Responsible Action as Embedded in Knowledge Practices: An Analysis of Forest Biodiversity Protection

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Following the global concern for the loss of biodiversity, biological knowledge has become a central tool in environmental governance. Science studies has addressed the data-driven nature of biodiversity protection and explored various aspects of it, ranging from knowledge infrastructures to engagement of various social groups in knowledge production. This article focuses on how this knowledge is applied in forestry, one of the most threatening socio-economic practices to biodiversity. Drawing from a case study in Finland, carried out as an ethnography of forestry expert practices, I analyse how biodiversity has been institutionalised in forestry operations. Responsible action and pro-environmental behaviour are much debated topics in environmental governance literature. Here the focus is on how they are articulated and enacted as embedded in the expert practices. The practices and techniques of identifying and locating the biological values are thus not viewed as resources for decision making but as performative of the partnerships in environmental governance, shaping the roles of science, corporations, government and civil society. These partnerships and power relations are constituted by the uncertainty of biological knowledge and the instability of biological objects travelling between the realms of science, administration and economy.

For more than a hundred years, forest science has been dedicated to improving the productivity of forest ecosystems. The so-called German regulation model, developed in the eighteenth and nineteenth centuries, transformed naturally-growing forest into 'normal forest'; this is a statistical model for managing forests based on homogeneous, even-aged stands. The aim of this scientific ideal was to maximise and secure long-term timber harvest. Although it was and still is debated, it has later stabilised a particular way of governing nature in European and North American

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boreal forests (Hölzl, 2010; Scott, 1998). The idealised management model enabled the rationalisation of industrial forestry and rendered forest owners as targets of new forms of governmental power (Demeritt, 2001; Jokinen, 2006; Prudham, 2007).

While the focus of forest science has been the manipulation of life-supporting processes to improve the regeneration of forests, it has put forward a specific notion of sustainable use of renewable resources. This notion has in recent decades been contradicted by another scientific conception of life and sustainability. Biodiversity science evokes a vocabulary of inventorying the heterogeneity of nature (Bowker, 2000; Kohler, 2006; Kwa, 2005). This project is linked to the normative goals of nature conservation. Nature's heterogeneity is considered to be the basis for life on earth, while the loss of this biodiversity is regarded as a threat to humankind and its existence.

In forestry, the two different conceptions of ecosystems and their sustainable use conflict. The standardisation of life-supporting processes by forestry has, in fact, been targeted against biodiversity for the sake of maximising forest growth. Thus, the decline in biodiversity in forestry has not been an unintended consequence of forestry actions, but an outcome of 'organized irresponsibility' (Hiedanpää et al., 2011). Biodiversity policies, in turn, aim at making an intervention in this institutionalised management ideal by designating responsibilities for forestry actors to secure heterogeneity as the key life-supporting characteristics of ecosystems.

In forestry, ecosystems have become growth machines, also in the sense of creating wealth and prosperity. In Finland, which forms the empirical context of this paper, the German regulation model has been strongly identified with industrialisation, economic growth and nation building (Åkerman, et al., 2010; Jokinen, 2006), while in North America the model has been adopted to rationalise industrial use of forests and coordination of cutting rights (Demeritt, 2001; Prudham, 2007). Globalisation of trade as well as global environmental problems have raised concerns and led to a new focus on the moral and economic impacts of business activities (see Dauvergne and Lister, 2011). This concerns not only biodiversity protection but also other life sciences (see, for instance, Ecks, 2008). Also, current theories of environmental governance emphasise the need for a collaboration between corporate actors, citizens and the government (Gottweis, 2008; Hajer and Wagenaar, 2003). However, the starting points for such partnerships may vary: while governments expect the practising of corporate responsibility to advance social justice and slow down environmental degradation, companies may expect it to allow them to retain their licence to operate and they may expect it to minimise mandatory intervention (Halme and Laurila, 2009). The critics claim that corporate responsible action is just a form of discursive power via which companies define the terms of public–private partnership (Dauvergne and Lister, 2011). Responsible action can also become a disputed term, as Quastel (2011) has shown in his analysis of global corporate networks.

The interplay of science, corporations, government and civil society is the focus of this article. While responsibility for biodiversity is nowadays firmly

institutionalised and practised by various forestry actors, it does not make sense to study it purely as a discursive move made by forest companies or as a struggle between stakeholders. Rather my aim is to study how responsibility is articulated and enacted in practice. Because biodiversity is a profoundly scientific concept, knowledge practices are key to responsible action. Knowledge is a central tool in modern environmental governance: accounting for nature has become a scientific, economic and political question (Asdal et al., 2008; Höhler and Ziegler, 2010). Biological values need to be identified and located in forests and this information has to be passed to those who make decisions concerning forestry operations. In addition to techniques for making nature present, knowledge of nature has to be coordinated by facilitating learning and communication. Becoming responsible is linked with these knowledge practices in three different ways: they delegate duties and tasks, set norms and enable the exercising of power.

Forestry experts, working in both the private and public sectors, are now facing biodiversity as a global political concern and goal. Previously focusing on extending scientific forest management, they are now encountering a redefined policy setting and attempt to make biodiversity an institutionalised routine in forestry. My analysis focuses on how these professionals make sense of biological knowledge in their work in order to fulfil the goals set by national legislation and international norms to secure biodiversity. Two particular questions arise when responsible action is viewed as embedded in expert practices: (a) How are various agents mobilised by knowledge practices to protect biodiversity; and (b) What kind of partnerships are formed for responsible action?

