Chapter 1: INTRODUCTION

This book is based on five years of fieldwork undertaken with a team of evolutionary biologists studying Siberian jay birds *(Perisoreus infaustus)* in northern Sweden. Ethnographic data were gathered during two extended field trips to the team study sites in the boreal forests of the Sápmi region, and several preparatory and follow-up visits to the researchers' offices. Employing a grounded theory approach, my findings were informed by participant observation and analysis of the scientists' field materials – some collected in the field and others preserved in the biologists' archives. The ethnography provides new perspectives on scientific knowledge production by investigating the role that tools, design decisions, and representational practices play in the scientific research process and how they are developed to produce knowledge. I do not aim to improve scientific practices or change the way data are presented in scientific literature. Instead, I aim to elucidate, for a non-scientific audience, the practices involved in the production of scientific papers.

In my attempt to do so, I combine two field sciences: anthropology and evolutionary biology. While the case study focuses on a group of evolutionary biologists studying the behaviour of Siberian jays, a bird species, the methodological approach derives from anthropology. Com-

bining anthropology with science and technology studies (STS) allows for the strengthening of an ecofeminist perspective on knowledge production, attending specifically to the role of the human and non-human actors.

The merger between STS and anthropology is informed by a design perspective. Visualisation practices first caught my attention as a formally trained visual communication designer and anthropologist. I became aware of the gap in the publication of scientific research by studying the raw field notes and data of evolutionary biologists. While field notes usually remain hidden in archives, I suggest that they are, to the same extent as the graphs in published articles, the result of specific design decisions that follow formal-aesthetic principles.

Accordingly, the way in which visualisation is employed in the field sciences suggests some commonalities with design, including the frequently used visual systems of organising, structuring, arranging, and categorising information. The practices of visualisation and the resulting material are highlighted by including design in the discourse. Thus, a design-informed perspective is valuable in reimagining knowledge production because it addresses the usually invisible aspects of scientific research, such as sensory and bodily skills, creativity, emotionality, aesthetics, and implicit thinking.

Evolutionary biology, like most branches of biology, is very generally characterised by positivism, objectivity, and empirical measurement. In contrast, anthropology is associated with constructivism and the knowledge contingency that entails. However, successfully responding to real-world exigencies may involve practices that fall somewhere between the two. Thus, combining these two disciplines in an experimental setting may transcend the boundary between the so-called *hard* and *soft* sciences in favour of new approaches to scientific knowledge production in the field sciences. This perspective extends beyond positivist and constructivist

practices of worldmaking to practices that produce 'faithful accounts of a "real" world'[1] by revealing the ontological and epistemological entanglements in which scientists find themselves during knowledge production.

Bearing this in mind, I aim to highlight the so-called *softness* of the natural sciences, an aspect that exists prior to the transformation of knowledge into scientific fact through systemic thinking, natural laws, and model-based reasoning. I also aim to address the practice–theory divide that manifests in natural sciences publications where most of the practical processes, observations, and manipulations that lead to conclusions are excluded from the discussion. This exclusion becomes clear when examining visualisation practices that extend beyond technologies of vision to other senses, as I shall demonstrate. This ethnography combines the *hard* and *soft* sciences into a productive discourse to reveal what is epistemologically and ontologically concealed. The biologist and ecofeminist Donna Haraway notes:

> It matters what matters we use to think other matters with; it matters what stories we tell to tell other stories with; it matters what knots knot knots, what thoughts think thoughts, what descriptions describe descriptions, what ties tie ties. It matters what stories make worlds, what worlds make stories.[2]

In this text, I expand on her musings by asking: what practices make worlds and what stories do those practices tell? The worlds I discuss in this ethnography are created through scientific knowledge production. By adopting a pragmatic approach, I question which sensory and bodily practices constitute data collection and processing, enable thoughts, and shape thinking. Ultimately, this monograph is focused on the epistemologies and ontologies of thinking and doing in the field sciences.

1
Haraway, 'Situated Knowledges', 579.

2
Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham, NC: Duke University Press, 2016), 12.

