobilise funding from tracking studies to fund long-term monitoring on their negotiated colonies. Indeed, tracking holds strategic importance, notably for offshore energy companies, which provides a new source of funding for seabird research. Instead of research *for* conservation, energy companies seek to understand where the birds are *not* going when collecting data for Environmental impact assessments. Although this simultaneously enables long-term studies to be maintained, I have shown that this also constrains fieldwork, which I have approached as fractionated (im)mobilities . Researchers can conduct field studies, but add tracking to other duties in the field, thereby increasing their workload and compressing the time they can spend

with the birds. Additionally, this tends to constrain researchers to economically strategic sites, instead of scientifically important sites. Morten Frederiksen, for instance, maintains his colony-monitoring efforts in Greenland through regular tracking funding, yet he cannot simultaneously secure resources to study birds in Denmark. Similarly, the ornithologists I joined in Boulogne-sur-Mer confessed that they hoped some tracked birds would be crossing prospective offshore wind areas, so that they would receive funding to continue the monitoring of this endangered species. Tracking thus holds an ambiguous role as a strategic tool for the exploitation of marine resources as well as a crucial resource for the conservation of seabirds. In this sense, scientists' (im)mobilities to seabird colonies are not just a capital for science, but also for the energy industry.

To summarise, by analysing how marine ornithologists end up on specific colonies to study seabirds, I have argued that they negotiate (im)mobility to field sites. This means that they aim to access particular colonies to turn them into research sites, maintain that access and transformation through repeatedly leaving and returning. These (im)mobilities are critical in the work of researchers, as they must constantly negotiate them, but they also determine their own careers and work. They hold a true symbolic and economic capital for the scientific study of seabirds.

Throughout this thesis, I have contributed to illuminating the efforts of marine ornithologists to sustain the study of seabird colonies despite a series of disruptions. I unravelled the processes of selecting scientific field sites, turning seabird colonies into sites for science, renewing that appropriation in the long term and how this can be seen as a capital for scientists. Turning to (im)mobility thus relates not only to a mere description of movements but to understanding what drives scientists to specific places, and how these sites matter for the production of scientific knowledge. At a time when seabirds and seabird colonies face major declines under the threats of climate change, attending to the efforts and continuous work of scientists to document these ecological evolutions in the long term is necessary. It emphasises that scientific data collection in the field is never straightforward and always demands negotiations.

Three 'spatial possibilities' with (im)mobility

This thesis is not solely an empirical contribution to describe and analyse marine ornithologists' fieldwork practices, which have been little studied in the literature. It is also, and importantly, a methodological and theoretical contribution to the dialogue between geography and STS, towards the formalisation of geography of science. I argue that the geography of scientific activity needs to be understood through the articulation of spatial *and* temporal issues. (Im)mobilities is one fruitful pathway to grasp scientists' concerns in selecting the *right* colonies to study, access, stay, leave, and return.

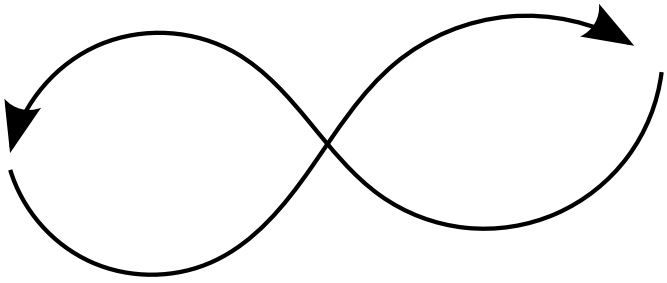
Writing as a geographer and STS scholar was a challenge, as it required combining two distinct disciplines, with different sensitivities, references, traditions and views. But it also emphasised how geography and STS can come together in the same concern of *situating* scientific activities. In *Power and Invention. Situating Science* (1997), philosopher of science Isabelle Stengers argued that if spaces of science are socially and materially structured, they are far from fixed but are constantly being (re)negotiated by their human and non-human inhabitants. Field sites, in my case, are not fixed places but constantly (re)generated spaces through the mobilities and immobilities of seabirds and marine ornithologists alike. Taking a similar approach, geographer Beth Greenhough argued that

> (…) we cannot simply read off the geography of scientific practice by responding only to the objectives and spatial rationales explicitly stated by the scientists themselves. To do so we risk, in Stengers words, 'silencing the very thing one is interrogating' (1997, 17) and reflecting more about the fieldwork and the spatial assumptions of scientists than the spatial possibilities generated by and through their work. (2006: 225–26)

This thesis has, too, been an attempt to move past spatial assumptions and generate, with seabirds and seabird scientists, new spatial possibilities. I have sought to reveal and analyse the concerns of researchers to negotiate (im)mobility to seabird colonies, as they themselves seek to understand the seabirds' (im)mobilities. This sensitivity to movements and stillnesses that emerged from the study of marine ornithology opens up new horizons for adopting spatial metaphors in STS and situating scientific activities in space, time and society. I find Greenhough's idea of 'spatial possibilities' helpful because it expresses the idea that the modes of knowledge production and relations to space are multiple – as long as we change the ways we look at them. In this thesis, and through my focus on (im)mobilities of researchers to seabird colonies, I have identified three core 'spatial possibilities'. These instances of (im)mobility relate to how fieldwork sites are

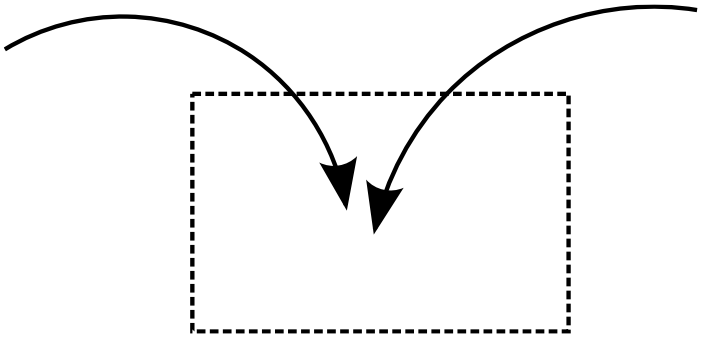
practised and produced by researchers. Field sites are not simply fixed places in space; they are interweavings, territories and rhythms.

1. Just as colonies are produced by the (im)mobility of seabirds, marine ornithologists' field sites are produced by the interweavings of their (im)mobility with the birds they study. While researchers are in their offices or laboratories, seabirds are migrating on the open sea. Whether for the entire breeding season or a week, a day or an hour, birds and researchers eventually become (im)mobile, meeting and generating field sites. Thus, field sites are not simply places but **interweavings**: the coordinated encounter of movements of seabirds and marine ornithologists. Researchers seek to control this encounter, but I have shown throughout this thesis that seabirds also have a say. In the case of tracking, for example, although researchers capture birds, they are primarily dependent on the return of these birds carrying loggers back to the colony. However, some resist the capture or disappear at sea during their migration, not returning to the colony. Thinking of field sites as interweavings – even going beyond researchers and seabirds, by including all kinds of human and non-human inhabitants, in the sense of a 'more-than-human geography of field science' proposed by Isla Forsyth (2013), allows us to take into account sometimes invisible but highly meaningful relationships that exist in the field.



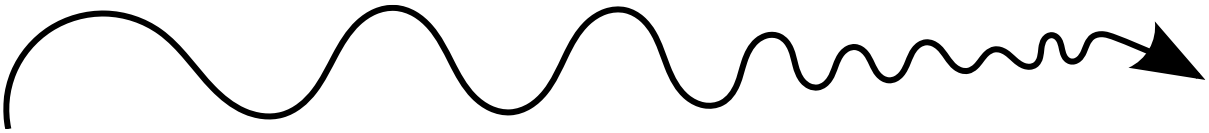
2. Field sites are not just places; they are also modes of representation and valuation for researchers. Throughout this thesis, I have demonstrated that transforming seabird colonies into field sites involves their appropriation as scientific **territories**. In the sense of Despret (2021: 50), this shows that territories are, above all, dynamic modes of producing and giving particular meanings to spaces. Although never fixed, they must appear as indisputably

unclaimable. They are dynamic but often seem fixed, with borders; territories are (im)mobile. For marine ornithologists, turning colonies into territories is a scientific requirement to ensure the sustainability of monitoring, but it also has to do with their modes of relating to colonies. This is clearly emphasised in the description of marking burrows with posts as described in chapter 4, where researchers leave their initials or hobbies on the nests they study – territorialising means leaving a *trace.* Thinking of field sites as territories reveals not only the dynamic of exploitation and land use emphasised by historian Megan Raby (2019). It also underscores the importance of the temporal aspect of scientific work through (im)mobilities, which always faces uncertain futures, especially in light of climate change. Colonies are transformed into territories by researchers and seabirds, faced with the uncertainty of whether they will be able to return the following year.



3. Field sites are also processes, (im)mobilities of researchers and birds unfolding in space as well as time; in this sense, they are constantly changing. Scientific fields, like colonies, are **rhythms**, appropriated and transformed for periods of time. These rhythms can be fast and accelerated, such as the decline of Cooper Islands' guillemots in Alaska, or the retrieval of loggers from gannets in Pauline's Irish site, or even the general expectations for productivity in academia. Fieldwork rhythms can also be slow, extended and contemplative, as required for birdwatching at a distance or access to remote colonies. Rhythms of movements in the field are managed, controlled, produced or endured by researchers, who seek to create conditions of accessibility that allow them to stay with the birds for varying lengths of time, and return year after year. Thus, field sites follow a certain measure of time and space,

produced and experienced by researchers and birds, which accelerates, slows down, expands and compresses.



(Im)mobility thus generates new ways of thinking about the spatiality of scientific knowledge production. Field sites as interweavings, territories and rhythms show that there are fruitful avenues to investigate new 'spatial possibilities' in science through (im)mobility.

In addition to offering new 'spatial possibilities', (im)mobility contributes to highlighting the ongoing work underpinning scientific practices. 'Maintenance and repair studies' approach maintenance as an 'art' (Denis and Pontille 2022), and I also emphasised that it forms part of epistemic cultures, commitments and practices of space and time. From the question of what leads researchers to select certain colonies for seabird studies, I emphasised what motivates them to stay and return to these sites. This analysis also contributes to recent scholarship concerned with the critique of scientific rhythms amid the acceleration of academic expectations toward utilitarian and innovation-driven science (Vostal 2016). Such 'accelerated' science tends to standardise scientific practices and overlooks entire peripheral regions and communities, as noted by Tousignant (2013), calling for consideration of scientific 'broken tempos'. In this context, the efforts by marine ornithologists to maintain the study of seabird colonies warrant further attention, as long-term studies are not generally considered in academic timescapes.

