4.3. Situated Enskillment

Biologists conducting fieldwork usually have different levels of knowledge of the study. There are very experienced biologists, such as Michael, less experienced biologists, such as Julian, who has been to the field a few times, some who are experienced field assistants but in other studies, such as Marine and Camille, and then complete novices, such as Kate. All researchers in the study, except for me, are formally trained biologists from different universities, who have learnt the practices and theory of biological research. While, on the one hand, they are familiar with propositional and formal biological knowledge, their education also gives them access to the relevant professional network that brought them to Arvidsjaur. Kate and Julian met Michael through the university as his students, whereas Marine and Camille were recommended to him by a former field assistant. Their ability to work as biologists and do biological fieldwork is certified by an academic degree, such as a BSc, MSc or PhD in the field of biology. This degree officially makes them peers and insiders of the discipline with a specific, practical skillset that engages bodily, sensory, and propositional theoretical knowledge. They are aware of current research methods, questions, and practices of analysis, as well as the rhetoric of the natural sciences and the overall practices of knowledge production. They, at least theoretically, know how to conduct biological research.

However, formal training and theoretical knowledge are not sufficient; their education as biologists does not help them to conduct their observations and experiments in Arvidsjaur with the Siberian jays. They need to undergo a further situated enskillment, as I shall call it, that meets the criteria and requirements of the Siberian Jay Project. This *situated enskillment,* inspired by Haraway's situated knowledge[13] occurs in situ during fieldwork. While the

13
Haraway, 'Situated Knowledges'.

body is always part of a situatedness, the term 'situated' emphasises the relation to a specific environment. In this case, the main aspects are the scientific context and the forests. In this sense, *nature* and *culture* come together in a way that co-constitutes them, making it difficult for them to be divided. The specific field situation needs formal knowledge from university training to be transferred into practice, thus requiring enskillment to this specific study. It is highly dependent on the location in which the biologists conduct fieldwork with the Siberian jays and the specific practices of data collection, as performed by Michael and his team.

Before participants who are new to the study – novices – can collect data on their own, they must undergo a process of enskillment. This enskillment serves two purposes: First, it enables the novices to acquire the skills of cultural and bodily practices[14] that facilitate data collection, such as handling the tools and devices, knowing how to back up data, and how to operate during fieldwork. They may also involve practices of drawing, writing, and note-taking, as well as digital and geographical literacy. Second, it enables them to acquire the professional skills necessary for data collection, which involve knowing what to look for, how to interpret behaviour, and the methods to formally document this. Data collection is possible only based on a combination of the two, and to apply the correct practices, the novices need to undergo training. This training, again, can be divided between the formal training received at university to become an educated biologist and learn how to conduct biological research, and the situated enskillment required for this specific study in the field. According to Michael, fieldwork is 'highly creative, requires improvisation and the ability to work independently' and these are aspects that cannot be formally learnt in university halls but only through immersion in the field.

14
Mauss, 'Techniques of the Body'; Maye, 'Was Ist Eine Kulturtechnik?'

In 2015, Kate had never done fieldwork or collected any data on birds. Thus, she was a complete novice to the study. While the two field assistants, Camille and Marine, whom I accompanied in 2020 were new to this study, they were placed on Kerguelen for the French Antarctic Program where they had gained ample field experience. And then there was me, a complete novice and a disciplinary outsider. In 2015, I had not undergone any enskillment in biological fieldwork; however, as a former designer I was familiar with the cultural practices they employ during data collection, such as visualisation.

Kate and I were the novices in 2015 who had to undergo situated enskillment. In contrast, in 2020 Marine and Camille were the novices. While for Kate, Camille, and Marine, situated enskillment was part of their job as field biologists, for me, it was part of my methodological approach. My aim was to become familiar with the sensory and bodily practices that enable knowledge production through participant observation and a sensory ethnography. Accordingly, I also underwent an abridged version of situated enskillment, mostly by assisting the biologists and witnessing the processes of enskillment. By accompanying this process of enskillment, I gained an understanding of the processes of data collection and the visual practices the biologists employ.

As part of the situated enskillment, the biologists learn what educational historians Thyssen and Grosvenor call the 'modes of meaning-making',[15] as they occur in this case study: 'Meaning-making and the modes employed to bring it about refer to cultural practices such as seeing, reading and writing, which in turn involve the handling of things and artefacts'.[16] Meaning-making does not occur only with

15
Geert Thyssen and Ian Grosvenor, 'Learning to Make Sense: Interdisciplinary Perspectives on Sensory Education and Embodied Enculturation', *The Senses and Society* 14, no. 2 (2019): 120, https://doi.org/10.1080/17458927.2019.1621487.

16
Geert Thyssen and Karin Priem, 'Mobilising Meaning: Multimodality, Translocation, Technology and Heritage', *Paedagogica Historica* 49, no. 6 (2013): 736, https://doi.org/10.1080/00309230.2013.848912.

fact-based knowledge, but needs to be complemented with a sensory enskillment involving 'the visual, aural, audio-visual, material, bodily and spatial'.[17] They refer to these capacities as 'embodied enculturation' arising from sensory enskillment, whereas I refer to it as situated enskillment to emphasise the role and meaning of the context in which the enskillment takes place.

This enskillment involves wayfinding practices, the practices of registering new birds, data collection, and observation; and learning about the technologies used in documentation practices. Most of these practices are accompanied by media and tools that extend and/or complement the bodily capacities and organise the data collection. Accordingly, their employment and handling must also be learnt, which I conceptualise as *situated mediations* in practices of *Collecting* (Chapter 5).

One of the first aspects to learn as novice is the reference system, which involves epistemic qualities that help biologists structure and organise the fieldwork. Only through these references – immutable mobiles – can data be collected consistently[18] and retraced back to the birds once they have been translated into a code, based on further technical manipulations (as discussed in Chapter 6 of the book). The reference system brings me back to the field notebook and the datasheets and maps contained therein. Knowing the reference system means being able to relate the Excel data plots and maps to their living referents in the forests, the colour-ringed Siberian jays. The ability to make these connections and find the actual locations of the bird territories in the field based on a GPS and map are the most basic skills required to conduct fieldwork and formally collect data.

Novices must also become familiar with the methods of data collection in this study (Chapter 5). While the general

17
Thyssen and Grosvenor, 'Learning to Make Sense', 120.
18
Latour and Woolgar, *Laboratory Life*.

method is a standard one of observation and documentation in behavioural ecology,[19] certain boundaries and grey areas that are not predefined must be agreed on by the biologists. This could be the frequency with which a behavioural activity is documented, for example, whether the biologists count the same behaviour that occurs twice in a row without anything else changing as one long activity or as two separate activities, and what behavioural patterns will be documented.

The biologists must learn how to set up the observations, what to focus on, and how to document it. The documentation method is particularly important because it defines what can become data and how. It determines the medial form and the quality and kind of data, and only if this method is employed consistently by all biologists does it allow for the merging of individual data points into one data plot where they can then be quantitatively analysed and compared (Figure 23).

The biologists also need to know *how* to record observations, which methods and notation techniques are used, and *what* to record, which is knowing what to look for. Lastly, the novices must learn precisely how experiments are conducted in the circumstances in Arvidsjaur. Therefore, all new study participants, regardless of their prior experience as field biologists, must receive specific situated training. Their university training will have focused on the technical aspects and theory around fieldwork, but not the actual practices of observation and data collection.

Situated enskillment is based on cooperation with other biologists and peer learning, with a protocol established for data collection. Within a student–master relationship, the novices learn by accompanying biologists who are already *in the know,* shadowing them for the initial days of research as assistants rather than independent biologists. Through this approach, they become familiar with the methods of data collection and documentation. They

19
Martin and Bateson, *Measuring Behaviour. An Introductory Guide.*

learn how the field is structured, how to navigate it, how to identify birds, and how to do the observations – which involves knowing what to look for and pay attention to, what to ignore, how to document these observations in their notebooks, and how to ring new birds. As I have witnessed and will show, these initiation processes are passed on between peers and are not based on textbook learning. They are developed through a communal learning process and social apprenticeship.

Thus, I received different perspectives on the apprenticeship and the required formal and informal/implicit skills. They became apparent to me when accompanying the individual biologists during their enskillment. Not only did I observe how they learn and collect data but I also documented the individual moods, mindsets, sensory attunement, emotions, and aesthetic thinking they engage in during fieldwork. Aspects such as these become particularly visible when examining scientific practices from a design perspective, which returns to the scientific process what is usually eliminated. In addition, the situated enskillment is also significantly bound to the working environment, namely the field and the conditions, which only allow certain practices. Thus, I highlight agencies that become invisible through the translation process – from field, to office, to paper – and aim to make them visible again for a more in-depth understanding of the practices of preparation, collection, and production in evolutionary biology.

