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Towards a New Approach for Studies of Endangered Species Management

Technologies of government in Norwegian wolf management (1960s–2010s)

Thesis for the degree of Philosophiae Doctor

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Summary

The doctoral thesis develops a new approach for studies of endangered species management by drawing on recent developments in science and technology studies, governmentality studies and environmental history. By making technologies of government its main object of study, the approach enables research not only of that which is commonly perceived as political, but also of techniques and instruments that enable and effect politics in practice. It argues that the proliferation of technologies of government over recent decades has transformed endangered species management and protected organisms in profound ways, and that these developments constitute a blind spot in the existing literature on endangered species management.

The thesis identifies and investigates such developments in Norwegian wolf management through four articles. Article one investigates how genetic techniques were incorporated into Norwegian wolf management in the 1990s, and argues that this process of 'molecularisation' was decisive in efforts to construct and stabilize Scandinavian wolves as natural, vulnerable and worthy of protection. Article two investigates how an extensive monitoring system, which enabled detailed and intensive 'nationwide field studies *in absentia*,' was constructed between the 1960s and the 2000s. Article three investigates how the protection of wolves in Norway has been conducted in practice by asking 'how many wolves it takes to protect the population.' It examines the employment of 'minimum viable population size' in regulations of wolf numbers, and argues that transitions in the authority to define its content, first from biologists to nature managers, and later from nature managers to politicians, involved major transitions in the number of wolves considered necessary for protecting a viable population. By drawing on the empirical findings of the other three articles, article four investigates whether the proliferation of technologies of government in Norwegian wolf management has 'preserved the wolves by transforming them.' The article further explores whether nature management, in general, has transformed so much that the recent period warrants the label 'the age of biodiversity,' and whether issues of naturalness, wildness and authenticity are new and typical management challenges of the period.

Preface

Spending hours upon hours inspecting seabed mud, digging through it with the aid of a microscope and tweezers to separate tiny animals from plants and inorganic material, might seem like an odd occupation for a young adult. Perhaps not, if it is decently paid. This is how I spent many of my summers, as an assistant in my father's marine biology laboratory. From then on, it was a crooked academic road to this point. After undergraduate studies in biology, chemistry, mathematics, religious studies, pedagogy and history, and a master's degree in cultural history, I found a PhD program and dissertation topic through which I was able to combine my interests for cultural history, biology and biodiversity. During this work, I also found two new interests: science and technology in society and the practice of public government.

When laboring through sample after sample of seabed mud over a microscope, I did not imagine that this work would be of any help to me many years later, in a PhD project on the technologies of government in wolf management. My experiences of practical biological research and environmental assessment were, however, invaluable in the process of identifying and working through the more specific topic of this doctoral thesis. I would therefore like to extend the first of many thanks to my father, for showing me how to appreciate the diversity of life.

I am very grateful for the opportunity to undertake this work, and for all the help I received in the process of writing this doctoral thesis. I would like to thank the Faculty of Humanities at NTNU for awarding this project a four-year PhD fellowship. I would like to thank my advisors, Per Østby and Finn Arne Jørgensen, for their solid scholarly contributions to this project – for opening new analytical spaces (as well as restricting them from getting out of hand), for having faith in this project throughout and for being generous and sympathetic persons. Terje Finstad deserves thanks for his contributions to this project through numerous interesting and rewarding conversations, manuscript comments and general enthusiasm from across the hallway. Thanks also to Dolly Jørgensen for providing much sound advice at the early stages of the project, and Øyvind Thomassen for helping me identify wolf management as the object of study for this thesis.

I would like to thank Reidar Andersen, Terje Bø, Øystein Flagstad, John Durrus Linnell, Hans Christian Pedersen, Ole Jakob Sørensen and Petter Wabakken for giving interviews, which contributed to this doctoral thesis in many ways. Some of you also provided thoughtful manuscript comments, which were very helpful and much appreciated. I am grateful to everyone who helped me identify and gain access to material at various archives, and particularly to Øyvind Rekdal and Anne Margrethe Sigstadstø at the Directorate for Nature Management's archive. Thanks also to Michael Egan for helping out at a difficult stage in the process, and Valerie Appleby at Orchard Editing for professional copy-editing.

My colleagues at the Department of Interdisciplinary Studies of Culture make it a great place to work. In particular, I am grateful to Stig Kvaal, Agnes Bolsø, Ane Møller Gabrielsen and Morten Haugdal for manuscript comments and valuable discussions at seminars in the research group Studies of Nature, Environment and Culture (aka the 'Animal Group'). I would also like to thank Knut Holtan Sørensen and the other contributors at the department for providing engaging and rewarding PhD courses, as well as other scholarly seminars and activities. Kari Bergheim and Lotte Johanne Sæther deserve thanks for their never-failing skills of resolving administrative and practical matters.

Finally, I would like to thank my wife June for her enduring patience and support throughout this process, and our daughter Alma for being exactly who she is. You make my life richer in so many ways.

Trondheim, December 22, 2014

Håkon B. Stokland

Contents

Introductory essay

Introduction

This doctoral thesis examines technologies of government in Norwegian wolf management, from the 1960s until today. The term 'technologies of government' reflects an ambition to investigate not only that which is commonly perceived as political, but also techniques and instruments that enable and effect politics in practice. These include techniques of notation, computation, calculation and assessment, in general, and DNA profiles, an extensive monitoring system, a wolf-zone and a population goal, in the specific case of Norwegian wolves. By examining the construction, employment and effects of such techniques and instruments, the thesis aims to provide new analyses of Norwegian wolf management, in particular, and endangered species management, in general. Most of the analyses are also relevant for biodiversity and nature management, more widely. The thesis further develops a new approach for studies of endangered species management by drawing on recent developments in science and technology studies, governmentality studies and environmental history.

This introductory essay will first provide some background on the management of Norwegian wolves, some conceptual clarifications and an outline of the thesis. This is followed by summaries of the four articles. The essay will subsequently present an analysis of the existing body of literature on endangered species management, as well as a new approach for studies of such management. Finally, the essay will provide an account of how the more practical aspects of the study was conducted.

The New Norwegian wolves

After varying highly in number since at least the sixteenth century – most historical accounts identify three periods of high numbers interrupted by periods of low numbers (e.g. Collett 1912; Johnsen 1928) – the population of wolves in Norway significantly decreased in the second half of the nineteenth century and into the twentieth century (Myrberget 1969, pp. 3–9). The latest decrease in number coincided with the government's establishment of public bounties and other measures to eradicate wolves from the 1840s. The wolf population kept decreasing into the twentieth century, and, by the 1960s, wildlife biologists assumed that the population was almost extinct (Myrberget 1969). In an effort to save the very few wolves remaining, the wolves were protected by law in 1971. Due to immigrant wolves from Finland and Russia, the numbers started to rise again – mostly from the 1990s (Wabakken et al. 2001, p. 3). Today, there are about 30 wolves in Norway, 320 in Sweden and 50 that reside on both sides of the border (Wabakken et al. 2014). In this regard, the protection of wolves in Scandinavia has been successful, at least to some degree. However, as in many other places where wolves have returned or been reintroduced, this has led to controversy. There have been conflicts with the livestock owners of sheep and reindeer, as well as with hunters, and also social conflicts relating to social transformation processes and cultural and economic power-relations (Skogen and Krange 2003; Krange and Skogen 2011; Figari and Skogen 2011).

The current population of Scandinavian wolves is commonly described as 'new' because wolf numbers remained at a minimum between the last decades of the nineteenth century and the 1990s. Molecular biologists have identified that the current population is genetically distinct from the previous one by establishing that all of the founders of the current population were immigrants from a Finno-Russian population (Vila et al. 2003). The current population of wolves in Scandinavia is, therefore, 'new' in a genetic sense, as well. This thesis argues that the population is distinct from the previous one in an additional sense: in the way in which the wolves have been molded as objects of government.

I alternately employ the terms 'New Norwegian wolves' and 'New Scandinavian wolves' to designate the wolves, which, in the articles of this thesis, I argue have been profoundly shaped by technologies of government. This is because some characteristics are common to the whole population of wolves that resides in Norway and Sweden, while some are specific to the part of the population that resides only in Norway. Genetic research, for example, typically addresses the whole population, while the Norwegian population goal and wolf-zone applies only to wolves in Norway. In a sense, both Scandinavian and Norwegian wolves exist, only in different contexts: in scientific documents, the wolves are typically understood as Scandinavian, while, in political documents, they are typically understood as Norwegian or Swedish. My use of terms in the articles of this thesis reflects this. When I investigated genetic research on the wolves in the first article, I described the wolves as the 'New Scandinavian wolves.' As I moved on to investigate the regulation of wolves in Norway, however, my analyses did not encompass wolves in Sweden. I therefore adopted the term 'New Norwegian wolves.' Although the specific analyses I provide of wolves in Norway are restricted to these wolves, the more general conclusions also apply, to a large degree, to the whole wolf population in Scandinavia.

Thesis outline

This thesis is a compilation of separate articles, but it is possible to read it as a monograph. It begins with an introduction that presents the research approach, situates it in the body of literature on endangered species management and presents the main findings of the articles. This is followed by three empirical articles that examine different technologies of government in Norwegian wolf management. The fourth article constitutes a cross-cutting analysis of the three empirical articles by employing their findings to draw some general claims about the current management of endangered species.

The introductory essay further constitutes an analysis of the literary body of research on endangered species management. It argues that recent developments, which have profoundly transformed endangered species management and endangered organisms, constitute a blind spot in this body of literature. By drawing on recent theoretical and methodological approaches from the humanities and social sciences – in particular science and technology studies, governmentality studies and environmental history – it develops a new approach that is more adept to identify and examine these developments.

While article one investigates how genetic techniques were incorporated into Norwegian wolf management, articles two and three investigate two aspects of the decisive question of wolf numbers by examining two types of governmental technologies. Article two investigates technologies of knowledge production in wolf management by examining how biologists, nature managers, bureaucrats, politicians and others have attempted to answer the question: How many wolves are there? Article three investigates technologies of intervention in wolf management by examining how such actors have attempted to answer the question: How many wolves should there be? Article four summarizes the findings of the three other articles and employs them in a broader analysis of recent developments in Norwegian wolf management and endangered species management, more generally.

By drawing on resources and ideas from STS, governmentality studies and environmental history, and employing them to study Norwegian wolf management, the thesis aims to produce new knowledge about Norwegian wolf management and endangered species management, more generally. The articles have been submitted to journals encompassing audiences within cultural studies, the history of science, environmental history and the sociology of nature management, respectively. In the hope that this thesis might also be of interest to biologists, nature managers, bureaucrats, politicians and others interested in endangered species management, but not familiar with the theoretical intricacies of the fields of study I draw on, I have attempted to write it in a non-technical and straightforward manner.

The four research articles

Article one. Molecularising nature: How Scandinavian wolves became natural[1]

This article investigates how genetic techniques were incorporated into Norwegian wolf management in the 1990s. It identifies two controversial issues that initiated studies of the wolves' genes: whether the current Scandinavian population of wolves had been illegally reintroduced and whether some or all of them were wolf-dog hybrids. Further, it argues that the concerns of biologists and nature managers about the level of inbreeding in the population were decisive for the prolongation of genetic studies, until such studies became an integral part of a permanent monitoring system for large carnivores in the 2000s.

The article construes the process of incorporating genetic techniques in the management of Scandinavian wolves as a molecularisation of the wolves. It argues that this process was decisive in efforts to construct and stabilize Scandinavian wolves as natural, vulnerable and worthy of protection, by disproving allegations of illegal reintroduction, drawing attention to

[1] Published as Stokland, Håkon B. 2013. Molecularising nature: How Scandinavian wolves became natural. *Forum* 16: 1–9. This is the author's final version of the work, as accepted for publication following peer review but without the publiser's layout or pagination. The definitive version is available at http://www.forumjournal.org/site/issue/16

their genetic vulnerability and identifying wolf-dog hybrids in order for them to be removed. In this regard, the article argues that the most significant work of the molecular biologists was to construct boundaries between pairs of categories such as natural and unnatural.