There is one specific aspect that the focus on knowledge practices brings forth when responsible action is discussed: the uncertainty of knowledge. In fact, most forestry decisions concerning biodiversity are made under conditions of uncertainty. In science and technology studies, uncertainty is a much discussed topic (see, for instance, Leach et al., 2005; Pellizzoni, 2003). It has been viewed as an inherent part of scientific knowledge that affects decision making. It is not only an outcome of insufficient data or stochastic natural systems (see Opdam et al., 2009), rather it stems from the open-endedness and mutability of political objects themselves (Hinchliffe, 2001). For example, ecologists do not work with natural objects whose presence is self-evident, rather their presence has to be worked out (Hinchliffe, 2008; Robertson, 2006). Furthermore, the controversial nature of scientific knowledge may limit its applicability in real-life decision making (Rydin, 2007; Turnhout, 2009).

On the basis of my analysis, I will argue that uncertainty forms a dynamic condition for responsible action. Although biodiversity science is supposed to form the basis for good forest management, responsibility is simultaneously enacted in the scientific, legal and economic realms. In principle, biological criteria have become significant in determining the allocation of legal and commercial rights and duties. However, the uncertainties related to the availability and applicability of biological knowledge make this challenging. Forestry experts practise responsible action by circulating uncertain knowledge to meet legal requirements and commercial goals.

Thus, environmental governance is about making the different realms of responsible action congruent with each other (see also Robertson, 2006). Uncertainties and the strategies to cope with uncertainties shape the policy outcomes, underlining the issue of fairness in environmental governance.

Normalisation of Biodiversity in Finnish Forestry

Nature conservation has been a highly contested issue in many countries. Conflicts and protests concerning biodiversity have become an object of study in environmental politics all over the world. In Finland, the history of conflicts in forest biodiversity protection started with heated debates over old-growth forests and new protected areas in the 1970s (Raitio, 2008). This phase was followed by fierce local- and national-level resistance against nature-protection programmes and, in particular, the establishment of the EU Natura 2000 network, which changed the focus of nature conservation towards privately-owned lands (Hiedanpää, 2002; Paloniemi and Varho, 2009). Private forest ownership has a special status in Finnish forest policy and subsequently in biodiversity protection. Since more than half of the forest land is owned by private forest owners and the large-scale forest industry is dependent on the raw-material supply from these forests, the German regulation model was adopted and firmly rooted in Finnish forest policy to govern both nature and forest owners after the Second World War (Jokinen, 2006). The model proved to be an economic success story and formed the basis for industrialisation and modernisation of the economy.

Starting from the middle of 1990s, biodiversity policies were reformed and targeted at private forest land and commercial activities. Nature conservation based on protected areas was considered insufficient to meet the objective of halting the loss of biodiversity and the government identified the need for complementary tools and measures (Paloniemi and Varho, 2009). Forest biodiversity protection in commercially-utilised, privately-owned forests required a substantial change in thinking, practice and planning of forest-resource use, involving a profound change in the expert system, which was tuned to advancing statistical forest management according to the German regulation model.

The policy reform included the renewal of the Forest Act in 1996 to include targets to protect small-sized valuable habitats outside nature reserves. The Forest Act sets minimum requirements for nature conservation by stating that special characteristics of seven particular habitat types must be conserved (including small watercourses, herb-rich habitats and barren areas). This introduced a new, multifunctional logic to nature conservation: instead of delineating entire habitats outside forestry operations, the law requires that the characteristics of the habitats may not be destroyed (Primmer and Karppinen, 2010; Primmer and Wolf, 2009). In commercial forests, the utilisation of timber resources is not prohibited but restricted to the extent that the nature values are secured. Moreover, the restrictions are subsidised by governmental funds.

In addition, practically all Finnish forests belong to forest-certification schemes (PEFC, FSC). Forest certificates are a market-driven tool to govern forestry to meet the demands of consumers. Timber products that are produced according to certification criteria and standards are granted environmental labels. In Finland, certification sets some extra responsibilities for forestry compared to the Forest Act: in addition to securing the seven valuable habitat types defined by the Forest Act, timber producers are committed to securing some other valuable habitats and to increasing the volume of decaying wood in forests, which is important for many threatened species (Auvinen, 2006).

While the EU membership and the implementation of the Natura 2000 network had given rise to a fierce conflict, there was also a need for more collaborative practice. This gradually led to the development of new governance tools as part of the Forest Biodiversity Programme for Southern Finland (Paloniemi and Varho, 2009). The programme introduced the idea of voluntary conservation and was based on nature-values trade. Nature-values trade introduced temporary contracts between land owners and public authorities for sites that meet certain scientific criteria for valuable natural objects.

Compared to previous nature-conservation programmes based on protected areas, the new policy tools for forest biodiversity protection gained seemingly legitimate and uncontested status. After years of heated debate, there is now an institutionalised commitment to securing nature values (Primmer and Wolf, 2009). In particular, the nature-values trade became very popular among forest owners and has led to a tremendous change of attitude towards biodiversity protection in forestry, as has been reported in previous studies (Paloniemi and Tikka, 2008; Paloniemi and Varho, 2009).