4.3.1. Wayfinding and Working with Maps

The first steps of fieldwork, before the biologists can collect data, are shaped by finding the individual bird territories in the study areas. This is a complex task executed differently by each biologist. The study area is defined according to the bird territories and the way the birds inhabit the for-

est. Studying the maps that the biologists use to maintain an overview of their study reveals that the territories are rarely located along streets or trails but rather deep into the forest. Usually, the birds have selected sheltered locations where they feel safe from predators, can build nests, and can find and hide food. The individual territories are not always easily accessible and require the researchers to venture away from the human-made paths. Thus, new biologists must first establish their wayfinding skills.

Finding paths can be difficult, especially in winter, when the entire landscape is covered in a thick layer of snow. For example, small bridges may have become invisible apart from a tiny mark on a map, and distinguishing them from snow that has been bulked up across the half-frozen river by the wind can be challenging (Figure 24). While, most of the time, it is fairly safe to trust one's visual judgement when navigating the field, moments such as this require additional navigation tools. Equally, wayfinding by means of maps is also unsuccessful in these conditions, as the references, such as tracks, rivers, or marshland, that support navigation have often disappeared under the snow or disappear once one has veered off the main paths and entered the forest.

Depending on their experience with the environment, the biologists use a combination of maps, tools, and techniques to navigate the study areas, where there are usually no signs or markings to guide the way; nor can they rely on smartphones for navigation because they run the risk of a flat battery or lack of signal. Without reliable devices and knowledge of the landscape, new biologists would easily become lost in the study area. Thus, wayfinding, based on spatial and visual orientation during fieldwork, is a vital skill that must be developed first.

In the anthropology discourse, wayfinding in the sense of spatial cognition is often and quite generally separated into route knowledge and mental maps. Route knowledge,

also referred to as 'practical mastery', 'permit[s] generalizations and inferences beyond the specific spatial information gained through direct experience'.[20] Mental maps, which are also associated with 'survey knowledge', work as 'cognitive representations of the spacial relations between objects',[21] and are thus 'survey, configurational, or layout knowledge as opposed to route or sequential knowledge'.[22] The mental map is also characterised by the ability to make shortcuts, detours, and point out relevant landmarks and 'the gradually changing vistas along the route'.[23] This knowledge is based on experience with the environment, which 'enables a subject to find a novel and more economical route [...] the ability would be absent if he/she had only route knowledge'.[24] Thus, it is understood as 'the process of moving from one recognized visual perspective (vista) to another (transition between vistas)'.[25] In this sense, when new biologists join the study, they must first develop their wayfinding practices and the spatial cognition required to navigate the field.

> The novice becomes skilled, not through the acquisition of rules and representations, but at the point where he or she is able to dispense with them. They are like the map of an unfamiliar territory, which can be discarded once you have learned to attend to features of the landscape, and

20
Gary Allen, 'Spatial Abilities, Cognitive Maps, and Wayfinding: Bases for Individual Differences in Spatial Cognition and Behavior'. In *Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes,* edited by Reginald George Golledge, 46–80 (Baltimore: Johns Hopkins University Press, 1999); as cited in Istomin and Dwyer, 2009a, 32.

21
Kirill V. Istomin and Mark J. Dwyer, 'Finding the Way: A Critical Discussion of Anthropological Theories of Human Spatial Orientation with Reference to Reindeer Herders of Northeastern Europe and Western Siberia', *Current Anthropology* 50, no. 1 (2009): 29.

22
Ibid.

23
Tim Ingold, *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill* (Taylor & Francis, 2000), 191.

24
Istomin and Dwyer, 'Finding the Way', 32.

25
Ibid., 29.

can place yourself in relation to them. The map can be a help in beginning to know the country, but the aim is to learn the country, not the map.[26]

Physical maps and navigation tools may be used to obtain an overview. In my case study during the first few days, they are essential to navigate the landscape. However, 'to learn the country', and develop a mental map and route knowledge, the biologists slowly have to evolve from studying the GPS for guidance to observing the landscape and memorising landmarks as reference points to navigate between bird territories.

During wayfinding, the biologists combine route knowledge with survey knowledge, which they gain from maps. Finding the way requires a certain geographical literacy[27] and spatial cognition. The most frequent combination of navigation tools I observed is a combination of a GPS and a map of the three study areas, *Managed, Reivo,* and *Fat Road*, as they are glued into the field notebooks (Figure 16).

These maps are highly formalised and offer only an approximate representation of the actual territories. They do not help the biologists navigate, unless they have prior experience with the study area and have already developed a mental map that they can follow to some extent. The schematic maps of the study areas by themselves are not meant to provide orientation but rather to help plan the study and maintain an overview of the progress made in the individual territories. To compensate for their shortcomings, they are usually employed in conjunction with a GPS. Locations where other biologists found birds' nests

26
Tim Ingold, *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill* (New York: Routledge, 2000), 415.

27
'The ability to understand, process, and utilize spatial data is termed geographic literacy, a skill that plays a significant role in our everyday lives whether or not we are geographers'. Sally Turner and Joseph Leydon, 'Improving Geographic Literacy among First-Year Undergraduate Students: Testing the Effectiveness of Online Quizzes', *Journal of Geography* 111, no. 2 (2012): 54, https://doi.org/10.1080/00221341.2011.583263. It involves 'geographic knowledge and geospatial recognition'. Thus, it encompasses the ability to employ geographical language and visual and spatial skills.

the previous year are marked with emojis in the GPS, for example 🍺 (a beer jug emoji). This is usually also the spot where the biologists want to work with the birds.

All the biologists have access to the same digital maps of the correct locations where they collect data every year, even if their individual mental maps and orientation change. Thus, they can all share, use, and edit the information. The topography of the site is also represented on the GPS maps, which helps in difficult situations, for example, when fieldworkers must cross snow-covered rivers or find a specific path. However, a GPS and geographical literacy alone are insufficient. A greater sensory attunement to the landscape is necessary for fieldwork. The biologists need to 'learn the country', and develop their own spatial orientation, which works somewhat independently from additional tools. Only once the biologists can stop studying the tools for guidance can they attune to the environment and navigate efficiently, and thus focus on the birds.

Michael has acquired extensive survey knowledge based on mental maps and routes, and is aware of the importance of this geographical overview. He knows that orientation of the study site is vital for navigating the field successfully and not being distracted by tools and becoming lost. A mental map also helps to identify and imagine locations on the maps (landmarks) more easily, while the combination of mental survey knowledge and maps facilitates phone conversations during fieldwork or when planning in the mornings and evenings. Thus, Michael uses the opportunity to help the team develop their survey knowledge and mental maps whenever we are driving in the field car, passing parts of the study area. He repeatedly points out where the study area starts by saying 'here, where you can see this treeline, is where our study area begins', drawing an invisible line along the trees ahead of us with his hand, which is divided by the street from which we are about to enter the study area: 'our study area'. With this, he relates the territory to the surrounding envir-

onment. This oral and visual marking of the area is followed by pointing out specific territories along the street, naming them, and – often on my request – telling an anecdote about them, usually those that explain the territory names.

We drive past the village Akkavare, where Lindgren, the primary school teacher who observed the jays until he died in 2017 at the age of almost 100 years, grew up. Michael points out the wooden cottage where he grew up, honouring his work. He also draws our attention to the bird territories around the village where Lindgren undertook his research: 'Folke's birds'. Michael does this mapping task almost every morning while we drive. As soon as we enter the study site, he informs us that we have now crossed the (imaginary) border.

These small sequences of enskillment are often accompanied by comments on how the forest management has advanced and how it has influenced the study area; thus also highlighting the changing vistas and the problem that the spatial orientation may be affected if vistas disappear with this transformation of the environment. This eliminates the connection between the vistas and the biologists' geographical survey knowledge, as their reference points have disappeared. Again, Michael points in their direction while driving, marking geographical locations that his peers may add to their spatial knowledge and that together may constitute their survey knowledge and mental maps. Despite his knowledge of the area and the local politics of Arvidsjaur, he occasionally seems surprised that the forest is gone. He provides background on the political and economic situation in Sweden and how landowners often decide to fell their trees for money without thinking of the consequences, despite a low market price for wood (although it has more than doubled since 2020).[28]

28
While in 2020 the prices for wood were still rather low, since that time the prices have risen by at least 50–70%. According to Michael, this has partly positive short-term impacts on deforestation. In particular, the private owners of the forests see them as a long-term investment, and have reduced deforestation because they expect the prices to rise even further. However, the state forest company, Sveaskog, continues cutting down the forests mostly to meet the high demand for paper, according to Michael (cf. zoom interview, 23 May 2022).

What the entrepreneurs consider a commodity is, for Michael, the habitat of his birds – something that requires protection for his study to continue, in addition to his broader commitment to preserving the environment and local ecology, shared by his scientific peers. The conflict between Michael's work, the way he perceives and uses the forest, and the entrepreneurs becomes visible during these short car journeys and will accompany our fieldwork, particularly in the 2020 study.

Wayfinding with Michael, Marine, and Camille

On the first day of fieldwork in 2020, Michael, Marine, Camille, and I drive to the study area, *Managed,* to put into action what had been planned and discussed at the kitchen table that morning. Michael parks the car near the best access point to the bird territories and we unpack the wooden touring skis we use to move through the forest, secure our leather boots in the metal binding, and make our way towards the bird territories.