Article two. Field studies *in absentia* – counting and monitoring from a distance as technologies of government in Norwegian wolf management (1960s–2010s)[2]

This article investigates how national and international measures to protect wolves turned the whole of Norway into a field of study for wildlife biologists, and how the extensiveness of this 'field' prompted a transformation in the methods employed to count and monitor wolves. As it was not possible to conduct traditional field studies throughout the whole of Norway, the biologists constructed an extensive infrastructure, which I have termed a 'counting complex,' in order to count wolves from a distance. The article identifies three decisive periods in the construction of this complex: the 1960s, the 1980s and the first decade of the new millennium. During the first two periods, biologists used the infrastructure to mobilize ordinary people's observations; they did this by first searching through newspaper notes, then enrolling people more directly through local committees of game management. However, the public's observations often turned out to be unreliable, and, in the 2000s, molecular biologists helped to incorporate genetic techniques into the counting complex. By using the infrastructure to mobilize wolf scat, rather than observations, and by constructing DNA profiles for individual wolves, the molecular biologists enabled research that I termed 'nationwide field studies in absentia.' The article argues that the biologists' main motive for constructing and refining the counting complex was to make wolves amenable to government, as they considered this a vital premise for the successful practice of protecting wolves. The increased intensity in monitoring in the last period, however, was also driven by international conventions and detailed regulations.

[2] Published as Stokland, Håkon B. 2014. Field studies *in absentia*: Counting and monitoring from a distance as technologies of government in Norwegian wolf management (1960s–2010s). *Journal of the History of Biology*. This is the author's final version of the work, as accepted for publication following peer review but without the publiser's layout or pagination. The definitive version is available at: doi: 10.1007/s10739-014-9393-0

Article three. How many wolves does it take to protect the population? Minimum viable population size as a technology of government in endangered species management (Norway, 1970s–2000s)[3]

This article investigates how the protection of wolves in Norway has been conducted in practice since the legal protection of wolves was enacted in the early 1970s, by tracing how political decisions to regulate the number of wolves Norway should protect have been determined. The scientific concept of a 'minimum viable population size' (MVP size), which the article construes as a technology of government, has been a central instrument in these processes. The article examines how biologists, nature managers, bureaucrats, politicians and others have attempted to define and employ MVP size through the period, and how many of the political negotiations concerning Norwegian wolf numbers have played out as controversies over what constitutes a viable population. The major questions have included how a viable population should be theoretically defined, how many wolves this would mean in practice and whether a viable population could be shared with other countries. The article identifies two decisive moments of transition in the way MVP size has been employed in the protection of wolves in Norway, in which the authority to define its content was transferred first from biologists to nature managers, and later from nature managers to politicians. These shifts involved major transitions in the practice of determining MVP size and in the number of wolves considered necessary for protecting a viable population. In a larger perspective, the article argues that environmental historians have much to gain from delving deeper into the practices and technologies of government, in terms of the histories of endangered species management and nature management, more generally.

Article four: The New Norwegian wolves – preserving by transforming in the age of biodiversity?[4]

This article investigates the construction of instruments and techniques that have been employed in the management of Norwegian wolves since the early 1980s, by construing them as technologies of government. It asks whether the proliferation of such instruments

[3] Stokland, Håkon B. (forthcoming). Accepted for publication in *Environment and History*. This is the author's current version of the work, as accepted for publication following peer review. The final version may not be identical, due to potential minor revsions.

[4] Paper submitted to a peer reviewed journal on 28.10.2014. Currently in review.

and techniques, which have been constructed in order to effect protection in practice, have also transformed the wolves in significant ways. Unlike the historic population of wolves, the New Norwegian wolves are highly amenable to detailed government and are regulated to stay at a fixed number and within a relatively small wolf-zone. The article further explores whether nature management, in general, has transformed so much over the period that the period warrants the label 'the age of biodiversity,' and whether issues of naturalness, wildness and authenticity are new and typical management challenges of the period, due to the proliferation of technologies of government.

Towards a new approach for studies of endangered species management

Endangered species management has gone through radical changes over recent decades, concerning, among other things, how we produce knowledge about endangered organisms, how endangered species are regulated, how we perceive such species and how we understand their relationship to society. Particularly, a host of political interventions, knowledge production and detailed regulations has been generated to effect protection in practice. The case of Norwegian wolves is indicative of this, although it is not an average case in terms of the number and intensity of governmental technologies. A quick review of the number of published articles concerning endangered species management, or even the number of journals addressing this issue,[5] suggests that the proliferation of technologies of protection in recent decades has not been restricted to those that address the management of Norwegian wolves. Studies of scientific knowledge production of biodiversity have noted a general increase, since the early 1990s, in efforts to collect data on biodiversity and to archive this data in databases (Bowker 2005; Turnhout and Boonman-Berson 2011; Turnhout

[5] *Conservation Biology* (established in 1987), *Journal for Nature Conservation* (established in 1991), *Biodiversity and Conservation* (established in 1992), *Animal Conservation* (established in 1998), *Biodiversity: Journal of Life on Earth* (established in 2000), *Conservation Genetics* (established in 2000), *Conservation in Practice* (established in 2000), *Ecological Management & Restoration* (established in 2000), *Endangered Species Research* (established in 2004), *International Journal of Biodiversity Science, Ecosystem Services & Management* (established in 2005), *Journal of Biodiversity and Endangered Species* (established in 2013), *Journal of Biodiversity Management and Forestry* (established in 2013) and *International Journal of Biodiversity and Conservation* (established in 2014) are only some examples of journals that address the conservation and management of endangered species. The number of more specialized journals that address conservation and management of, for example, insects or wildlife, has also increased significantly over the period.

et al. 2012). In particular, the Convention on Biological Diversity elevated monitoring to the heart of conservation efforts by assigning it an entire article (United Nations 1992). Nations that have ratified the convention are required to identify and monitor their biological diversity, assess which organisms are threatened and create national plans or strategies to ensure the protection of these organisms. This implies the construction of a multitude of technologies of protection, including extensive monitoring systems, detailed assessment criteria, numerous regulations and other instruments of intervention. I argue that these changes are inherently about government, and that the current massive project to protect endangered species – involving, among other things, the United Nations, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), the International Union for Conservation of Nature (IUCN), Red Lists, national monitoring programs, thousands of biologists, nature managers, bureaucrats, politicians, activists, technology, regulations and endangered organisms – is inherently about protection, through enabling and effecting government.

When examining studies of endangered species management, whether through the focus of human or social dimensions, history, policy and management or science, these changes are surprisingly absent in the body of literature. Has no one noticed them? Many biologists, nature managers and other practitioners of endangered species management are, of course, well aware of these changes. They usually do not, however, analyze them in a larger perspective, or at least publish such analyses. My argument is, therefore, that these developments seem to occupy a blind spot in research on endangered species management.

I will first review the body of literature on endangered species management, with particular attention to how (or if) it deals with these developments. Here, I will group the literature according to which aspect of endangered species management is studied: human or social dimensions, history, policy and management, or science. I will then present a new approach to endangered species management, which I developed in my research on Norwegian wolf management, and argue that it is well suited both for studying particular initiatives to protect endangered species and to tackle broader developments. The approach consists of four main components: (1) opening the black box of science, (2) opening the black box of government, (3) investigating how technologies of government affect the objects to be governed and (4) employing a larger historical framework. I developed this approach by drawing on recent theoretical and methodological developments in science and technology studies, governmentality studies and, to some extent, environmental history. Finally, I will provide concrete examples of the results that can be achieved by employing this approach, taken from my own studies of Norwegian wolf management.

Former research – how has endangered species management been investigated?

It is practically impossible to get a complete overview of the body of literature on endangered species management. Research on the topic has been conducted with vast variations in method, research questions, empirical material and scope. When I argue that there seems to be a blind spot in this literature, it should, therefore, not be understood to mean that absolutely no literature exists that in some way treats what I claim to be the blind spot. My argument should rather be taken to mean that what I find to be profound aspects of endangered species management do not occupy a significant place in the body and analyses of the current literature.

Given the size of the body of literature, I can only present some examples of how research on endangered species has been conducted within the humanities and social sciences. Most of my examples concern wolf management; however, where I have found trends in the literature that have not been represented by research on wolf management, I also provide examples that concern other species, or more general aspects of endangered species management.

Studies of human and social dimensions

Studies of the human or social dimensions of endangered species management have investigated topics such as wolf attitudes and why the return of wolves, by either immigration or reintroduction, has often been highly controversial. In the case of Norway, such studies have played an important role in shifting our understanding of wolf conflicts (Skogen et al. 2013). Such conflicts were previously understood mainly as economic conflicts in which livestock owners, and to some degree landowners and hunters, opposed the return of wolves due to livestock losses and smaller game populations. Studies of wolf attitudes and social representations, however, have concluded that the conflicts were much more complex and involved many actors who lacked economic incentives for opposing wolves. They have argued that larger social transformation processes and cultural and economic power-relations were important dimensions of the controversy, and these findings have subsequently influenced efforts to mitigate controversy (Skogen and Krange 2003; Krange and Skogen 2011; Figari and Skogen 2011).

Other Norwegian examples of studies of the human or social dimensions of endangered species management have been conducted by Knutsen et al. (1998), Kaltenborn and Bjerke (2002), Blekesaune and Rønningen (2010), Dalen (2011) and Krange et al. (2012). International examples of such studies can be found in journals such as *Human Dimensions of Wildlife* (e.g. Bright and Manfredo 1996; Glikman et al. 2010; Shelley et al. 2011; Johansson et al. 2012; Sponarski et al. 2013), *Society and Natural Resources* (e.g. Hovardas and Korfiatis 2012), *Conservation Biology* (e.g. Kellert et al. 1996; Treves et al. 2013), *Biological Conservation* (e.g. Ericsson and Heberlein 2003), *International Journal of Biodiversity and Conservation* (e.g. Lyamuya et al. 2014) and *International Journal of Biodiversity Science, Ecosystem Services and Management* (e.g. Ericsson et al 2006; Kaltenborn et al 2013).

Studies of attitudes, cultural understandings and social relations constitute a substantial part of the social sciences and humanities literature on endangered species. By largely restricting the field of study to human or social dimensions, however, they rarely investigate the scientific or regulatory technicalities of endangered species management. Occasionally, such studies might investigate how regulations affect certain actors or propose policy recommendations, but the technicalities of regulations (both in particular cases and more generally) are rarely the main object of analysis. This means that studies of the human and social dimensions of endangered species management are largely restricted from investigating recent developments in the way in which the government of endangered organisms is enabled and effected, and, more particularly, the degree to which this has become a massive effort.

Some studies of human and social dimensions have, however, investigated the scientific and regulatory technicalities of current endangered species management. This applies notably to studies within the field of political ecology. These studies have tended, however, to focus on how humans and power-relations, rather than objects of government, are affected by scientific knowledge production and regulation. Social impacts on those who are local to the sites of protection efforts, the political power of conservationists and international biodiversity conservation organizations, and neoliberal thinking in biodiversity protection efforts are some examples of the core topics of investigation in this field (Adams and Hutton 2007). Other examples are inequality, poverty, class, ethnicity and race in nature conservation (Robbins 2012). Examples of political ecology studies of endangered species management can be found in journals such as *Journal of Political Ecology* (i.e. White 2014; Gupta 2013) and *Conservation and Society* (e.g. Pretty et al. 2009; Anthony et al. 2010). Although such studies might unpack the scientific and regulatory technicalities of endangered species management, and therefore might, to some degree, investigate how the government of endangered organisms is enabled and effected, their focus on the way in which such technicalities affect humans seems to restrict them from examining, in depth, how these same technicalities affect endangered organisms.

Studies of history

Historical studies of endangered species management provide a larger historical framework for our understanding of current endangered species management. Barrow Jr. (2009a) investigated the history of extinction by examining how it had been discovered in the decades around 1800, and how the later identification of particular endangered species led to a rise in concern over endangered species, in general. Donald Worster (1994) studied the history of ecology, which intersects with the history of endangered species at many points, and Farnham (2007) studied the historical origins of biological diversity. These studies investigated the understandings of endangered species, ecology and biodiversity, respectively, but they also investigated how the concepts were products of, and subsequently affected, scientific research projects and particular regulations. Other historical studies have examined the development of scientific instruments and techniques, and how these have affected the management of endangered species. One example is Etienne Benson's (2010) study of the development of radio telemetry for wildlife monitoring, which had a great impact on knowledge production concerning endangered wildlife.