Governing Through Knowledge Practices

Each of the regulatory devices applied depend on knowledge practices that make the biological values visible and tangible for the economic actors or the public sector. Following global concern over the loss of biodiversity, data on nature values has increased tremendously during the last few decades. However, it is unclear to researchers and decision makers how scientific knowledge is utilised in practice to protect biodiversity (Hildén et al., 2006). A case study on the implementation of the Forest Act in Southern Finland showed that regional forestry authorities identified only 10 per cent of the sites fulfilling the scientific criteria for valuable nature sites and only 4 per cent of threatened species (Pykälä, 2007). It has also been reported that nature values have been secured in only 6 per cent of the valuable sites during logging operations (Siitonen and Ollikainen, 2006). The aforementioned examples indicate that increasing knowledge of nature is not enough to enable responsible action. Biodiversity is an abstract and profoundly scientific concept. It means little to the forestry actors whose activities are geared towards commercial utilisation of forests and maximising the timber yield.

There is a growing body of literature aiming to explain the role of knowledge in changing the environmental behaviour of citizens or corporations. Of particular interest are theories that aim to explain how environmentally-responsible action gets normalised. For instance, drawing from Foucault, it has been pointed out that knowledge practices act as 'responsibilizing mechanisms', creating environmental subjects (Hargreaves, 2012; Miller and O'Leary, 1994; Rose and Miller, 1992). This kind of self-governance is based, for example, on setting up certification criteria and adjusting one's activities to meet such criteria. Responsible action thus requires coordination and management of the conduct of individuals and groups (see also Novas, 2006).

A similar point has been made in science and technology studies which emphasise that knowledge is not only something that flows between organisations and individuals or within networks but it also changes the world while it is travelling. Knowledge technologies and tools aim to bring order and coherency to the world in a way that makes the world governable. Here the focus is on knowledge practices, techniques and instruments that sustain heterogeneous collectives of people and make it possible to observe, influence and manipulate reality (Asdal et al., 2008; Callon, 1998; Callon and Law, 2005; Hinchliffe et al., 2007).

For example, biodiversity science has had an important role in making the loss of nature values visible to political decision making. As science study scholar Geoffrey Bowker (2000) has argued, securing biodiversity is data-intensive: the techniques for gaining knowledge about nature (for example, species surveillance) aim at building a comprehensive catalogue of biological resources to enable their sustainable management. He argues that these knowledge practices recreate the world in such a way that biological values become visible and thus governable. However, science studies have been criticised for focusing only on the internal workings of the scientific knowledge system (Robertson, 2006). Therefore, this kind of analyses are not capable alone of addressing processes via which biological knowledge becomes relevant within economic forums or is translated into the legal realm where rights and duties are allocated. In his study of botanist practices to make ecosystem functions visible to capital logic, Robertson (2006) points out the need to study such circulations between different realms of action. Moreover, Höhler and Ziegler (2010) claim that science's role in governance cannot be reduced to providing adequate methods and tools for taking nature into account, rather we also need to be attentive to the intertwining of scientific, political and economic goals. Understanding how nature is made present in these interactions is related to power relations and partnerships between the state, corporations and civil society highlighted also by governance studies (see Hajer and Wagenaar, 2003).

The literature focusing on the materialities of social interactions helps us here because it clarifies how power operates through mundane practices. When the mobilisation of the actors is seen as a practical achievement, inscribed into the materialities of everyday life (Hargreaves, 2012; Hobson, 2006), environmentally-responsible action can be researched as formulated in specific situations. Knowledge practices, such as routines of collecting and processing data and

communication, organise social interaction and social relations, roles and duties for the governance of natural resources (see Mol, 2002; Moser, 2006). They are crucial in setting up physical boundaries (between 'naturally' valuable and 'commercially' valuable forest stands), legal boundaries (allocation of rights to use forests) and organisational boundaries (responsibilities and resources). Nature conservation becomes not only the government's responsibility, but also that of various other actors: through knowledge practices forestry companies, forest owners and their Forest Management Associations together with public authorities are engaged in ensuring that nature values are secured in commercial logging.

While travelling between the scientific, legal and commercial realms, the biological objects appear anything but stable. This instability also makes the social orders fragile. This has implications for responsible action. Responsibilities are defined in conditions where biological objects can simultaneously be present and absent, or present only for some actors or in some contexts (see also Hinchliffe, 2008). Moreover, the same ecological information may be valid in some realms and insignificant in others. Thus, while knowledge practices aim to build coherent objects of governance, there are various orderings of reality that overlap with each other. These overlaps lead to overflows (Callon, 1998), which form specific conditions for the allocation of responsibilities, duties and rights. There is a need to look at the practices via which scientific knowledge and even uncertain scientific knowledge, is made significant across the legal and economic realms.

The Case-study Materials and Analysis

This study has been carried out as an ethnography of forestry in Finland in the region where the Forest Biodiversity Programme for Southern Finland is being implemented. The research material has been collected by following and interviewing forestry actors during their daily activities. I have used expert interviews to identify various working situations in which they deal with ecological knowledge, and collect, process or pass it between organisations and individuals. The informants have been chosen from both the public and private sector, performing various biodiversity-related tasks. The framework for choosing the informants is summarised in Table 1.