The four of us ski along a forest road towards the first territory we shall observe this season, *Kara*. On arrival, Michael starts calling for the birds by making whistling sounds and attaching a feeder on a tree. Marine and Camille, who have now entered the mode of situated enskillment, focus on what Michael is doing. He first gives advice on how to study the birds. It appears to me that his training method is not a didactic step-by-step guide, but rather one of 'learning on the go'. He comments on everything he does and explains why he does it, occasionally sharing advice on how to approach the field in general. Marine and Camille stand next to each other, a short distance from Michael, and start imitating what he is doing; looking at the birds that now are starting to arrive through their binoculars and making their first notes.

Standing here in the low sunlight of Sweden's winter sun with Michael, Marine, and Camille in Spring 2020, I am reminded of my first field day in 2015. Michael had invited me to accompany him for fieldwork, while Julian was training Kate. Once we had dropped them off and arrived at the place where we would enter the study area by car, we put on our skis and our backpacks filled with our equipment. Back then, I was a complete novice. Not only did I barely know what would be expected of me during fieldwork, I had also never used the kinds of skis that we were using to move through the field. Once I locked my slightly-too-big leather boots into the clunky metal bindings, we started skiing into the forest. I vividly remember how, without any advice on how to use the skis, Michael set off at speed into the forest, following his spatial knowledge and disappearing before my eyes. Despite being a good skier, I was struggling to keep up with him. This was the moment I realised that this was not going to be an easy trip. It was going to be work – fieldwork – and Michael had just entered the field. From now on, he was in fieldwork and data-collection mode. This had top priority and, as with everything else, I had to align with it.

Michael suddenly changed direction, leaving the small path we were following to head deeper into the forest. He made this decision based on route knowledge, probably vistas, alone. He then slowed his pace and suddenly stopped. As he hung up the fat on a suitable tree (Figure 25), he started calling the birds and looking through his binoculars. After a few moments of whistling, the first birds arrived. He identified the first bird as female, looking through his binoculars and studying the coloured rings on its legs. He commented that the bird was still timid, and he identified the bird sounds in the background as that of willow tits that also live in the forest. Sometimes we would hear the calls of owls or ravens, both predators of the Siberian jays and a possible reason for their absence. We continued wait-

ing until more birds arrived. Then, once the entire group of birds was present, Michael began formally observing their behaviour. He commented that they were mobbing one another and that he was now focusing on their social behaviour within the group. Back then, he also checked his GPS to see whether the feeding spot was marked on the map.

This scenario surprised me the first time because I could see no indicators of why we had stopped at that exact location. Thus far, I had imagined that we would walk through the forest until we saw some birds, whereafter we would study them through our binoculars. However, Michael and his team followed an entirely different process to what I had imagined. There was a specific procedure with clear aims on where to go, and we never wandered aimlessly through the forest looking for birds. It was the other way around: we would go to where the birds should be, attract them, and then study them. There was no 'searching' for the birds, but rather 'calling' or 'checking for' them, as Michael refers to it. He attracted the birds to where we were, and, as I learnt later, Michael knew from experience that this small spot between the trees, away from the paths, where he had decided to stop, was the centre of the first bird territory that we visited that day. It would be where the nest would be located in summer and where we would now set up the fat to attract them (Figure 26).

Now, in 2020, I am again standing in this cold but beautiful scenery of Arvidsjaur, and it is the first field day. Being surrounded by the landscape, sounds, sights, birds, snow, and trees, and with my feet attached to the skis, evokes memories of my previous field trips. Now, Camille and Marine must become enskilled, and Michael suggests that one goes with him and one with me, as I 'half know the deal', according to Michael. Before we split up, Michael explains to Camille how to get to the territories, named *Troll* and *Måskomyran,* where we shall meet later. They are

standing close together, studying one of the small maps of the study area that they have glued into their notebooks, as I had done with Julian at the kitchen table before my previous field trip with them. Michael does not use the maps for guidance, but rather to show Camille where to go. He names the territories, points to their location on the map, and describes the route. The way he explains the route to us reveals his route knowledge, as he points out specific vistas, details on the path, and landmarks that help with orientation.

In this way, he not only describes the route, but is also forced to recall the route by heart and thus update and actualise his own mental map and route knowledge; and, as today is the first day of fieldwork, probably also activate it. Over the next few days, Michael will also pass on his perception of the environment and the aspects to which he pays attention by pointing out specific vistas and landmarks when describing the routes to Camille and Marine. Furthermore, as they attempt to follow his directions, Marine and Camille develop mental maps based on the same indicators. In this way, route knowledge is passed on between peers, thus contributing to the situated enskillment of the fieldwork in Arvidsjaur.

I am not engaged much in this process; my duties are limited to helping Camille with the more specific practices of attracting Siberian jays, such as setting up the observations and documenting them. Accordingly, Camille is in charge of the route, as I have only a basic idea based on the directions Michael gave us before we walked off into the forest by ourselves. Camille and I fail to attract birds in *Troll*, where we navigate to with the additional help of a GPS (Figure 27). We return to *Kara* and swap teams, where I go to the next territory with Marine. On our way, we stop and whistle after what felt like 900 m, which Michael had asked us to do on a phone call. A bird crosses our paths, flying above our heads. We identify it as a Siberian jay and

note that it seems to be wearing coloured ring markings (IDs). We keep calling for it, and Marine tries to trace it through the binoculars. However, it flies away and she does not manage to identify it. When we arrive in *Måskomyran,* where we all plan to meet again, we can only tell Michael that we saw a Siberian jay, not which one.

Marine

The next day, after we have headed to a few territories together, I set off with Marine. We follow Michael's instructions on getting to *Rågången*. We ski down a road until we arrive approximately where Michael told us to go. Now, Marine's mental map that Michael had started to develop with her the day before is insufficient and she takes out the GPS for more specific indications of the route. Before we left, she had typed in *Rågången* to get the directions. She checks the screen while I wait beside her, and then decides on a direction.

According to the GPS, we must follow a straight line into the forest for a few hundred metres. However, how does one ski in a straight line between bushes and trees without a horizon to focus on? Once we have skied a few hundred metres into the forest, we are lost and must completely rely on the GPS. Navigating with a GPS, while also being new to moving on skis that require both arms to use the poles and maintain balance, while also pushing oneself forward, proves to be difficult. I follow Marine as she is engaged in guiding with her entire body. Ultimately, we ski around the bird territory twice, in circles, as the tracks in the snow brutally reveal to us.

This wayfinding cost us time, which discourages Marine. She becomes frustrated and comments, 'Oh, tomorrow I will bring a compass! This is so inefficient with the GPS. I am used to maps and compass'. Moreover, the GPS works only

when moving, and it has a small delay, which is problematic when skiing. However, it is sufficient if we follow a straight line. The GPS also turns off when it is not being used, and every time Marine wants to check the screen, she has to start the device again and wait for it to turn on and update the location, which costs us a significant amount of time. Finally, the arrow on the GPS gets closer to the waypoint that marks our destination.

Once the arrow representing Marine's location and the waypoint of the territory overlap on the GPS, Marine and I set ourselves up for the process of behavioural observation (Figure 28). We drop our bags, take a brief break, and take out the equipment we need. Now Marine finally has some time to share her thoughts with me. She explains that 'the first days, it's always difficult, I have to get used to everything here first: the gear, the way I move, the weather, the codes for the behavioural observation. It takes a few days but I'll get the hang of it'. While she clearly has the professional knowledge, as she has done much fieldwork in the past, what she describes to me is her lack of the situated enskillment, which she only started acquiring today.

Situated enskillment involves the formal knowledge of data collection, and the knowledge of navigating the field on skis while consulting a GPS. It also includes a sensory attunement to the landscape to understand where one can ski, and attunement to the birds. For instance, when it comes to determining where to set up for the observation, route knowledge is required, which results only from training, enculturation, and situated sensory enskillment. It also involves being able to read and identify clues in the landscape that help develop a mental map and improve navigation in the field.

En route to the next territory, which no longer follows any streets or tracks, Marine changes her navigation strategy once we are outside the dense forest and on more open marshland. She checks the GPS and then chooses a gen-

eral direction and a spot on the horizon; this is a skill she must have transferred from other experiences of moving through natural landscapes without navigational help. Even though it seems difficult to move in straight lines on the skis, we manage to reach the next forest line fairly directly in this way. Once we enter the forest, wayfinding becomes difficult again. Marine takes out the GPS and I follow her. Walking behind her, I can tell that she is struggling with learning to ski and simultaneously guiding us through the unknown landscape. She skis with one pole in her right hand to push herself forward, while the other pole dangles from her left hand, in which she is holding the GPS, drawing thin lines in the snow.

Guiding us closer to *Nadine,* the territory where we are going to meet Michael and Camille again, Marine's gaze switches between the screen of the GPS and the landscape, as she must be careful about where she goes next, avoiding walking into bushes, falling into rivers, or colliding with trees. She continuously shifts her attention between the GPS and the environment, sometimes navigating difficult terrain because the GPS is not always an exact representation of the territory. However, to collect information from the immediate environment, she must develop her own spatial cognition for this study area. Her solution of combining the GPS for general direction with landmarks and vistas as further guidance appears to be a smart one.