Most historical works that deal with aspects of endangered species management do not examine the most recent developments. The studies mentioned above by Barrow Jr. (2009a), Worster (1994) and Benson (2010), for example, only provide brief outlines of developments after the 1970s. All studies must, of course, restrict their empirical scope. In my view, however, these studies leave out the most interesting part of the histories they investigate. They provide valuable insights for current endangered species management, but I wonder if the insights would be even more valuable if the studies had analyzed recent developments in endangered species management in light of their findings. Alagona's study of the role of place in endangered species management is one exception to this trend in historical studies of endangered species management (2013). By examining the history of endangered species management to the present day, his findings can be employed more readily to better understand and potentially improve current species management.

Another trend in historical studies is a preoccupation with the general political status of endangered species. This is not surprising, and it relates to studies of how and whether decisions were made to eradicate so-called vermin species or to protect endangered species. For example, such studies have investigated who was responsible for discovering and providing knowledge about endangered species (Barrow 2009a, 2009b), ideas of conservation (Farnham 2007) and controversies and battles to protect particular species or to establish particular regulations (Cioc 2009; Petersen 2002; Holdgate 1999). Similarly, the historical literature about wolves has typically focused on eradication measures (Robinson 2005; Walker 2005; Coleman 2004) and subsequent transformations in attitudes towards wolves (Jones 2010; Worster 1994, pp. 258–291; Dunlap 1988). Most such studies have not, however, examined how political decisions and ideologies are put into practice by various means. Scientific and regulatory technicalities are often incorporated in such processes, which are decisive for the success or failure of political decisions, in practice. Effecting political decisions is inherently about conducting government in practice, and usually affects the organisms in question in intended or unintended ways. The focus on the general political status of endangered species might have restricted most historical studies from examining, in more depth, how efforts to enable and effect their protection in practice affected the species. The tendency to not examine recent developments might, further, have restricted such studies from examining the ongoing massive effort to know and govern endangered organisms in a larger historical framework.

Studies of policy and management

Studies of endangered species management that have investigated policy and management aspects have typically examined how current or potential regulations and management tools have impeded or aided such management, in order to improve it. Such studies have been conducted by a variety of researchers concerned with endangered species management, often in interdisciplinary cooperation: biologists, nature managers trained in natural science, social scientists and, to some degree, researchers from the humanities. Some examples of studies of the Norwegian management of large carnivores, which were conducted in preparation for a white paper, are Guldvik and Arnesen 2001, Sand et al. 2002, Bjøru et al. 2003, Brainerd 2003, Bruteig et al. 2003, Hegrenes and Kjuus 2003, Linnell et al. 2003 and Schei 2003. Examples of international studies can be found in journals such as the *Journal of Wildlife Management* (e.g. Mech 2010; Way and Bruskotter 2012; Jachowski et al. 2014; Loring et al. 2014; Mackay et al. 2014), *Conservation Letters* (e.g. Olson et al. 2014), *Restoration Ecology* (e.g. Fritts et al. 1997), *Conservation Biology* (e.g. Araiza et al. 2012) and *International Journal of Biodiversity Science, Ecosystem Services and Management* (e.g. Krause and Zambonino 2013; Bjärstig et al. 2014).

Studies of the policy and management of endangered species are valuable because they investigate protection in practice, by examining how tools and practices beyond the political realm (as it is commonly perceived) influence protection efforts. They are, however, for the most part preoccupied with their main purpose: improving the policy and management of endangered species by providing knowledge, proposing solutions to problems and developing novel management tools. This means that they are generally more preoccupied with providing specific policy and management advice than with understanding the practices and technicalities of protection through a larger perspective. Although such studies often examine scientific and regulatory technicalities, and indeed often constitute components of such technicalities, they rarely investigate how these technicalities (which are highly determining of the practice of protection) are produced in specific circumstances by specific actors. They also rarely investigate how these technicalities and practices constitute a management regime that is very particular, if viewed through a larger historical framework, and affect the organisms to be protected in particular ways. For this reason, such studies might have been restricted from identifying, or at least explicitly examining and analyzing, the current massive project to enable and effect the government of endangered organisms.

Studies of science

Some studies have investigated scientific knowledge related to endangered species management, notably within the field of STS. Some of these have investigated the practices of knowledge production and, in particular, how these practices have transformed in recent decades. Bowker (2005), Turnhout and Boonman-Berson (2011) and Turnhout et al. (2012) have identified and investigated the general increase, since the early 1990s, in efforts to collect data on biodiversity and archive it in databases, by a wide variety of institutions and initiatives, such as the World Conservation Monitoring Centre, the Global Biodiversity Outlook, the European Biodiversity Observation Network and the Global Biodiversity Information Facility. Waterton et al. (2013) investigated how recent efforts to improve the identification and classification of natural species by DNA barcoding have also transformed such practices in some ways. Other studies have investigated how the production, practice, understanding and employment of scientific knowledge might affect the management of endangered species or biodiversity (e.g. Takacs 1996; Bowker 2000; Goedeke and Rikoon 2008; Zimmermann 2008; Blok 2011; Kleinman and Suryanarayanan 2012; Hemert 2013; Peltola 2013).

Studies of scientific knowledge production, then, have investigated how the technicalities of science might affect endangered species management. Although this, in many cases, has partly constituted investigations of how regulatory technicalities affect such management (since these are often guided by scientific knowledge), such studies have generally been less focused on other technical aspects of endangered species management (such as judicial and bureaucratic aspects). They have also rarely employed a larger historical framework to investigate broader developments in the production and use of scientific knowledge in endangered species management. This might have restricted such studies from deeper investigations of how endangered organisms are transformed into objects of government (in part by scientific knowledge production), and how the recent massive effort to produce knowledge about endangered organisms is also an effort to enable and effect government in practice.

Towards a new approach for studies of endangered species management

The blind spot, when seeing with one eye, constitutes an area that is not seen, although the impression is that nothing in the vision is missing. I have demonstrated that the body of literature on endangered species management includes investigations of its human and social aspects, historical aspects, policy and management aspects and scientific aspects. This might give the impression that the body of literature includes most aspects of endangered species management in its 'vision' of research. Still, the massive project to enable and effect the government of endangered organisms remains largely unexamined. Since most aspects of endangered species management seem to be covered by research, I construe the massive project as a blind spot in the body of literature on endangered species. We have seen that various fields of research often leave some aspects of endangered species management out of their 'vision.' These include a sensitivity to how scientific knowledge about endangered species management is the result of particular actions and work, how protection is enabled and executed in practice, how this practice affects the organisms to be protected and how these practices are particular when understood through a larger historical framework. Specifically, the vision enabled by the composite of these aspects is missing from the body of literature.

I will now present an approach that I developed for my studies of Norwegian wolf management, which aims to identify and investigate aspects of this blind spot by combining elements of the current approaches with some new ones. The approach consists of four main components: (1) opening the black box of science, (2) opening the black box of government, (3) investigating how technologies of government affect the objects to be governed and (4) employing a larger historical framework.

Opening the black box of science

The first component of the approach draws on literature from the field of science and technology studies (STS).[6] A core criticism from this field is that other fields in the humanities and social sciences exclude science from their studies, or treat it as something profoundly different from the other actors or activities they study. The latter is often pointed out in criticisms of studies that treat science strictly as a truth-base, such as Kristin Asdal's criticism of Donald Worster's argument that environmental historians should seek nature through sciences such as ecology (Asdal 2003). The main point of such criticisms is rarely that science is wrong, but that the actors, activities and processes behind a scientific finding should be unpacked and investigated as part of the study.

A major strand in Bruno Latour's research is concerned with what he designated modern dichotomies.[7] These include nature–culture, science–politics, facts–values and objects–subjects – dichotomies that prescribe different properties to entities according to their belonging in each pair (Latour 1993, 2004). A tree, for example, would be described as an object belonging to the categories of nature, science and facts. A human, in contrast, would be described as a subject belonging to the categories of culture, politics and values. According to Latour, scientists occupy a special position in this ontological arrangement, because of their perceived ability to "free themselves of the tyranny of the social dimension, public life, politics, subjective feelings, popular agitation" (Latour 2004, p. 10) in order to access truths that were not made by human hands. These truths, in turn, can be put to use to "silence the endless chatter of the ignorant mob" (Latour 2004, p. 11) that political value-based discussions are perceived as in this ontological arrangement. According to Latour, these dichotomies only exist in our theoretical understanding of the world, rather than our practical conduct in it. Regardless of one's opinion concerning the ontological existence of different dichotomy realms, however, many practitioners of endangered species management would agree that it is not always easy to identify exactly where nature, science and facts end, and where culture, politics and values begin.

[6] See Hess 1997, Latour 2005, Yearly 2005 and Sismondo 2010 for introductions to STS and related fields of study.

[7] Dichotomies such as nature–culture have been investigated by numerous researchers within STS (e.g. Gieryn 1999; Haraway 2003) and outside of STS (e.g. Cronon 1996; Adams and Hutton 2007; Morton 2007).

The insistence on studying science as any other social activity constitutes a core objective of most STS research (Sismondo 2010, p. 10–11), and Bruno Latour designated investigations of the work behind scientific knowledge as “opening the black box of science” (Latour 1987). The ‘black box’ refers to the reduction of complicated mechanisms in cybernetics or genetics to a black box by focusing only on their inputs and outputs. In Latour’s approach to studies of science, the black box designates how the complex process and context of the creation of scientific knowledge are often forgotten or neglected once the knowledge is accepted as true. Nevertheless, the process and context often have a decisive impact on how we later understand and treat the object of knowledge. By opening the black box of science, researchers who study endangered species management could arrive at more comprehensive understandings of how scientific knowledge of the organisms is constructed, and how this affects the management of these species.

Opening the black box of government

The second component of the approach draws on so-called governmentality studies, which are inspired by the work of Michel Foucault (but also STS). The insistence on studying how government is conducted in practice is a central assertion in this field, and it criticizes other studies within the humanities or social sciences for studying government only in theory. Peter Miller and Nicholas Rose argued that studies of government should focus on the actual mechanisms, or ‘technologies,’ that enable government in practice, rather than restrict themselves to the “actions of a state … construed as a relatively coherent and calculating political subject” (Miller and Rose 2008, p. 27). Modern government is not only constituted by grand political schema and negotiations between politicians, they argue with inspiration from Michel Foucault, but, in practice, is dependent on “apparently humble and mundane mechanisms” such as techniques of notation, computation, calculation and assessment.[8] It is often such techniques and instruments that make objects amenable to government, and therefore enable the interventions of practical politics. Miller and Rose designated such techniques and instruments ‘technologies of government.’

[8] See also Rose 1989; Porter 1995; Barry 2001; Dean 2010.

They coined the terms ‘government at a distance’ and ‘technologies of government’ to describe the conduct and means of government, respectively. In this, they drew on Bruno Latour’s notion of ‘action at a distance’ and Latour and Michel Callon’s studies of “the complex mechanisms through which it becomes possible to link calculations at one place with action at another … through a delicate affiliation of a loose assemblage of agents and agencies into a functioning network” (Miller and Rose 2008, p. 34). Although it is not possible to absolutely separate the two in practical government, for analytical purposes, it can be beneficial to separate technologies of knowledge production from technologies of intervention. While technologies of knowledge production make an object amenable to government from a distance (by producing information, calculations and so forth), technologies of intervention employ this knowledge to intervene upon the object and effect politics in practice. For practical purposes, I sometimes designate technologies of government (of both intervention and knowledge production) that are specific to the management of endangered species as ‘technologies of protection.’

The purpose of studying technologies of government is to understand how government is conducted in practice, as well as to understand how objects of government are created, shaped or transformed by these technologies (the latter is treated in the next section) (Miller and Rose 2008, e.g. p. 32). Such studies of public government have often concentrated on the government of subjects and ‘social’ objects of government, such as the marked, populations and mental illness, and hence on the production of knowledge and instruments by professionals such as psychologists, social workers, accountants and factory managers.[9] One of the objectives of this thesis is to show that governmental technologies of knowledge production and intervention have also been decisive for the management of wolves in Norway, and that studies of endangered species management and nature management, generally, could benefit from this approach.