The research material was collected by interviewing and observing forestry experts in their work. I have attended field trips with my informants and during these trips observed forest extension, logging-site planning and official inspections of logging sites—all activities related to biodiversity protection. These working situations included social interaction. While doing their work, the forestry experts met forest workers and forest owners and collaborated with environmental authorities. In addition to field trips, I also attended short field courses on biodiversity targeted at forestry professionals, forest workers, students and land owners. During both the field trips and courses, I kept a field diary of my observations about what people did and discussed while they 'take biodiversity into account'. I also included in

Table 1

Informants Representing the Various Biodiversity-related Tasks and Organisational Backgrounds in Forestry

Informant	*Region*	*Organisation*	*Activity*	*Task*
1	1	Regional Forestry Administration	Forest extension	Nature management
2	1	Regional Forestry Administration	Forest extension	Nature management
3	1	Regional Forestry Administration	Government	Monitoring
4	1	Regional Forestry Administration	Government	Reporting official
5	1	Local Forest Management Association	Forest extension	Management
6	1	Forest company 1	Business	Timber procurement
7	1	Forest company 1	Business	Timber procurement
8	2	Regional Forestry Administration	Forest extension	Nature management
9	2	Regional Forestry Administration	Forest extension	Forestry planning + Nature management
10	2	Regional Forestry Administration	Forest extension	Communication
11	2	Regional Forestry Administration	Government	Reporting official
12	2	Regional Forestry Administration	Government	Monitoring
13	2	Regional Forestry Administration	Government	Monitoring
14	2	Forest company 2	Business	Monitoring
15	2	Forest company 2	Business	Management
16	2	Forest company 2	Business	Timber procurement
17	2	Forest company 3	Business	Forestry planning
18	2	Local Forest Management Association	Forest extension	Forestry planning
19	2	Regional Environment Administration	Government	Management
20	2	Regional Environment Administration	Government	Nature management
21	National	Consulting	Forest extension	Other

the diary short interviews with participants to clarify why they did what they did or why they think how they think. In addition, I conducted longer interviews with the expert informants before or after we met in the field. I have also used interview material collected by another person who has used a similar thematic outline for the interviews. These research materials are backed up by various documents to follow the formal procedure of biodiversity protection, that is, how it is represented and technically treated in the process and how the various actors are formally mobilised to conserve nature.

In the analysis, I place myself as a witness to the mobilisation of actors in biodiversity policy. I also follow how the partnerships between the mobilised actors are shaped by knowledge practices and circulation of knowledge between the scientific, legal and economic realms. The analysis focuses on: (a) delegation of rights and duties between actors; and (b) techniques of making biodiversity present in the forest as well as in legal and commercial activities. I also describe: (c) how these configurations of responsible action become unstable; and (d) how strategies of dealing with uncertainty affect how actors become engaged with the biodiversity project and how the responsibility is shared between them.

Delegation of Rights and Duties

I begin the analysis by describing how the duty to protect biodiversity is being delegated to forestry actors in practice. No forestry operations can be done without considering nature values first. There are two key knowledge practices that engage commercial actors and allow public actors to intervene into commercial activities: (a) monitoring of the Forest Act; and (b) declarations for loggings. Both of these practices have been established to enable the circulation of ecological knowledge to the administrative and economic realms. As the following incident reveals, this circulation is unreliable.

In 2008, something went wrong in an Eastern Finnish forest: a spring that provides clean water and maintains a habitat for certain endangered species was destroyed in loggings. Many informants referred to this case, which received a lot of publicity and involved many actors. The destruction of the spring was discovered by an inspector who worked at the Regional Forestry Centre. He selected the site randomly from the database to check its status. Random inspections are a specific tool in monitoring the Forest Act, introduced after 1996. Regional Forestry Centres are responsible for such monitoring activities, as the focus of regulation shifted from pre-logging monitoring to retrospective surveillance (Laakso et al., 2003). As a consequence of the inspection, a police investigation began to find out who was guilty of destroying the spring. Similar events are not rare, although they cannot be regarded as the outcome of intentional actions. In 2008, Regional Forestry Centres reported 143 suspected cases in the whole country, of which 50 were reported for prosecution (Tapio, 2008).

Monitoring is but one example of new duties that have been allocated to both public and private forestry organisations. In principle, land owners are responsible

for safeguarding nature values on their land. In practice, they depend on the expertise of various forestry professionals: Forest Management Associations help them through the process of the timber trade and forest company experts buy the logging rights, plan each logging site and carry out loggings. Finally, logging contractors and harvester drivers do the actual job and they have also been trained to identify nature values. If something goes wrong, even the police and legal experts in court may get involved in nature-conservation issues.

While biodiversity conservation has implications for a broad group of stakeholders, the challenge of policy integration has been grasped in terms of multi-level governance requiring exchange of information, collaboration and new expertise (Primmer, 2011). Exchange of information was indeed a particular focus of the police investigations in the aforementioned case. The investigation was targeted at who knew and who should have known the whereabouts of the spring and who was responsible for safeguarding it during the loggings.

The police found out that the company that had bought cutting rights to the forest stand had declared the loggings in time, two weeks prior to the planned operation. The declaration is another key procedure of forest biodiversity protection, besides monitoring. When a land owner plans to sell timber, a declaration has to be made to the Regional Forestry Centre to give the authorities the chance to check the information included in the logging plan. The declaration is a formal routine that links actors together and allows biodiversity to be taken into account. Via this procedure, forest owners and their collaborators (logging companies who hold the logging rights and local Forest Management Associations that help forest owners in the logging process) are mobilised to act responsibly. The declaration is an institutionalised event of biodiversity protection, while it allows official intervention in commercial activities.