The way the GPS is designed makes it appear to represent every tree, bush, fence, and river on its maps, so that one can move safely and efficiently through the territory by simply consulting the map and following the arrow. However, the GPS is not that precise and is not always updated. We discover that the GPS is of no help when we want to cross a river because it lacks this precision. We then return to our visual judgement without any technological assistance and decide that the snow pile a few metres further down the river is most likely the bridge. We manage to

cross it successfully, uncertain of whether the pile of snow we crossed on skis was actually the bridge we had been looking for, or if perhaps it was just a tree that had fallen over the river, or some ice and snow that had turned into something resembling a bridge, a similar experience to one I had with Kate in 2015.

Interestingly, this bridge has inscribed itself as a landmark in my route knowledge of the study area as we spend significant time studying the environment, thereby cementing it as a vista. This was necessary to gauge whether we were taking the correct and safest route. These moments of struggle are potentially decisive in developing spatial cognition. After having crossed the bridge, we finally see Michael and Camille waiting for us in *Nadine*.

Camille

In *Nadine,* we swap teams again and I accompany Camille. Having been to a few territories with Michael and on her own, she already seems more dexterous with the equipment than she did the previous day. Now she moves through the forest in a determined and self-confident way. After we left Marine and Michael, where we repeated all the steps of fieldwork together, we make our way to *Södra G.* We arrive via a small detour because we walked on the wrong side of what appeared to be a snowmobile path. We alert the birds to our presence with some whistling on arrival. Just before we stop, Camille double-checks the GPS to make sure that we found the correct spot. She then stops, removes the fat from her bag, and puts it up, while I set up a video camera with which she will record the behaviour of the birds.

After we have finished setting up, we stand next to each other silently, as we do on many more occasions over the following days. Camille is looking at the trees through her binoculars, while occasionally breaking the silence by whistling.

I am taking notes in my field notebook to document what she is doing, the set-up of this territory, the weather conditions, and my thoughts. After a few minutes of whistling, which I occasionally join, and just after our first thoughts of leaving the territory, thinking that the birds will not show up, the forest is suddenly filled with life. Between the tops of the trees, the birds invade our surroundings one after the other from all directions, diving towards the fat Camille has put up. Once they start feeding, the birds settle, peck at the fat, fly away, and return a second later; they dismiss other birds, revealing their hierarchies. Flapping their wings, they twitter, and jump between the snow-covered ground, the fat, and branches of the trees.

Sometimes, this spectacle takes a rapid turn when birds from nearby territories arrive. Then, the scene turns into what Michael calls a 'fight'. Rather than all eating from the feeder together, the birds banish one another from it. This lively scene means that the biologists cannot use the data because they are not studying the competition between bird families. Despite this unplanned situation, Camille starts checking the colour-coded rings of the birds, notes them, and checks if all the birds of the group(s) are present. This at least helps to obtain data on the bird population and their cooperative behaviour. Most of the time, however, only one group appears; 'fights' are rare and occur only once every few days. If the correct group emerges for the territory, according to the data plots in Camille's field notebook, she starts observing them in a more formalised way based on the protocols for behavioural observation that Michael had introduced her to during the last couple of days. Once the relevant data have been collected, which I describe thoroughly in *Collecting* (Chapter 5), we continue our fieldwork approximately 30 minutes later and move on to the next territories.

This next territory, *G-stjärn,* is close to a snowmobile path where the snow has been flattened into a small road that serves as a landmark we can follow without much addi-

tional navigation. It is thus easy to find and follow. Now, the forest becomes less dense. On arrival in *G-stjärn,* we manage to find the tree on which the biologists from the previous year must have put up their fat. The wire is still attached to the tree, which becomes an unintentional landmark and affirms that we have arrived at the correct location.

To both of us, this seems a rather unusual territory for birds because it is somewhat unprotected and right at the edge of the forest. Nonetheless, we start whistling to the birds. We both feel confident that we are at the correct spot, as the wire on the tree reassures us, more so than in other locations. We continue whistling and look up into the trees, Camille with the help of binoculars and I with my bare eyes. Then we take a break from whistling, let the silence sink in for a moment, exchange a glance and then start calling to the birds again by imitating their noises. It takes a long time; the sky is grey, and the missing trees create a bleak scene.

The conflict between the biologists and the landowners who have felled the old, tall pine trees for profit becomes visible here. It appears we are standing right at the boundary where it is not quite clear whether the forest with the bird territories will remain, whether it has already disappeared, or whether the trees that form the edge will be felled next. The birds do not appear today, even though we are positive that we are right in the centre of the territory marked by the wire – Camille double-checks on her GPS and concludes that the birds may have changed territory owing to the invasion of their habitat.

This conflict is not merely one between biologists and landowners. The sight is also reminiscent of a historical conflict between landowners and the Sámi people. It had long been disputed whether landowners have logging rights or whether the Sámi were granted reindeer grazing rights in several areas of the Sápmi region. Only in 2011 did the Su-

preme Court decide in favour of the Sámi for the region of Västerbotten,[29] which lies around 50 km south of Arvidsjaur. Wood is not the only raw material of value in the land of the Sámi; other critical materials are mined. Following the Critical Raw Materials Act of 2023, so-called 'essential mineral supplies crucial for the EU's green and digital transitions'[30] are extracted here. Moreover, it is also a popular region for governments and industry to develop hydro and wind power.[31] As such, the Sámi are suffering not only from the impacts of climate change on their lives, which are shaped by Indigenous practices, but also from green colonialism. Let us return to the forests of Arvidsjaur and the Siberian jays.

On our way to the next territory, *G-liden,* the impact of deforestation becomes even more extreme. What is marked as a dense forest on the GPS reveals itself to us as vast, open land. Where we expected to encounter trees and groups of birds, we find ourselves standing in a wide, open area covered in snow, with a few individual trees left in the centre, almost as a reminder of what once used to be there (Figure 29). The GPS indicates a dense forest, but this is not the reality. Here, the vista has changed; and while Camille does not know any different, as she is here for the first time, Michael will have to update his route knowledge when he arrives. While Camille does not require any *updating,* as she must first develop a mental representation of the landscape, Michael's existing memory of the landscape will be overwritten by its new version soon. This will not be in such a way that his memory will be erased entirely, but rather so that he becomes a witness to the

29
Eivind Torp, 'The Legal Basis of Sami Reindeer Herding Rights in Sweden', *Arctic Review on Law and Politics,* 1, no. 4 (2013): 43–61.

30
The European Parliament website, 12 December 2023 https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials/critical-raw-materials-act_en.

31
David Nathaniel Berger et al., '2 IWGIA – The Indigenous World – 2024', 2024, 463–70.

'temporality of the landscape'[32] and its permanent transformation, knowing the past and the present appearance of this area. Through forest management, this landscape becomes increasingly inscribed with anthropogenic traces. This observation, again, will enhance the biologists' implicit knowledge of the study: making them experts in data collection from the birds and the birds' environment. This is not the only instance where some territories have disappeared owing to forest management.

When we share our observation with Michael later that day, he is surprised to hear that this section of the forest has been all but eradicated. I wonder how this will influence his geographical knowledge of the study area if such fundamental changes occur from one season to the next. In situations such as these, with all reference points having disappeared, Michael's oral descriptions no longer suffice, and Camille must revert to following the GPS.

It is easy to change direction and ski straight towards the next territory given that there are no trees in our way. In fact, I enjoy the way the skis carry us across the untouched snow without any of the usual obstacles. After a few hundred metres, Camille stops, checks the GPS, adjusts her direction slightly and continues towards the next patch of trees and the next bird territory to which Michael had directed us. Then, she receives a phone call from Michael asking us to come to the nearest street where he will pick us up. Again, Camille looks at the GPS, chooses a direction, and starts skiing with me following close behind. Cutting a straight line into the snow, we soon arrive at the main road, take the skis off, and wait for Michael to appear in the field car.

If one were to take an aerial photograph of our tour today, the lines we had drawn in the snow would reveal the network of bird territories, the trace of our day's fieldwork. The lines would also reveal that, aside from the first day with Marine, we did not have to navigate through difficult

32
Tim Ingold, 'The Temporality of the Landscape', *World Archaeology* 25, no. 2 (1993): 152–74.

territory and mostly followed straight lines: first on the snowmobile path and later through the bare forest. We drew straight lines because there were no obstacles or trees to navigate around, given the forest was gone and, with it, some bird territories. These traces will eventually also change the biologists' wayfinding behaviour, as they offer new, temporary reference points for orientation and navigation.