Similar to what STS scholars have argued in relation to science, the often complex technicalities of government tend to be forgotten or left out in both public debates and studies within the humanities and social sciences. I like to think of this as a black box of government, that studies of endangered species management should be more aware of and

[9] Kristin Asdal’s history of Norwegian environmental politics in the twentieth century, which draws in part on such literature, is one notable exception (Asdal 2011).

should attempt to open in their studies. By opening the black box of government and investigating what happens beyond the political realm as it is commonly perceived, research within the social sciences and humanities could become more attentive to the way in which political decisions and ideologies are put into practice by various means. It is particularly important to employ this approach when studying the aftermath of public or legal protection, considering the massive and complex problems that have been encountered by biologists, nature managers, bureaucrats and others when attempting to conduct protection of endangered species in practice. The technicalities of government are often partly scientific in such processes – technologies of knowledge production usually constitute scientific and regulatory-driven research – and thus the content of the black boxes of science and government might overlap, to some degree. By opening the black boxes of government and science, such studies can contribute to a more comprehensive understanding of how various actors have sought to accomplish the protection of endangered species in practice, often through complex scientific-bureaucratic technologies of government intended to render the objects of protection amenable to intervention. We should not overlook this part of endangered species management, as it is often through such obscure and technical arrangements that the very concrete politics of endangered species is determined.

Investigating how technologies of government affect the objects to be governed

While the two previously discussed components of the approach mainly concern the objects to be studied – complex and often obscure technicalities of science and government – the third concerns the effects of such technicalities on the objects to be known or governed. This component draws on STS constructivism[10] and governmentality studies. Since the process and context of scientific research often have a decisive impact on how we later understand and treat the object of knowledge, the way in which it is conducted matters. This was one of the arguments for opening the black box of science. It implies that if research were to be conducted in a different way or in a different context, the object of the research might also appear differently. This is not to say that scientific research can produce 'any' result about

[10] Constructivism and social constructivism have constituted several different ontological and methodological positions in STS (Sismondo 2010, pp. 57–72) and the humanities and social sciences, more generally (Hacking 1999). Latour criticized social constructivism for not taking materiality into account, advocating instead for a constructivism that does (Latour 2004, pp. 32–42; Blok and Jensen, e.g. p. 77).

an object of study – when conducted properly, it is firmly based on and restricted to the physical reality of an object. However, empirical science is not objective in the way that any scientist in any context will produce exactly the same knowledge about an object. Different research questions lead to different answers, not to mention different funding options and knowledge requests from policy makers.

Thus, what an object 'is', in our understanding of it, is affected by the way in which scientific knowledge production of the object is conducted. Since an object might very well appear differently if research is conducted in a different way, we might say that the object is constructed by scientific research. A physical object might, of course, still be the same after research as it was before research of it was conducted. Our altered understanding of the object might, however, in turn affect our treatment of it. Most objects that scientists receive funds to research are governed in some way. This is particularly true for much regulatory-driven research, in which knowledge production often serves as a technology of government. For any object that is somehow incorporated into politics, some technologies intended to enable and effect government are constructed – this is how an object becomes incorporated into politics in practice. These technologies of government are often directly affected by the way in which scientific knowledge has constructed them, or are indirectly affected through our affected understanding of an object. The main point is that technologies of government, because they enable and effect government, often change the physical reality of an object as well as our understanding of that object. Technologies of government, including scientific research, can therefore shape, transform and even create the objects they are constructed to govern (Asdal 2007; Miller and Rose 2008). This is perhaps not so surprising, considering that this is usually the main purpose of technologies of government; they are constructed in an attempt to change something in the world (also with regards to initiatives to preserve nature, which attempt to reverse or obstruct potential processes that, in some way, degrade nature). However, technologies of government often turn out to have unexpected or unintended effects, particularly in the processes of making objects into objects of government (Miller and Rose 2008). Such processes can transform both the materiality of an object and the way in which we understand and relate to it in profound and unexpected ways. This is a major reason for the importance of studying technologies of government.

It is important to note that it is not a one-way process from science to technology of government to object. The context that might affect scientific knowledge production includes particular understandings of an object of study, which could affect research questions and methods – specifically through funding options and knowledge requests from policy makers, and more generally through broader cultural understandings and practices. Miller and Rose denoted the processes through which an object becomes incorporated into government as 'problematizing' (Miller and Rose 2008, p. 14). They argued that a thing only appears to require government when it appears problematic to someone. One should, therefore, ask how this rendering of things problematic first occurs. Miller and Rose argued that such problems are never pre-given or self-evident, but must be constructed and made visible through the process of problematizing. Scientific knowledge production is often part of this process, in which it might take as a starting point the (often legitimate) concerns and understandings of other experts, pressure groups, politicians, corporate leaders and so forth, and subsequently join them in making an object appear in a particular (problematic) way.

Are endangered species constructed by technologies of government? I will argue that they provide a good example of the way in which objects are constructed by scientific knowledge production and technologies of government. This does not imply that the organisms in question are not species or endangered. It simply means that, in order for them to become endangered species, someone had to first do something. The understanding of organisms in terms of 'species' has a long and complex history that involves the work of numerous actors, and the understanding that such species can become extinct, and therefore be endangered, took a lot of work for naturalists and others to establish (Barrow Jr. 2009a). Similarly, it takes work and resources to establish whether a particular species or population is endangered today. It is, however, possible to imagine the construction of endangered species not having happened, or having developed differently (for example humans remaining ignorant of the reality of extinction, or not caring much about it, or, in more recent contexts, those who do care not attempting to reverse the situation through a massive governmental project involving global institutions, big science and detailed monitoring and assessment instruments). Since the work affects how the organisms in question are understood (e.g. as endangered and vulnerable) and treated (e.g. by protective regulations), we might say that it constructs something in the world (e.g. endangered species, or endangered Norwegian wolves) that has not existed before. The construct might have material aspects (e.g. the number or locations of organisms) or immaterial aspects (e.g. our understanding of, or relation to, the organisms), and these aspects will most often be mixed up in complex management practices of endangered species. They will also often have unexpected or unintended consequences (e.g. a population of wolves that is highly amenable to government and regulated to stay at a fixed number[11]). The main point is that organisms of endangered species can be shaped, transformed and even created by the technicalities of scientific knowledge production or governmental regulations, and this should not be overlooked in studies of endangered species management.

Employing a larger historical framework

The fourth component of the approach draws on governmentality studies. In some ways, this component might seem more straightforward and commonsensical than the former three. It asserts, quite simply, that understanding a particular phenomenon (such as endangered species management) through a larger historical framework enhances our understanding of the phenomenon and produces some new knowledge about it that would be difficult to see without such a perspective. Particularly slow developments, even if profound and extensive, can be very difficult to notice without the past employed as a comparison. These include transformations such as those treated in component number three, which can be slow and profound, but also difficult to notice if no one opens the black boxes of science and government.

This take on employing a historical perspective, which emphasizes discontinuities and contrast rather than continuity, draws particularly on the work of Michel Foucault and the governmentality studies Foucault subsequently inspired.[12] The main purpose of his historical studies of prisons, for example, was to understand how the practice of imprisonment "was capable of being accepted at a certain moment as a principal component of the penal system, thus coming to seem an altogether natural, self-evident and indispensable part of it" (Burchell et al. 1991, p. 75). In order to do this, he investigated the histories of discipline and

[11] See article four.
[12] See Asdal (2004) for a discussion of how Foucault influenced core STS developments.

prisons and attempted to identify how the transition from other forms of punishment had happened. This manner of identifying the historicity of phenomena, or ways to conduct or practice (for example) government, uses the past as a contrast to the current state and emphasizes transformations.

Similarly, one could investigate the historicity of current endangered species management. By employing a larger historical framework as a contrast, researchers within the humanities and social sciences could attempt to identify and articulate what is particular about aspects of endangered species management that seem natural, self-evident and indispensable. By articulating the contingency of aspects that are usually taken for granted, the larger developments of such management, which sometimes have a tendency to seem so self-evident that they are neglected or forgotten, can become part of (or even the focus of) critical examination and discussion. For an activity that is so extensive, in terms of both the amount of resource it requires and how crucial it is for the treatment of millions of organisms, self-reflection and self-criticism are decisive. Historically-oriented studies of seemingly self-evident aspects of larger developments could help expand such reflections and discussions, and help critical examinations encompass additional aspects of current endangered species management.

The case of the New Norwegian wolves

I employed the above approach in my studies of Norwegian wolf management, and will now provide some concrete examples of the results it can yield from the four research articles of this doctoral thesis.

By opening the black box of genetic research on Scandinavian wolves and construing the content of the box in relation to how they are understood and managed, article one investigates how the wolves came to be firmly understood as natural, vulnerable and worthy of protection by political and management institutions. It argues that the most significant work of the molecular biologists in this regard was to construct boundaries between pairs of categories such as natural and unnatural, which were the products of a heated controversy that the scientists were hired to resolve. Although the molecular biologists were not always able or willing to draw such boundaries, their findings were nevertheless used to fortify the categories and boundaries that were expected to exist. In this way, the article argues, their work stabilized understandings of the wolves in Scandinavia safely within the categories of natural, Scandinavian, vulnerable and worthy of protection. Without opening the black box of science by investigating how the molecular research had been conducted and how its results had affected the understandings of the wolves, it would not have been possible to arrive at this conclusion.

By opening the black box of wolf number regulations, article three examines how minimum viable population size (MVP size) was employed in determining such regulations. By construing MVP size as a technology of government and examining its construction and use, the article investigates what happens beyond the political realm as it is commonly perceived – how the protection of wolves is conducted in practice. MVP size is one example of a scientific, policy-directed instrument that many would not immediately consider constructed. Those who construct and employ such instruments know better, but many might perceive MVP size as merely an instrument that indicates how low wolf numbers can become before the population's viability is at risk. The same can be said about the IUCN Red List criteria and many other instruments in endangered species management.

The point here is not that MVP size does not necessarily indicate the correct limit to a population's viability. Rather, MVP size has been constructed by someone, employed by someone and made to have a decisive impact on the number of wolves Norway should protect. By examining these processes, the article shows that the content of MVP size – the number of wolves Norway needs to protect in order to secure the population's viability – is far from evident. Biologists' estimates have varied from three family groups to several hundred wolves, and other actors – such as nature managers, bureaucrats, politicians and NGOs – have presented their own interpretations of MVP size. The estimates have been contested, and other controversial issues have been whether Norway is required by the Bern Convention to protect a viable population of wolves (and, if so, whether the population can be shared with neighboring countries). The article shows that the authority to define the content of MVP size was transferred first from biologists to nature managers, and secondly from nature managers to politicians. These transitions in definitional authority involved decisive shifts in the content of MVP size, and therefore in how many wolves it was considered necessary to protect. By opening the black box of government, therefore, the article shows that the construction and employment in practice of a scientific policy-directed instrument that might initially have seemed commonplace and self-evident, was in fact the result of negotiations and transfers of definitional authority, which had a decisive impact on wolf numbers in Norway.

By focusing on the constructivist aspects of technologies of government, the approach presented above could help researchers attend to how work to govern an object very often also affects the object in some way. Constructions of technologies of government to protect endangered species, for example, often also affect the organisms to be governed. This is not surprising, as the aim of such work is often to protect certain species and, hence, to transform them from endangered species to just 'species.' A constructivist approach could, however, help us attend to not just how such work affects the species in terms of numbers, geographical range and so forth; it could also help us understand how technologies of government might affect what an endangered species is in a more fundamental way.

Article two investigates how attempts to count and monitor Norwegian wolves to enable their government turned into a system of permanent and intensive monitoring of their numbers, movements and genetic health. In many ways, this has not affected the wolves much. They still hunt, mate and live with their family groups – although some now wear GPS collars. However, if we include in our definition of wolves not only how they live and understand their own situation, but also how they are understood in a larger societal context, it is clear that the current monitoring system has shaped the Norwegian wolves. The detailed knowledge of particular wolves' movements, family relations and genetics, in this perspective, makes the current wolves very different from wolves in the nineteenth century. At that time, little public knowledge existed of wolves, although local and less systematically gathered knowledge surely existed. Through the development of the current monitoring system, however, it became possible to incorporate the wolves into a detailed and intensive government regime. It is now possible to effect a population goal of exactly three new litters of cubs each year, within a relatively small wolf-zone in southeast Norway. The article concludes, therefore, that the main transformation effected by the monitoring system was to make wolves highly amenable to government.