One notable feature of natural science journals – particularly those in the life sciences – is the rare visibility of actual research *objects,* such as birds, mammals, or fish, as they exist in the natural world. Readers are typically presented with image complexes[3] presenting data in charts, numbers, figures, tables, and graphs embedded within a larger framework of information. The data are usually presented in a highly formalised and abstract way, dominant in the natural sciences. Scholars perpetuate a certain perception of their discipline by adhering to this format. While presenting results in this way may make perfect sense to a natural scientist, publications often become completely detached from their referent (in nature) by obscuring the events and people who contributed to the scientific process. Important practices that lead to scientific advancements become naturalised, ahistorical, and inaccessible to the wider public. In addition, the biologists themselves, and the research objects and tools used, become almost entirely invisible, as if they were never part of the process of knowledge production. Condensed methodology sections remain that obscure the individual stages of knowledge production through intense filtering of the research data.[4] In this sense, scientific journals become a platform where scientists perform what Haraway has dubbed the 'god trick',[5] the phenomenon that creates the

3
Martina Merz, 'Bildkomplexe als Geschichten: Naturwissenschaftler erzählen', in *Erzählen in den Wissenschaften,* 2009.

4
When it comes to methodology in the natural sciences, many publications focus solely on research methods. However, these are usually highly technical, excluding, e.g., the specifics of documentation or sensory attunement. They address a peer-to-peer audience and do not, as I aim to do with my science and technology studies (STS) approach, attempt to facilitate communication between the sciences and the public. Thus, these publications are less accessible to those outside the relevant disciplines.

5
Donna Haraway uses the metaphor of the 'god trick' in her critique as one in which objectivity is created through 'a view from above' (589): a 'god trick of seeing everything from nowhere' (581). However, according to her, 'that view of infinite vision is an illusion' (582) and the result of the 'highest technoscientific visualizations' (584). She argues that 'the view from a body, always a complex, contradictory, structuring, and structured body, versus the view from above, from nowhere, from simplicity' (589) is situated and does not try to hide the bodily and sensory involvement. She proposes situated knowledges as an alternative to objectivity. Haraway, 'Situated Knowledges'.

gap between the presentation of the research object and research problem, and the scientific conclusions. This text connects design, social anthropology (here referred to as anthropology), and evolutionary biology to bridge this gap in the discourse.

At its core, this presentational gap is characterised by the disappearance of the 'long series of manipulations' described by anthropologist and philosopher Bruno Latour,[6] which results in a contradiction in the scientific apparatus of representation. On the one hand, according to Latour, '[T]he more steps there are in between the objects and those who make judgments about them, the more robust those judgments will be' (ibid.). In this sense, the chain of manipulation is a distinguishing feature of *good* scientific work. On the other hand, when it comes to the publication of results, '[The scientists] suddenly are more than happy to display one isolated image extracted out of the chains as "the definitive proof"[7] of the phenomenon they wish to describe'.[8] What the scientific community considers a sign of excellence is invisible to the public. The information that is ultimately published in scientific journals is limited to whatever lies on either side of the gap, and scientific facts have been directly extracted from the scientific object without any steps in between.

To expand on this observation, I focus on what has been eliminated during the process. Revealing the scientific practices obscured in the presentation of the data provides valuable insights, both epistemological and ontological, into knowledge production. By examining this gap, I highlight existing aspects of the scientific process and reintroduce them to the discourse of knowledge production in the

6
Bruno Latour, 'The More Manipulations the Better', in *New Representation in Scientific Practice,* ed. Catelijne Coopmans et al. (Cambridge, MA: MIT Press, 2014), 348.

7
While for public representation, the rhetoric of the images and the written account often come across as if they were 'definitive proof', as Latour refers to it, I would, instead, call it an 'approximation to truth' with reference to my interlocutors that I shall introduce in the following sections of the text.

8
'The More Manipulations the Better', 348.

natural sciences. In this way, a different narrative can be constructed; one that makes the matters, events, thoughts, descriptions, and connections that create worlds visible again. In this book, I bridge the gap by bringing the biologists, the birds, and their environment back into the discourse, thereby revealing the processes that produce scientific knowledge.

