Environmental Science and Policy 137 (2022) 120–127

Contents lists available at ScienceDirect

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

Segmented forest realities: The ontological politics of biodiversity mapping

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ARTICLE INFO

Keywords:
Forest governance
Biodiversity mapping
Ontological politics

ABSTRACT

Since the late 1990 s, biodiversity mapping has been a key instrument for preventing loss of species and habitats in Norwegian productive forests. Having major implications for the abilities of actors to pursue their interests in practical forest management, the methodologies of biodiversity mapping have been highly controversial and contested. We identify two different forest ontologies, or realities, that were enacted by the two main competing methodologies for such mapping. The methodologies, SiS and EiF, were supported by what we term the environmental and the forestry segments, respectively. Whereas a mapping approach associated with the environmental segment enacted a varied and complex forest ontology, a mapping approach related to the forestry segment enacted a comprehensible and more standardized forest ontology. In analyzing the two ontologies, we explore the links between the configuration of the mapping methodologies and 1) the forest realities they enact, 2) the scientific ideals they advocate, and 3) the relationship between mapping and management decisions. In particular, we argue that the ontologies have different political implications, generally favoring the actors that support them. On a more general level, we show that ontological politics is performed in the enactment of different ontologies related to different political segments, associated with different sectors.

1. Introduction

In June 2019, the organization BioFokus leveled strong allegations against Norwegian forestry companies for failing to fulfill their duties to safeguard biodiversity (Blindheim, et al., 2019). The claims were substantiated by comparing results from the forestry sector's biodiversity mapping efforts with BioFokus' own, from a forest area by Follsjå, Notodden in southeastern Norway. The report was met with severe counter-criticism by leading forestry companies. But this was nothing out of the ordinary. In fact, the dispute represented yet another chapter in a long struggle over scientific knowledge in relation to environmental concerns in Norwegian forestry.

The incident concerned a specific practice to produce such knowledge known as *biodiversity mapping*. Essentially, mapping is carried out through fieldwork, in which occurrences of biodiversity, such as species and habitats, are plotted into maps. Biodiversity mapping gained attention in Norway in the context of increased focus on biodiversity loss following the ratification of the 1992 Rio convention. Mapping schemes materialized on two arenas: as part of forestry planning and environmental certification (private sector) and as part of environmental governance (public sector). Mapping has sparked controversies for both purposes.

In this paper, we focus on mapping related to private forestry, where the proponents of two different approaches have struggled for influence. Their advocates seem to not only disagree on how forests should be governed, but also on which reality governance should take place. We ask how these methodologies have functioned to enact different forest realities. We analyze the ontological politics involved in the struggles over different methodologies for biodiversity mapping, and question whether these have different political implications, both in terms of the actors and decisions they benefit.

2. Siste sjanse and Environmental Inventories in Forests

In 1992, a group of conservation biologists organized under the name '*Siste sjanse*' ('Last chance'). Initially a part of Friends of the Earth Norway in Oslo and Akershus, the group re-organized in 2000, becoming the autonomous foundation 'BioFokus'. Inspired by the Swedish group 'Steget føre', Siste sjanse developed a procedure for biodiversity mapping specific to Norway's coniferous forests (Haugset et al., 1996). The methodology, which was given the abbreviation *SiS*, aimed to identify the most biologically diverse areas on forest properties

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https://doi.org/10.1016/j.envsci.2022.08.015
Received 28 September 2021; Received in revised form 16 August 2022; Accepted 23 August 2022
Available online 6 September 2022

so that these could be spared from being logged.

Around 2001, SiS received competition after the Ministry of Agriculture launched its own biodiversity mapping methodology '*Miljøregistrering i skog*' or '*Environmental Inventories in Forests*' (EiF). EiF resulted from a research project allocated from the Ministry of Agriculture to the Norwegian Institute for Forest Research. The Ministry claimed that various schemes for biodiversity mapping had emerged recently but of varying scientific quality. Therefore, the Ministry regarded it as necessary to secure that mapping was based on *scientific* methods (Ministry of Agriculture, 1998).

Initially, both SiS and EiF were integrated with 'Levende skog' (later renamed PEFC Norway), a private scheme for environmental certification of forestry properties. But only EiF was made part of 'skogbruksplanlegging' ('forestry planning'), a tool for private forest owners to organize future exploitation of the resources on their properties under administration by the Ministry of Agriculture. Further, the Ministry restricted the judicial regulation of financial grants to biodiversity mapping in relation to forestry planning to only accept EiF (The Government, 2004). The decision was upheld despite objections from environmental NGOs, who expressed limited faith in EiF and suggested that other methods for biodiversity mapping could be better suited to locate biodiversity (Sabima, 2003). The disagreement culminated in an investigation by the National Committee for Research Ethics in Science and Technology, which concluded that norms for good scientific conduct had not been violated. It noted, however, that the Ministry should have done more to include environmental stakeholders (NENT, 2004; Gulbrandsen, 2008).