A large historical framework makes it easier to identify and articulate particularities of aspects of current endangered species management that seem natural, self-evident and indispensable. Article four investigates such particularities in Norwegian wolf management by comparing the current population of wolves to the historic population. It shows how the current monitoring system and regulations, which were constructed to effect protection of the wolves, also transformed them in some ways. While the historic population of wolves varied highly in number and was spread over large parts of the country, the current population is regulated to stay at a fixed number and mainly within a relatively small area in southeast Norway. This was only made possible through the monitoring system, which – also in contrast to the historic population – made the wolves highly amenable to government. By articulating the historical contingency of the current regulations and monitoring system, the article aims to expand the field of potential self-reflection and self-criticism by asking whether we are preserving wolves by transforming them. Without the larger historical framework and the contrast of the historic population of wolves, it would have been very difficult to attend to and identify these shifts in what Norwegian wolves are – and therefore what constitutes the New Norwegian wolves.

Conclusion: Towards a new approach for studies of endangered species management

The approach that I have presented above could be employed to identify and investigate aspects of endangered species management that are rarely treated in studies of such management: how scientific and governmental technicalities affect the practice of such management; how such technicalities might have unintended or unexpected effects; and how aspects of such management that seem natural and indispensable often turn out to not be so self-evident when viewed through a larger historical framework. In sum, identifying and examining these aspects enable identification and investigation of broader developments in endangered species management. Specifically, they enable identification and investigation of the ongoing massive project to enable and effect the government of endangered organisms. The objective of that project is, of course, to protect such organisms. We should, however, expand the self-criticism and self-reflections of this activity to encompass discussions of how such government affects the organisms, often in unintended and unexpected ways.

Methodology

This thesis is based on extensive studies of political and scientific documents, as well as the historical archives of the Directorate for Nature Management (DN)[13] and the Ministry of Climate and Environment (MCE). I reviewed a large majority of the several hundred major political and scientific documents that had been produced in relation to the management of wolves in Norway since the 1960s. These included white papers, national plans, regulatory documents, scientific reports and articles. I examined in more detail the most central documents, and those concerning the construction of technologies of government. I also traced the internal processes of governmental technology construction in archival material from DN and MCE, of which I copied and reviewed more than 20,000 pages. Further, I interviewed six biologists and one nature manager who had been central in efforts to enable and effect the protection of wolves in practice. I will now provide an account of how I conducted the more practical aspects of the study, apart from developing and employing the approach presented in the previous section (which also informed these more practical choices). It narrates how I first developed an overview of the field of study, how I gathered material, how I identified the core objects of study and how I analyzed the material.

<u>Developing an overview of the field of study</u>

When I began work on this project, my knowledge of wolf management was not very comprehensive – though perhaps slightly above that of an average Norwegian. In order to develop an overview of wolf management and the controversy surrounding it, I began by reading what social scientific research I could find about it (e.g. Knutsen et al. 1998; Kaltenborn and Bjerke 2002; Skogen and Krange 2003). Further, I gathered the journals of two main NGOs occupied with wolf management in Norway: Foreningen våre rovdyr's *Våre rovdyr* and Folkeaksjonen ny rovdyrpolitikk's *Rovdyr*. These journals are, respectively, supportive of and opposed to wolf protection in Norway. While reading through their

[13] The Directorate for Nature Management changed title several times during the period covered by this thesis. It was founded in 1964 as the Directorate for Hunting, Game Management and Freshwater Fishing, and was renamed in 1974 to the Directorate for Game and Freshwater Fish, as it was transferred from the Ministry of Agriculture to the Ministry of the Environment. In 1985, the name changed to the Directorate for Nature Management, and, in 1988, the research section was separated out as NINA (the Norwegian Institute for Nature Research). In July 2013, the name was changed to the Norwegian Environment Agency, as it merged with the Norwegian Climate and Pollution Agency. To facilitate the readers, however, I refer to the institution as simply 'DN,' or 'the Directorate for Nature Management,' throughout most of the thesis.

published material, I attempted to map the main controversial topics. This was done in part by marking every instance of each topic with Post-its of various colors, so I could easily access them at a later point and develop an overview of the chronological range and number of instances related to each topic. This work revealed several controversial topics, among them wolf number estimates and the number of protected wolves, which I later examined in more detail. I also conducted two interviews with biologists who had conducted wolf research that had been employed in wolf management. These semi-structured interviews further helped me gain an overview of the larger developments and controversies in Norwegian wolf management, as well as potential topics for closer examination. I also visited the archive at MCE in the early period of the project, where I studied and copied a substantial amount of material concerning the establishment of the Norwegian wolf-zone and the legal right to kill large carnivores in self-defense. Although I did not use this material explicitly in the thesis, studying it contributed considerably to my understanding of how the politics and management of Norwegian wolves had been conducted in practice.

<u>Gathering material</u>

During the early period of the project, I also began to study the literature that I later drew on to develop the approach presented in the previous section. Opening the black boxes of science and government allowed me to unlock a large variety of sources, many of which would not usually be considered in humanities and social science research. These included scientific articles and reports, but also archival material from research, management and political institutions.

Some time into the project period, I identified technologies of government as the main object of my study. When I searched for relevant sources, I found a rich archive at DN that fit well with the approach I was developing. The archive contained masses of remnants from former practices of wolf management in their most concrete form, and I was struck by the wealth of potentially relevant and valuable material. Considering my objective to study how wolf management had been enabled and effected in practice, literally everything in the archive had some relevance: the first incoming compensation demands from livestock owners whose sheep had been killed by protected wolves; bounty demands for killed wolves after bounties had been abolished and the total protection of wolves had been established (as well as copies of letters in response, explaining that the new regulations had made it illegal to kill wolves); several rounds of debate between various actors, including cancellations and rewriting, of the specific wording of legal protection; the first methods of calculating compensations for livestock killed by protected carnivores, and how these methods later developed; piles of research material on the numbers, locations and other aspects of large carnivores; preparations for and treatment of issues after meetings in international organizations; specific instructions on the positioning of a dead wolf in an order to a taxidermist; and receipts of office telephones – just to mention a few.

The personnel at the archive were of great help in navigating the masses of material, and they helped me identify most of the relevant material for my purposes. I also reviewed the titles of all of the archival boxes, and was granted access to investigate the content of any box for which the title indicated potential relevance. I spent five weeks in the archive, copied almost 20,000 pages and reviewed much more material that I did not consider sufficiently relevant for my work back at the office.

Identifying the core objects of study

When investigating technologies of government, it can be hard to restrict the scope of sources, since so much material is potentially relevant. (Installing office telephones surely changed the practice of management in some ways?) Back at my office, I realized that I needed to find a way to restrict the study and identify some core issues, preferably those that would be considered relevant and of interest to those who conducted wolf management in practice (including biologists who produced knowledge that would be employed in such management). It was during this process that I conducted most of the interviews (with four biologists and one nature manager), and these proved very helpful at this stage. My previous review of NGO literature proved quite helpful in establishing controversial topics of interest to both supporters and adversaries of wolf protection. The interviews, however, helped me identify more precisely the issues and problems of practical management. They also helped me gain an overview of the larger developments of practical wolf management since the 1960s, which would have been very hard to obtain from the massive amount of separate archival information pieces, alone. The later interviews were also very helpful in developing my understanding of the way in which specific technicalities of knowledge production and regulation had been conducted in practice; this was not always evident from the archival materials. The interviews typically lasted for two hours, though some lasted even longer. They were conducted in a semi-structured manner, typically with a loose interview guide consisting mainly of topics that I intended to cover over the course of the interview. In addition, the guide usually contained some specific questions that I intended to ask.

I have not cited or employed the interviews explicitly in this thesis. The thesis is largely based on written material, and the interviews were not conducted to investigate how biologists or nature managers understood or related to the technologies of government in question (or their development and effect on wolf management). They were, rather, conducted so that I could identify issues of practical wolf management, gain an overview of the larger developments of technologies of government and understand the practical conduct of specific regulatory or scientific technicalities. Usually, what I learned from the interviews led me to various written sources, which I then examined closer. Thus, although I might have learned something from an interview, in this thesis, I referenced a written source. This is because I could examine the source in more detail, and because it is easier for critical or curious readers to access a written document than an interview conducted in the past.

I examined much of the archival material in the same period that I conducted most of the interviews. The weeks I spent at the DN archive, reviewing and copying material, greatly improved my understanding of how the Norwegian management of wolves had developed and been conducted in practice. More detailed examination of specific material, such as the careful negotiations concerning the wording of a protective regulation or the problems encountered in counting wolves in a particular location, however, enabled me to proceed to more analytical work. As with the interviews, many of the findings and objects of study I encountered in the archive could be examined and explained by more readibly accessible documents. Again minding the critical or curious reader, I referenced more accessible documents (scientific reports, white papers, law regulations etc.) in this thesis, where possible. In some of the articles, where this was not possible, I employed archival material explicitly.

Many of the sources that I referenced in the empirical articles are easily accessible documents that have had major effects on wolf management. They typically constitute scientific reports, white papers, legal regulations and so forth. I studied such documents throughout the project period, and, with the help of the archival studies and interviews, they enabled me to identify and examine some core technologies of government. Such documents have often been decisive for the development of technologies of government in wolf management. Some have partaken in the construction of technologies of government, some constitute or display the effects of such technologies and others are, themselves, technologies of government. Such documents, therefore, made it possible for me to examine how technologies of government had been constructed, how they had been employed in practice and what effects they had had on wolves and the management of wolves.

<u>Analyzing the material</u>

The main objective of this project was to investigate how technologies of government in Norwegian wolf management have been constructed and employed in practice, and how they have affected such management and the wolves, themselves. Miller and Rose criticized the tendency in much social scientific work to provide explanations for various phenomena through an "appeal to pre-given notions of class or professional 'interests'" (Miller and Rose 2008, p. 6) or "by gesturing to global processes such as modernization or individualization" (Miller and Rose 2008, p. 6). Instead, they advocated for a shift in research questions from why to how, "thereby lightening the weight of causality … and enabling us to abstain from the problems of 'explaining' such indigestible phenomena as state, class, and so on – indeed we argued that these typically went unexplained despite the claims of those theorists who wrote in these terms" (Miller and Rose 2008, p. 6). By making this shift, they argued, it is easier to study the singularity and complexity of particular historical developments and "begin to discern the web of relations and practices that result in particular ways of governing" (Miller and Rose 2008, p. 7).

A main objective of this project was to study the singularity and complexity of particular practices of the government of Norwegian wolves. Based on Rose and Miller's critique of explanations that refer to global processes or pre-given categories, I attempted to avoid ‘why questions’ and focus on ‘how questions’ (e.g. How have technologies of government in Norwegian wolf management been constructed? How have they been employed in practice? How have they affected such management and wolves?). I further took the empirical material as the starting point of my analyses, and built my claims and analyses mainly on the basis of it.

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Molecularising Nature: How Scandinavian Wolves became Natural[1]

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Abstract:

This paper examines the construction and stabilization of Scandinavian wolves as natural and worthy of protection. I argue that molecular biology was crucial to this process, and that the most significant work of the molecular biologists was to construct boundaries between pairs of categories such as natural and unnatural.

Environmental historian William Cronon has argued that nature is a human construction; not in the sense that the nonhuman world is unreal or exists only in language or minds, but in the sense that "the way we describe and understand that world is so entangled with our own values and assumptions that the two can never be fully separated" (25). The BBC documentary series Unnatural Histories (2011) represents one of the more interesting recent explorations in popular media of that which we see as natural, as it examines how the iconic wild places of the Serengeti, Yellowstone National Park, and the Amazon have been shaped by humans over time. Bearing Cronon's argument in mind, however, the greatest achievement of the series is that it also investigates how these places have come to be viewed as natural and wild in the first place. As the processes of constructing nature often have great impact on the politics concerning both nature and humans, they should be obvious targets for critical examination by scholars from the social sciences and the humanities.