The following section introduces the case study on which the ethnography is based: a team of evolutionary field biologists working in northern Sweden with Siberian jays *(Perisoreus infaustus),* a bird species uniquely associated with the Indigenous Sámi people who live in that area.

Case Study

Siberian jays *(Perisoreus infaustus)* are found in the Sápmi region of northern Sweden and share a deep cultural connection with the Sámi people. The birds are often described as 'charismatic' and 'almost tame,'[9] tending to appear near people and viewed as 'hunters' friends' in the northern hemisphere. Siberian jays often appear during food offerings – a Sámi tradition in which food is placed in trees – not only seeking nourishment but also seemingly drawn to human presence.[10] At the same time, they have traditionally been regarded as birds of 'ill omen'. The Latin word 'infaustus' means unlucky or associated with bad luck or even death. Most importantly for research purposes, Siberian jays are easy to study because they are a curious rather than shy species, making them readily observable.

9
Ingela Bergman and Lars Östlund, 'A Sacred Tree in the Boreal Forest: A Narrative about a Sámi Shaman, Her Tree, and the Forest Landscape', *Human Ecology* 50, no. 6 (December 2022): 1023–33, https://doi.org/10.1007/s10745-022-00365-x.

10
Ibid.

PD Dr Michael Griesser[11] has served as the principal investigator (PI) of the project since 2004, and in 2023, Dr Miya Warrington joined him as co-PI. The researchers in Michael's team aim to discover why animals cooperate with each other and live in family groups, and to learn more about communication and language from animals. The team use field experiments and behavioural, longitudinal, and comparative data to explore mechanisms underlying sociality. These insights are relevant for conservation, species resilience, and climate change adaptation and mitigation.[12] The team works with Siberian jays because the birds' social system is unusual. Besides a breeding pair, 'family' groups of jays may include their own offspring that remain with their parents for up to four years, and unrelated non-breeders. This variation in kinship among non-breeders allows the scientists to study the benefits of family living.[13] They investigate the *proximate* and *ultimate* causes of cooperation,[14] a common focus in behavioural biology: the cost and benefit of certain behaviours and how birds (or other animals) cooperate within their social structures. For this, they work not only in laboratories and offices but also in the field, where an extensive part of data collection takes place. Siberian jays are widespread across northern Eurasia. Thus, the biologists' study site is in northern Sweden, in Swedish Sápmi, the land of

11
Hereafter, I shall refer to Michael by his first name, as I do with the other biologists I observed in the field. I introduce those who are officially involved in the study by their full name, position, and affiliation. I refer to the students and researchers who took part in the study only temporarily by their first names.

12
Michael Griesser: C-Wild Griesser. Retrieved from: https://sites.google.com/view/c-wild-griesser. 28/4/2025.

13
Ibid.

14
During experiments, biologists are interested in studying the behaviours of birds in terms of their cost (investment) and benefit (advantages). With cost–benefit analyses in behavioural biology, the biologists address the investment (cost) against the benefit (advantage) of survival or breeding advantages. In such analyses, the consequences of behaviour are addressed on two levels, answering the 'why' and 'how' of the proximate and ultimate causes. The immediate, proximate causes motivate behaviour, such as a warning call for a predator that allows other birds to escape. The long-term functions and ultimate causes relate to the survival of the genetic information of a breeding couple when protecting and raising their offspring.

Europe's only Indigenous people, the Sámi. However, the study site is located there not only because of the research focus but also because of the history of the Siberian Jay Project, which was initiated by the teacher Folke Lindgren, who lived there. Carl von Linné also travelled to the region during his eighteenth-century research journeys to gather ecological and anthropological knowledge, as documented in his posthumously published research journals.[15] Here, biologists observe the birds' behavioural responses to their experimental settings. To turn these observations and experiments into scientific data, the biologists must document them. Using visualisation practices, they create permanent inscriptions[16] that are processed until the final images are produced. However, they must also find, attract, register, and study the birds to collect data. For this, particularly during fieldwork, the biologists engage in various sensory and bodily practices, and they use several visual tools to record, store, and transport their observations.