In effect, the Ministry of Agriculture's EiF-policy led to a gradual decrease in and finally a discontinuation of the practice of the SiS-methodology in the mid-2000 s. EiF, on the other hand, has since enjoyed a hegemonic position as the sole methodology for biodiversity mapping in relation to Norwegian forestry. Siste sjanse, or BioFokus, thus lost their influence in forestry governance. However, they continued to map biodiversity for other purposes, especially on behalf of environmental authorities (according to yet another procedure developed by the Directorate for Nature Management), while regularly criticizing agricultural authorities and forestry companies for EiF.

3. Ontological politics

We use an ontological politics approach to analyze methodologies for mapping biodiversity, drawing on science and technology studies (STS). This framework allows us to explore the different realities that are produced in processes often understood to be merely descriptive, by enabling analysis of the political contingencies involved in biodiversity mapping.

The concept of ontological politics represents a pragmatic approach to the recurring constructivism-realism debates within academia (Mol, 1999; Mol and Law, 2004; Law and Lien, 2013; Sismondo, 2015). Similar to other approaches within science and technology studies, such as actor-network theory (Latour, 2007), the approach seeks to overcome the constructivism-realism dichotomy. The position taken in ontological politics is that objects are both real and constructed (van Heur et al., 2012). A key point is thus that reality, here mostly referred to as ontology, is not a given and passive context for, or background to, social action. Rather, reality is altered and produced continuously (Mol, 1999). According to Latour (2007), reality is enacted through material-semiotic interactions in which both humans and non-humans participate. Thus, the construction of reality is neither only based on human social processes nor only determined by materiality. Instead, humans, non-humans and objects interact in entangled ways in the construction of reality (Latour, 2003).

Since the different ways in which humans, non-humans and materiality might interact will produce different ontologies, Mol argued that multiple ontologies can coexist at the same time in the same place (Mol, 2002). However, ontologies should be understood as multiple, and not plural. That is, the number of different ontologies enacted in specific contexts are limited and not endless. Put more simply, there is "always more than one but less than many" (Hinchliffe, 2007, p. 21). This is in contrast to the relativism often embedded in perspectivism and social constructivism. In the latter case, the presumption is that different human actors construct social interpretations of material reality, so there is only one reality but different interpretations of that reality, which can be disputed among the actors. Within the framework of ontological politics, however, the number of possible different realities is limited by the attributes of the materiality and the actors involved in the enactment (Mol, 1999, 2002; Law and Lien, 2013; Latour, 2003). There will often be frictions and tensions between different ontologies enacted at the same time and place. These frictions and tensions give rise to 'ontological politics', a style of politics that revolves not only around how to act upon reality, but also around which reality to act upon (Mol, 1999, 2002). In the case of biodiversity mapping, the different methodologies consider certain aspects of forests and leave out others, thus producing selective representations that enact some ontologies over others (Turnhout, 2018). These ontological enactments are inherently political since they have implications for decisions that affect environments and actors, and thus produce winners and losers.

There is a growing research literature on ontological politics related to environmental issues. Several studies have investigated water management with this approach (de Rijke et al., 2016; Götz and Middleton, 2020; Lavau, 2013; Morita, 2016; Whatmore, 2013; Yates et al., 2017), while others have focused on ontological politics related to topics such as climate change (de Wit, 2018; Goldman et al., 2018; Zegwaard et al., 2015), biodiversity (Lorimer and Driessen, 2013; Pauwelussen and Verschoor, 2017; Petitpas and Bonacic, 2019), farming and food production (Jonsson et al., 2019; Munster, 2018; Robins, 2012), marine spatial planning (Boucquey et al., 2016), environmental remote sensing (Rothe, 2017) and urban green spaces (Jones et al., 2014). Further, a number of studies have investigated the ontological multiplicity of environmental problems more generally (Carolan, 2004; Chaves et al., 2017; Forsyth and Levidow, 2015; Simon and Randalls, 2016; Sullivan, 2017).

Few studies on forests have applied an ontological politics framework, although some have discussed ontological multiplicity of forests as part of environmental issues more broadly (DePuy et al., 2021; Forsyth and Levidow, 2015). However, research on forest controversies have adopted similar approaches. Such controversies have recently received increasing attention in research (Eckerberg and Sandström, 2013). Studies have for instance observed that conservation science challenges forestry science (Sténs et al., 2019), the great extent to which political struggles over forests have taken on scientific terminology (Berglund, 2001) and that biodiversity mapping have reflected conservation perspectives in such struggles (Simonsson et al., 2015). Studies have also explored contingencies of other tools of environmental governance in forestry, such as Red Lists (Jørstad and Skogen, 2010; Gustafsson and Lidskog, 2013; Campbell, 2012). A key finding is that such tools gain legitimacy by enhancing purely scientific ideals and political neutrality. However, a common claim in STS studies is that knowledge is always embedded in social processes and that knowledge therefore never is neutral (e.g., Latour, 2007; Jasanoff, 2004). Similarly, contributions from critical cartography have argued that biodiversity maps facilitate power and that they, far from being neutral, promote and naturalize particular worldviews (Hamylton, 2014; Harris and Hazen, 2006; Malavasi, 2020).