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Constructions of nature often require a great deal of work by scientists, and this work usually remains hidden once something has begun to be understood as natural (Asdal 139-172). Anthropologist and historian of science Bruno Latour has argued that scientists are commonly perceived to be able to transcend their values by scientific methods and instruments and access the natural world without mediation (Politics of Nature 10-18). It is this view of science, according to Latour, that in large part accounts for the weight given to the natural sciences in political matters. Further, this understanding has left science largely unscrutinised by the social sciences and the humanities, despite the integral role played by the natural sciences in society. However, by showing that values and assumptions are present in scientific research, Latour has argued that scientists too partake in constructions of different natures and what we understand as natural (Science in Action). Hence, science should not be excluded from investigations of nature and that which is perceived as natural within the humanities and social sciences. On the contrary, if scientific work has been central to the construction of naturalness as in the case of the Scandinavian wolves, it should itself become the focus of such investigations.

After being more or less absent from Scandinavia for a hundred years, wolves have returned and at present the population counts around 300 animals (Wabakken et al., "Recovery" 6). The new population of wolves has grown continually in numbers during the last thirty years. These wolves are, however, not the same as the wolves which were living in Scandinavia in the nineteenth century; they are new in many respects, some of which I shall investigate in this paper. For example, no one questioned whether the nineteenth-century wolves were natural or Scandinavian. These categories, and the questioning of them, are properties of the new wolves.

Nikolas Rose has studied the molecularisation of humans from a biopolitical perspective, investigating how the application of molecular biology in medicine has changed the way in which we understand ourselves as humans; that is, how life is now understood and acted upon at the molecular level, and how this process has "so modified each of its objects [such as the brain, the cell, or the human body] that they appear in a new way, with new properties, and new relations and distinctions with other objects" (12). This paper represents a brief exploration into the molecularisation of nature, and how our views and treatment of nature change by the application of molecular biology in nature management. My main argument is that this subdiscipline of the life sciences has played a decisive role in the construction of the new wolves as objects of government, that is, of how we understand and treat them. More specifically, I shall argue that molecular biology has been crucial to the process of stabilising the wolves as new, natural, Scandinavian, and vulnerable. The wolves' status regarding these categories has been controversial, as the categories have been closely linked to the politics of their protection. Further, I shall argue that the most significant work of the molecular biologists has been to explicitly or implicitly construct boundaries between pairs of categories such as natural and unnatural, an activity which has been possible only through the intertwining of materiality and language, science and politics.

* * *

After being intensively hunted in the mid-nineteenth century, the historical and rather large population of wolves in Norway and Sweden remained at a minimum from the 1860s to the 1960s. By 1969 the population was considered functionally extinct by wildlife biologists, after the last known wolf in Norway, known as Fridtjof, was shot in 1964 (Myrberget 165, 170-172). Wolves were nevertheless established as a protected species in Sweden and Norway by 1971, and in the early 1980s a family group of wolves was discovered right in the middle of the two countries – about 1500km from the nearest population of wolves in Finland and Russia (Ellegren et al. 1662). This group founded what has become the present Scandinavian population (Wabakken et al. 2001 715).

As is the case in most places to which wolves have returned during the last few decades, controversy followed. When the family group was discovered in 1983 in southern Norway, it did not take long before accusations were made that the wolves had been illegally reintroduced from zoos by conservationist organizations, scientists, nature managers and/or politicians generally in favour of conserving nature. The accusations were directed in particular towards conservationist organizations that had investigated the possibilities for reintroducing wolves in the 1970s. As part of these investigations, and in order to enable potential reintroductions, the conservationists had contacted several zoos in Scandinavia for the purpose of establishing breeding stations for wolves. The conservationists were, however, explicit in their intention to proceed within the constraints of official law and politics (Norderhaug 2-4). Additionally, the historic Scandinavian population was considered extinct, and not even biologists found it plausible at the time that wolves could migrate over 1500km. These accusations soon turned into a question of the wolves' right to remain in Scandinavia: if it could be proved that they had been reintroduced by humans, they would most likely be put to death, as it is illegal to import and release animals without permission; on the other hand, if they were remnants from the former population of wolves, they would receive strict protection. Their lives depended, so to speak, on whether human hands had been involved in their presence in this particular place; on whether they were understood to have arrived naturally, or unnaturally.

It was not until 20 years later, however, that anyone was able to go beyond pure speculation, following scientific advances achieved by the Centre for Evolutionary Biology at the University of Uppsala, Sweden. The centre, specialising in molecular evolution and evolutionary genomics, had developed methods for analysing the genetic history of different animals such as birds and horses. By bringing in to their laboratory hair, body tissue, feces, and teeth from present and historic Scandinavian wolves, and additionally from wolves in zoos and in Finland and Russia, the geneticists could investigate the past of the new wolves in Scandinavia. They proved conclusively that the wolves had not been reintroduced from zoos (Sundqvist 1964). They also established that the wolves were not survivors from the historic Scandinavian population, but that they originated from the population in Finland and Russia (Flagstad et al. 878; Vila et al. 93-94). This meant that the most powerful accusation was disproved. However, it was still fully possible that the wolves had been reintroduced from Finland or Russia by humans (Linnell 384).

In order to establish such a history of the wolves, the geneticists had to construct new boundaries. Even though there are but minuscule variations in the genetic material of the four groups of wolves involved in the analysis – present Scandinavian, historic Scandinavian, Finno-Russian, and captives in zoos – the molecular biologists were able to draw demarcations between them, and place each wolf in one group, based on tiny physical fragments. Though the line between the zoo wolves and the present Scandinavian ones was definite, the differences between the other three groups were continuous. The latter is not surprising, as there have been migrations – and therefore gene exchanges – between the Scandinavian and the Finno-Russian populations over the centuries. The molecular biologists were nevertheless able to distinguish between the two historic populations, and determine that the present Scandinavian population was based on wolves from the Finno-Russian one. And even though the current Scandinavian population was formed only twenty years earlier by two wolves from Finland/Russia, the geneticists concluded that it constituted a separate population. By constructing new boundaries, the geneticists in Uppsala had in large part disproved the accusations claiming that the wolves had been reintroduced. And even though the accusations of reintroduction could not be completely disproved, the wolves were now accepted by most – and importantly by those in nature management and politics – as natural. In addition, the genetic analysis and construction of boundaries between different wolf populations identified the wolves neither as survivors of the historic population in Scandinavia nor as part of the current Finno-Russian one, but rather as a new Scandinavian population.

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The naturalness of the new wolves has, however, been questioned in yet another and even more fundamental way. Since the wolves reappeared in the early 1980s, claims have been made by people who oppose their preservation that the wolves, or at least some of them, were hybrids: either wolves and dogs had been deliberately hybridised and let out, or wolf bitches had mated with dogs and delivered hybridised cubs (Vila et al. 94). In this case, it was not merely a link to humans that potentially made the wolves unnatural; it was the existence of domesticated genes at the very core of their being. The claims of hybridisation could not, however, be proved or disproved until the technology and knowledge of molecular biology was made available: certain dog races are very similar to wolves, and the variations between wolves both in size and fur makes it impossible to definitively separate hybrid from pure wolf based on appearance. So the claims did not receive much attention within politics or nature management, until a family group of wolves was reported by a biologist as having suspicious behavior and appearance. One of the cubs was later observed playing with a dog in a number of domestic gardens, and it did not take long before the family group had become famous through national news media ("Vanskelig"; "Radiomerket"). The deputy managing director of the Norwegian Directorate for Nature Management called the scenario of hybrid wolves a faunal catastrophe, and announced that they would be put to death immediately if this was the case ("Hybrider" 7). For once, people who favoured preservation of the wolf population and feared for the pureness and naturalness of it, and people who opposed preservation and wanted to get rid of the animals whatever they were, were in agreement. Some of the members of the family group were anaesthetized and radio collars attached to them, in case they might wander off before genetic analyses could be undertaken.

However, the genetic differences between wolves and dogs are not necessarily more easily distinguishable than physical traits: dogs are descended from wolves, and have been treated as a subspecies of wolves since 1993.[2] Their genetic materials have much in common, and where the wolf ends and the dog begins is unclear. Once again it was required of the geneticists to draw a defining line through a continuum of variations. At first the geneticists were sceptical, and questioned whether it would be possible to genetically differentiate between wolf and hybrid. Only reluctantly did they accept the task of determining what these animals were, a task that involved establishing whether the wolves were to be considered natural or unnatural, and whether they should be allowed to live or be put to death. In this case the molecular biologists in Uppsala refused to draw a definitive line, but based on body tissue from one of the cubs found it highly probable that they were in fact hybrids ("Dødsdom"). The conclusions of their report were convincing enough for the Norwegian Directorate for Nature Management, which effected a hunt for the cubs within days. Two were shot within the next two months, but the two remaining cubs were never found. Strong evidence suggested, however, that they were killed illegally by unauthorized hunters ("Ulvehybrid"). The wolves that were considered unnatural were thus removed from the Scandinavian population, and this left the status of the remaining wolves as even more natural and pure: firstly by being defined as natural in opposition to the hybrids, and secondly as they had been rescued from the domesticated genes.

* * *

Ever since the family group from 1983 started to grow in numbers, nature managers and people arguing for their preservation had cautioned that they might suffer from inbreeding. But until body tissues from the wolves were brought into the laboratory in Uppsala, it was not possible to know this for certain, as the wolves had few visible degenerative signs of inbreeding. After processing the materials in the laboratory, however, the geneticists concluded that the population of more than one hundred had originated from only three wolves: the founding pair and one other immigrant from Finland that joined the group in the early 1990s (Vila et al. 93-95). This insight was achieved by generating genetic profiles for the wolves from which the scientists had been able to gather tissue samples, which

[2] Though the taxonomic relationship between dogs and wolves is still subject to contention, the general trend since 1993 has been to include dogs (familiaris) within Canis lupus as the subspecies Canis lupus familiaris (Nowak 257).

constituted most of the wolves in the population, and inducing profiles for the rest. In this process the relationship between most of the wolves was mapped, and not much later an almost complete pedigree of the population was produced.

The pedigree made it possible to calculate a so-called coefficient of inbreeding; that is, a measure of how inbred the wolves were, based on the probability of an offspring inheriting the same gene from both parents (Liberg et al. 1-3). But even though the molecular biologists had developed methods to measure inbreeding, drawing a line between healthy and inbred wolves was a very different matter, and remained obscure. However, the analysis showed that the Scandinavian wolves were more closely related than siblings. The rhetoric of this knowledge, which has become sort of a slogan for many people who argue for their preservation, proved powerful enough to stabilise an understanding of the wolves as being vulnerable. The vulnerability of the wolves has later had a major influence on the politics towards them. Immigrants from the Finno-Russian population, for example, have received stricter protection than Scandinavian wolves because of their potential to reduce inbreeding. It has also become the main argument used by conservationists in defending the current size of the population and insisting that it should be allowed to grow.

* * *

In conclusion, the molecular knowledge and technology produced by scientists from the Centre for Evolutionary Biology at the University of Uppsala have contributed strongly to a transformation of the perception and treatment of wolves in Scandinavia. From being veiled in uncertainty and so difficult to manage, the wolves are now understood and treated as a stabilised construction: the new Scandinavian wolves. They are accepted in politics and nature management as natural, Scandinavian, vulnerable, and therefore worthy of protection. This does not mean that politics and management always favours the wolves; in fact, many people advocating their preservation would argue that the wolves are treated so carelessly that their survival is at risk. Additionally, the stability of this construction does not go beyond the complex of politics and management; it is generally not accepted by people who oppose the preservation of the wolves, many of which still argue that the wolves have been illegally reintroduced, that they are not Scandinavian and that they are not vulnerable. However, the fundamental politics of protecting the wolves is at present non-negotiable, and this is in no small part due to what might be called the molecularisation of the wolves.

As we have seen, however, this molecularisation consisted not only in making the tiny fragments of wolf bodies reveal secrets about the animals' past and present; it also involved classifying wolves according to binary categories such as natural and unnatural. These categories were not found in the genes of the wolves, and they were not invented by the molecular biologists. They were products of a heated controversy that the scientists were hired to resolve. The molecular biologists were, however, not always able or willing to draw boundaries between these categories. Their findings were nevertheless used to fortify the categories and boundaries that were expected to exist, and only in this way could their work stabilise the understanding of the wolves in Scandinavia as safely within the categories of natural, Scandinavian, vulnerable, and worthy of protection. In this respect, it was through the intertwining of molecular biology and politics that the wolves' inner molecular structure was made decisive for how we understand and treat them.