Michael

Today we drive to *Reivo,* a nature reserve where trees cannot be felled; for this reason, wayfinding is different here. The paths are more challenging but the landscape is more unique, and landmarks and vistas are easier to identify. According to Michael, *Reivo* has 'the oldest birds, as the best forests are here'. The car journey to *Reivo* is longer. After around 20 minutes, we enter *Managed,* 'our study site', and pass Lindgren's house. After approximately 40 minutes, Michael parks the car next to a shed in a small village consisting of one house – nowadays inhabited only on weekends because the owners work during the week along the coast further south – and a farm. We have arrived in *Reivo* (Figure 30).

In *Reivo,* we unpack our material, pull the lever to secure our leather boots into the ski bindings, and, with Michael leading the way, enter the study site as a group one last time. After a small ski tour, following a path through the dense and beautiful winter forest of *Reivo,* Michael stops. He does not double-check but seems to know that we have arrived at the bird territory, *Maderängen,* which is near the path, thus offering a prominent landmark. Together, the biologists begin attracting the birds through a rich pattern of calls. The jays arrive quickly, which is often the case when Michael is around. Over the next 15 minutes,

he again shows Marine and Camille how to record their observations. The three of them stand beside one another, and while Michael installs the camera, Marine and Camille begin observing the birds, switching their gaze between their notebooks and the birds – with the help of binoculars, this practice has become much more routine now. Michael explains how the camera should be positioned to film the birds and what should be in the frame (Figure 31). He then comments, 'I will break the branch off', finishes his set-up, and walks towards the tree that is in the way.

Once this is done, we discuss who will collect data in which territory (Figure 32 a). The three biologists have their GPS devices on and notebooks open, ready to take notes. Michael defines clusters of territories that could be visited together, also describing the general characteristics of the route and the levels of difficulty and skiing effort it will take to get there. Again, he mostly speaks from memory rather than using a map with a geographical profile. He occasionally checks the map of the study site and uses it to show Marine and Camille where the territories are located. The clusters contain four to five territories each with some additional options if someone is fast. Those who enjoy skiing go to those that are farther away, while the others remain near the car. Marine heads to the easier territories, while Camille heads to the more difficult ones. Michael explains to Camille that *Norna* is very difficult to reach and shows her the directions on the GPS. He also mentions that if she does not want to go (Figure 32 b), Julian might be able to do this when he joins them in a few days, once Michael and I have left, as 'he likes skiing'.

In that moment, I remember the *Norna* study site, which I had gone to with Kate in 2015. It was one of our worst experiences. I was following Kate, who, without any route knowledge, had chosen an arbitrary path up the steep hill, simply following the GPS in a straight line. She did not pay attention to the properties of the landscape indicated

on the map because of a lack of geographical literacy, such as reading the map and the indications for altitude. While the route up was very steep and exhausting, coming back down was dangerous. I remember commenting on my bewilderment that Michael had sent us up there. I had drawn this route with a zigzag line into my field notebook with the comments 'up the hill, no birds, come up all the way for nothing'.

As for today, I decide to go with Michael to *Baggins, Take 5, Spång, Angel,* and *Laxtjärn*. I know that I have signed up for the longest and most exhausting route because Michael moves fast and only takes short breaks to maximise his efficiency. To update his mental map between one landmark and the next,[33] we reorient ourselves, as he usually knows the route by heart.

Today, to my surprise, Michael uses the GPS more than I have ever seen him use it. I asked him why this was the case and he answered that he wanted to get as close to the centres of the territories as possible so that Camille and Marine will be able to find the exact spot where he put the fat up when they return to this location in the following days. When guiding our way with the GPS, Michael's wayfinding expertise suddenly changes. Our route becomes less direct, and he stops several times to study the GPS; we even ski past our destination by a few metres and have to turn around.

During the rest of our tour through *Reivo,* once Michael abandons the GPS, he not only knows the most direct links between territories but also which route is best with the skis, and which shortcuts connect the individual territories. He knows which track is the most direct, what snow is easiest to ski on, where it is too steep to walk up on skis, and where zigzag skiing is required. In these moments, he changes his skiing method and, rather than drawing a straight line in the snow, he starts making sharp kick turns every few metres. The same thing occurs when we

33
Istomin and Dwyer, 'Finding the Way', 30.

go downhill. He does not seem to take new routes every year, but rather remembers the previous year's routes and follows them.

Julian, whom I accompanied in 2015, appears to be using the territory anecdotes to navigate to the territories. During the fieldwork, Michael discussed the research in general, such as the methods and objectives, while Julian would share anecdotes about his experiences over the past few years, and those of others, such as seeing an elk, which resulted in a territory called *Fat Moose* in *Fat Road*. Julian had worked in this study area before our study in 2015 and thus knew many of the anecdotes, which he could use, along with the maps in his notebook and mental maps, to guide to the territories, only occasionally relying on the GPS. When accompanying him, it was obvious that he had been in the area before and had developed a first mental map. He always knew where to go.

To me it seemed as though Julian was using the anecdotes as immaterial landmarks or vistas to remember the routes and landscapes. These stories enable him to relate to the environment, similar to how I remember *Norna* because of its difficulty, or the body of water in *Managed* that Marine and I did not dare cross. Thus, a network of narratives allows certain aspects of the field to be more easily recalled. This does not seem to facilitate wayfinding alone but also helps the biologists keep track of the characteristics of the individual bird groups. *Troll,* for example, refers to a bird that was difficult to find for several years and, as Michael told me, somehow represents all the birds living in that territory. Thus, these territory names play a much greater role than the biologists appear to give them credit for, even though they disappear when the research is published.

Maps

The maps that Michael had put up on a corkboard in the kitchen are designed in a simplified manner to represent the most essential aspects of the landscape, which allow the biologists to plan, structure, and discuss the fieldwork. They narrow down the scale of the study areas so that the biologists can conceptualise them and maintain an overview.[34] Thus, they extend the field to include the kitchen of the field house, allowing them to continue working with reference to the field even there.

All of the bird territories are marked on these maps, and Michael will mark in them the steps that have been completed each day. In the mornings and evenings, he updates everyone on the latest progress. In this manner, the maps will become the datasheets that document the progress of the research tasks. Thus, they serve as a reference to discuss the territories, routes, and tasks that the biologists must still complete. In the mornings before we leave, and occasionally in the evenings as well, Michael uses them to discuss who will go where and what to prioritise. He also uses the maps as a visual tool to provide more general information on the field. For example, they show where to park or which territories to combine when the fieldworkers are alone in the field once Michael and I have left. But for now, we remain in the field and focus on the data-collection practices that we will soon prepare for.

Following Previous Tracks

As the maps on the corkboard reveal after a few days, we have been to most of the territories in *Managed* and *Reivo* this season at least once. In the following days, we return to the territories and, accordingly, our wayfinding practices

34 Cf. Merz and Hinterwaldner, 'Neue Bilder, Modelle und Simulationen: Zwischen Repräsentativität und Produktivität', 303.

change. Today, when I accompany Marine, we do not rely on the GPS but rather follow tracks that we or our colleagues have drawn in the snow on previous days. We follow Camille's tracks, in which I can also see the traces of where she dragged her left pole when she was probably consulting the GPS. For now, we return to the bird territories for further observations. Proper data collection starts now because the first days were mainly practice to gain an overview of the study sites. The first territory Marine and I go to today is one that she has already visited. Thus, she knows where to go, and we can simply follow her previous tracks. Not having to rely on the GPS so much allows her to focus on other aspects. Marine is much more stable on the skis now, and seems more confident and regimented in her movements and fieldwork. There is now also time to study the surrounding trees and environment, which will eventually add to her spatial cognition and implicit knowledge of the field. She comments on the sounds we hear when we stop moving, and we talk more to each other than we did on the previous days. Despite coming back to *Mader,* we do not encounter any birds today, and we continue to the next territories by following Camille's tracks to *Basilika* and *Guorbavagge*. If we have sufficient time today, we will also go to *Fello*. Marine occasionally checks the GPS to ensure that we are following the correct tracks and again on arrival to confirm that we are at the centre of the territory. However, most of the time, we encounter a piece of fat on a tree or the ground that has been left over from the day before. When we get to *Basilika,* we find birds from the wrong territory and move on, after she has identified and observed them for a bit. During this observation, Marine comments, while studying a bird sitting close to her on a branch above her head: 'It's interesting how sometimes we turn into their subjects of study and they start observing us. I wonder what they are thinking.' Once we arrive at the correct location in *Guorbavagge,* we use our skis as a bench and sit between the trees.

While we wait for the birds to arrive, Marine comments on the tools and media that are often used in biological research: 'You miss out on so much if you spend all the time looking at a screen. You see so much more and become more confident when guiding according to the environment'. After a short break, she adds, 'It's so much better to just be there and watch the nature, you see so many more things and that is how questions come up. Digital tools are often only employed because people are obsessed with the technique'. This confirms what I had been wondering all along, if there is a *Type A* biologist, who is more technology and data driven, and a *Type B* biologist, driven by the actual fieldwork and data collection, which seems to be the case with Michael's project. From this perspective, the choice of tools, media, and methods is not only based on facts but also becomes a matter of taste, preference, and worldview.