Many studies on ontological politics emphasize that the environmental issues they investigate would benefit from acknowledging the multiplicity of ontologies involved. The failure to consider ontologies enacted by marginalized groups are investigated by some (de Wit, 2018; Littlejohn, 2020; Petitpas and Bonacic, 2019; Yates et al., 2017), while others show how environmental realities become objects of ontological debate and competition (de Rijke et al., 2016; Götz and Middleton, 2020; Morita, 2016; Munster, 2018; Robins, 2012). Studies also scrutinize the political implications of dominant ontologies related to environmental issues (Boucquey et al., 2016; Forsyth and Levidow, 2015; Lavau, 2013; Pauwelussen and Verschoor, 2017; Rothe, 2017; Simon and Randalls, 2016; Sullivan, 2017; Zegwaard et al., 2015). With this study, we show that ontological politics are also performed in the enactment of different ontologies by actors from or associated with different governance systems. We argue that ontological multiplicity can indeed be a matter of inconsistency regarding upon which reality should be governed, and that the ontologies involved can become objects of fierce dispute by actors associated with separate governance systems.

4. The political segments of Norwegian forest governance

To understand the governance related implications of our findings, we consider the SiS/EiF controversy in light of the first Norwegian power investigation, which had relevant observations concerning the influence of agricultural interests. The investigation, conducted between 1972 and 1981, was commissioned by the Government to a group of researchers to bring about “the best possible knowledge of the real power relations in Norwegian society” for “actual power relations [to be] unveiled and disclosed for public debate and critical analysis” (Maktutredningen, 1982: 1; Götz, 2013). A key finding was that political power was not first and foremost confined to the state or private enterprises, but to different constellations of actors emerging around specific societal activities sharing similar interests.

Segments can be defined by the actors, values, problems, goals and strategies, as well as types of knowledge and expertise that are considered legitimate (Olsen, 1978). In terms of actors, segments may be comprised of politicians, bureaucrats, researchers, and representatives from private enterprises and NGOs (Egeberg et al., 1978; Klausen and Opedal, 1999). The concept drew on *iron triangles*, a term referring to networks of “beneficiaries, politicians, and bureaucrats” functioning to maintain status quo (Friedman and Friedman, 1984). The leader of the investigation suggested that such constellations can be multiple and compete each other for limited resources, thus counteracting effective and integrative governance (Hernes, 1983).

The observations of the power investigation were followed by efforts to reverse tendencies of political segmentation and thus overcome problems of governance related to the autonomy of segments and tension among them, through parliamentary reform (Rommetvedt, 1998). The notion of the segmented state received longstanding attention in academia, too. For instance, some critics argued that its accuracy diminished as reformist measures were taken (Rommetvedt, 2002).

While this discussion has largely revolved around the question of whether the Norwegian political system as a whole can be described as a multitude of segments, the observations still have relevance for studies of agriculture. Indeed, scholars emphasizing the effects of desegmentation have recognized that agricultural interests had a particular ability to retain its influence despite reform (Rommetvedt, 2002). Moreover, agriculture represented the prime example of both segments in Norway (Egeberg et al., 1978; Hernes, 1975, 1983) and iron triangles in USA (Friedman and Friedman, 1984) and Sweden (Bolin, Meyerson and Ståhl, 1984).

By taking this into account we can relate our analysis to a Norwegian setting. This enables us to understand how different political communities engage in enacting different forest ontologies, as well as how the methodological struggle has affected the ability of these communities to influence decision-making.

5. Methods and data

Data were gathered over approximately six months, according to the logic of snowball sampling (Naderifar et al., 2017) or the chain-method (Polit-O′Hara and Beck, 2006). The approach is widespread within qualitative methods and well-suited for exploratory studies. Snowball sampling implies a non-probable procedure in that data are collected out of availability and convenience (Allen, 2017). Collecting and selecting data happened in three stages. In the first, five exploratory start-up conversations with key informants were carried out in February and March 2020. These informants were chosen due to their long-standing experience with the interaction between scientific knowledge and forest policy, and had background from research, mapping, NGOs, and public administration. The interviews sparked an interest in this topic and helped to shape the empirical focus and strategy of this article. The second stage consisted of media analysis by employing the services from the media archive *Retriever*. This was initiated to provide an overview of the public debate about biodiversity mapping and an understanding of what has been at stake for the different parties. Keywords related to the methods for producing information on biodiversity in forests were used for searches before results were exported to reports in PDF-format and analyzed manually. Number-wise these amounted to some 300 sources consisting of news articles, op-eds, and feature stories. The results from the media analysis provided a well-suited foundation for studying policy documents in stage three. These included white papers and recommendations to the Storting, statements from stakeholders, as well as biodiversity mapping handbooks. Such data were sought out to base the analysis not only on secondary information but also more primary sources. This additional empirical dimension in turn enabled more in-depth insight into the disputes over the mapping methodologies of SiS and EiF.