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Field studies *in absentia*: Counting and monitoring from a distance as technologies of government in Norwegian wolf management (1960s–2010s)[1]

Abstract: The article investigates how national and international measures to protect wolves turned the whole of Norway into a field of study for wildlife biologists, and how the extensiveness of this "field" prompted a transformation in the methods employed to count and monitor wolves. As it was not possible to conduct traditional field studies throughout the whole of Norway, the biologists constructed an extensive infrastructure, which I have termed a "counting complex," in order to count wolves from a distance. The article identifies three decisive periods in the construction of this complex: the 1960s, the 1980s, and the first decade of the new millennium. During the first two periods, biologists used the infrastructure to mobilize ordinary people's observations; they did this by first searching through newspaper notes, then enrolling people more directly through local committees of game management. However, the public's observations often turned out to be unreliable, and, in the 2000s, molecular biologists helped to incorporate genetic techniques into the counting complex. By using the infrastructure to mobilize wolf scat, rather than observations, and by constructing DNA profiles for individual wolves, the molecular biologists enabled research that I have termed "nationwide field studies *in absentia*." The article argues that the biologists' main motive for constructing and refining the counting complex was to make wolves amenable to government, as they considered this a vital premise for the successful practice of protecting of wolves. The increased intensity in monitoring in the last period, however, was also driven by international conventions and detailed regulations.

Keywords: biodiversity, field sciences, endangered species management, conservation biology, wolves

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Biologists produce an astonishing amount of information on wolves living in the forests and mountains of Norway; the number and movement of wolves, often assigned labels such as "V211," are continually monitored. This monitoring is dependent on an extensive complex of people and infrastructures, and this article investigates the historical origin and development of this complex. It investigates how the entire geography of Norway has become a field of study for wildlife biologists, how the extensiveness of this field has transformed the conduct of field studies, and how studies in this field have been conducted in order to enable the management and protection of wolves.

The practices of counting and monitoring wolves are, by necessity, closely tied to the places in which wolves reside, as they require observation. Place has become the focus of much research conducted by historians and other scholars of science, and, in particular, historical studies of field sciences (Finnegan 2007; Kohler 2011).[2] These studies have emphasized how scientific knowledge is affected by the specific sites in which it is produced, and how scientists affect the places they occupy when conducting field studies; the studies have also emphasized political background and the effects of the knowledge gained (Alagona 2012; Bocking 2012; Rumore 2012; Vetter 2012; Manganiello 2009). Most of the historical research on field sciences has concerned restricted fields that biologists singled out mainly for the scientific merits they held – places in which biologists could research nature and biology directly. However, national legal protection and international conventions, such as the Convention on Biological Diversity, have prompted scientific research requiring *in situ* studies of much larger fields. For example, participating nations are presently required to continuously monitor biological diversity within their borders, and, as a result, some biologists have been made responsible for researching nationwide fields. Through an examination of the development of regulation-driven research on wolves in Norway, I argue that biologists in this case used various technologies of mobilization to transform the whole of Norway into their field of study (Miller and Rose 2008; Latour 1987; Law 1986). By constructing an extensive complex for counting and monitoring wolves that involves a great number of people and infrastructures, the biologists have become able to perform field studies *in absentia*, or at a distance.

[2] See also Alagona 2013 for a study of the role of place in endangered species management in California.

Historians and other scholars of public government have emphasized the decisive role of knowledge production in enabling the practice of management and regulation, and have construed much regulatory-driven research since the mid-20th century as "technologies of government."[3] Nicholas Rose and Peter Miller argued that studies of government should focus on the actual mechanisms, or "technologies," that enable government in practice. These often include "apparently humble and mundane mechanisms," such as notation, computation, calculation, and assessment. They coined the terms "government at a distance" and "technologies of government" to describe the conduct and means of government, respectively. In this, they drew on Bruno Latour's notion of "action at a distance" and Latour and Michel Callon's studies of "the complex mechanisms through which it becomes possible to link calculations at one place with action at another … through a delicate affiliation of a loose assemblage of agents and agencies into a functioning network."[4] Such studies of public government have often concentrated on the government of subjects, and hence on the production of knowledge by professionals such as psychologists, social workers, accountants, and factory managers.[5] In this article, I argue that such mechanisms have also been evident in biologists' efforts to count and monitor wolves. These efforts have been intimately related to efforts of managing and regulating wolves over the period, from the process that led to protection in 1971 to subsequent efforts by the Directorate for Nature Management (DN)[6] to count wolves in order to make them "amenable for intervention" (Miller and Rose 2008, p.15). For this purpose, and since the 1960s, biologists in Norway have constructed an extensive network (or assemblage) of various agents, agencies, materials, and infrastructure. Due to its purpose and complexity, I have chosen to term this network a "counting complex."

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[3] Miller and Rose 2008, pp.32–35. See also Rose 1989; Porter 1995; Barry 2001; Dean 2010.

[4] Miller and Rose 2008, p.34.

[5] Kristin Asdal's history of Norwegian environmental politics in the 20th century, which draws in part on such literature, is one notable exception (Asdal 2011a). See also Benson 2010 for an empirical examination of the origins and development of tracking technologies in wildlife research and management.

[6] The Directorate for Nature Management changed title several times during the period covered by this article. It was founded in 1964 as the Directorate for Hunting, Game Management and Freshwater Fishing, and was renamed in 1974 to the Directorate for Game and Freshwater Fish, as it was transferred from the Ministry of Agriculture to the Ministry of the Environment. In 1985, the name changed to the Directorate for Nature Management, and, in 1988, the research section was separated out as NINA (the Norwegian Institute for Nature Research). In July 2013, the name was changed to the Norwegian Environment Agency, as it merged with the Norwegian Climate and Pollution Agency. To facilitate the readers, however, I refer to the institution as simply "DN," or "the Directorate for Nature Management," throughout the article.

The techniques for counting and monitoring wolves from a distance, which I investigate in this article, in some ways resemble more nation–state accounting practices than traditional field study methods (Miller and Rose 2008; Scott 1998). However, the aim of these accounting practices has not been to satisfy the profit-accumulating or domination-seeking appetites of a control-minded state. Rather, it is evident (throughout the three periods under study) that efforts to count and monitor wolves were pivotal "technologies" in the endeavors to protect and bring wolves back to Norway. In the first two periods, efforts to count wolves were initiated by biologists, or by nature managers in cooperation with biologists. In the final period, however, international conventions and national politics were central in what became an effort to monitor wolves permanently. In this respect, this article represents an empirical and historical investigation of the information-producing machinery that has come to surround many animals, plants, and places that have received protected status. The counting and monitoring of wolves in Norway provides an excellent case study for the intensification of such knowledge production, as wolves in Norway constitute one of the most closely monitored wild animal populations in the world.

Counting to protect wolves

In the first half of the 19th century, wolves were common in Norway. However, after the government established public bounties and other measures were taken to eradicate them in this period – such as the publication of a book on methods for killing wolves (Asbjørnsen 1840) – the wolf population decreased significantly, and this decrease continued into the 20th century.[7] The decrease made it possible for livestock owners to reduce the level of attendance at summertime grazing in outlying fields and remote areas, and, as a result, the practice of continual herding was abandoned in the 20th century.[8] Efforts to eradicate wolves in Norway were part of an international trend of utilitarian conservation in game management that prevailed in much of the Western world in the 19th century and into the 20th century (Walker 2005; Robinson 2005; Coleman 2004; Lopez 1978; and Jones 2002). This rational approach, which had roots in 18th century scientific agriculture and forestry,

[7] Myrberget 1969a, pp.3–9. See also Collett 1912; Helland 1914; Aaseth 1935; Olstad 1945; Johnsen 1957. These crude accounts of the changes in wolf numbers were made in general books on the status of wild animals or carnivores in Norway, and based on the number of granted wolf bounties.

[8] St. meld. nr. 35 1996–1997, pp.54–55. See also Drabløs 2003.

prescribed that the eradication of large predators would maximize game populations and reduce livestock losses (Worster 1994, pp.256–290; Scott 1998, pp.11–52; Dunlap 1988, pp.48–61). A few of the most influential Norwegian foresters of the 19th century were educated at the influential German school of scientific forestry at Tharand (Berntsen 2011, p.32). Efforts to eradicate carnivores peaked in the first decade of the 20th century, when the government supported a "war" on carnivores conducted by the Norwegian Association of Hunters and Anglers (Søilen 1995, pp.95–115).[9]

In 1914, the internationally renowned explorer and scientist Fridtjof Nansen argued that Norway would benefit from a more systematic and scientific approach to game management (Hagen 1952, p.17). *Statens viltundersøkelser* (the government's game research institute), which would later become part of DN, was established in 1936 for this purpose (Skavhaug 2005, p.69). A move away from utilitarian conservation and towards a more ecologically-based conservation ideology, in line with international trends, occurred in the decades following World War II (Berntsen 2011; Worster 1994). Yngvar Hagen, leader of the government's game research institute from 1955 to 1977, criticized the eradication campaigns in an extensive book titled *Rovfuglene og viltpleien* (Raptors and game management). Published in 1952, the book is considered a classic in Norwegian nature management, and Hagen has been credited as one of the most important characters in the move towards a more ecological management and public understanding of nature (Mysterud 2001). According to Hagen, the complexity of ecological mechanisms often means that eradication measures do not lead to the anticipated increases in game populations (Hagen 1952, pp.558–598). This line of reasoning implied that the eradication campaigns had been responsible for killing a great number of carnivores in vain. While Hagen mostly concerned himself with raptors, other wildlife biologists soon argued for the protection of wolves.

On October 31, 1967, *Norsk-Svensk forening* (the Norwegian-Swedish Society) arranged a conference on nature conservation to discuss the potential for increased cooperation between Nordic countries on issues of nature management and conservation. Cross-border national parks and the future of large carnivores in Nordic countries were the main

[9] The association waged war by various means, including importing traps from Germany and supporting the education and costs of a teacher travelling throughout Norway to teach methods of trapping and killing carnivores (Søilen 1995, pp.95–115).

conference topics. However, the main outcome of the conference was a campaign to protect wolves in Norway, by law. The panel attendants were specialists in game management and conservation from Norway, Sweden, and Finland; Svein Myrberget, who had occupied a position at *Statens viltundersøkelser* since 1960, acted as the Norwegian representative (Skavhaug 2005, p.69). The researchers presented crude estimates (which were in fact more guesses in the Norwegian case) of the number of wolves still remaining in each country (Myrberget 1969b, p.160). Somehow, these numbers, when put together, created a very concrete image of how alarming the situation had become for wolves. The panel attendants adopted the following statement after the meeting: "The data presented [at the conference] showed that the situation for the wolves is so serious that unless they are immediately given better protection, they might disappear from Scandinavia within very few years. Even if an immediate total protection is executed throughout the Nordic countries, they might not survive."[10] They also sent a letter to the Norwegian government by way of the Ministry of Agriculture, arguing for total protection of wolves in Norway.[11]

In order to achieve political impact, however, the biologists deemed it necessary to produce a more robust fundament and presentation of the wolf numbers that had been presented at the conference. Hence, the three wildlife biologists agreed to create a joint and more accurate scientific report on the status of wolves in Fennoscandia. For Myrberget, this represented a new challenge – he had to find a way to count wolves throughout Norway's more than 300,000 km^2. Estimating increases or decreases in populations of (for example) game animals was not new to him or to the other wildlife biologists, but accurately counting numbers nationwide, was. Further, drawing inferences from smaller samples was not an option, as the number of wolves was too small. He concluded that fieldwork (i.e. counting snow tracks in wolf habitats) would be the most reliable method for counting wolves. This was, however, impossible for one man with few resources, considering the vast extensiveness of this "field," which encompassed the whole of Norway.

Instead, Myrberget searched for a way to count wolves from a distance – to reach out through the country's landscapes without having to travel there in person.[12] In this regard,

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[10] Myrberget 1969b, p.160. My translation – this applies to all citations in the article.

[11] DN archive: Forlegg for styret [Proposal to the board]. Forlegg sak nr. 129/68. A: 761.545. Archival box: Fredning av ulv, bjørn, jerv, gaupe [Protection of wolf, bear, wolverine, and lynx], p.2.