I hope this thesis has demonstrated that the constant focus on innovation and project-based research does not necessarily align with the aspirations and practices of marine ornithologists. I have shown that, even when new sites are created, the concern for maintaining fieldwork is ubiquitous. Long-term monitoring not only allows for the collection of essential scientific data but also fosters researchers' care and attention towards seabirds. Even in short-term project settings, the long-term temporality is

critical. For example, I showed that SEATRACK operates because researchers have already been negotiating their (im)mobilities to colonies for decades.

However, I do not necessarily intend this thesis as a call for *slow science*[155]. Rather, I argue that both timescapes (Vostal 2021), accelerated and slowed science, could and should be integrated. We should not forget that the decline of bird colonies is not slowing down; it is even accelerating. Bronte Evans Rayward (2025), for instance, notes in her study of ecological research in the Falkland Islands that researchers are putting aside long-term monitoring practices in favour of targeted action for seabird conservation. This indicates that strategies for aligning scientific and ecological rhythms vary among scientific communities. Further research could focus on different epistemic and geographical contexts to understand how field (im)mobilities evolve with, or despite, contemporary scientific constraints and biodiversity collapse. The 'non-human charisma' of specific seabirds (Lorimer 2007, 2014), like the Atlantic puffin, certainly shapes whether scientists and the general public care for their conservation; at least as these birds often become sentinel species (Lescroël et al. 2016) for the protection of larger environments. What might happen then, when the puffin population would disappear?[156] In addition, recent avian influenza outbreaks have decimated several seabird colonies in Europe in 2022-2023 and appeared for the first time in the Antarctic and subantarctic regions, highly threatening already fragile marine ecosystems (Dias et al. 2019; Boulinier 2023; Dewar et al. 2023). Although these have greatly impacted field seasons and research practices, even closing access to some colonies, this is an aspect I have not extensively covered in this thesis and could be the subject of future focused studies.

Thus, while I have demonstrated throughout this thesis the value of viewing science as produced by (im)mobilities, repetitions and stability in space and time, and emphasised the maintenance and long-term work of researchers against academic pressure for productivity; the future of seabirds could not be more uncertain.

[155] Emerged around 2010, the Slow Science movement promotes a vision of science as a slow and steady process, which should not be expected to produce immediate results. It defends alternative modes of science under the acceleration of social times and argues that a slower science is, in fact, a better science. Isabelle Stengers notably argues that a 'slowing-down' of science is a task scientists must engage with as part of their social responsibility (Stengers 2011b)

[156] Fayet et al. (2021), in addition to being an inspiring material to discuss the selection of field sites (Chapter 4), demonstrate the worrying trends of Atlantic puffin population declines.

Epilogue – leaving and coming back

Figure 29. View over the Vestmann archipelago from Elliðaey (07.08.2025)

Strangely, I am ending this thesis by returning to one of my field sites. Going back to Elliðaey, Iceland, in parallel to almost submitting this thesis – a document, but mostly, several years of my life – places me in a hybrid position of closing and opening up to new investigations.

Over the summer of 2024 – during which I joined twice the monitoring of several seabird populations in the Vestmann archipelago with Erpur Snær Hansen and Stephen Hurling – I got into contact with Jessica Bishopp, a documentary filmmaker based in London. She had already directed an award-winning documentary[157] on the rescue of 'pufflings', about baby puffins which, leaving their nests, follow the urban lighting of Heimaey, Vestmann and crash onto the buildings instead of wandering out at sea. Following a group of local teenagers who rescue these puffins and bring them to sea, she interrogates the interweaving of pufflings, trying to leave the colony, and young residents, wondering if their lives reside on this remote island in Iceland or if they should move overseas. Thus, in a way, this documentary also deals with making sense of (im)mobilities.

[157] '*Puffling'*, directed by Jessica Bishopp, 2023. Film available via: https://www.newyorker.com/culture/the-new-yorker-documentary/preparing-to-fly-in-puffling.

After this first documentary on puffling rescue, Bishopp sought to direct another documentary, this time following other groups of people in the Vestmann who care for seabirds. She got in touch with Erpur, as we were about to conduct the 'puffin rally' in June 2024, who then introduced me as a member of the field team. When Bishopp found out I was not actually an ornithologist but rather, like her, 'an observer' and somehow 'story-teller', she insisted I participate in the documentary too. The documentary will observe me observing those who observe seabirds. After several disruptions over the summer of 2024, preventing her from filming when I was conducting my ethnographic fieldwork, Bishopp encouraged me to come back in the first week of August 2025, just as I was putting an end to this thesis. This means I am, too, regenerating my field site, coming back to Elliðaey.

Returning to the field as I am concluding this work, interestingly, forces me to look at patterns instead of new information. What remained? Some members of the field team have changed, but some people, such as Erpur, Stephen or Valeria, have stayed or rather, *returned*. The birds, too, have returned. Those captured last year and equipped with geolocators have returned and need to be captured again. Just like last year, during the week I spent on the Vestmann Islands, we can only access Elliðaey for one day. The weather conditions constantly shift, but their unpredictability never changes. Even though I have done it before, I am worried again about the jump ahead of me to access the island. Indeed, to access Elliðaey, we all need to jump between the small inflatable boat and the slippery rocks, gripping a rope before climbing the cliff that leads to the burrows.

The island thus seems unchanged, although I know that some of the birds inhabiting it have changed; some have returned, others have arrived, and others have been lost at sea or have abandoned breeding. Our mission that day on Elliðaey is to return to some of the Leach's storm petrel nests that the team is tracking – under the scrutiny of the film crew – to check if the right bird has returned and, crucially, is still equipped with a geolocator. With male and female petrel recordings, the team checks for the birds' presence, listening to see if they respond to calls which they believe are from a foreign bird. That day, none of the birds the team wanted to recover responded, frustrating Stephen. Most nests seem unoccupied, indicating the bird has either abandoned the breeding season or died at sea. Only one burrow responds, but it is the partner. To find

the right bird, the team will need to return at the right time again, which depends solely on the weather allowing them to access the island. Hopefully, this will coincide with the bird's rhythm at the colony.

We spend the rest of the day locating accessible nests to equip new birds, which will be revisited next year. I feel like I am part of a rhythm, renewing yet inexorably changing. The colony's monitoring depends on the birds' (im)mobility; they must return, though many will not. It also depends on the researchers' (im)mobility, while they are unsure whether they can return next year. Stephen's doctoral contract has ended, and he does not know how he will return. Yet, he already has the next field season in mind and how he will retrieve the equipped bird.

At 5 pm, we need to leave the island as the wind is expected to intensify. At the same time, the local family, practising puffin hunting and hosting their children from the capital for the holidays, is also waiting for their boat captain. However, due to the waves and tide, both captains refuse to risk bringing us on board, and we all spend the night together – researchers, hunters, filming crew, and children – in 'the loneliest house in the world'. The following day, before the boat tries to pick us up again, Stephen suggests trying once more to visit that one petrel burrow where he hopes to retrieve a geolocator from. Under the watchful eye of the cameras, he finally retrieves his first bird of the season, hoping it will reveal its migratory path along the African coast. Despite the inconvenience of an unexpected night on the island, we all feel it was all worth it; simply because that bird had returned too.

Back now in front of my computer, telling this story, I reflect on how much seabird fieldwork is made of (im)mobilities. The field has both changed and remained; the birds have left and returned; so have the researchers; and me. Beyond the scientific reasons I have discussed throughout this thesis to explain why marine ornithologists seek to maintain their field sites, I realise now that there might be a motivation I have underestimated. Leaving Elliðaey again, I cannot help but think of when and how I will come back to a seabird colony.

Figure 30. Puffins on Elliðaey (26.08.2024)

Bibliography

Ackers, Louise. 2008. 'Internationalisation, Mobility and Metrics: A New Form of Indirect Discrimination?' *Minerva* 46(4): 411–35.

Adey, Peter. 2006. 'If Mobility Is Everything Then It Is Nothing: Towards a Relational Politics of (Im)Mobilities'. *Mobilities* 1(1): 75–94.

————. 2017. *Mobility*. 2nd ed. Routledge.

Adler, Antony. 2014. 'The Ship as Laboratory: Making Space for Field Science at Sea'. *Journal of the History of Biology* 47(3): 333–62.

Agar, Jon. 2006. 'What Difference Did Computers Make?' *Social Studies of Science* 36(6): 869–907.

Ahmed, Sara. 2004. *The Cultural Politics of Emotion*. Edinburgh University Press.

Allen, David Elliston. 1994. *The Naturalist in Britain: A Social History*. Princeton University Press.

Allison, Paul D., and J. Scott Long. 1987. 'Interuniversity Mobility of Academic Scientists'. *American Sociological Review* 52(5): 643.

Alcayna-Stevens, Lys. 2016. 'Habituating Field Scientists'*. Social Studies of Science* 46(6): 833–53.

Amélineau, F., B. Merkel, A. Tarroux, S. Descamps, T. Anker-Nilssen, O. Bjørnstad, Vs Bråthen, O. Chastel, S. Christensen-Dalsgaard, J. Danielsen, F. Daunt, N. Dehnhard, M. Ekker, Ke Erikstad, A. Ezhov, P. Fauchald, M. Gavrilo, Gt Hallgrimsson, Es Hansen, Mp Harris, M. Helberg, Hh Helgason, Mk Johansen, Je Jónsson, Y. Kolbeinsson, Y. Krasnov, M. Langset, Sh Lorentsen, E. Lorentzen, Mv Melnikov, B. Moe, Ma Newell, B. Olsen, T. Reiertsen, Gh Systad, P. Thompson, Tl Thórarinsson, E. Tolmacheva, S. Wanless, K. Wojczulanis-Jakubas, J. Åström, and H. Strøm. 2021. 'Six Pelagic Seabird Species of the North Atlantic Engage in a Fly-and-Forage Strategy during Their Migratory Movements'. *Marine Ecology Progress Series* 676: 127–44.

Andersen, Casper, Jakob Bek-Thomsen, and Peter C. Kjærgaard. 2012. 'The Money Trail: A New Historiography for Networks, Patronage, and Scientific Careers'. *Isis* 103(2): 310–15.

Anderson, Ben. 2009. 'Affective Atmospheres'. *Emotion, Space and Society* 2(2): 77–81.