The paper employs several principles from document analysis. There are several advantages from studying documents, including availability and efficiency (Bowen, 2009). Investigative document studies are especially suited for qualitative research, allowing thick descriptions (Stake, 1995). The present study also utilizes insights from thematic analysis by identifying key themes in the empirical field and allowing them to emerge as analytical categories (Fereday and Muir-Cochrane, 2006). In processing data, several ontological disagreements were identified. Data were coded according to these, which structure parts of the analysis.

6. Segmented forest ontologies

The two ontologies enacted by the EiF and SiS methodologies differed in some crucial respects. These are highlighted in Table 1.

6.1. Similarities between SiS and EiF

Before we go on to analyze the differences and disputes among SiS and EiF, we will take a brief look at their similarities. Indeed, several commonalities can be found. We limit our focus to those of significance for the controversies discussed in this paper. Both SiS and EiF are fieldwork-based efforts to locate biodiversity, as opposed to less physically situated approaches to biodiversity knowledge such as large-scale

Table 1
Key aspects of the two forest ontologies enacted by SiS and EiF. The differences between the ontologies are highlighted for the sake of clarity.

Methodology	Siste sjanse (SiS)	Environmental inventories in Forests (EiF)
Related social segment	Environmental segment	Forestry segment
Enacted forest ontology	Varied and complex forests	Comprehensible and standardized forests
Biodiversity registrations	Qualitative approach	Quantitative approach
Scientific ideal	Expert discretion	Objective and neutral
Relationship between mapping and management	Integrated tasks	Separated tasks
Authority to make assessments and proposals	Mapping practitioner	Committee
Mapping process	Flexible	Rigid
Decision-making process	Rigid	Flexible

monitoring and overall ecosystem assessments. A crucial aspect of the two methodologies concerns their focus on locating specific habitats with good conditions for biodiversity, meaning the environment in which species live, rather than species themselves. Related to this is the notion of *woodland key habitats*, which was given great significance in SiS and EiF. The concept expresses the idea that biodiversity is unevenly distributed across ecosystems and that maintaining areas with high concentrations will benefit biodiversity as a whole, with maintenance referring to protection from logging. How this was to be carried out, however, differed between SiS and EiF.

6.2. Different forest realities

In SiS, woodland key habitat status was attributed to areas which reflected certain environmental qualities. Areas worthy of such status were identified via two kinds of indicators, that had to meet certain criteria. The first kind were 'key elements': occurrences of small habitats assumed to be important for biodiversity. Examples were dead wood, old trees, deviant trees, damp and mossy rock walls, as well as streams and water sources. The second kind were 'signal species' and typically included various species of bryophytes (mosses and liverworts) and lichens. The presumption was that rare species often were concentrated in hotspots (Haugset et al., 1996) and that certain species would indicate such hotspots. Drawing on insights from island biogeography, the SiS handbook argued that biodiversity could be maintained in productive forests by the establishment of networks of woodland key habitats, or 'islands', between which dispersive species would be able to migrate.

In the field, SiS practitioners would rely on their biologist competence to evaluate which occurrences of key elements or signal species that together constituted woodland key habitats and how these habitats should be delimited. Mappers would also register red-listed species and consider landscape ecological concerns. The latter involved a focus on the interactions within and among ecosystems on a larger scale and tended to result in relatively large woodland key habitats. After woodland key habitats had been identified, they were classified according to 13 ideal types of forest habitats assumed to be valuable for biodiversity (Haugset et al., 1996). Among them were old spruce forests, old pine forests, swamp forests, and stream gorges. The mapper would then advise the forest owner on how findings could best be managed. Such advice would, importantly, specify which parts could be logged, and which should be set aside for conservation.

As noted, in EiF, too, the aim was to identify habitats of particular value for biodiversity. However, whereas in SiS the practitioner was tasked to evaluate where signal species and key elements constituted woodland key habitats, EiF made clear that there was no causation between such occurrences and such habitats. EiF stressed that a woodland key habitat was not a discovery, but rather a management tool dependent on decision-making (Gjerde, 2000). Further, EiF did not apply signal species as indicators of valuable habitats (Baumann and Gjerde, 2002). The concept of signal species was scientifically disputed by several of the researchers involved in developing EiF (Rolstad et al., 2002).