In the present case, the logging plan made by the forest company did include information on some valuable nature sites, such as the creek starting from the destroyed spring, but it did not include the spring itself. The inspector at the Regional Forestry Centre who received the declaration checked the database (which includes information gathered through the national inventory of nature values) and noticed that the spring was missing from the logging plan. He informed the representative of the forest owner, the local Forest Management Association, which acted as a mediator between the forest owner and the logging company. Up to that point, everything was in line with the protocol. However, it turned out that the forestry expert of the Forest Management Association was on holiday and the information never reached the forest owner, nor the logging company. Therefore, it was never marked by red tape in the forest to bring the logging-machine driver's attention to the valuable site. As a consequence, the spring was destroyed. Since nobody could be considered guilty of intentional damage, the prosecutor dropped the case.

This case shows that the ecological object was unstable in many ways. First, it was simultaneously present and absent as it was present in forestry databases and information systems, but only visible to some actors. Second, its physical

presence was not secured because its virtual presence was only partial. Third, although there was no doubt that a valuable biological object was destroyed by actors that could be specified, this information was not significant in the legal realm. The evidence for wilful damage was more important in determining responsibility than ecological knowledge as such.

Coordination of Responsible Action

The status of biological knowledge can be unclear in other ways too. The Forest Act is based on scientific criteria: its target is to protect natural characteristics that are 'crucial for biological diversity, including biological, physical, chemical, geological or geomorphological features' (Lehesvirta and Vuokko, 2001). Despite the clear principle, there is still room for interpretation. It is not always clear how to identify and define valuable natural objects, or their characteristics, in real-life situations. Some habitats, such as herb-rich groves, seem to be particularly difficult for forestry experts. Moreover, forestry experts need to interpret the scientific criteria in ways that are relevant to the commercial actors: logging companies and forest owners. There has, for example, been lot of debate about how wide a zone needs to be left to protect the site's valuable characteristics. Furthermore, the interpretations need to fulfil the criteria set by the legal system as well. The guidelines for the protective zones have, for example, changed during the implementation period of the Forest Act.

Forest biodiversity policy is simultaneously made more inclusive through the recruitment of various groups and social practices, but there also seems to be a need to coordinate the actions, motivations and interpretations (see also Ellis and Waterton, 2005). Below, I give an example of how the need to coordinate the interpretations organises responsible action.

During my fieldwork, I attended a one-day forest-biodiversity field course targeted at forestry professionals of a forest company. The course, organised in collaboration with a Regional Forestry Centre and a Regional Environment Centre, aimed to teach the forestry experts how to identify valuable natural objects and how to deal with them in practice. The diverging interpretations and difficulty in making judgements about nature's values has given rise to the development of various tools to make interpretations more unified. Recommendations and guidelines have been developed to streamline common understandings. Training courses offered to personnel, both in the public and private sector and land owners serve the same purpose.

During one exercise, a site that was interpreted by most participants as a valuable habitat was eventually defined by the representative of the Regional Forestry Centre as not valuable. This judgement was based on the fact that there were traces of human influence (ruins of an ancient building), even though the biological qualities fulfilled the criteria for a Forest Act habitat. Thus, the site was no longer considered to be in its natural state.

When I discussed this case with the course organisers, it became clear that the particular site was chosen to teach the participants the right interpretation with the aim of harmonising and coordinating the ways of implementing the law. This kind of harmonisation is, of course, needed to secure fair implementation process throughout the country. But through such coordination, biodiversity is also enacted in a very specific way: as a legal and procedural issue. In the aforementioned example, it was not the scientific quality of the site that was decisive but its legal qualification. 'Natural state' is a key term here. Natural state is an ambiguous condition of nature that needs to be interpreted in the landscape but there are no exact criteria for defining it. For example, as there hardly exist forests without any human impact, the significance of such impact needs to be interpreted based on the timing and extent of human activities. When the status of the site was evaluated in legal terms the interpretations of natural state as well as observations of human impacts of the site overruled the scientific criteria for habitats.

The site was thus chosen to exemplify and teach the hierarchy of knowledge to the forestry practitioners. Yet there is room for contrasting perspectives. The last lines of the quote below reveal that not all experts are willing to adapt to this order. The case raised debate among the participants and I discussed the site with some of my informants afterwards:

> R: Here we enter such deep waters of biodiversity and biology that not all people are able to maintain their interest. But I find it interesting to master these things and also to discuss them with somebody. And I find it positive that I have been able to disagree, for instance, with the planner of the Regional Forestry Centre when I feel that a site is really worth protecting and they don't see the value. I think this is a crazy situation.
> Q: Yeah, it's interesting…
> R: I am representing a forest company!
> Q: You would assume it's the other way around. (17)

By reflecting on the official policy interpretations of the authorities, the representative of the forest company makes it clear that there might be other policy interpretations too. The contrasting perspective also points to power relations: Regional Forestry Centres are in a key position to defining what qualifies, in the legal framework, as significant ecological information. They also decide which sites are eligible to receive compensation from Sustainable Forestry Funds.