On the final day of my fieldwork, the temperature display in the car indicates –22°C after a few minutes' drive, and I take photos of the display to 'prove' it. We drive through this cold morning towards *Reivo*. Every time the temperature drops even further, I take a new photo, and I end up with several. While everyone focuses on the display by peering around Michael's shoulders, he continues driving us towards our destination. The temperature has now dropped to –27°C.

Before we separate to make our way towards the bird territories we are planning to work in today, Michael gives Camille, who I am to accompany, and me some additional advice and guidance on how to reach the first territory. On our way to it, having followed our tracks from the day before for about 40 minutes and having crashed at least once each (as the snow has become very slippery and the wooden skis are difficult to control with their telemark bindings and no edges), Camille stops at some point. She peers into the forest, turns left and comments, 'Let's try

here'. To me, there was no sign of why we should 'try here'. It turns out that she had chosen the correct location to start walking up in a zigzag towards our first territory of the day, at which we arrive a few minutes later.

Now her movements on the skis and through the snow are regimented and confident. She appears to be confident in her navigation, knowing which routes are best to take and where to make a detour to get to our destination as safely as possible. Every time we get close to a territory, Camille takes out her GPS to double-check that we are on the right track. If we are close enough, and if another biologist has been there recently, she starts whistling to attract the birds. Marine told me the day before that 'now that there is fat in all territories we can whistle before we arrive. Without the food already installed, we would run the risk of teaching the birds not to listen to the whistling anymore if they then do not find any fat'. This is a new insight for me.

In the final few metres, Camille usually follows her gut, memory, or previous tracks, to find the fat that either she or someone else from the group has attached to the tree in the previous days. Occasionally, it has disappeared overnight, as ravens are also very fond of it. During fieldwork, Camille, who is usually quiet and focused when working, tells me that wayfinding is an easy task for Michael because he knows the routes by heart and is not distracted by skiing, which makes him very efficient. Camille usually follows the GPS and tracks from the previous day, and she already partly knows the territory as she has been to some places before, which helps her to navigate.

However, guiding through the field simply by following tracks does not always work. After a few days, there are so many tracks that it becomes difficult to know which ones are the correct ones. Of course, there are also tracks that are the result of someone having taken a wrong route or a detour. Accordingly, relying only on the tracks is not a solution.

Wayfinding always requires a combination of techniques that shift with the progress of the fieldwork and reflect the situated enskillment of the biologists.

Conceptualising Wayfinding Practices

Many anthropology scholars have studied the concept of wayfinding, including Alfred Gell, who differentiates between 'mental maps' and 'practical mastery';[35] Istomin and Dwyer[36] who distinguish between 'routes' based on 'vistas and transitions' and 'survey knowledge' based on mental maps; and Ingold, who focused on the 'dwelling perspective' of landscape as 'an enduring record of [...] the lives and works of past generations'.[37] However, this ethnographic study may offer new insights into the interactions between the skill of wayfinding and the tools that support this 'spatial orientation',[38] thus uncovering hidden agencies.

The process of wayfinding, as I have attempted to illustrate, is an important and highly complex requirement. However, it is neither formalised nor reflected on by the biologists. It is employed implicitly, with knowledge passed on through oral explanations and direct peer learning in the field. Wayfinding is clearly treated as a side effect. However, I argue that it influences fieldwork considerably. In this environment, the biologists cannot rely on smartphones or GPS alone to navigate between the territories. Wayfinding is also a highly sensory practice; it requires orientation skills through which survey knowledge of the study site is collected. It occurs through a combination of tools, landmarks, experience, research progress, general

35
Alfred Gell, 'How to Read a Map: Remarks on the Practical Logic of Navigation', *Man* 20, no. 2 (1985): 271–86.
36
Istomin and Dwyer, 'Finding the Way'.
37
Ingold, 'The Temporality of the Landscape', 152.
38
Istomin and Dwyer, 'Finding the Way'.

orientation skills, and skills in handling navigation tools, such as GPS and printed and, occasionally, hand-drawn maps (Figure 33).

Detours and iterations, becoming lost, and taking an indirect route are all part of wayfinding, and reflect the reality of fieldwork, which is messy, often redundant, and not always clear. Hence, wayfinding is a complex task often not captured in research papers. During the first days of research, the biologists must become attuned to the environment, tools for guidance, and practices in the field. As I observed with Camille and Marine, wayfinding turned out to be more challenging this time; particularly for the novices who were not yet familiar with the research and had to learn several practices in addition to developing a mental map and skills for orientation.

During fieldwork, I observed that new participants follow the GPS and maps closely to find the bird territories, whereas more experienced researchers can use their knowledge from previous studies to direct their routes. This changes their attention and perception of the landscape. More experienced biologists find their bearings largely through the help of natural markers, using treelines, rivers, rock formations, or other indicators as reference points. They continuously study changes in the landscape, collecting more informal information about the geographic conditions of the research territories, which then enhances their literacy of the field. Navigating between landmarks by means of maps and memory requires the biologists to study the landscape and surrounds. Landmarks can be either concrete, such as houses, paths, stones, rivers, trees, and anthropogenic infrastructure, or abstract, such as anecdotes. The better one knows a study site, the more embodied and implicit this process becomes, and the less wayfinding distracts from the data collection, birds, and features of the landscape. The GPS requires staying focused on the screen with one's head down until the waypoints have been reached.

However, landmarks and survey knowledge work only if the physical landmarks, or the context of the abstract ones, remain. Owing to certain events, such as forest management, even Michael, who has a strong mental map of the study sites, reacts with bewilderment when the forest has disappeared. Consequently, his route descriptions to others also become unreliable, especially if he does not yet know about the changes in the environment. The same can happen with a GPS. We encountered moments where the GPS indicated a thick forest, but we were, in fact, standing in a barren field covered in snow. Nevertheless, in this case, we could still use the GPS to navigate to our destination.

Besides landscape markers, the birds also help us to find the path in some instances, as we hear them twittering or moving in the trees, which usually happens before seeing them fly above us on our arrival. Accordingly, to navigate through the field, experienced biologists such as Michael and Julian use a mental map that allows sophisticated wayfinding that has developed in their minds over the years, along with a strong 'survey knowledge' that enables navigation between territories.

Depending on who I accompany, these tools and the way they are used differ. The choice of tool results in different ways of knowing the field and different metadata, as they evaluate the environment differently. The way the biologists collect route information is entirely different based on the method they use. This might not directly affect the research, affecting only the ability to get to know the field. However, it is one example of – often unintentional – filtering that occurs during fieldwork, ultimately leading to differently informed biologists. Lastly, it is highly dependent on the space and environment through which the biologists move, thus also adding to the situated practices and enskillment that constitute the capacity to do fieldwork.

4.3.2. Registering Birds

Having just drawn our last tracks in the snow before emerging at the road to which Michael had directed us, Camille and I are tired and cold. I am looking forward to going home, but Michael shatters this wish. He parks the car in front of us, greets us excitedly, and says, 'There are unringed birds in *Glottje*', and we shall have to go and catch them. He believes that this might be a new territory; thus, the field day is not over. From previous experience, I know that catching and ringing birds could take hours. We quickly put our equipment and rucksacks in the car, this time not being too concerned about removing the snow and ice from our skis or carefully putting them in the car. Time is more important right now. A few minutes after his arrival, we are already driving off towards *Glottje,* with Michael's usual, slightly rough, driving style, which does not always make me feel safe on the icy roads.

A few minutes later, he stops the car. Michael and Camille remove their skis while he gives me the car keys and tells me to pick up Marine. With the keys in one hand, I am standing in the forest next to the car that has been carelessly parked in a pile of snow, while Camille and Michael move off on their skis without telling me where to find Marine. Michael's mind is too occupied with the unringed birds. On my request, he gives me general directions on where to find Marine, and while we both have phones that would allow me to call her, I do not have a map or a smartphone with navigation with me, so I must rely on Michael's directions. In this moment I notice how dependent my daily life has become on my smart phone and digital technology.

Michael and Camille disappear into the forest, and I drive off. Just as I go past the location where I should have picked up Marine, I see her emerge from the forest in my rear-view mirror. Eventually sitting in the car together, we are relieved that we found each other. Back in *Glottje,* I park the

car, and Marine and I put on our skis and follow Michael and Camille's tracks; we find them a few metres into the forest. Ringing the birds, thereby registering them for the study and making them part of the research, will be the final task for the day before we make our way home, which we will be doing in roughly two hours.

Here, in *Glottje,* Marine and Camille will learn how to ring the birds, a necessary task for consistency in the data. To note observations on the birds, the biologists must identify them as individuals; therefore, they put small, coloured plastic rings and one aluminium ring with a number code on their legs, for which Michael has permission from the Swedish Museum of Natural History in Stockholm. Most fieldworkers have experience in this ringing task because it is a widespread practice in behavioural ecology. However, ringing differs greatly according to the species of birds and their size and agility. It is something that cannot be taught in universities but has to be practised and experienced in situ (in the field). Accordingly, this next situated practice requires sensory attunement and alignment with the birds. The rings cannot be forced onto the birds, and it requires several steps – catching them being one of the most difficult ones.