The biologists' field notebooks containing handwritten notes, drawings, protocols, and datasheets, in addition to hard drives containing video recordings and other raw data, provide interesting material for anthropological STS. While final scientific images are usually created digitally, hiding the processes involved in the raw field data, field notebooks reveal the human engagement and practices of knowledge production from start to finish.

The use of tools and media such as notebooks and pencils to capture data has a long tradition, particularly in evolutionary biology. Early naturalists such as Maria Sibylla Merian, Alexander von Humboldt, Carl von Linné, and Alfred Russel Wallace (another early proponent of natural selection,

15
Nelson Goodman, *Ways of Worldmaking* (Brighton: Harvester Press, 1978).

16
Bruno Latour, 'The "Topofil" of Boa Vista: A Photo-Philosophical Montage', in *Pandora's Hope: Essays on the Reality of Science Studies,* ed. Bruno Latour (Cambridge, MA: Harvard University Press, 1999), 24–79; Latour, 'The More Manipulations the Better'; Bruno Latour, 'Visualisation and Cognition: Drawing Things Together', in *Knowledge and Society: Studies in the Sociology of Culture Past and Present: A Research Annual, Vol. 5, 1984,* ed. Henrika Kuklich and Elizabeth Long (Greenwich, CT: JAI Press, 1984), 1–40.

along with Charles Darwin, who should also be mentioned here) made use of handwritten field notes. Their early field notebooks reveal that evolutionary biology observations always involve a combination of noting, collecting, describing, and categorising – along with relevant bodily and sensory practices – to create inscriptions. In addition, I suggest that biologists engage in design practices.

Charles Darwin's archives were filled with images that had been produced in cooperation with artists such as John and Elizabeth Gould, William Swainson, Joseph Wolf, Oscar Gustav Rejlander, Briton Rivière, and Thomas Woolner.[17] However, arts and science were not so easily separable, especially in the early nineteenth century. The Goulds, for instance, were considered not only artists but also naturalists. Together, they contributed to ornithology through their widely recognised survey, *The Birds of Australia,* with Elizabeth serving as a skilled illustrator and John as an obsessive bird collector.[18] The archives of these early scientists, which include scientific image production, have recently attracted the attention of art and science historians.[19] These scholars have observed that the archives would be less comprehensive and many of the resulting scientific insights may not have been possible without the contributions of artists and their visualisation practices. Their goal is also to understand how forms of knowledge and modes of production came together in early scientific studies. These were the first collaborations between the arts and sciences; current collaborations between the two

17
cf. Julia Voss, *Darwins Bilder: Ansichten Der Evolutionstheorie 1837–1874* (Berlin: Fischer Taschenbuch Verlag, 2007), 332.

18
John Gould, *The Birds of Australia* (London: Richard and John E. Taylor, 1848).

19
Lorraine Daston and Peter Galison, 'The Image of Objectivity', *Representations* 40, no. 1 (1992): 81–128; Peter Galison, 'Objectivity Is Romantic', in *Humanities and the Sciences,* ed. Jerome Friedman, Peter Galison, and Susan Haack (ACLS, 2000), 15–43; Christoph Hoffmann and Alexandre Métraux, 'Working with Instruments: Ernst Mach as Material Epistemologist, a Short Introduction', *Science in Context* 29, no. 4 (2016): 429–33; Christoph Hoffmann and Barbara Wittmann, 'Introduction: Knowledge in the Making: Drawing and Writing as Research Techniques', *Science in Context* 26, no. 2 (2013): 203–13.

fields often have different intentions.[20] However, sensory and bodily engagements beyond visualisation practices have received little attention thus far. To understand these worldmaking[21] practices beyond the analysis of visual material in the field sciences, I qualitatively observe and analyse a case study in evolutionary field biology in the chapters that follow.

Overview of Chapters

The following chapters continue to lay the foundation for the study. Chapter 2 describes the methods used, focusing on the dual aspect of my ethnographic fieldwork observing the evolutionary biologists, and the biologists' fieldwork collecting data from the Siberian jays. Chapter 3 presents the theoretical framework on which the work is based, drawing mainly on STS and anthropology and further informed by design. Key concepts are introduced in that chapter, which are essential for understanding the substantive chapters that follow. Chapters 4–6 represent the research process and build on one another, focusing on the practices of scientific fieldwork.