The regional forestry administration thus holds a key position to control the interpretations on valuable sites. This allows them to safeguard biodiversity but also to define ways in which this is done. Thus, a specific framing of biodiversity was put forward: the key aim of nature conservation is to meet the minimum requirements of the law and the key role of forestry experts is to work towards this goal. Most forestry experts share this motivation for biodiversity protection: biodiversity is not their top priority, instead they want to learn to cope with this new task of being able to conduct logging operations while meeting the legal requirements.

Normalising Economic Rationale of Biodiversity Protection

In this section, I further discuss the diverging policy interpretations and the partnerships for biodiversity protection they entail. The new tools of environmental protection, the voluntary protection schemes and compensation for Forest Act habitats, have been warmly welcomed by many forestry professionals and forest owners. This has given new meaning to responsible action: protection of mosses, weeds and creeks has become a matter of maintaining the income flow of forest owners. This is in contrast with the above mentioned principle of minimum protection. I explain below how ecological knowledge has started to work towards private economic goals and changed the idea of responsible action.

Another follow-up interview with a forest company manager after the training course discussed the changing logic of nature conservation in the following way:

> I've tried to sell the idea and probably also mentioned it [on the training course] that when a site needs to be left untouched by the law, and especially when it is difficult to harvest, it should be quite easy for our experts to suggest that either Kemera [sustainable forestry funds] or Metso [voluntary protection programme] funding could be used [to compensate the cutting restrictions]. The timber buyer would receive income, and we could get our timber somewhere else. (15)

In the quote, nature conservation is described as a win-win situation for the logging company and the private land owner. The rationale for nature conservation diverges from the legal framework promoted by the regional forestry administration focusing on minimising the effect of nature conservation on forestry. This ethos is further exemplified by another story of how protected sites are being negotiated. My informant, who is acting as a forestry planner in a logging company, took me on our field trip to a very beautiful place, a high rift, with views across the surrounding landscape. While we were walking to the scenic spot, he pointed out a tiny patch of habitat fulfilling the criteria of a valuable site according to the Forest Act. He proudly explained that a much wider area of land is included in what now forms a private protected area. He explained that he took advantage of the rift beneath our feet in his effort to persuade the land owner to apply for voluntary protection through the Metso programme. He emphasised that due to the high cost of logging in this kind of terrain it would make more sense to leave the forest as it is and obtain compensation from the protection programme.

In certain landscapes, the economy works for biodiversity protection because logging companies are reluctant to log sites that are expensive to harvest. The rocky terrain in the above example also widened the possibilities for my informant to engage in biodiversity protection. It enabled him to make a move between two different legislative systems: the Forest Act and the Nature Conservation Act. The latter regulates voluntary contracts with land owners. These sites must also fulfil certain scientific criteria and be larger than those protected under the Forest Act.

The informant was also travelling between two different administrative sectors: the Forest Act is enforced by the Regional Forestry Centre, while the voluntary contracts are administered by the Regional Environmental Centre. Thus, he was communicating with different expert systems. The informant—with a higher than average interest in biodiversity issues—was exploiting the possibility to interpret the site's value in two different ways—a possibility arising from institutional ambiguity of a site covered by two different legal frameworks.

The widening of the interpretative horizon is not necessarily in the interests of forest administration. Conventionally, forest policy was based on the assumption that scientific forest management secures ecosystems as resource- and wealth-creating machines. In Finland, this has been strongly linked to the democratic ideals of distribution of economic welfare: because forests are to a large extent owned by small forest farm holders, it has been argued that industrial development based on forest-resource use widely benefits society as the income flows to the resource peripheries. However, this idea has been strongly contradicted by some forest economists (Tahvonen and Kallio, 2006), who claim that following the scientific model does not necessarily yield the best possible profit for forest owners. The voluntary nature-conservation programme highlights this point further as it gives the forest owner an opportunity to earn by leaving some forest stands untouched. The legal framework for nature conservation is thus contrasted with an economic one that emphasises the monetary value of biodiversity (see also Paloniemi and Varho, 2009) and the right of the forest owner to earn by engaging with nature conservation.

The disciplining of interpretations described earlier aims to control the effects of biodiversity policy on forestry, not extending nature conservation too much so that it threatens the national framework of economic utilisation of the forest. However, the private economy of a forest company and land owner presents a different rationale. Here, the fact that nature values have exchange value made ecological information significant. It also allowed the forestry expert to act responsibly, not in the sense of fulfilling legal requirements but in terms of moral accountability for biodiversity protection: although he rationalised nature conservation in economic terms he also pointed out in a later interview that for him '[nature conservation] is an ethical issue'. However, in practice, the power of the Regional Forestry Centre to frame biodiversity policy could be undermined, only because the Regional Environment Centre happens to have more funds to subsidise the voluntary protection schemes.

Making Biodiversity (Partly) Present in Forestry

Not all forestry experts would have made a similar decision over the site mentioned above. The attempts to make biodiversity present are simultaneously attempts to mobilise experts who belong to overlapping knowledge systems for the governance of natural resources. Below, I describe the contradictions and overflows between these, affecting how responsibility for making nature present is exercised.

Figure 1

Information systems and GPS are key technologies for making nature present in policy collectives for biodiversity. However, the virtual presence of valuable sites needs to be translated into red tape markings in the forest to physically safeguard them during loggings.