Michael and Camille are already setting up the net with which they are going to catch the birds. I witnessed the catching process several times in 2015, and I stand some distance away to observe the event. Watching them, it becomes clear that, this time, it is not a collaboration between one expert and three novices, but rather three experienced field biologists. However, Marine and Camille, who are experienced field assistants, have never worked with Siberian jays, which are smaller and 'a bit fiddly', as Marine comments later once they catch them.

The thin black net that Camille and Michael have set up is fixed on two poles that divide the forest into two parts. I never measured the net, but from memory I estimate

that it is 9 × 2.5 m. Thus, a 30-m² trap has now been positioned in the centre of the bird territory. The hierarchy between birds and biologists that is always implicitly at stake during this study now becomes manifest. It is only a matter of time before the first bird will be caught in the net; its only way out is with the biologists' help. Indeed, one bird soon becomes too excited about the food that has been placed around the net, and even in the net, as bait, and it becomes distracted and flies straight into it (Figure 34). Now its life depends on Michael, Camille, and Marine because it will freeze to death if it remains trapped for too long. Fortunately, they have mercy on the small, hopeless creature. Its death would also mean the death of data. It is in the biologists' own interest to save the jay and carefully disentangle it from the net while they wait for the other birds to get caught. The net almost literally forms a boundary between the Siberian jays as *free* living birds in the forest and the birds as research objects. Once the rings have been attached to their legs, they become naturecultures, permanently transcending the boundary between free living birds in *nature* to birds as research objects for scientific interests, as *culture*.

Catching Birds: Skilled Touch

Watching the birds fly into the nets, one can tell how surprised they are. One can almost see the fear in their eyes as their movements suddenly become more frantic. There is an exhausted flapping of wings, while the yarn wraps tighter around their small legs as they dangle upside down. The more the birds move, the more entangled they become. However, Julian had told me that the net is designed to prevent the birds becoming too entangled and getting hurt.

At some point, the birds appear to give up, drop their small bodies entirely into the net, and end up dangling upside down or lying on their backs. However, a few moments later, just when I think that they have calmed down, they attempt to flap their wings again to escape from their trap. Some downy feathers fall from their plumage, drifting slowly down until they silently hit the ground. This growing exhaustion will then be followed by the touch of two hands that, other than what they may think, will ultimately help free them; however, not before further treatments. Not only are the birds and I stressed about the situation, the three biologists also seem more alert, focused, and slightly nervous during the scenario.

Michael detangles the first bird from the net with dexterity and experience, giving it a quick stroke, and then putting one hand around its body and wings so that it cannot move much; at the same time, it seems as though his hand is also protecting the bird in an effort to calm it down. During this process, Michael often speaks calming words to the birds while he holds them up at eye level or comments on their weight and sex. If it is a heavy bird, he considers it male, while the lighter ones are considered female. With one movement, he then opens the bird's tail feathers into a fan and picks one for analysis, commenting 'it will grow again'.

Marine and Camille are standing beside Michael, observing what he does, while he comments on each step and explains how he is handling the bird. He then slides the bird into a little cotton bag and attaches the feather he plucked to the bag and hangs it on a nearby tree (Figure 35). Judging from the movement of the bag, the bird appears calm, and if one did not know, it would be impossible to tell that a living animal is inside. The second and third birds fly into the net shortly after one another; Camille and Marine remove one bird each, while Michael observes their skills, making sure they are doing it cor-

rectly and, if necessary, advising them. In general, he does not intervene much and lets them practise working with the Siberian jays.

A while later, three cotton bags – in different shades of blue and green and each containing a bird – dangle from a branch beside us. The birds sporadically become more active, briefly flapping their wings, before giving up again. With this, the first step of ringing the birds has been completed; now the actual ringing and measuring can proceed, and with it, Marine and Camille's process of enskillment.

Ringing and Measuring Birds

Michael sets up the 'ringing station' by removing his skis, something we hardly ever do during fieldwork because the snow is usually too deep and the skis are necessary to disperse our body weight and ensure that we remain on top of the snow; Michael does this only to ring the birds. However, removing the skis is also pragmatic: when the two skis are stacked next to each other, they serve as a bench. Shortly after taking them off, Michael stamps a deep hole on one side of his skis and a smaller one on the other. Sometimes, he places a small rubber mat across the two skis, but today he simply puts it on the snowy ground to sit on; he calls it his 'flexible fieldwork bench'. Before he finally sits down on the mat, he makes the hole a bit deeper to perfect his design. The small hole is now behind him so that his back does not touch the snow and he does not become wet or cold. Watching Michael sit there, it strikes me that it is rare to see this agile person, who never rests, sitting down. Camille and Marine imitate Michael, positioning themselves to his right and left. They have created a group of three benches or snow seats, where they now all sit next to each other, ready to progress to the next step of situated enskillment by registering the birds (Figures 36 a–q).

Before Michael rings the first bird, he selects three pre-printed measurement cards called ringing sheets with new colour codes on them (Figure 37); they also include spaces where Michael records the necessary measurements. Before Michael decides on one ringing sheet, he makes sure that the colour code is sufficiently different from the existing ones near this territory and those that the three biologists plan to put on the next two birds. This is important so that when they observe the birds through binoculars later, it is easy to tell them apart. Michael explains to Marine and Camille that 'pink, orange, and red are difficult to tell apart, especially once they have fainted out'. He also checks that the colours are sufficiently different from that of the nearby territories, in case they attract the wrong birds in the future, which occasionally happens. The colour codes are not chosen arbitrarily but require experience for smooth data collection in the future. This is the result of prior occasions where the field biologists struggled to identify the colour codes of some birds. Knowing that this must be considered is clearly not a result of formal training but rather the result of situated learning and knowing. Once all these aspects are considered, Michael decides on the three sheets. Camille and Marine follow this process with their own field notebooks open to check on the existing ring colours. They listen quietly as they begin shivering slightly from the cold. Now the ringing starts.

I get up to select one of the three bird bags still dangling from the tree. I do this carefully to avoid disturbing the bird too much, and bring the bag over to the group. Michael slowly removes the bird from the bag (Figure 36 a), using the same careful movement with which he had put it into the bag. With an invisible grip inside the bag, it appears as though he manages to wrap his hands around the bird's body, including its wings, in such a way that its legs are between his middle and ring finger. Knowing how to grab

the fragile bird bodies in the bag is a matter of embodied skill. This can be acquired only through situated training, as this sense varies depending on the bird species and the environment, which, here in Sweden, for example, numbs the fingers and necessitates working with gloves whenever possible. However, this is only a means to an end, which will no longer be of importance to the biologists when the data are being processed in their offices.

I have observed this way of holding the birds many times in the past. This bird, however, tries to resist and bites Michael's fingers. He calls out indignantly and then uses a trick that appears well-practised: he substitutes a piece of his trousers for his finger. It seems to work and the bird continues to bite the fabric.

Once he has the bird under control, Michael puts the feather that he plucked earlier on top of his ringing kit. To avoid mixing it up with the other birds' feathers, he asks Marine to write down the colour and number code that he will attach to the bird onto a piece of tape, which he sticks in the field notebook along with the feather.

However, before this, the feather remains untouched, and Michael puts the aluminium ring with the number code and the three colour-coded rings onto the bird's legs. He explains that he chooses this order, because if the bird manages to escape, the aluminium ring itself allows for identification, whereas the colour codes work only in combination. In this way, he ensures that the bird can be turned into an inscription. Once the number rings are attached to the birds' legs, they can be individually identified; even though, for now, this would still mean having to catch them to read the numbers on the aluminium ring. Once all four plastic bands have been carefully attached to the birds' tiny feet, he closes them with glue.

Next, Michael takes a blood sample, which will be analysed by a lab to confirm or dismiss his first guess on the sex of the birds. For this, he opens the bird's wing and rubs

some snow on the area that he plans to draw blood from to disinfect and numb it. He takes a small cannula to carefully puncture the bird's vein (Figures 36 f–h). He then replaces the needle with a small tube to draw a few drops of blood. This is a difficult task as blood does not circulate as easily in the cold temperature, and it requires some experience. Usually, as I witnessed many other times, Michael can do all these tasks with a bird in one hand while working with the other (Figure 36 i). Marine and Camille assist him, thus learning the individual steps.

To measure the bodies of the birds (Figures 36 j–p), Michael uses a calliper and a ruler, and Camille writes down the numbers he says out loud. He comments on each step and talks Camille and Marine through what he is doing. He says not only what it is that he does but also why, what for, how, and what to avoid.

Once all measurements have been taken and the bird has been marked with the rings, just before Michael lets it fly off, he talks to the bird one last time and says something along the lines of 'well done', 'here you go, get some of your favourite dish' (Figure 36 p). He strokes it one last time from head to tail, and the bird, which has now become calm, is set free again. Each bird reacts differently to the procedure: some fly off straight away, while others remain for a few seconds before they escape. Some twitter and bite the biologists throughout the process, while others seem calm and relaxed.