Aronova, Elena, Karen S. Baker, and Naomi Oreskes. 2010. 'Big Science and Big Data in Biology: From the International Geophysical Year through the International Biological Program to the Long Term Ecological Research (LTER) Network, 1957–Present'. *Historical Studies in the Natural Sciences* 40(2): 183–224.

Aronova, Elena. 2015. 'Environmental Monitoring in the Making: From Surveying Nature's Resources to Monitoring Nature's Change'. *Historical Social Research* 40(2): 222–45.

Arpin, Isabelle, and Céline Granjou. 2015. 'The Right Time for the Job? Insights into Practices of Time in Contemporary Field Sciences'. *Science in Context* 28(2): 237–58.

Asase, Alex, Tiwonge I. Mzumara-Gawa, Jesse O. Owino, Andrew T. Peterson, and Erin Saupe. 2022. 'Replacing "Parachute Science" with "Global Science" in Ecology and Conservation Biology'. *Conservation Science and Practice* 4(5): e517.

Aubin, David. 2009. 'The Hotel That Became an Observatory: Mount Faulhorn as Singularity, Microcosm, and Macro-Tool'. *Science in Context* 22(3): 365–86.

Azoulay, Pierre, Ina Ganguli, and Joshua Graff Zivin. 2017. 'The Mobility of Elite Life Scientists: Professional and Personal Determinants'. *Research Policy* 46(3): 573–90.

Balaban, Corina. 2018. 'Mobility as Homelessness: The Uprooted Lives of Early Career Researchers'. *Learning and Teaching: The International Journal of Higher Education in the Social Sciences* 11(2): 30–50.

Barbalet, Jack. 2002. 'Science and Emotions'. *The Sociological Review* 50: 132–50.

Barrier, Julien. 2011. 'La science en projets : financements sur projet, autonomie professionnelle et transformations du travail des chercheurs académiques'. *Sociologie du travail* 53(4): 515–36

Barrow, Mark. 1998. *A Passion for Birds. American Ornithology after Audubon*. Princeton University Press.

Barry, Kaya, and Benjamin Lucca Iaquinto. 2023. 'Hostel Frictions: Backpackers Living under Lockdown'. *Mobilities* 18(1): 37–53

Barwell, Graham. 2014. *Albatross*. Reaktion Books.

Beaulieu, Anne. 2010. 'Research Note: From Co-Location to Co-Presence: Shifts in the Use of Ethnography for the Study of Knowledge'. *Social Studies of Science* 40(3): 453–70.

Benson, Etienne S. 2010. *Wired Wilderness: Technologies of Tracking and the Making of Modern Wildlife*. John Hopkins University Press.

————–. 2012. 'One Infrastructure, Many Global Visions: The Commercialization and Diversification of Argos, a Satellite-Based Environmental Surveillance System'. *Social Studies of Science* 42(6): 843–68.

————–. 2016a. 'Movement Ecology and the Minimal Animal'. *LA Simulation* (4): 30–33.

————–. 2016b. 'Naming the Ethological Subject'. *Science in Context* 29(1): 107–28.

————. 2016c. ‘Trackable Life: Data, Sequence, and Organism in Movement Ecology’. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 57: 137–47.

————. 2022. ‘The Post-Heroic Field’. *Isis* 113(1): 114–20.

Bergman, Charles. 2005. ‘Inventing a Beast with No Body: Radio-Telemetry, the Marginalization of Animals, and the Simulation of Ecology’. *Worldviews* 9(2): 255–70.

Bernard, Alice, Ana S. L. Rodrigues, Victor Cazalis, and David Grémillet. 2021. ‘Toward a Global Strategy for Seabird Tracking’. *Conservation Letters* 14(3): e12804.

Besse, Jean-Marc, Pascal Clerc, and Marie-Claire Robic. 2017. ‘Qu’est-ce que le « spatial turn » ?’. *Revue d’histoire des sciences humaines* (30): 207–38.

Birkhead, Tim. 2010. *Great Auk Islands; a Field Biologist in the Arctic*. Bloomsbury.

————. 2014. ‘Stormy Outlook for Long-Term Ecology Studies’. *Nature* 514(7523): 405.

Birkhead, Tim, Jo Wimpenny, and Bob Montgomerie. 2014. *Ten Thousand Birds. Ornithology since Darwin*. Princeton University Press.

Bissell, David. 2007. ‘Animating Suspension: Waiting for Mobilities’. *Mobilities* 2(2): 277–98.

Bissell, David, and Gillian Fuller, eds. 2011. *Stillness in a Mobile World*. Routledge.

Blair, James J. A. 2022. ‘Tracking Penguins, Sensing Petroleum: “Data Gaps” and the Politics of Marine Ecology in the South Atlantic’. *Environment and Planning E: Nature and Space* 5(1): 60–80.

Bocco, Gerardo. 2016. ‘Remoteness and Remote Places. A Geographic Perspective’. *Geoforum* 77: 178–81.

Bocking, Stephen. 2012. ‘Science, Salmon, and Sea Lice: Constructing Practice and Place in an Environmental Controversy’. *Journal of the History of Biology* 45(4): 681–716.

Bonta, Mark. 2010. ‘Ornithophilia: Thoughts on Geography in Birding’. *Geographical Review* 100(2): 139–51.

Börger, Luca, Allert I. Bijleveld, Annette L. Fayet, Gabriel E. Machovsky-Capuska, Samantha C. Patrick, Garrett M. Street, and Eric Vander Wal. 2020. ‘Biologging Special Feature’. *Journal of Animal Ecology* 89(1): 6–15.

Boulinier, Thierry. 2023. ‘Avian Influenza Spread and Seabird Movements between Colonies’. *Trends in Ecology & Evolution* 38(5): 391–95.

Bourdieu, Pierre. 1984. *Homo academicus*. Éditions de Minuit.

Bourguet, Marie Noëlle, Christian Licoppe, and H. Otto Sibum, eds. 2003. *Instruments, Travel and Science: Itineraries of Precision from the Seventeenth to the Twentieth Century*. Routledge.

Bourlessas, Panos. 2018. '"These People Should Not Rest": Mobilities and Frictions of the Homeless Geographies in Athens City Centre'. *Mobilities* 13(5): 746–60.

Brooke, Michael. 2018. *Far from Land*. Princeton University Press.

Brosius, J. Peter, and Lisa M. Campbell. 2010. 'Collaborative Event Ethnography: Conservation and Development Trade-Offs at the Fourth World Conservation Congress'. *Conservation and Society* 8(4): 245.

Brunet, Lucas. 2025. 'Mapping for Mapping's Sake? Ecosystems Services Maps and the Modes of (Ir)Relevance of Ecological Knowledge for Nature Conservation'. *Minerva* 63: 231–55.

Burke, Peter. 2000. *A Social History of Knowledge: From Gutenberg to Diderot*. Polity Press.

Bustnes, J. O., K. E. Erikstad, V. Bakken, F. Mehlum, and J. U. Skaare. 2000. 'Feeding Ecology and the Concentration of Organochlorines in Glaucous Gulls'. *Ecotoxicology* 9(3): 179–86.

Calbérac, Yann. 2010. 'Terrains de géographes, géographes de terrain. Communauté et imaginaire disciplinaires au miroir des pratiques de terrain des géographes français du XXe siècle'. Université Lumière - Lyon II

———. 2015. 'Le terrain : la fin d'un grand récit ?' *Bulletin de l'association de géographes français* 92(1): 84–94.

Calkins, Sandra. 2020. 'Lab Hands and Knowing Toxic Substances in Uganda'. *Anthropology Today* 36(6): 29–32.

Callon, Michel. 1984. 'Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay'. *The Sociological Review* 32: 196–233.

Calvert, Jane. 2024. *A Place for Science and Technology Studies: Observation, Intervention, and Collaboration*. MIT Press.

Camerini, Jane R. 1996. 'Wallace in the Field'. *Osiris* 11: 44–65.

Candea, Matei. 2010. '"I Fell in Love with Carlos the Meerkat": Engagement and Detachment in Human–Animal Relations'. *American Ethnologist* 37(2): 241–58.

Ceballos, Gerardo, Paul R. Ehrlich, Anthony D. Barnosky, Andrés García, Robert M. Pringle, and Todd M. Palmer. 2015. 'Accelerated Modern Human–Induced Species Losses: Entering the Sixth Mass Extinction'. *Science Advances* 1(5): e1400253.

Chansigaud, Valérie. 2012. *Des Hommes et Des Oiseaux*. Delachaux et Niestlé.

———. 2014. *Histoire de l'ornithologie*. Delachaux et Niestlé.

Clairbaux, Manon, Mia Rönkä, Tycho Anker-Nilssen, Yuri Artukhin, Jóhannis Danielsen, Maria Gavrilo, Grant Gilchrist, Erpur Snær Hansen, April Hedd, Robert Kaler, Kathy Kuletz, Bergur Olsen, Mark L. Mallory, Flemming Ravn Merkel, Hallvard Strøm, Jérôme Fort, and David Grémillet. 2024. 'An Ecologically Sound and Participatory Monitoring Network for Pan-Arctic Seabirds'. *Conservation Biology* 38(6): e14287.

Clark, Tom, Liam Foster, Luke Sloan, and Alan Bryman. 2021. *Bryman's Social Research Methods. Sixth Edition*. Oxford University Press.

Clifford, James. 1977. '10. Spatial Practices: Fieldwork, Travel, and the Disciplining of Anthropology'. Pp. 185–222 in *Anthropological Locations: Boundaries and Grounds of a Field Science*, edited by A. Gupta, and J. Ferguson. University of California Press.

————. 1986. 'Introduction: Partial Truths'. Pp. 1–26 in *Writing Culture*, edited by J. Clifford and G. E. Marcus. University of California Press

Collins, H. M., and Robert Evans. 2002. 'The Third Wave of Science Studies: Studies of Expertise and Experience'. *Social Studies of Science* 32(2): 235–96.

Commenges, Hadrien. 2024. 'L'usage Des Modèles Pour l'aménagement'. Habilitation à Diriger des Recherches, Université Paris 1 Panthéon-Sorbonne.

Crang, Mike. 2002. 'Qualitative Methods: The New Orthodoxy?'. *Progress in Human Geography* 26(5): 647–55.

Cohn, Marisa Leavitt. 2016. 'Convivial Decay: Entangled Lifetimes in a Geriatric Infrastructure'. Pp. 1511–23 in *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. San Francisco California, USA: ACM.

Cresswell, Tim. 1996. *In Place/out of Place: Geography, Ideology, and Transgression*. University of Minnesota Press.