So how were areas important for biodiversity located according to EiF? EiF gave great emphasis to what it termed "livsmiljøer", or simply habitats. Twelve in total, these closely resembled the key elements of SiS and included snags, logs, old trees, and rock walls (Baumann and Gjerde, 2002b). Occurrences of such habitats would be *counted* and concentrations plotted into maps by the practitioner. Areas with satisfactory concentrations, determined by limits specific to different regions, would qualify to be *considered* for woodland key habitat status. The definition of woodland key habitats was thus restricted to areas chosen for conservation. Another defining presumption of EiF was that biodiversity occurrences were more scattered and less concentrated in hotspots than "earlier assumed" (Gjerde, 2000). Therefore, EiF's methodological handbook expressed caution towards setting aside woodland key habitats as the only biodiversity conservation measure related to forestry and suggested that other measures also could be effective. Therefore, setting aside more scattered occurrences of EiF-habitats, such as individual dead trees, was presented as a feasible alternative (Baumann and Gjerde, 2002c).

Through the lens of ontological politics, we see that SiS and EiF enact forest realities that are quite similar but differ in some crucial respects. SiS placed great emphasis on *finding* woodland key habitats, while EiF disputed that woodland key habitats could simply be found. This was related to another aspect of the forest reality enacted by EiF. Unlike SiS, which presumed that biodiversity is often concentrated in hotspots, EiF assumed that biodiversity occurrences are distributed more evenly and throughout larger forest areas. The emphasis in EiF on less variation made the enacted forests more predictable, comprehensible and standardized. The emphasis in SiS on variation and complexity, on the other hand, contributed to the enactment of forests that were difficult to know and predict.

In line with Mol's thesis that multiple ontologies coexist at the same time in the same place, the two forest realities enacted by SiS and EiF coexisted side by side (Mol, 1999). However, rather than cooperate or supplement each other as the ontologies in Mol's study of anemia, in which both clinical diagnoses and statistical detection could be applied to identify anemia, the forest ontologies of SiS and EiF conflicted because they were enacted by different methodologies that aspired to perform the same task. Similar to the cases of guanacos management in Peru (Petitpas and Bonacic, 2019) and infrastructure development in the Chao Phraya Delta in Thailand (Morita, 2016), the interaction between the ontologies was uneasy and characterized by internal interference, or outright competition. We will shortly return to how these different forest realities had important political implications. First, however, we explore the question of what constitutes a scientific methodology for biodiversity mapping.

6.3. A scientific methodology?

As mentioned, a major rationale behind EiF was an alleged need for a *scientific* methodology (The Ministry of Agriculture, 1998). This represented an implicit criticism of SiS. However, Siste sjanse and their supporters considered SiS to be scientifically sound. What constitutes a scientific methodology for biodiversity mapping, then, became contested following the launch of EiF. A major issue that had to be addressed was uncertainty, particularly related to the requirements of various species. The instructive handbook of the SiS-methodology acknowledged such uncertainties:

As long as we lack thorough knowledge (…) it is almost impossible to say anything [about how large key habitats must be to secure the existence of species] without making rough and probably very uncertain assumptions (Haugset et al., 1996: 15).

Therefore, it was not enough to employ standardized criteria for habitats, such as plotting registered occurrences. In order to delimit woodland key habitats, and rank them according to their importance for biodiversity, qualified evaluations by trained biologists were necessary:

Delimitation can in some cases be very difficult and must be done with a certain discretion (Haugset et al., 1996: 18).

Discretion referred to the opportunity of the registrant to evaluate the significance of a habitat for biodiversity by qualitative considerations. The approach involved a skepticism towards standardized categories:

[SiS] uses qualified biological discretion (…) to suggest functional delimitation and possibly buffer zones. (…) In our opinion it is a definitive advantage to propose biologically important areas in the field. The registrant can then fine-tune delimitation according to where elements (concentrations and singular elements) and species are located (Løvdal et al., 2001: 15–16).

In SiS, delimitation was considered a scientific matter. As we saw in the previous section, it was a question of locating and securing biodiversity. Therefore, this task was carried out by a biologist in the field, as a part of mapping itself. Importantly, this implied that other parties were not involved in identifying and delimiting woodland key habitats.

As we have seen, EiF took a more quantitative approach to identifying and delimiting habitats. Determining which occurrences that were considerable for woodland key habitat status was conducted by a group of actors in a decision process that we will return to. The more standardized approach to biodiversity mapping in EiF was grounded in the ontological characteristics of forests that it enacted, in particular the more even distribution of species and the skepticism toward the concept of signal species.

The dispersion of species was empirically scrutinized through fieldwork in the initial EiF research project. The researchers observed that many species were less concentrated than previously assumed, hence contradicting some of the elementary concepts of the SiS methodology. One conclusion was that so-called signal species were unreliable indicators of biodiverse areas. Another was that setting aside key habitats in forest areas of high economic value was not always the most desirable measure:

It may often be more efficient and profitable to choose the implementation of scattered environmental measures or measures associated with non-profitable areas instead of having to set aside economically vital parts of a mature forest (Baumann and Gjerde, 2002c: 8–9).