However, something has changed. The birds with the colour rings have become research subjects, but only in relation to one another do the scientists and the birds 'intra-actively co-constitute'[39] one another. In this sense, they are entangled with each other. The birds form part of the study and deliver data, but only in relation to the biologists studying them. They shape what becomes bird territory and, in turn, influence how the study areas develop. In these settings, biologists and Siberian jays are 'bodies in

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Barad, *Meeting the Universe Halfway*.

the making' that are 'never separate from their apparatus of bodily production'.[40] In this sense, the learning environment here goes beyond the mental processing of oral explanations; it is a practice-based process of enskillment and enculturation that integrates cognitive, bodily, and sensory learning. Through this enskillment, the biologists' cognition changes and they also become part of the study. This aspect is still widely rejected in traditional discourse on objectivity. However, a situated perspective on scientific knowledge production elucidates the role of the body as sensory and bodily practice. And, with the registering of the next two birds, which Marine and Camille will do, they and the birds will become further entangled in the knowledge production and part of the scientific apparatus, as it is shaped in this study.

Marine and Camille are sitting on either side of Michael, while I am standing in front of them, occasionally sitting down on my knees when I want to be at eye level with them, and then standing up again and moving around to warm up. Each assistant holds a slightly dirty green or blue cotton bag, with two bird feet sticking out of it. They use a different technique from Michael and simply put the bag over the birds' heads and wings to keep them under control. Then Michael talks them through their first ringing practice with the jays. Marine and Camille clearly have experience. Occasionally, Michael helps accelerate the process, as everyone, and possibly even the birds, starts to grow unbearably cold. Towards the end, he takes over entirely, so that everyone is released from the biting cold that the early evening hours bring. However, through this initiation, Marine and Camille have undergone sensory and bodily enskillment to register birds and, thus, advanced one step further in their situated enskillment.

After both birds have been successfully measured, and added to the study, they are set free. This process goes faster than with the first bird; these jays rushed slightly to receive

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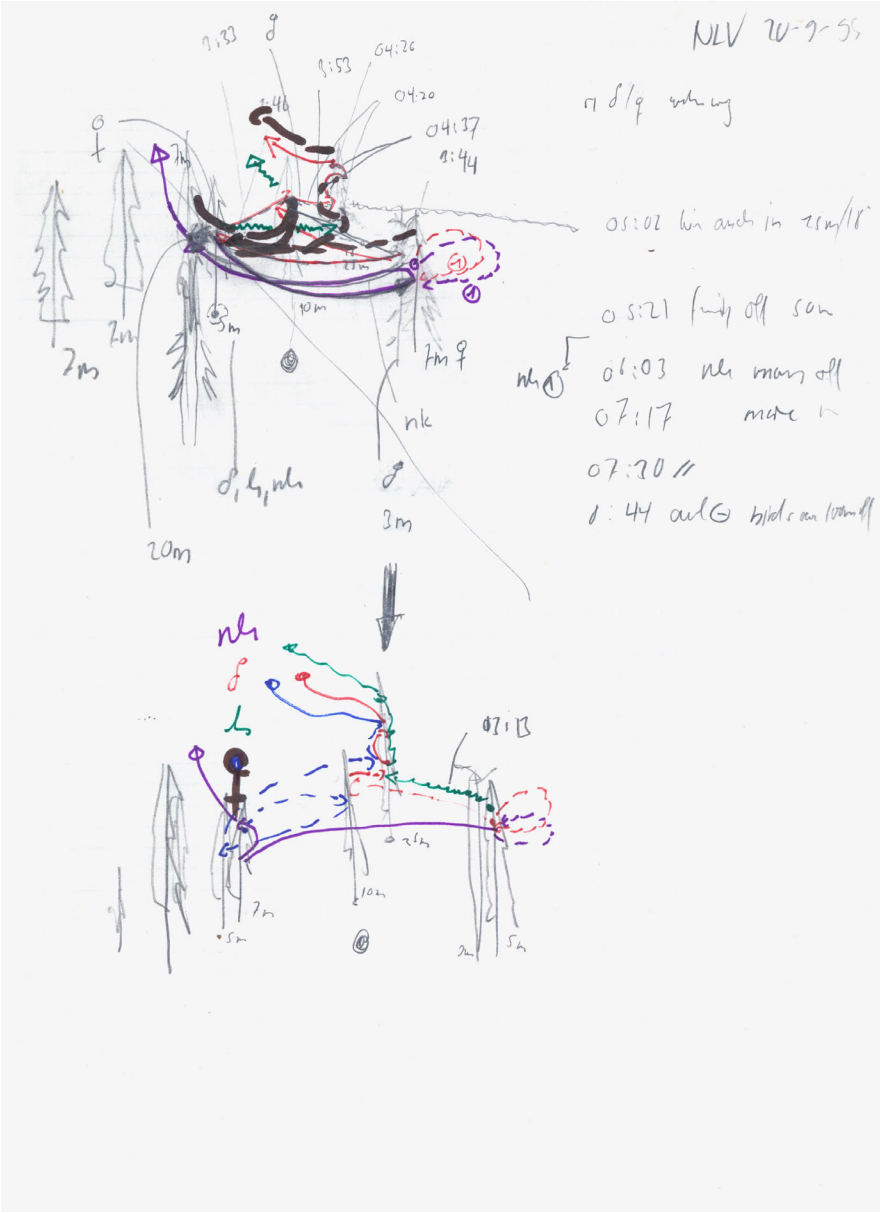
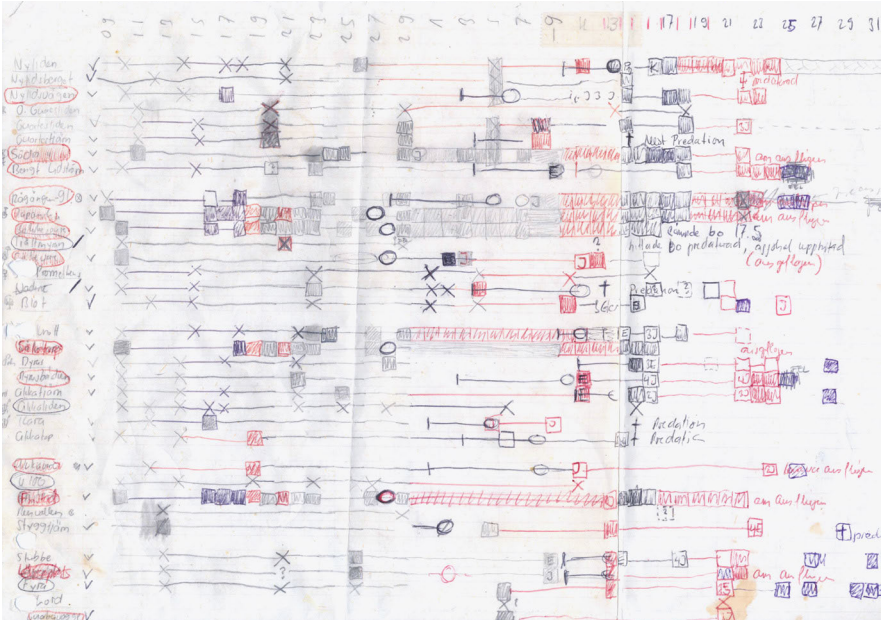
Ibid., 158.

some food and a comment of appreciation from the biologists, before flying off. The four of us quickly pack up and rush to the car, which will not get warm until we arrive back at the field house. Once at the house, we revisit the field day at the kitchen table, as we do every evening. The biologists empty their rucksacks and pockets and cover the table with blood samples and notebooks to check if everything has been marked correctly. Michael shows the assistants where and how to store everything and puts the blood samples in the freezer (Figures 38 a–e).

The material on the kitchen table, which creates a direct connection to the birds, is not only evidence of today's fieldwork but also marks the starting point of a transformation: three Siberian jays whose identities have shifted into those of research objects. They are not only birds of the boreal forests anymore; they have been assigned new identities as research animals. Thus, not only have their duties changed, but a specific relationship between them and the biologists has been created, one in which the birds shift between being Siberian jays as subjects and research objects that will provide the biologists with data twice a year. As subjects, with an individual identification based on the rings, the biologists engage and interact with them, as can be seen during the ringing task. However, simultaneously, this subjectification would not occur independently from the biologists' research interest, where the aim is to turn the birds into data for analysis and interpretation. I return to this tension between subject and object, and the different qualities of the relationship between the birds and biologists in Chapter 5.





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42 a, b, c, d, e, f, g, h

Figure 39:
Hand-drawn illustrations of Siberian jay movement during mating. Pen and pencil on paper. Folke Lindgren in Arvidsjaur, 1971. Zurich, 2014.

Figure 40:
Drawings of the movements of a Siberian jay group mobbing a perched hawk model, based on a video recording. Pencil and colour pens on paper. Zurich, 2014.

Figure 41:
Handwritten documentation of the breeding events in 38 territories. Colour-pen on paper. Arvidsjaur, 2001.

Figure 42 a–h:
Screenshots of videos recording the interactions of different bird groups around a feeder, as they are produced to conduct behavioural observation protocols in the office. Arvidsjaur, 2015.