————. 2006. *On the Move: Mobility in the Modern Western World*. Routledge.

————. 2010. 'Towards a Politics of Mobility'. *Environment and Planning D: Society and Space* 28(1): 17–31.

————. 2011. 'Mobilities I: Catching Up'. *Progress in Human Geography* 35(4): 550–58.

————. 2012. 'Mobilities II: Still'. *Progress in Human Geography* 36(5): 645–53.

————. 2014. *Place: An Introduction*. Wiley-Blackwell.

Crutzen, Paul J., and Eugene F. Stoermer. 2013. "The 'Anthropocene"'. Pp. 479–90 in *The Future of Nature: Documents of Global Change*, edited by L. Robin, S. Sörlin, and P. Warde. Yale University Press.

Daston, Lorraine. 2004. 'Are You Having Fun Today?' *London Review of Books*, September 23.

————. 2012. 'The Sciences of the Archive'. *Osiris* 27(1): 156–87.

Davies, Sarah R. 2021. 'Atmospheres of Science: Experiencing Scientific Mobility'. *Social Studies of Science* 51(2): 214–32.

Davies, Sarah R., and Bao-Chau Pham. 2022. 'Luck and the "Situations" of Research'. *Social Studies of Science* 53(2): 287-99.

De Bont, Raf. 2009. 'Between the Laboratory and the Deep Blue Sea: Space Issues in the Marine Stations of Naples and Wimereux'. *Social Studies of Science* 39(2): 199–227.

———. 2015a. 'Chap 7 - Rossitten. Moving Birds'. In *Stations in the Field: A History of Place-Based Animal Research, 1870-1930*. University of Chicago Press.

———. 2015b. *Stations in the Field: A History of Place-Based Animal Research, 1870-1930*. University of Chicago Press.

De Bont, Raf, and Jens Lachmund, eds. 2017. *Spatializing the History of Ecology: Sites, Journeys, Mappings*. Routledge.

Denis, Jérôme, and David Pontille. 2015. 'Material Ordering and the Care of Things'. *Science, Technology, & Human Values* 40(3): 338–67.

Denis, Jérôme, and David Pontille. 2022. *Le soin des choses. Politiques de la maintenance*. La Découverte.

Despret, Vinciane. 2004. 'The Body We Care for: Figures of Anthropo-Zoo-Genesis'. *Body & Society* 10(2–3): 111–34.

———. 2013. 'Responding Bodies and Partial Affinities in Human–Animal Worlds'. *Theory, Culture & Society* 30(7–8): 51–76.

———. 2016. *What Would Animals Say If We Asked the Right Questions?*. University of Minnesota Press.

———. 2021. *Living as a Bird*. John Wiley & Sons.

De Vos, Asha, and Mark W. Schwartz. 2022. 'Confronting Parachute Science in Conservation'. *Conservation Science and Practice* 4(5): e12681.

Dewar, Meagan, Michelle Wille, Amandine Gamble, Ralph E. T. Vanstreels, Thierry Bouliner, Adrian Smith, Arvind Varsani, Norman Ratcliffe, Jennifer Black, Amanda Lynnes, Andrés Barbosa, and Tom Hart. 2023. 'The Risk of Highly Pathogenic Avian Influenza in the Southern Ocean: A Practical Guide for Operators and Scientists Interacting with Wildlife'. *Antarctic Science* 35(6): 407–14.

Dias, Maria P., Rob Martin, Elizabeth J. Pearmain, Ian J. Burfield, Cleo Small, Richard A. Phillips, Oliver Yates, Ben Lascelles, Pablo Garcia Borboroglu, and John P. Croxall. 2019. 'Threats to Seabirds: A Global Assessment'. *Biological Conservation* 237: 525–37.

Dijstelbloem, Huub. 2023. 'Moving the Immovable: Climate Change and the Multiple Tensions between Mobility and Immobility'. *Tecnoscienza – Italian Journal of Science & Technology Studies* 14(2): 51–68.

Dritsas, Lawrence. 2005. 'From Lake Nyassa to Philadelphia: A Geography of the Zambesi Expedition, 1858–64'. *The British Journal for the History of Science* 38(1): 35–52.

Driver, Felix. 1994. '"Making Space: Territorial Themes in the History of Science", a Conference Organized by the British Society for the History of Science, Held at the University of Kent, Canterbury, 28-30 March 1994'. *Ecumene* 1(4): 386–90.

————. 2000. 'Editorial: Field-Work in Geography'. *Transactions of the Institute of British Geographers* 25(3): 267–68.

Dubiau, Antoine, and Nicolas Szende. 2023. 'Triplicité, Trialectique, Trilogie ? Circulations Internationales de La Triade Lefebvrienne Dans Le Champ Académique'. in *La production de l'espace au XXIe siècle - Luttes de pouvoir, pouvoir des luttes*. Réseau International d'études sur la production de l'espace.

Dumoulin Kervran, David, Jérôme Lamy, and Jan Verlin. 2024. 'Outposts of Science: Placing Scientific Infrastructures at the Margins of French (Post)Colonial Territories'. *Science as Culture* 34(2): 137-167.

Dubois, Philippe J. 2019. *Mais Ornithologue C'est Pas Un Métier ! Voyage Au Pays Des Fous d'oiseaux*. Delachaux et Niestlé.

Eckert, Denis, Michel Grossetti, Laurent Jégou, and Marion Maisonobe. 2014. 'Les Villes de La Science Dans Le Monde'. M@*ppemonde* 4(116).

Edgerton, David. 2006. *The Shock of the Old. Technology and Global History since 1900*. Profile Books.

Edwards, Paul N. 2006. 'Meteorology as Infrastructural Globalism'. *Osiris* 21(1): 229–50

————. 2010. *A Vast Machine. Computer Models, Climate Data, and the Politics of Global Warming*. MIT Press.

Ekerholm, Helena. 2015. 'Keeping a House for Science: Sofia Kristensson as Matriarch and Gatekeeper at Kristineberg Zoological Station as a Scientific Household, 1877–1889'. *Science in Context* 28(4): 587–611.

Elliott, Anthony, and John Urry. 2010. *Mobile Lives*. Routledge

Ellis, Rebecca. 2011. 'Jizz and the Joy of Pattern Recognition: Virtuosity, Discipline and the Agency of Insight in UK Naturalists' Arts of Seeing'. *Social Studies of Science* 41(6): 769–90.

Eren, Selen, and Anne Beaulieu. 2023. 'Between a Bird-in-the-Hand and Species Data in the Bank: Intermittent Care in Conservation Science'. *Theory, Culture & Society* 42(1): 69-87.

Evans Rayward, Bronte. 2025. '"Walk the Perimeter" – Stories of Place in the Falkland Islands'. Presented at the PHaSS seminar series, May 29, Cambridge, United Kingdom.

Ezequiel, Sosiuk, and Emiliano Martín Valdez. 2021. 'Penser des épistémologies depuis le terrain'. *Revue d'anthropologie des connaissances* 15(2). doi:10.4000/rac.23144.

Faugère, Elsa. 2019. *Le Making-of des grandes expéditions. Anthropologie des sciences de terrain*. Les Éditions La Discussion.

Fayet, Annette L., Dave Boyle, Robin Freeman, Akiko Shoji, Chris M. Perrins, and Tim Guilford. 2013. 'Tracking the Migration of Atlantic Puffins on Skomer Island'. *Birds in Wales* 10(1): 48–57.

Fayet, Annette L., Gemma V. Clucas, Tycho Anker-Nilssen, Martyna Syposz, and Erpur S. Hansen. 2021. 'Local Prey Shortages Drive Foraging Costs and Breeding Success in a Declining Seabird, the Atlantic Puffin'. *Journal of Animal Ecology* 90(5): 1152–64.

Fernandez, Mégane. forthcoming. 'Les Terrains de La Recherche Sur Projet. Dimensions Structurelles, Collectives et Individuelles de La Localisation Des Terrains de Recherche'. Doctoral thesis. Université Paris 1 Panthéon-Sorbonne.

Fish, Adam. 2022. 'Saildrones and Snotbots in the Blue Anthropocene: Sensing Technologies, Multispecies Intimacies, and Scientific Storying'. *Environment and Planning D: Society and Space* 40(5): 862–80.

Flanagan, Kieron. 2015. 'International Mobility of Scientists'. Pp. 364–81 in *The Handbook of Global Science, Technology, and Innovation*. John Wiley & Sons, Ltd.

Fochler, Maximilian. 2016. 'Variants of Epistemic Capitalism: Knowledge Production and the Accumulation of Worth in Commercial Biotechnology and the Academic Life Sciences'. *Science, Technology, & Human Values* 41(5): 922–48.

Forsyth, Isla. 2013. 'The More-than-Human Geographies of Field Science'. *Geography Compass* 7(8): 527–39.

Foucault, Michel. 1980. *Power/Knowledge: Selected Interviews and Other Writings, 1972-1977*. Knopf Doubleday Publishing Group.

———. 2004. *The Birth of Biopolitics: Lectures at the Collège de France, 1978-1979*. Palgrave Macmillan UK.

Framsenteret, 2018. 'Meet the puffin man'. URL: https://framsenteret.no/meet-the-puffin-man/.

Franssen, Thomas, Wout Scholten, Laurens K. Hessels, and Sarah de Rijcke. 2018. 'The Drawbacks of Project Funding for Epistemic Innovation: Comparing Institutional Affordances and Constraints of Different Types of Research Funding'. *Minerva* 56(1): 11–33.

Friese, Carrie. 2019. 'Intimate Entanglements in the Animal House: Caring for and about Mice'. *The Sociological Review* 67(2): 287–98.

Fujimura, Joan H. 1987. 'Constructing `Do-Able' Problems in Cancer Research: Articulating Alignment'. *Social Studies of Science* 17(2): 257–93.

———. 1996. *Crafting Science: A Sociohistory of the Quest for the Genetics of Cancer*. Harvard University Press.

Gabillet, M., Isabelle Arpin, and A. C. Prévot. 2020. 'Between Hope and Boredom: Attending to Long-Term Related Emotions in Participatory Environmental Monitoring Programmes'. *Biological Conservation* 246: 108594.

Gabrys, Jennifer. 2016. *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet*. University of Minnesota Press.

————. 2019. 'Sensors and Sensing Practices: Reworking Experience across Entities, Environments, and Technologies'. *Science, Technology, & Human Values* 44(5): 723–36.

————. 2020. 'Smart Forests and Data Practices: From the Internet of Trees to Planetary Governance'. *Big Data & Society* 7(1): 2053951720904871.