The director of forestry in the Ministry of Agriculture put it this way:

(…) it has been shown that environmental features associated with biodiversity are spread throughout the forested areas. Thus, the attempts of preserving a large share of important environmental features on relatively small areas by defining so-called key habitats have a rather limited effect (Ekanger, 2002: 2).

In a retrospective interview he elaborated on the topic from the perspective of forestry authorities. They had suspected SiS of being scientifically dubious, hence signifying the need for a new methodology:

One of the reasons that it was important to develop [EiF] was that Friends of the Earth Norway established a group of biologists who started the project “Siste sjanse” [SiS]. They claimed that there existed “signal species” that functioned as indicators for continuity and the state of forests and in the Ministry [of Agriculture] we got the feeling from several places that this was not good enough. If “signal species” were to be the starting point for demands for restrictions on a financial enterprise, we had to be certain that the requirement was scientifically sound (Kløvstad, 2015: 18–19).

The ontologies enacted by the methodologies were not restricted to different forest realities, but also encompassed different positions about what constitutes a scientific methodology. One position, articulated in EiF, held that a scientific methodology should be objective and neutral. The other position, integral to SiS, was based on the necessity of qualified evaluations by trained biologists.

The forest reality enacted by SiS was highly varied, unpredictable, and required a precautionary methodology which required qualified evaluations by trained biologists. The forest reality enacted by EiF, on the other hand, was less varied and more comprehensible. This forest reality was compatible with a standardized mapping methodology that made qualitative evaluations inappropriate. In this way, the enacted forest realities, the configuration of the mapping methodologies, and the positions taken on what counts as a scientific methodology were interrelated and co-constructed aspects specific to the two ontologies in question. That is, the aspects of the ontologies were to some degree mutually dependent and shaped in parallel, in the process of developing the methodologies (Mol, 2002).

6.4. Management decision process

The relationship between mapping and management was the point at which SiS and EiF diverged the most. In SiS, the mapping procedure entailed management recommendations to the forest owner. In EiF, however, it was not appropriate for the mapper to provide recommendations about management decisions. Such tasks were considered normative and to be performed post-fieldwork, by others than the practitioner. In the field, the mapper would classify areas of registered concentrations according to environmental quality. Subsequently, the findings would be assessed by a committee consisting of the forest owner, biological expertise, representatives from local forestry enterprises, certification holders, and public forestry administrators. Importantly, the evaluation of the areas was not only based on ecological concerns. According to EiF, the group’s evaluations should also be conducted with respect to economic and operative concerns. Further, the EiF handbook stressed that it was the sole responsibility of the forest owner to make final decisions about which woodland key habitats should be set aside and which areas should be logged (Gjerde, 2000; Baumann and Gjerde, 2002).

The management recommendations of SiS were defended following the implicit criticism from EiF. The response emphasized that decisions should be based on biological evaluations:

Management proposals produced in the field involve that the registrant evaluates the area (and decides whether the area is a candidate for a biologically significant area), proposes a management procedure, and delimits the area in the field. The evaluation of management proposals is a biological evaluation, which requires the competence of a trained biologist, of how the habitat’s biodiversity can best be secured. To optimize precision, it is desirable that the same person carries out both the field-registration and proposes management measures. It is environmentally favorable that this is done in the field before information from the registration is degraded (Løvdal et al., 2001: 18).

We see that the mapping practitioner was ascribed a more authoritative role in SiS. Not only would its expertise be key in defining the location and concentration of biodiversity occurrences, and thus which areas were most environmentally important. The mapper was also given the responsibility of suggesting how the area should be managed. This was justified by arguing that the consideration of management strategies was a *biological* task, hence not normative.

In the view of the EiF developers, however, this was scientifically dubious:

In registrations done so far, there has been a tendency to mix the registrations themselves (descriptive) with management decisions (normative) […] Priorities are made during the registrations, and one acts as registrant and manager simultaneously. (…) A more orderly procedure would be to perform registrations according to fixed criteria and let the more political decisions concerning scope and choice of measures come afterwards. To deal with this problem, EiF has established a clear-cut distinction between registration and management (Gjerde, 2000: 3–4).

The view was elaborated in the EiF-handbook, which made it an explicit ambition to eradicate decision-making from the mapper’s fieldwork (here referred to as ‘inventory’):

The environmental inventory clearly distinguishes between data collection and forest management. The actual inventory is a purely descriptive task, whereas use of the collected data for conservation of biodiversity requires an assessment of values related to the determination of the scope of different measures. Distinguishing these two aspects implies that management decisions are not made in the course of the inventory, but rather are implemented as an integrated evaluation after the data collection phase is completed (Baumann and Gjerde, 2002: 22).