A major effort to map valuable natural sites in commercial forests was carried out in Finland between 1998 and 2004, with surveyors finding a total of 96,487 small-sized sites (on average 0.6 hectares) defined as valuable according to the law (Kotiaho and Selonen, 2006). As a result, a database was formed to include all the information that was gained through the inventory. In forestry, both expert and forest work is increasingly based on electronic databases, maps and information systems. These are important tools without which biodiversity would not come into being, first as pixels on the screen and then as red tape markings in the forest (Figure 1). In fact, a harvester is a highly sophisticated communication system equipped with computers and GPS. While databases contain place-specific data on the logging sites, including nature values, the data on the logging plan can be electronically transferred to the logging machine. The driver uses the map- and GPS-based information to carry out the work. If there is a need to update the logging plan, the new information can be transferred online. Use of such technology also improves the cost efficiency of data management.

Despite the efforts to make nature present through investments in staff time and information systems, biodiversity is brought into being only partially. There are gaps in the information systems due to lack of data in certain regions and poor expertise in biodiversity at the time of inventories. The skills of the surveyors were not nearly as developed as they are nowadays and because of this sites that do not meet the criteria have been included in the database and sites that would meet the criteria have been excluded. Currently, the database is complemented by collecting data on nature values during the everyday forestry planning activities of both private companies and public authorities.

Forestry planning is carried out to extend forestry and forestry plans are made for each private forest farm. Valid for ten years, the plan includes information about the timber resources of the farm, designates harvesting potential and gives instructions for forest management. It is a key technique in 'organized irresponsibility': forest owners are given advice on how to grow forest in a way that maximises the long-term forest growth on their land, although nowadays forest owners have more freedom to express their preferences and goals for forest management than before. Despite being a technique to advance the standardisation and homogenisation of forest ecosystems, forestry planning is also an important resource for biodiversity protection as well. Drafting of forestry plans requires fieldwork: forestry experts visit farms and estimate the resources. This kind of fieldwork provides good opportunities for checking the farm's nature values as well.

My informants agreed that fieldwork is a key practice in securing nature values. The forestry actors whom I talked to were convinced that only by physically going into the forest can the nature values be fully secured. This view is backed by the survey results by Primmer and Wolf (2009), who also found out that engagement in field operations is regarded by forestry experts as the most productive resource for conserving habitats. Fieldwork is important because it is a technique of engaging with the natural world materially. Such material engagement has been recognised as the basis for gaining knowledge about nature, in ecological work too, although its forms have evolved historically (Hinchliffe, 2008; Nygren and Jokinen, 2013). However, there are internal tensions within and between organisations concerning the allocation of resources, such as staff time, to such engagement with nature. The following interview quote exemplifies this:

> Q: […] could you think of something else that is crucial for the protection of nature values, concerning the activities of the Regional Forestry Centre?
> R: Our problem is that we don't see the value of working […] more slowly but utilising personnel resources fully. [Meaning that] if someone has already been to the field location, there is no need for anyone else to go. But I don't know if we can change anyone's job description [to include the collection of data on nature values] if s/he does not feel it is part of their field. But, those [valuable] sites are out there in the forest, and if someone is doing forestry planning, I think s/he should feel [biodiversity] is part of his/her job. […]
> And, it is a matter of what is appreciated in our organisation. [It is a question] of whether forest extension is conducted in a holistic manner or not. Forestry planners do have to get a certain amount of… have you ever heard about 'Metsäänpalstat'?
> Q: Yeah, the web-based timber market.
> R: So, they need to activate land owners to give sites for sale to this web service. And this is compulsory. But they are not obliged to identify nature values. This reflects the values of our organisation. (8)

Regional Forestry Centres are not only monitoring the Forest Act but promote forest extension and allocate funding to various state-subsidised forest-management

activities, such as ditching, thinning and forest road construction. Within these organisations, there are officials who do forestry planning and are allocated a lot of staff time to carry out fieldwork. They could collect data on biodiversity as well, but it seems to be dependent on their personal skills and motivation, as indicated by the quote above. There is also a lack of proper incentives. For example, the salary system does not encourage the planners to collect biodiversity information; if biodiversity data collection slows down their work, they actually lose money. Nature's presence is thus dependent on personal motivations. The lack of motivation for nature conservation is, however, institutionalised in work practices, which seem to be more supportive of other policy goals than biodiversity. Another example relates to budget planning. A leader of a Regional Forestry Centre commented to me that his 'job is to reduce the number of days when the employees put their rubber boots on'. Similar pressures are present in the private sector as well. The budget constraints determine the extent to which biological knowledge can be collected, thus keeping the biological objects unstable.

Redistributed Responsibilities

Forestry experts recognise the instability of biological objects as an inherent part of their work. Therefore, strategies are developed to manage uncertainty, thus making it a practical challenge. These strategies affect how the partnerships are organised. In this final section, I present examples of how power relations between organisations and groups are formed and responsibilities shared through knowledge practices.

Firstly, not all actors have equal access to the knowledge pools. Most importantly, institutional boundaries restrict access to data. In Finland, the privacy of forest owners is strictly protected by law and therefore, access to the national database maintained by the Regional Forestry Centres is limited. Forest companies have claimed the right to this knowledge to decrease the risk of accidentally destroyed nature values and this was also regarded as a major problem by many of my informants. However, the forest owner lobby has long protested against such opening up of private information. Nature's presence is thus a matter of political bargaining.