————. 2022. 'The Forest That Walks: Digital Fieldwork and Distributions of Site'. *Qualitative Inquiry* 28(2): 228–35.

Galison, Peter, and Emily Thompson. 1999. *The Architecture of Science*. MIT Press.

Garlick, Ben. 2019. 'Deceptive Landscapes: Ornithological Hide Work and the Perception of Ospreys on Speyside, 1957–1987'. *GeoHumanities* 5(1): 215–36.

Gieryn, Thomas F. 1983. 'Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists'. *American Sociological Review* 48(6): 781–95.

————. 2002. 'Three Truth-Spots'. *Journal of the History of the Behavioral Sciences* 38(2): 113–32.

————. 2000. 'A Space for Place in Sociology'. *Annual Review of Sociology* 26: 463.

————. 2006. 'City as Truth-Spot: Laboratories and Field-Sites in Urban Studies'. *Social Studies of Science* 36(1): 5–38.

————. 2018. *Truth-Spots: How Places Make People Believe*. University of Chicago Press.

Gläser, J., G. Laudel, S. Hinze, and Linda Butler. 2002. 'Impact of Evaluation-Based Funding on the Production of Scientific Knowledge: What to Worry about, and How to Find out'. *Expertise for the German Ministry for Education and Research*.

Glückler, Johannes, Emmanuel Lazega, and Ingmar Hammer, eds. 2017. *Knowledge and Networks. Vol. 11. Knowledge and Space*. Springer International Publishing.

Golinski, Jan. 2005. *Making Natural Knowledge. Constructivism and the History of Science*. The University of Chicago Press.

Gramaglia, Christelle. 2002. 'Humains et goélands: interactions et conflits de proximité en Languedoc-Roussillon'. *Espaces et sociétés* n°110-111(3): 167–88.

Granjou, Céline, Isabelle Mauz, and Michel Daccache. 2013. 'Les conditions de l'articulation entre recherche et expertise'. *Revue d'anthropologie des connaissances* 7(1). https://journals.openedition.org/rac/7801.

Greenhough, Beth. 2006. 'Tales of an Island-Laboratory: Defining the Field in Geography and Science Studies'. *Transactions of the Institute of British Geographers* 31(2): 224–37.

————. 2007. ‘Situated Knowledges and the Spaces of Consent’. *Geoforum* 38(6): 1140–51.

Greer, Kirsten. 2008. ‘Placing Colonial Ornithology: Imperial Ambiguities in Upper Canada, 1791- 1841’. Scientia Canadensis : Canadian Journal of the History of Science, Technology and Medicine / Scientia Canadensis : *Revue Canadienne d’histoire Des Sciences, Des Techniques et de La Médecine* 31(1–2): 85–112.

————. 2009. ‘Ornithology on “The Rock”: Territory, Fieldwork, and the Body in the Straits of Gibraltar in the Mid-Nineteenth Century’. *Historical Geography* 37: 26–52.

Gregory, Derek. 1994. *Geographical Imaginations*. Blackwell.

Grémillet, David. 2015. ‘Let There Be Light - My Personal Account of How Rory P. Wilson Invented Seabird Geolocation’. doi:10.13140/RG.2.1.1731.9123.

————. 2016. ‘On the Advent of GPS-Tracking in Ornithology’. URL: https://www.researchgate.net/publication/304062396_On_the_advent_of_GPS-tracking_in_Ornithology

————. 2021. *Les Manchots de Mandela et Autres Récits Océaniques*. Actes Sud.

Guasco, Anna. 2022. ‘On an Ethic of Not Going There’. *The Geographical Journal* 188(3): 468–75.

Guggenheim, Michael. 2016. ‘Im/Mutable Im/Mobiles: From the Socio-Materiality of Cities towards a Differential Cosmopolitics’. In *Urban Cosmopolitics. Agencements, assemblies, atmospheres*, edited by A. Block, and I. Farías. Routledge.

Guilford, Tim, Robin Freeman, Dave Boyle, Ben Dean, Holly Kirk, Richard Phillips, and Chris Perrins. 2011. ‘A Dispersive Migration in the Atlantic Puffin and Its Implications for Migratory Navigation’. *PLOS ONE* 6(7): e21336

Geissler, P. Wenzel, and Ann H. Kelly. 2016. ‘A Home for Science: The Life and Times of Tropical and Polar Field Stations’. *Social Studies of Science* 46(6): 797–808.

Gläser, Jochen, and Grit Laudel. 2016. ‘Governing Science: How Science Policy Shapes Research Content’. *European Journal of Sociology / Archives Européennes de Sociologie / Europäisches Archiv Für Soziologie* 57(1): 117–68.

Hackett, Edward J. 2014. ‘Academic Capitalism’. *Science, Technology, & Human Values* 39(5): 635–38.

Hannam, Kevin, Mimi Sheller, and John Urry. 2006. ‘Editorial: Mobilities, Immobilities and Moorings’. *Mobilities* 1(1): 1–22.

Hansen, Erpur, and Rodrigo Martinez Catalan. 2024. *STOFNVÖKTUN LUNDA 2023 Áfangaskýrsla Til Umhverfisstofnunar*.

Haraway, Donna. 1988. ‘Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective’. *Feminist Studies* 14(3): 575–99.

Hartman Davies, Oscar. 2024. ‘Ocean Sentinels: Seabirds and the Lively Governance of Marine Ecologies’. Doctoral thesis. Oxford University.

Harvey, David. 1989. *The Condition of Postmodernity: An Enquiry Into the Origins of Cultural Change*. Blackwell.

———. 2006. ‘Space as a Keyword’. Pp. 70–93 in *David Harvey: A Critical Reader*, edited by N. Castree, and D. Gregory. John Wiley & Sons, Ltd.

Head, Lesley, and Theresa Harada. 2017. ‘Keeping the Heart a Long Way from the Brain: The Emotional Labour of Climate Scientists’. *Emotion, Space and Society* 24: 34–41.

Hebblewhite, Mark, and Daniel T. Haydon. 2010. ‘Distinguishing Technology from Biology: A Critical Review of the Use of GPS Telemetry Data in Ecology’. *Philosophical Transactions of the Royal Society B: Biological Sciences* 365(1550): 2303–12.

Heggie, Vanessa. 2016. ‘Higher and Colder: The Success and Failure of Boundaries in High Altitude and Antarctic Research Stations’. *Social Studies of Science* 46(6): 809–32.

Henke, Christopher, and Thomas F. Gieryn. 2008. ‘Sites of Scientific Practice: The Enduring Importance of Place’. In *The Handbook of Science and Technology Studies, Third Edition*, edited by E. J. Hackett, O. Amsterdamska, M. E. Lynch, and J. Wajcman. MIT Press.

Hennessy, Elizabeth. 2018. ‘The Politics of a Natural Laboratory: Claiming Territory and Governing Life in the Galápagos Islands’. *Social Studies of Science* 48(4): 483–506.

Hinchliffe, S. J. 2016. *Sensory Biopolitics: Knowing Birds and a Politics of Life*. Routledge.

Hine, Christine. 2007. ‘Multi-Sited Ethnography as a Middle Range Methodology for Contemporary STS’. *Science, Technology, & Human Values* 32(6): 652–71.

Hirsch, Shana L. 2020. ‘Anticipatory Practices: Shifting Baselines and Environmental Imaginaries of Ecological Restoration in the Columbia River Basin’. *Environment and Planning E: Nature and Space* 3(1): 40–57.

Hirsch, Shana L., David Ribes, and Sarah Inman. 2022. ‘Sedimentary Legacy and the Disturbing Recurrence of the Human in Long-Term Ecological Research’. *Social Studies of Science* 52(4): 561–80.

Hobbie, John E., Stephen R. Carpenter, Nancy B. Grimm, James R. Gosz, and Timothy R. Seastedt. 2003. ‘The US Long Term Ecological Research Program’. *BioScience* 53(1): 21–32.

Hodgetts, Timothy, and Jamie Lorimer. 2020. ‘Animals’ Mobilities’. *Progress in Human Geography* 44(1): 4–26.

Howlett, Marnie. 2022. ‘Looking at the “Field” through a Zoom Lens: Methodological Reflections on Conducting Online Research during a Global Pandemic’. *Qualitative Research* 22(3): 387–402.

Hughes, Brent B., Rodrigo Beas-Luna, Allison K. Barner, Kimberly Brewitt, Daniel R. Brumbaugh, Elizabeth B. Cerny-Chipman, Sarah L. Close, Kyle E. Coblentz, Kristin L. de Nesnera, Sarah T. Drobnitch, Jared D. Figurski, Becky Focht, Maya Friedman, Jan Freiwald, Kristen K. Heady, Walter N. Heady, Annaliese Hettinger, Angela Johnson, Kendra A. Karr, Brenna Mahoney, Monica M. Moritsch, Ann-Marie K. Osterback, Jessica Reimer, Jonathan Robinson, Tully Rohrer, Jeremy M. Rose, Megan Sabal, Leah M. Segui, Chenchen Shen, Jenna Sullivan, Rachel Zuercher, Peter T. Raimondi, Bruce A. Menge, Kirsten Grorud-Colvert, Mark Novak, and Mark H. Carr. 2017. 'Long-Term Studies Contribute Disproportionately to Ecology and Policy'. *BioScience* 67(3): 271–81.

Hunter, Hannah. 2023. 'Listening for the Ivory-Billed Woodpecker: Sonic Geography and the Making of Extinction Knowledge'. *Social Studies of Science* 54(3): 325-351.

Hunter, Hannah, and Adam Searle. 2024. 'Postextinction Geographies: Audiovisual Afterlives of the Bucardo and the Ivory-Billed Woodpecker'. *Annals of the American Association of Geographers* 114(4): 770–91.

Ingold, Tim. 2014. 'That's Enough about Ethnography!' *HAU: Journal of Ethnographic Theory* 4(1): 383–95.

Isaacs, Jenny R. 2019. 'The "Bander's Grip": Reading Zones of Human–Shorebird Contact'. *Environment and Planning E: Nature and Space* 2(4): 732–60.

Isaacs, Jenny R., and Ariel Otruba. 2019. 'Guest Introduction: More-than-Human Contact Zones'. *Environment and Planning E: Nature and Space* 2(4): 697–711.

Joly, Pierre-Benoit. 2015. *Governing Emerging Technologies?: The Need to Think Outside the (Black) Box' in Science and Democracy*. Routledge.