In contrast to SiS, which to a larger extent regarded the declaration of woodland key habitats, and even the conservation of such, as biologically informed expert considerations, EiF regarded such tasks as political. Therefore, it communicated that registrations would not lead to restrictions:

There are always many alternatives when it comes to choosing between forestry operations and environmental considerations. The environmental inventory will not limit these choices, rather quite the opposite. If the registered elements cannot be protected on the basis of existing laws or regulations, the affected forest owner becomes the decision maker in each specific case. (…) Important considerations in this process include the assessment of which elements do not result in additional costs or inconveniences for the forest owner (…) (Ekanger, 2002: 3–4).

The implication of this was not only that mapping and management was to be organized in two separate stages of the EiF process, and that the former would have no direct consequences for the latter, but also that the responsible party differed between the two. While EiF recognized the need for biological insight for sound decision-making, this was suggested to be more of a consulting role:

When applying the inventory in forest management planning, it is recommended that the environmental quality of the areas are assured by using forest biologists or environmental experts, thus making sure that the data have been optimally prepared for the final selection process (Baumann and Gjerde, 2002: 22).

As such, the responsibility of the mapper was limited to present information for the other parties to evaluate and base their management decision on.

With this, we can add another aspect to the ontologies. We saw in the previous section how the forest realities, the configuration of the mapping methodologies, and the positions taken on what counts as a scientific methodology, were interrelated and co-constructed aspects of the two ontologies in question. In this section, we have seen that SiS and EiF had different approaches to the relationship between mapping and management decisions. This is related to the enacted forest realities previously described. The insistence in SiS that management recommendations should be made by a trained biologist in the field was grounded in its enactment of forests as varied, unpredictable, and complex. In order to identify key habitats in such a forest, a methodology that allowed the mapper to make qualified evaluations was required. Given the complexity involved in this, in addition to the emphasis on conserving biodiverse areas, it made sense that the management recommendations should also be made by a biologist in the field. The more standardized and less complex forests enacted by EiF, on the other hand, allowed for a standardized and quantitative mapping methodology. In this ontology, it also makes sense to separate mapping from management decisions. This connotates to a scientific ideal in which descriptive and objective science should be separated from normative and political decisions.

6.5. Political segments of biodiversity mapping

So far, we have seen how the struggle between the different forest ontologies were enacted by SiS and EiF and their respective developers and administrators. But the dispute was not restricted to these actors. The methodologies in fact quickly gained support from other parties. A pattern materialized, with forestry enterprises defending EiF and criticizing SiS and environmental NGOs criticizing EiF and defending SiS. While a large number of sources could have been referred, we draw on a few examples due to lack of space. An early reaction against EiF came from Sabima (The Norwegian Biodiversity Network) and was, in fact, a response to the EiF project leader's insinuations of SiS mixing descriptive and normative tasks:

[He] puts great emphasis on separating registration and management. In many instances this is appropriate. But when he claims that it is impossible to separate woodland key habitats from nature reserves in the field, he has gone astray. Because even if there are grey areas, it is obvious that there are areas that are so important for biodiversity that they have to be conserved (Aanderaa, 2001).

The Sabima leader thus reacted to EiF's claim that key woodland habitats could not simply be found and asserted that some areas were of such biological significance that if biodiversity was to be maintained, there was in reality no choice but to conserve them. Moreover, he stressed that identifying these required qualified biologists:

Until now biologists are those who have registered woodland key habitats. (…) [But] it seems like the objective [of EiF] has been to exclude other actors. The impression is strengthened by the link between state aid to biodiversity mapping and the use of EiF. In practice it is only the forestry sector's appraisal companies that are able to fulfill these. The Ministry of Agriculture seemingly think it's better if unskilled personnel map biodiversity with an indirect method, than if trained biologists do it directly (Aanderaa, 2001).

Further, while recognizing decisions themselves as political, he argued that assessing the environmental effects of different decisions was not, and that EiF was too vague in this regard.

Whereas early resistance towards EiF concerned its methodological principles, later criticism also targeted how it functioned in practice, prompting response from a variety of forestry actors. From the private sector, one of the most active has been (The Norwegian Forest Owner's Federation., 2017). For instance, they met BioFokus' report with bold counterclaims:

That BioFokus, as an important part of the Siste sjanse-group, recently condemned the forestry sector's biodiversity mapping, appears as a desperate attempt to regain lost influence (Sørlie, 2019).

The Federation's spokesman went on to defend EiF, blaming BioFokus for unsubstantiated and subjective claims. Shortly after, however, the Federation took action to investigate the matter. New mapping efforts were carried out in the Notodden area before researchers compared the new and the old results. The project report, authored by several EiF developers, found that the discrepancy between the two mapping efforts was indeed substantial. Nevertheless, in addressing this gap it largely resolved to technical explanations, seemingly having little faith in BioFokus' conclusions of lacking competence among EiF mappers (Gjerde et al., 2021).