Chapter 4 discusses the practices of *Preparing* that the biologists and I engaged with prior to the data collection. This chapter describes the requirements for scientists to be part of the study and focuses on preparation, from arriving at

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Art programmes in scientific institutions and laboratories, as well as transdisciplinary fine arts–science collaborations, have become popular in the past few decades. However, they appear to serve the purpose of scientific communication through the fine arts to increase public interest in the sciences, which are often accused of functioning in ivory towers. Actual fine arts–science collaborations in which the arts are involved in the scientific process – from funding applications to production of the results – appear to be rare. However, a growing publication record of recent scientific papers resulting from such collaborations has been observed, substantiating the epistemological role of fine arts beyond science communication (e.g. Amber Dance, 'Art Graft: Putting an "A" into "STEMM"', *Nature* 590 (2021): 351–53; Amanda C. Niehaus, 'Tell the Stories in Your Science', *Nature* 557 (2018): 269; Matthias C. Rillig and Karine Bonneval. 'The Artist Who Co-Authored a Paper and Expanded My Professional Network', *Nature,* 27 February (2020): 1–8.

21
Goodman, *Ways of Worldmaking*.

the field camp and preparing for field days to a more detailed analysis of the skills that must be acquired beyond formal training in peer-learning settings within the field. These include wayfinding and registering, which I refer to as *situated enskillment*. I conclude by juxtaposing these preparations with my own entry into the field as an anthropologist and my enskillment as a participant observer.

Chapter 5, *Collecting,* provides a detailed description of how the biologists collect data on the birds. These practices are shaped by approaching the birds in their territories and identifying and observing them. I pay particular attention to the sensory alignment necessary to find, attract, and observe the birds. I conclude my detailed account of situated mediations by revealing the entanglements of sensory, bodily, and technological practices. My reflection on the relationship between anthropology and the biological research practice focuses on *participant behaviour observation,* a speculative compound suggested as a way to reflect on the human–non-human interactions at stake during my observations as an anthropologist and during the biologists' observations of the birds.

Chapter 6 focuses on the processing of data based on practices of *Producing*. In this section, I focus on the transformation of the raw field data into final datasets and graphs based on technological operations. The metaphor of filtering is introduced and used to describe what is filtered out in three stages. Along with this, the locations of practice change from field to office, and the research becomes less dependent on the field and, as I shall argue, less situated as well. I conclude with a *thick description by means of visualisation,* which aims to emphasise the difference in data handling between anthropology, where thick description is part of qualitative data, and biology, where everything that is *thick* must be filtered out to produce universally valid models of nature. The final chapter, Chapter 7, provides some concluding thoughts and insights for the future.

A Note on Images as Interludes

The individual chapters in this book are, where relevant, introduced by image-interludes, a concept inspired by the creation of mood boards in design. The images brought together at the beginning of the chapters visually set the tone and juxtapose the dismantling that, as I shall argue throughout the text, occurs during scientific knowledge production. Rather than putting them between the text, these image collections serve as an independent sensory narrative with images that simultaneously form part of my data.

The images are employed diffractively to thicken my written account and create transparency, not merely by illustrating what is already there but rather by extending my empirical descriptions. Studying the images that are marked as 'Figures', thus becoming part of a referential system in the text, the reader will notice that they do not always correlate with what is written. Rather, they may notice small shifts, for example, observing a different researcher doing the practices described, thus adding to the narration beyond illustrating what has been said. This approach helps to exemplify the repetitiveness of the fieldwork and add an additional perspective by showing different researchers based on different modalities. This should not be misunderstood as an affirmation of scientific reproducibility and objectivity, suggesting that individual researchers do not have an impact on the data collection. This is not my aim. Rather, I want to bring together several layers describing my observations and take the opportunity to not merely duplicate information but extend it.

From the biologists' perspective, as I shall show, much of what is made visible in the interludes is treated as an aesthetic surplus and will become a waste product. This also becomes visible in the decreasing number of images with every step of research. The interludes offer a space for

this surplus. They make it visible as raw data that, from my perspective, are a source of insights into the conditions of knowledge production.