Jouvenet, Morgan. 2022. *Des glaces polaires au climat de la Terre - Enquête sur une aventure scientifique*. CNRS Editions.

Kalshoven, Petra Tjitske. 2018. 'Piecing Together the Extinct Great Auk: Techniques and Charms of Contiguity'. *Environmental Humanities* 10(1): 150–70.

Karasti, Helena, Karen S. Baker, and Florence Millerand. 2010. 'Infrastructure Time: Long-Term Matters in Collaborative Development'. *Computer Supported Cooperative Work (CSCW)* 19(3): 377–415.

Kaufmann, Vincent, Manfred Max Bergman, and Dominique Joye. 2004. 'Motility: Mobility as Capital'. *International Journal of Urban and Regional Research* 28(4): 745–56.

Keen, Sam, Martha Lomeli-Rodriguez, and Helene Joffe. 2022. 'From Challenge to Opportunity: Virtual Qualitative Research During COVID-19 and Beyond'. *International Journal of Qualitative Methods* 21. https://doi.org/10.1177/16094069221105075.

Kim, Terri. 2017. 'Academic Mobility, Transnational Identity Capital, and Stratification under Conditions of Academic Capitalism'. *Higher Education* 73(6): 981–97.

Knorr Cetina, Karin. 1999. *Epistemic Cultures: How the Sciences Make Knowledge*. Harvard University Press.

Kohler, Robert E. 1994. *Lords of the Fly: Drosophila Genetics and the Experimental Life*. University of Chicago Press.

———. 2002a. *Landscapes and Labscapes: Exploring the Lab-Field Border in Biology*. University of Chicago Press.

———. 2002b. 'Place and Practice in Field Biology'. *History of Science* 40(2): 189–210.

———. 2002c. 'Labscapes: Naturalizing the Lab'. *History of Science* 40(4): 473–501.

———. 2011. 'Paul Errington, Aldo Leopold, and Wildlife Ecology: Residential Science'. *Historical Studies in the Natural Sciences* 41(2): 216–54.

———. 2012. 'Practice and Place in Twentieth-Century Field Biology: A Comment'. *Journal of the History of Biology* 45(4): 579–86.

———. 2019. *Inside Science: Stories from the Field in Human and Animal Science*. University of Chicago Press.

Kralj, Jelena, Aurore Ponchon, Daniel Oro, Barbara Amadesi, Juan Arizaga, Nicola Baccetti, Thierry Boulinier, Jacopo G. Cecere, Robin M. Corcoran, Anna-Marie Corman, Leonie Enners, Abram Fleishman, Stefan Garthe, David Grémillet, Ann Harding, José Manuel Igual, Luka Jurinović, Ulrike Kubetzki, Donald E. Lyons, Rachael Orben, Rosana Paredes, Simone Pirrello, Bernard Recorbet, Scott Shaffer, Philipp Schwemmer, Lorenzo Serra, Anouk Spelt, Giacomo Tavecchia, Jill Tengeres, Davorin Tome, Cara Williamson, Shane Windsor, Hillary Young, Marco Zenatello, and Ruben Fijn. 2023. 'Active Breeding Seabirds Prospect Alternative Breeding Colonies'. *Oecologia* 201: 341–54.

Kress, Stephen W. 2015. *Project Puffin. The Improbable Quest to Bring a Beloved Seabird Back to Egg Rock*. Yale University Press.

Kuklick, Henrika, and Robert E. Kohler. 1996. 'Introduction'. *Osiris* 11: 1–14.

Lam, Alice. 2010. 'From "Ivory Tower Traditionalists" to "Entrepreneurial Scientists"?: Academic Scientists in Fuzzy University—Industry Boundaries'. *Social Studies of Science* 40(2): 307–40.

Landrø, Juliet, Signe Christensen-Dalsgaard, Rob T. Barrett, and Tycho Anker-Nilssen. 2024. 'Silent Birdcliffs'. URL: https://storymaps.arcgis.com/stories/09067f325f33407b81f7a60ff608c2d3.

Latour, Bruno. 1983. 'Give Me a Laboratory and I Will Raise the World'. Pp. 141–70 in *Science observed: Perspectives on the social study of science*. SAGE Publications.

———. 1987. *Science in Action: How to Follow Scientists and Engineers through Society*. Open University Press.

———. 1993. 'Portrait d'un Biologiste En Capitaliste Sauvage'. Pp. 100–129 in *Petites leçons de sociologie des sciences*. La Découverte.

———. 1991. *We Have Never Been Modern*. Harvard University Press.

———. 1996. 'On Actor-Network Theory: A Few Clarifications'. *Soziale Welt* 47(4): 369–81.

———. 1999. 'Circulating Reference. Sampling the Soil in the Amazon Forest'. in *Pandora's Hope. Essays on the Reality of Science Studies*. Harvard University Press.

———. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford University Press.

Latour, Bruno, and Steve Woolgar. 1979. L*aboratory Life. The Construction of Scientific Facts*. Princeton University Press.

Laudel, Grit. 2006. 'The Art of Getting Funded: How Scientists Adapt to Their Funding Conditions'. *Science and Public Policy* 33(7): 489–504.

Law, John, and Michael Lynch. 1988. 'Lists, Field Guides, and the Descriptive Organization of Seeing: Birdwatching as an Exemplary Observational Activity'. *Human Studies* 11(2/3): 271–303.

Law, John, and Annemarie Mol. 2001. 'Situating Technoscience: An Inquiry into Spatialities'. *Environment and Planning D: Society and Space* 19(5): 609–21.

Lefebvre, Henri. 1974. *La production de l'espace*. Paris: Editions Anthropos.

———. 2004. *Rhythmanalysis: Space, Time and Everyday Life*. Continuum.

Lehman, Jessica. 2018. 'From Ships to Robots: The Social Relations of Sensing the World Ocean'. *Social Studies of Science* 48(1): 57–79.

———. 2020. 'Making an Anthropocene Ocean: Synoptic Geographies of the International Geophysical Year (1957–1958)'. *Annals of the American Association of Geographers* 110(3): 606–22.

Lescroël, Amélie, Raphaël Mathevet, Clara Péron, Matthieu Authier, Pascal Provost, Akinori Takahashi, and David Grémillet. 2016. 'Seeing the Ocean through the Eyes of Seabirds: A New Path for Marine Conservation?' *Marine Policy* 68: 212–20.

Lévy, Jacques, and Michel Lussault. 2003. *Dictionnaire de géographie et de l'espace des sociétés*. Belin.

Lindenmayer, David B., and Gene E. Likens. 2010. *Effective Ecological Monitoring*. CSIRO Publishing.

Livingstone, David N. 1995. 'The Spaces of Knowledge: Contributions towards a Historical Geography of Science'. *Environment and Planning D: Society and Space* 13(1): 5–34.

———. 2003. *Putting Science in Its Place: Geographies of Scientific Knowledge*. University of Chicago Press.

Lockley, Ronald. 1942. *Shearwaters*. Devin-Adair.

————. 1953. *Puffins*. JM Dent.

Lorimer, Hayden. 2003. 'Telling Small Stories: Spaces of Knowledge and the Practice of Geography'. *Transactions of the Institute of British Geographers* 28(2): 197–217.

Lorimer, Jamie. 2007. 'Nonhuman Charisma'. *Environment and Planning D: Society and Space* 25(5): 911–32.

————. 2008. 'Counting Corncrakes: The Affective Science of the UK Corncrake Census'. *Social Studies of Science* 38(3): 377–405.

————. 2014. 'On Auks and Awkwardness'. *Environmental Humanities* 4(1): 195–205.

Lynch, Michael. 1991. 'Laboratory Space and the Technological Complex: An Investigation of Topical Contextures'. *Science in Context* 4(1): 51–78.

———— . 2011. 'Credibility, Evidence and Discovery: The Case of the Ivory-Billed Woodpecker'. *Ethnographic Studies* (12, Dec. 2011): 78–105.

Lynch, M., and John Law. 1999. 'Pictures, Texts and Objects: The Literary Language Game of Birdwatching.' Pp. 317–41 in *The science studies reader*, edited by M. Biagioli. Routledge.

Macdonald, Helen. 2002. '"What Makes You a Scientist Is the Way You Look at Things": Ornithology and the Observer 1930–1955'. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 33(1): 53–77.

MacLeod, Roy. 2001. '"Strictly for the Birds": Science, the Military and the Smithsonian's Pacific Ocean Biological Survey Program, 1963-1970'. *Journal of the History of Biology* 34(2): 315–52.

Magnuson, John J. 1990. 'Long-Term Ecological Research and the Invisible Present'. *Bioscience* 40(7): 495.

Mahony, Martin. 2021. 'Geographies of Science and Technology I: Boundaries and Crossings'. *Progress in Human Geography* 45(3): 586–95.

———— . 2023. 'Geographies of Science and Technology III: Careful Entanglements, Responsible Futures'. *Progress in Human Geography* 47(4): 613–23.

Maisonobe, Marion. 2015. 'Étudier la géographie des activités et des collectifs scientifiques dans le monde : de la croissance du système de production contemporain aux dynamiques d'une spécialité, la réparation de l'ADN'. Doctoral thesis. Université Toulouse Jean-Jaurès.

————. 2020. 'Regional Distribution of Research: The Spatial Polarization in Question'. Pp. 377–96 in *Handbook Bibliometrics*, edited by R. Ball. De Gruyter Saur.

Maisonobe, Marion, Michel Grossetti, Béatrice Milard, Laurent Jégou, and Denis Eckert. 2017. 'The Global Geography of Scientific Visibility: A Deconcentration Process (1999–2011)'. *Scientometrics* 113(1): 479–93.

Mallory, Mark L., H. Grant Gilchrist, Michael Janssen, Heather L. Major, Flemming Merkel, Jennifer F. Provencher, and Hallvard Strøm. 2018. 'Financial Costs of Conducting Science in the Arctic: Examples from Seabird Research'. *Arctic Science* 4(4): 624–33.

Malpas, Jeff. 2018. *Place and Experience: A Philosophical Topography*. 2nd ed. Routledge.

Manceron, Vanessa. 2013. 'Limn: Recording and Monitoring: Between Two Forms of Surveillance'. URL: https://limn.it/articles/recording-and-monitoring-between-two-forms-of-surveillance/.

———. 2022. *Les Veilleurs Du Vivant. Avec Les Naturalistes Amateurs*. La Découverte.

Marcus, George E. 1995. 'Ethnography in/of the World System: The Emergence of Multi-Sited Ethnography'. *Annual Review of Anthropology* 24: 95–117.