The positions taken in the struggle between SiS and EiF together constitute a social organization of biodiversity mapping consisting of two communities. These are comprised of a variety of actors from various sectors. With this vocabulary we can say that the struggle between SiS and EiF also entails a struggle between two political segments. Whereas actors related to a *forestry segment* actively promoted and enacted the forest ontology of EiF, actors related to an *environmental segment* promoted and enacted the forest ontology of SiS. And because a multitude of actors have been involved in this struggle, the ontologies are more than products of the methodologies. In fact, by publicly advocating either SiS or EiF, supporting actors functioned to co-enact their respective forest realities in a broader sense. This resonates with Krange et al. (2013), who observed a similar pattern in a study of the response to the Nature Index (NI) for Norwegian forests.

7. Political implications of segmented forest ontologies

By holding the various aspects of the ontologies together, it is evident that the two ontologies enacted by SiS and EiF have different political implications: the ontological *politics* of the two methodologies consist in how their enactments grant flexibility and authority to different actors.

SiS, by granting authority to mappers to define the forest landscapes and flexibility to define them as complex and varied, as well as providing mappers with the opportunity to define acceptable alternatives for management measures, granted less authority and flexibility to those responsible for making final decisions. Conversely, EiF, by providing mappers with a less flexible and more standardized methodology, while also relocating tasks from mappers and rather assigning these to a post-mapping committee, granted less authority and flexibility to mappers and more to other the actors of the committee, both in terms of defining valuable areas and suggesting which areas to safeguard for the future and how this should be done. Therefore, we can conclude that while the forest ontology of SiS ascribed authority and flexibility to actors from an environmental segment, the forest ontology of EiF ascribed authority and flexibility to actors from a forestry segment.

Further, we can conclude that the Ministry of Agriculture's, hence the Government's, development, launch, and exclusive treatment of EiF, which in effect excluded all other methodologies for forestry purposes, also had political consequences. Arguments emphasizing EiF's alleged scientific superiority legitimized the methodological prevailing of EiF over SiS, an incident which increased the influence of the forestry segment in on-the-ground forest management while decreasing the influence of the environmental segment. The example from Notodden illustrates this: logging operations were carried out as usual, producing timber that was environmentally certified according to PEFC Norway, partly by virtue of EiF mapping.

The different forest ontologies enacted by SiS and EiF are indeed made evident by these specific mapping efforts: in the varied and complex SiS-ontology, still to some extent enacted by BioFokus' activities despite the discontinuation of the SiS-methodology, the forests around Follsjå were rich and unique; while in the predictable and comprehensible EiF-ontology, these areas were less distinctive from their surroundings. Importantly, the ontologies are not restricted to their descriptive aspects. Refusing to accept the taken-for-granted distinction between reality and politics, ontological politics reveals how they are intertwined: in the forest ontology of SiS the forests in Follsjå had great significance for biodiversity, making biodiversity dependent on the area being maintained; in the forest ontology of EiF, however, the same forests were less extraordinary and thus less indispensable for biodiversity concerns.

Emphasizing that ontologies are processual, time-dependent and in continual flux, Woolgar and Lezaun (2013) argued that 'the ontological status of the entities involved is an accomplishment'. That is, stabilization of the ontological status of different entities is more of an exception than something to be expected. In this perspective, albeit not straightforward, the ontological stabilization in the SiS/EiF case is remarkable. Evidently, the developers and proponents of EiF achieved an ontological stabilization of biodiversity mapping for forestry governance purposes. But, as BioFokus and others related to an environmental segment continued to map biodiversity in forests for environmental governance purposes, EiF prevailing over SiS did not entail a ontological stabilization of biodiversity mapping per se. How biodiversity mapping in environmental governance interacted with EiF, then, is a question that must be asked elsewhere.

In this paper, we have shown that ontological politics is performed in the enactment of different forests by actors related to different segments. We have also shown how different ontologies enacted by biodiversity mapping methodologies might have different political implications and how this can instigate fierce and recurring controversy (Mol, 1999; Mol and Law, 2004; Turnhout, 2018). To conclude, we have also illustrated how such controversies become part of political struggles and how their outcomes can grant more influence to some actors and less to others. More research is needed on the role of ontological politics in cross-sectoral integration, a topic that is repeatedly highlighted as a requisite to move in a more sustainable direction, halt biodiversity loss and mitigate climate change (IPCC, 2018; IPBES, 2019; UN, 2015). A start could be to acknowledge that different ontologies, with different political implications, can be enacted by knowledge-producing mechanisms such as biodiversity mapping.

Declaration of Competing Interest

The authors have no competing interests to disclose.

Data Availability

Data will be made available on request.

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