Access to knowledge is a limiting factor that creates differences between the actors. Unequal access to resources, environmental knowledge and distribution of rights and responsibilities have been addressed especially by feminist political ecologists, who have claimed that gendered processes lead to uneven development and opportunities (see Elmhirst, 2011). In the case of forestry, access to knowledge defines capacities for responsible action. Those denied access are forced to make decisions based on uncertain knowledge. To some, the ecological objects thus appear more stable and present than to others. However, in current poststructuralist thinking, predefined social roles are seen in a more complex light. Access to knowledge can be determined based on complex relations and multiple memberships in social communities. My informants have also developed various strategies to increase their access to knowledge pools. For example, one of my informants, a forestry expert

who was also a bird enthusiast, had obtained access to knowledge not available to his forestry expert colleagues. Generally speaking, birdwatching communities may want to keep information on rare birds confidential, because they are afraid that it would be misused. However, my informant used the information he gained through his birdwatching networks to safeguard the nesting sites of raptors while drafting forestry plans.

The second example concerns the incomplete e-infrastructures. The logging planners often need to check other sources of information, for example, basic maps, for possible features of nature values, such as blue lines marking small water bodies, springs or rifts, or place names hinting that there might be something valuable nearby. The professionals also depend on local information sources, most importantly land owners. Lack of local knowledge is a problem in situations when a land owner is not living close to his/her property or has bought the land recently and cannot be consulted on these issues. In Finland, the structure of forest ownership is changing (Karppinen and Ahlberg, 2008) and as a consequence the number of urban forest owners is increasing.

Land owners form an important back-up source of information, but they are not usually regarded as legally responsible for ensuring biodiversity, unless they keep relevant information from the experts (Laakso et al., 2003). Responsibility thus lies with those who plan and carry out loggings. However, it is not evenly distributed among the forestry experts and workers. The following quote from an interview describes how the material form of knowledge practices affects the relationships between the parties:

> The logging plans are made out of the blue. There is a risk when we have the electronic forestry plans and we do desktop logging plans […] and we do not necessarily enter the forest at all. So, when the poor forest owner is in court with us, can s/he really say that s/he was relying on an expert? And now there will be these new laser-scanning and other technologies. We've been instructed to check every inch of the forest, but as we also need to be more and more efficient, we don't have the resources for that. (17)

While nature's presence is increasingly based on the use of e-infrastructures and the traditional practice of 'knowing by walking' is diminishing, plans for logging sites can be done without entering the site physically. Often, only the boundaries of the forest farm are checked on foot. The weight given to biological knowledge is thus related to the material forms of knowledge practices. However, this is not the only consequence of the choice of method. Relying on e-infrastructures often means erosion of expertise as alluded to by my informant. The logging-machine driver is often the only person who really goes through the logging site, inch by inch. The professional community recognises this: 'I sleep well when I know that the driver knows,' commented one of my informants, a forestry professional working in a large, multinational forest company as a logging-site planner (16). Loggers are expected to develop the capabilities to apply complex ecological

knowledge in their daily work. Nowadays, the forest companies usually require a certificate indicating successful completion of a course on nature management from their contractors and they organise training courses for the drivers and other forest workers. This is an example of how environmental subjects are normalised. However, although training is important, it implies that responsibility for awareness of possible nature values is delegated from forestry professionals to forest workers and from the multinational to micro-sized companies.

Conclusions

The routines, techniques and tools for the identification of valuable natural objects and their locations have made ecological knowledge an important element in commercial forestry. These knowledge practices are important in creating a boundary between two different policy objectives in the forest: forest stands that can be logged and those that need to be left untouched. At the same time, the knowledge practices and information technologies are also key to allocating legal rights. The Forest Act itself is not very clear in allocating responsibilities, although it states that the party carrying out loggings is responsible for fulfilling the legal requirements (Laakso et al., 2003). In practice, the responsibility has been shared between the land owner and the various professional groups who take part in the logging process. Despite the impressive machinery set for data collection and processing, there are knowledge-related uncertainties that make the task of boundary definition challenging. Consequently, the allocation of legal rights and responsibilities is not clear either.

The instability of rights and duties exemplifies the challenges of environmental governance. Collaboration between corporate actors, citizens and government is needed to resolve pressing social and environmental problems (Gottweis, 2008; Hajer and Wagenaar, 2003), but the format of this collaboration is open. Therefore, there is a need to understand the distributional effects, benefits and burdens of policy implementation. In my analysis of forest biodiversity protection, I have demonstrated that knowledge practices that have been developed to implement biodiversity policy may organise social relations and partnerships, define roles, rights and duties for social actors and produce social differences among them. Therefore, knowledge production and processing for decision making should not be treated as a technical issue but as performative of the public–private partnerships required by the new governance approaches.

The practices and strategies for dealing with uncertain knowledge in environmental decision are, in particular, key to restructuring the possibilities to move away from organised irresponsibility. I have pointed out with my analysis that the instability of biological objects is not only conditioning decision making but leads to unstable articulations of responsibility. The institutional and practical responses to uncertainty are thus also exercises of power while they affect the production of accountabilities and sharing of responsibilities. Therefore, uncertainty of knowledge is not a technical problem in decision making but constitutive of the partnerships in environmental governance. Understanding the formation of these partnerships is

one way of advancing the institutional reflexivity needed to review the underlying commitments and outcomes of governance through science.

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