Massey, Doreen B. 1999. *Power-Geometries and the Politics of Space-Time: Hettner-Lecture 1998 / Doreen Massey*. Heidelberg: Department of Geography, University of Heidelberg.

Matless, David. 2003. 'Original Theories: Science and the Currency of the Local'. *Cultural Geographies* 10(3): 354–78.

Mauz, Isabelle, Taru Peltola, Céline Granjou, Severine van Bommel, and Arjen Buijs. 2012. 'How Scientific Visions Matter: Insights from Three Long-Term Socio-Ecological Research (LTSER) Platforms under Construction in Europe'. *Environmental Science & Policy* 19–20: 90–99.

Mauz, Isabelle, and Céline Granjou. 2013. 'A New Border Zone in Science. Collaboration and Tensions between Modelling Ecologists and Field Naturalists'. *Science as Culture* 22(3): 314–43.

McCormack, Derek. 2012. 'Geography and Abstraction: Towards an Affirmative Critique'. *Progress in Human Geography* 36(6): 715–34.

Medby, Ingrid A., Berit Kristoffersen, Philip Steinberg, Klaus Dodds, Mia M. Bennett, Johanne M. Bruun, and Danai-Maria Kontou. 2025. 'Polar Projections: Political Geographies of Arctic Mapping'. *Political Geography* 103391. https://doi.org/10.1016/j.polgeo.2025.103391.

Mels, Tom, ed. 2004. *Reanimating Places: A Geography of Rhythms*. London: Routledge.

Merton, Robert K., and Elinor Barber. 2004. *The Travels and Adventures of Serendipity: A Study in Sociological Semantics and the Sociology of Science*. Princeton University Press.

Messeri, Lisa. 2016. *Placing Outer Space: An Earthly Ethnography of Other Worlds*. Duke University Press.

Meusburger, Peter. 2008. 'The Nexus of Knowledge and Space'. Pp. 35–90 in *Clashes of Knowledge, Knowledge and Space*, edited by P. Meusburger, M. Welker, and E. Wunder. Dordrecht: Springer Netherlands.

Meusburger, Peter, Derek Gregory, and Laura Suarsana, eds. 2015. *Geographies of Knowledge and Power. Vol. 7. Knowledge and Space*. Dordrecht: Springer Netherlands.

Meusburger, Peter, David Livingstone, and Heike Jöns, eds. 2010. *Geographies of Science. Vol. 3. Knowledge and Space*. Dordrecht: Springer Netherlands.

Meyer, Morgan. 2012. 'Placing and Tracing Absence: A Material Culture of the Immaterial'. *Journal of Material Culture* 17(1): 103–10.

————. 2013. 'Domesticating and Democratizing Science: A Geography of Do-It-Yourself Biology'. *Journal of Material Culture* 18(2): 117–34.

Meyer, Morgan, and Susan Molyneux-Hodgson. 2016. 'Placing a New Science: Exploring Spatial and Temporal Configurations of Synthetic Biology'. Pp. 61–77 in *The Local Configuration of New Research Fields: On Regional and National Diversity*, edited by M. Merz and P. Sormani. Cham: Springer International Publishing.

Milam, Erika Lorraine. 2022. 'Making Place in the Field'. *Isis* 113(1): 121–27.

Mitman, Gregg. 1996. 'When Nature Is the Zoo: Vision and Power in the Art and Science of Natural History'. *Osiris* 11: 117–43.

Mol, Annemarie, and John Law. 1994. 'Regions, Networks and Fluids: Anaemia and Social Topology'. *Social Studies of Science* 24(4): 641–71.

Monteiro, Eric. 2022. *Digital Oil: Machineries of Knowing*. The MIT Press.

Morley, David. 2002. *Home Territories: Media, Mobility and Identity*. London: Routledge.

Moss, Stephen. 2004. *A Bird in the Bush: A Social History of Birdwatching*. Aurum.

Murdoch, Jonathan. 1998. 'The Spaces of Actor-Network Theory'. *Geoforum* 29(4): 357–74.

Newton, Ian. 2010. *Bird Migration*. Collins.

Olechnicka, Agnieszka, Adam Ploszaj, and Dorota Celińska-Janowicz. 2019. *The Geography of Scientific Collaboration*. Taylor & Francis.

O'Mahony, Kieran, Andrea Corradini, and Andrea Gazzola. 2018. 'Lupine Becomings—Tracking and Assembling Romanian Wolves through Multi-Sensory Fieldwork'. *Society & Animals* 26(2): 107–29.

Ophir, Adi. 1991. 'A Place of Knowledge Re-Created: The Library of Michel de Montaigne'. *Science in Context* 4(1): 163–90.

Ophir, Adi, and Steven Shapin. 1991. 'The Place of Knowledge A Methodological Survey'. *Science in Context* 4(1): 3–22.

Oreskes, Naomi. 1996. 'Objectivity or Heroism? On the Invisibility of Women in Science'. *Osiris* 11: 87–113.

———— . 2003. ‘A Context of Motivation: US Navy Oceanographic Research and the Discovery of Sea-Floor Hydrothermal Vents’. *Social Studies of Science* 33(5): 697–742.

Paasi, Anssi. 2011. ‘Geography, Space and the Re-Emergence of Topological Thinking’. *Dialogues in Human Geography* 1(3): 299–303.

Pálsson, Gisli. 2024. *The Last of Its Kind: The Search for the Great Auk and the Discovery of Extinction.* Princeton University Press.

Parmiggiani, Elena, and Eric Monteiro. 2016. ‘A Measure of “Environmental Happiness”: Infrastructuring Environmental Risk in Oil and Gas off Shore Operations’. *Science & Technology Studies* 29(1): 30–51.

Phillips, Richard A., Jose C. Xavier, and John P. Croxall. 2003. ‘Effects of Satellite Transmitters on Albatrosses and Petrels’. *The Auk* 120(4): 1082–90.

Philo, Chris, and Chris Wilbert. 2000. *Animal Spaces, Beastly Places: New Geographies of Human-Animal Relations*. Taylor & Francis Group.

Pickstone, John V. 2000. *Ways of Knowing: A New History of Science, Technology and Medicine*. Manchester University Press.

Pinel, Clémence. 2021. ‘Renting Valuable Assets: Knowledge and Value Production in Academic Science’. *Science, Technology, & Human Values* 46(2): 275–97.

Podjed, Dan. 2013. ‘De l’observation à la protection des oiseaux’. *Revue d’anthropologie des connaissances* 7(2): 461–83.

Powell, Richard C. 2007. ‘Geographies of Science: Histories, Localities, Practices, Futures’. *Progress in Human Geography* 31(3): 309–29.

Puig de la Bellacasa, Maria. 2015. ‘Making Time for Soil: Technoscientific Futurity and the Pace of Care’. *Social Studies of Science* 45(5): 691–716.

————. 2017. *Matters of Care: Speculative Ethics in More Than Human Worlds*. University of Minnesota Press.

Raby, Megan. 2015. ‘Ark and Archive: Making a Place for Long-Term Research on Barro Colorado Island, Panama’. *Isis* 106(4): 798–824.

————. 2019. ‘“Slash-and-Burn Ecology”: Field Science as Land Use’. *History of Science* 57(4): 441–68.

Rafiq, Kasim, Neil R. Jordan, J. Weldon McNutt, John Neelo, Nina Attias, Dee Boersma, Meredith S. Palmer, Jennifer Ruesink, and Briana Abrahms. 2024. ‘The Value of Field Research in Academia’. *Science* 384(6698): 855–56.

Rees, Amanda. 2006. ‘A Place That Answers Questions: Primatological Field Sites and the Making of Authentic Observations’. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 37(2): 311–33.

———— . 2009. *The Infanticide Controversy: Primatology and the Art of Field Science*. University of Chicago Press.

Reinecke, David. 2021. 'When Funding Fails: Planetary Exploration at NASA in an Era of Austerity, 1967–1976'. *Social Studies of Science* 51(5): 750–79.

Reinecke, David, and Jordan Bimm. 2022. 'The Maintenance of Ambiguity in Martian Exobiology'. *Social Studies of Science* 52(2): 199–226.

Reinert, Hugo. 2013. 'The Care of Migrants: Telemetry and the Fragile Wild'. *Environmental Humanities* 3(1): 1–24.

Ribeiro, Barbara, Robert Meckin, Andrew Balmer, and Philip Shapira. 2023. 'The Digitalisation Paradox of Everyday Scientific Labour: How Mundane Knowledge Work Is Amplified and Diversified in the Biosciences'. *Research Policy* 52(1): 104607.

Ribes, David, and Thomas A. Finholt. 2009. 'The Long Now of Technology Infrastructure: Articulating Tensions in Development'. *Journal of the Association for Information Systems* 10(5): 375–98.

Ribes, David, and Steven J. Jackson. 2013. 'Data Bite Man: The Work of Sustaining a Long-Term Study'. In *Raw Data is an Oxymoron*, edited by L. Gitelman, MIT Press.

Roberts, Peder, and Eric Paglia. 2016. 'Science as National Belonging: The Construction of Svalbard as a Norwegian Space'. *Social Studies of Science* 46(6): 894–911.

Rosa, Hartmut. 2013. *Social Acceleration: A New Theory of Modernity*. Columbia University Press.

Russell, Andrew L., and Lee Vinsel. 2018. 'After Innovation, Turn to Maintenance'. *Technology and Culture* 59(1): 1–25.

Safina, Carl. 2002. *Eye of the Albatross: Visions of Hope and Survival*. Henry Holt.

Schönbauer, Sarah Maria. 2025. 'Environmental Care: How Marine Scientists Relate to Environmental Changes'. *Minerva* 63(1): 93–113.

SEATRACK. 2025. *Annual Report 2024*. https://brage.npolar.no/npolarxmlui/bitstream/handle/11250/3192315/Seatrack2024.pdf?sequence=1

Shapin, Steven. 2003. 'David N. Livingstone, Science, Space and Hermeneutics. Hettner-Lectures, 5. Heidelberg: Department of Geography, University of Heidelberg, 2002. Pp. 116. ISBN 3-88570-505-2. No Price given (Paperback)'. *The British Journal for the History of Science* 36(1): 87–127.

————. 2010a. *The Scientific Life: A Moral History of a Late Modern Vocation*. University of Chicago Press.

————. 2010b. *Never Pure: Historical Studies of Science as If It Was Produced by People with Bodies, Situated in Time, Space, Culture, and Society, and Struggling for Credibility and Authority*. John Hopkins University Press.

Sheller, Mimi, and John Urry. 2006. 'The New Mobilities Paradigm'. *Environment and Planning A: Economy and Space* 38(2): 207–26.

Simões, Ana, A. Carneiro, and M. P. Diogo. 2010. *Travels of Learning: A Geography of Science in Europe*. Springer Netherlands.

Smart, Alan, and Josephine Smart. 2011. '(Im)Mobilizing Technology: Slow Science, Food Safety, and Borders'. *Identities* 18(6): 529–50.

Smith, Robert DJ, Stefan Schäfer, and Michael J. Bernstein. 2023. 'Governing beyond the Project: Refocusing Innovation Governance in Emerging Science and Technology Funding'. *Social Studies of Science* 54(3): 377-404.

Soja, Edward W. 1989. *Postmodern Geographies: The Reassertion of Space in Critical Social Theory*. Verso.

Star, Susan Leigh. 1999. 'Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work'. *Computer Supported Cooperative Work (CSCW)* 8(1): 9–30.

Star, Susan Leigh, and Karen Ruhleder. 1996. 'Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces'. *Information Systems Research* 7(1): 111–34.

Stehr, Nico. 2010. 'Global Knowledge?' Pp. 23–34 in *Geographies of Science, Knowledge and Space*, edited by P. Meusburger, D. Livingstone, and H. Jöns. Dordrecht: Springer Netherlands.

Stengers, Isabelle. 2011a. *Cosmopolitics II*. University of Minnesota Press.

———— . 2011b. ''Another science is possible!' A plea for slow science'. Faculté de Philosophie et Lettres, ULB (13 December 2011). Inaugural lecture Chair Willy Calewaert 2011-2012 (VUB). https://threerottenpotatoes.wordpress.com/wp-content/uploads/2011/06/stengers2011_pleaslowscience.pdf

Stengers, Isabelle, Bruno Latour, and Paul Bains. 1997. *Power and Invention: Situating Science*. Theory out of Bounds. University of Minnesota Press.

Stokland, Håkon B. 2015. 'Field Studies in Absentia: Counting and Monitoring from a Distance as Technologies of Government in Norwegian Wolf Management (1960s–2010s)'. *Journal of the History of Biology* 48(1): 1–36.

Strasser, Bruno J. 2019. *Collecting Experiments: Making Big Data Biology*. University of Chicago Press.

Strier, Karen B. 2010. 'Long-Term Field Studies: Positive Impacts and Unintended Consequences'. *American Journal of Primatology* 72(9): 772–78.

Strouk, Mayline. 2022. '« Parce que l'environnement ne peut pas faire la différence entre le forage commercial et le forage scientifique » : l'exemple du Kongsfjorden au Svalbard pour poser la question du surpâturage du terrain de recherche'. *Annales de géographie* 748(6): 82–110.

Strouk, Mayline, and Marion Maisonobe. 2024. 'Field Science and Scientific Collaboration in the Svalbard Archipelago: Beyond Science Diplomacy'. *Science and Public Policy* 51(5): 780–94.

Sullivan, Brian L., Christopher L. Wood, Marshall J. Iliff, Rick E. Bonney, Daniel Fink, and Steve Kelling. 2009. 'eBird: A Citizen-Based Bird Observation Network in the Biological Sciences'. *Biological Conservation* 142(10): 2282–92.

Taylor, Peter J., Michael Hoyler, and David M. Evans. 2010. 'A Geohistorical Study of "The Rise of Modern Science": Mapping Scientific Practice Through Urban Networks, 1500–1900'. Pp. 37–56 in *Geographies of Science, Knowledge and Space*, edited by P. Meusburger, D. Livingstone, and H. Jöns. Dordrecht: Springer Netherlands.

Thrift, Nigel. 1999. 'The Place of Complexity'. *Theory, Culture & Society* 16(3): 31–69.

———. 2003. 'Practising Ethics'. Pp. 95–108 in *Using Social Theory: Thinking through Research*, edited by M. Pryke, G. Rose, and S. Whatmore. SAGE Publications.

Tinbergen, Nikolaas. 1953. *The Herring Gull's World: A Study of The Social Behaviour of Birds*. Collins.

Toogood, Mark. 2011. 'Modern Observations: New Ornithology and the Science of Ourselves, 1920–1940'. *Journal of Historical Geography* 37(3): 348–57.

Tousignant, Noemi. 2013. 'Broken Tempos: Of Means and Memory in a Senegalese University Laboratory'. *Social Studies of Science* 43(5): 729–53.

Trappes, Rose. 2023. 'How Tracking Technology Is Transforming Animal Ecology: Epistemic Values, Interdisciplinarity, and Technology-Driven Scientific Change'. *Synthese* 201(128). https://doi.org/10.1007/s11229-023-04122-5.

Traweek, Sharon. 1988. *Beamtimes and Lifetimes: The World of High Energy Physicists*. Harvard University Press.

Tsing, Anna Lowenhaupt. 2011. *Friction: An Ethnography of Global Connection*. Princeton University Press.

Tuan, Yi-fu. 1977. *Space and Place: The Perspective of Experience*. Edward Arnold.

Urbano, Fernandino. 2015. 'Smart Ecology: Surfing the Wave of Wildlife Tracking Data'. PhD Thesis Università Iuav Di Venezia.

Urry, John. 2007. *Mobilities*. Polity.

Urry, John. 2012. *Sociology Beyond Societies: Mobilities for the Twenty-First Century*. Routledge.

van Dooren, Thom. 2014. *Flight Ways: Life and Loss at the Edge of Extinction*. Columbia University Press.

von Essen, Erica, Jonathon Turnbull, Adam Searle, Finn Arne Jørgensen, Tim R. Hofmeester, and René van der Wal. 2023. 'Wildlife in the Digital Anthropocene:

Examining Human-Animal Relations through Surveillance Technologies'. *Environment and Planning E: Nature and Space* 6(1): 679–699.

Vermeulen, Niki. 2013. 'From Darwin to the Census of Marine Life: Marine Biology as Big Science'. *PLOS ONE* 8(1): e54284.

———— . 2015. 'From Virus to Vaccine: Projectification of Science in the VIRGO Consortium'. in *Collaboration across Health Research and Medical Care*, edited by B. Penders, N. Vermeulen, J. Parker. Routledge.

Vermeulen, Niki, John N. Parker, and Bart Penders. 2013. 'Understanding Life Together: A Brief History of Collaboration in Biology'. *Endeavour* 37(3): 162–71.

Verne, Julia. 2012. '"Le Terrain, c'est Moi ?" Reflections on the Emergence of the Field in Translocal Research'. *Annales de Géographie* 687-688(5): 561–82.

Verreault, Jonathan, Robert J. Letcher, Derek C. G. Muir, Shaogang Chu, Wouter A. Gebbink, and Geir W. Gabrielsen. 2005. 'New Organochlorine Contaminants and Metabolites in Plasma and Eggs of Glaucous Gulls (Larus Hyperboreus) from the Norwegian Arctic'. *Environmental Toxicology and Chemistry* 24(10): 2486–99.

Vetter, Jeremy. 2004. 'Science along the Railroad: Expanding Field Work in the US Central West'. *Annals of Science* 61(2): 187–211.

———— . 2012. 'Labs in the Field? Rocky Mountain Biological Stations in the Early Twentieth Century'. *Journal of the History of Biology* 45(4): 587–611.

Vostal, Filip. 2015. 'Academic Life in the Fast Lane: The Experience of Time and Speed in British Academia'. *Time & Society* 24(1): 71–95.

————. 2016. *Accelerating Academia*. Palgrave Macmillan UK.

Waquet, Françoise. 2019. *Une histoire émotionnelle du savoir XVIIe-XXIe siècle*. CNRS Editions.

Weidensaul, S. 2022. *A World on the Wing: The Global Odyssey of Migratory Birds*. Pan Macmillan.

Whatmore, Sarah. 2002. *Hybrid Geographies: Natures Cultures Spaces*. Sage Publications.

Wheelwright, Nathaniel T., and Robert A. Mauck. 2018. 'Charles Ellsworth Huntington, 1919–2017'. *The Auk* 135(1): 158–59.

Whitney, Kristoffer. 2014. 'Domesticating Nature?: Surveillance and Conservation of Migratory Shorebirds in the "Atlantic Flyway"'. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 45: 78–87.

———— . 2019. 'It's about Time: Adaptive Resource Management, Environmental Governance, and Science Studies'. *Science, Technology, & Human Values* 44(2): 263–90.

Wilson, Helen F. 2017. 'On Geography and Encounter: Bodies, Borders, and Difference'. *Progress in Human Geography* 41(4): 451–71.

———— . 2022. 'Seabirds in the City: Urban Futures and Fraught Coexistence'. *Transactions of the Institute of British Geographers* 47(4): 1137–51.

Wilson, Rory P., David Grémillet, Jon Syder, Mandy A. M. Kierspel, Stefan Garthe, Henri Weimerskirch, Christian Schäfer-Neth, J. Alejandro Scolaro, Charles-André Bost, Joachim Plötz, and Deon Nel. 2002. 'Remote-Sensing Systems and Seabirds: Their Use, Abuse and Potential for Measuring Marine Environmental Variables'. *Marine Ecology Progress Series* 228: 241–61.

Wilson, Rory P., Klemens Piitz, Gerrit Peters, Boris Culik, J. Alejandro Scolaro, Jearv-Benoit Charrassin, and Yan Ropert-Coudert. 1997. 'Long-Term Attachment of Transmitting and Recording Devices to Penguins and Other Seabirds'. *Wildlife Society Bulletin* 25(1): 101–6.

Withers, Charles. 2002. 'The Geography of Scientific Knowledge'. Pp. 9–18, in *Gottingen and the Development of the Natural Sciences*, edited by N.A. Rupke. Wallstein.

———— . 2005. 'History and Philosophy of Geography, 2002-2003: Geography in Its Place'. *Progress in Human Geography* 29(1): 64–72.

Withers, Charles, and Diarmid A. Finnegan. 2003. 'Natural History Societies, Fieldwork and Local Knowledge in Nineteenth-Century Scotland: Towards a Historical Geography of Civic Science'. *Cultural Geographies* 10(3): 334–53.

Wohlforth, Charles, and Loren Holmes. 2024. 'The Polar Bear and the Bird Scientist: George Divoky's 50-Year Arctic Vigil'. *Anchorage Daily News*. URL: https://www.adn.com/alaska-news/science/2024/10/06/the-polar-bear-and-the-bird-scientist-george-divokys-50-year-arctic-vigil/.