[12] On "action at a distance," see Latour 1987; Law 1986; Miller and Rose 2008; Asdal 2011b.

he attempted to employ an institutional network of local committees for game management that could provide reports on their area. The results of this were not very satisfactory; many committees had limited information on wolves, and some were not interested in protecting them (Myrberget 1969a, pp.9–11). Instead, Myrberget came up with the idea of counting wolves according to newspaper notes. Considering the amount of attention a single wolf entering a new area stirred up, he assumed that most observations of wolves would have resulted in at least a note in the local newspaper. Moreover, there was a methodological shortcut for studying newspapers that meant that he would not have to search through them all: a newspaper monitoring service called Norske Argus. This company was given the task of collecting news clippings that included the words “wolf” or “wolves” from Norwegian newspapers published between 1948 and 1967 (Myrberget 1969b, pp.162–163). Myrberget then categorized the observations in these clippings as reliable or dubious, according to his

Tabell 1. Antall noenlunde sikre observasjoner av ulv i Norge ifølge avisutklipp i tiden 1/7 1961—30/6 1967.

Fylke	61/62	62/63	63/64	64/65	65/66	66/67	Total
Finnmark	5	5	3	0	2	4	19
Troms	1	7	3	1	1	1	14
Nordland	1	1	0	1	0	0	3
Nord-Trøndelag	5	2	0	0	1	0	8
Sør-Trøndelag	0	0	1	0	2	0	3
Hedmark — Oppland	2	6	2	2	2	0	14
Total	14	21	9	4	8	5	61

Tabell 2. Høyeste antall ulv observert i de ulike norske fylker i de enkelte sesonger ifølge avisutklipp.

Fylke	61/62	62/63	63/64	64/65	65/66	66/67
Finnmark	1	5	3	—	1	3
Troms	1	10(?)	1	1	1	1
Nordland	1	1	—	1	—	—
Nord-Trøndelag	6	1	—	—	3(?)	—
Sør-Trøndelag	—	—	1	—	1	—
Hedmark — Oppland	5(?)	1	1	2	1	—
Total	6	10(?)	3	2	3(?)	3

Fig. 1 “Somehow reliable observations” of wolves in Norway (upper table) and estimated number of wolves (lower table), both by county and year, according to Myrberget’s evaluations of newspaper notes (Myrberget 1969b, p.162)

own evaluation. Following this categorization, Myrberget estimated the number of wolves in Norway. Figure 1, upper table, shows the number of newspaper notes he considered to contain "somehow reliable observations" of wolves in different Norwegian counties. His estimation of the number of wolves in Norway, based on his reading of the newspaper notes, is depicted in the lower table (Myrberget 1969b, p.162). Myrberget's estimation was low, and, joined with Sweden and Finland's independent estimations, the report concluded that only 15 wolves remained in the region, and that the situation was disastrous (Myrberget 1969b, p.170).

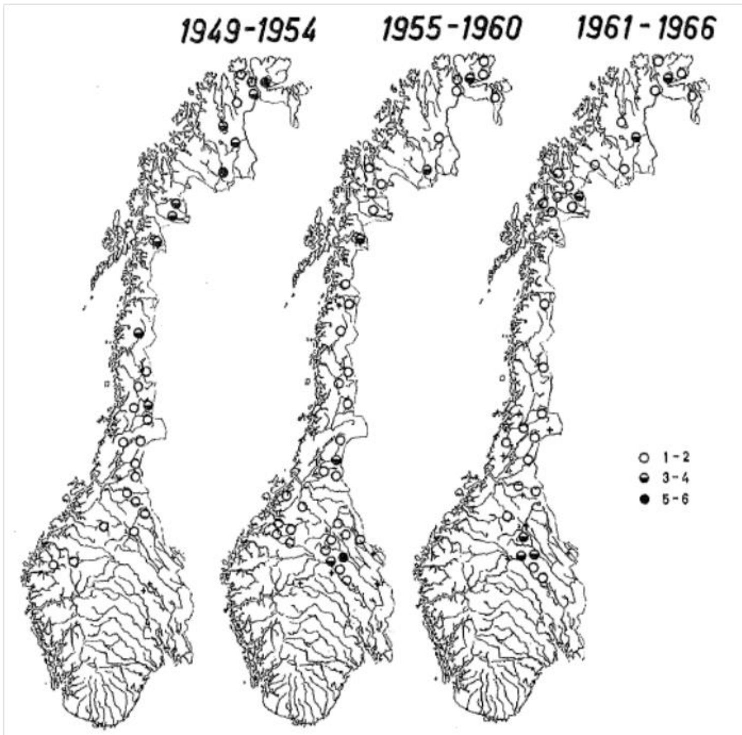


Fig. 2 Locations of wolves in Norway from 1949–1966, according to Myrberget's evaluation of newspaper notes. The different circles indicate how many of the six years in each period anyone had observed wolves. Crosses indicate dubious observations (Myrberget 1969b)

The wildlife biologist was well aware of the limitations of his method, and he discussed these limitations in a publication in DN's internal report series, in which he admitted that it was hard to evaluate the reliability of newspaper notes and that confusion of wolves with dogs was a considerable source of error (Myrberget 1969a, p.3). In a published report in the journal *Naturen*, through which he intended to reach out to a larger public, he defended the method as reliable: "Hardly any of the large Nordic mammals are as easy to estimate the numbers and migration of, as the wolf" (Myrberget 1969b, p.161). Myrberget based this claim on the fact that, because there were very few wolves, they attracted much public attention wherever they appeared. Further, he noted that snow covered their habitats seven months a year, so tracking enabled quite accurate verification. He ended his methodological discussion by stating, "the estimates that we bring here should therefore be considered as rather reliable…. We have not noticed any particular sources of error" (Myrberget 1969b, p.162). It is not hard to imagine that Myrberget attempted to make the report seem as robust as possible to the public, given that the report was his central tool for achieving the political protection of wolves. Perhaps he saw it as most urgent to show the public that there were only very few wolves left, and that it was possible to keep some record of their numbers.

It seems that Myrberget's research had the intended effect: only three years later, in 1971, wolves became protected by law. If we follow the case of wolf protection through the political process, it is evident that the population estimates and the report had a decisive impact. The subsequent treatment of this case within the political system invariably took Myrberget's report as its base of knowledge and as a guide for management regulations. The Council for Nature Protection, for example, argued for total wolf protection, with reference to the report:

> It is evident from the report that the situation of the wolves in this geographical area is such that the population cannot bear further decimation if the species is to have a possibility to survive as part of the Nordic fauna. In a situation where the scientists so evidently have documented that a species is about to become extinct from the Nordic fauna, we strongly suggest that protection should be executed immediately.[13]

[13] DN archive: Forlegg for styret [Proposal to the board], p. 3./Forlegg sak nr. 129/68. A: 761.545. Archival box: Fredning av ulv, bjørn, jerv, gaupe [Protection of wolf, bear, wolverine, and lynx].

Further, DN used the report as the basis for their argument for protecting wolves, and these recommendations led to a temporary protection by law in 1971.[14] DN could not make the protection permanent until they had gathered and processed statements from affected stakeholders, so they executed a temporary protection in order to follow the urgent call of the report to establish protection. The newly established Ministry of the Environment also used the report's conclusions to support their decision to protect wolves permanently from 1973: "The urgency concerning the possibilities to protect a Nordic population of wolves is strongly emphasized in the report by the Nordic wildlife biologists. The number of individuals has in all likelihood reached the lowest limit possible for biological reproduction."[15]

The conference and subsequent report from the three wildlife biologists seems to have set much in motion. In the newspaper notes that Norske Argus gathered for Myrberget (and which he and the other biologists continued to gather up until 1988), an abrupt shift in the way in which journalists and the public construed wolves is evident. Until the 1960s, the notes almost exclusively reported on observed wolves (e.g. "Wolf spotted in Trysil!"); however, after the conference, the notes included many letters to the editor debating wolf protection and general notes on the initiative to protect wolves.[16] There were very few and isolated letters to the editor arguing for protection in the years prior to the conference, and those present were mainly from nature writer Mikkjel Fønhus in relation to the 1964 killing of "Fridtjof," the wolf assumed to be the last living wolf in southern Norway.[17] After the conference and the report, however, the protection of wolves, which seems to have hitherto been unimaginable, turned into a very real possibility. Mark V. Barrow, Jr. argued that naturalists played a central role in American wildlife conservation, and it is evident that biologists were decisive in establishing the protection of wolves in Norway, as well.[18]

[14] DN archive: Direktoratet for jakt, viltstell og ferskvannsfiske. Kongelig resulosjon [The Directorate for Hunting, Game Management, and Freshwater Fishing. Royal resolution], p.1./Fredning av bjørn og jerv 1969–august 1971 [Protection of bear and wolverine 1969–August 1971]. A: 761.545. Archival box: Fredning av ulv, bjørn, jerv, gaupe [Protection of wolf, bear, wolverine, and lynx].

[15] DN archive: Kongelig resolusjon [Royal resolution]. Statsrådsak nr. 4. 5. 73. p.2. / Fredning av bjørn og jerv 1969–august 1971 [Protection of bear and wolverine 1969–August 1971]. A: 761.545. Archival box: Fredning av ulv, bjørn, jerv, gaupe [Protection of wolf, bear, wolverine, and lynx].

[16] DN archive: Klipparkiv, DN [Newspaper notes archive, DN]. Ulv 1948–1958 [Wolf 1948–1958] and Klipparkiv, DN [Newspaper notes archive, DN]. Ulv 1958–1970 [Wolf 1958–1970].

[17] DN archive: Klipparkiv, DN [Newspaper notes archive, DN]. Ulv 1958–1970 [Wolf 1958–1970].

[18] Barrow 2009a, 2009b, and 2011. See also Farnham 2007; Takacs 1996; Alagona 2004 and 2013.

Although the whole of Norway was not a practicable or particularly well-suited field for studying wolves, Myrberget decided to make the area his basis for counting wolves. A major reason for this is probably that he was seeking to protect wolves by law, and that laws are constructed at the national level and encompass the entire nation. He was also working for an agency that had national responsibility for nature research, and had been established to improve the state of the nation's natural environment. In order to make a case for the protection of wolves on a national level, therefore, Myrberget attempted to show that wolves were threatened at this level. Thus, the identification of his field of study was determined by the political map, and not by the suitability of the place for biological research. Stephen Bocking argued that, "[i]n an era when ecological research is often conducted amidst the pressures of environmental affairs, the sites of research may not be of the scientists' own choosing. Instead, they are often located amidst complex, nearly intractable ecological and social conditions" (Bocking 2011, p.711). The construction of place in the efforts to count wolves in Norway supports the first of these claims and highlights another type of research site that is typical for contemporary environmental history; in addition to highly controversial localities, politically defined areas such as nations have become common sites of research in relation to protective regulations.

The vast area of the field in which Myrberget attempted to count wolves prompted him to develop a new method for the purpose. Instead of conducting *in situ* field studies, he attempted to mobilize the public's observations of wolves and the subsequent coverage of these observations in local newspapers, in order to bring the wolves into his tables and maps from a distance. However, by making a nationwide estimate of wolf numbers, he also attempted to bring wolves back into Norway and protect them. At least in this last regard, he was successful. We have seen that the conclusion of the report, describing the situation for wolves as "disastrous," was repeated through the different institutions that treated the proposition to protect wolves by law. Perhaps a less obvious effect of the report was that it established wolves as seemingly governable objects – objects that would be possible to govern because, once legal protection made them objects of government, it would be possible to produce knowledge of their numbers (Miller and Rose 2008). Perhaps it was facts relating to the vulnerability of wolves that made protection a possibility, while it was the establishment of scientific population estimates and methods to make these estimates that made wolf management after the protection seem possible.[19]

Building a nationwide "counting complex"

It turned out, however, that the wolves were not easily manageable. By 1982, wolves had returned at two different locations in Norway, due to long-distance dispersal from Finland and Russia (Flagstad et al. 2003; Vila et al. 2003). As has been the case in most places where wolves have returned by migration or reintroduction, their renewed presence turned out to be highly controversial (Mech and Boitani 2003; Hayward and Somers 2009; Skogen et al. 2013; Nie 2003). Sheep killed by a wolf in the municipal Vegårdshei soon made national headlines. The challenges of managing protected large carnivores had, however, become gradually clearer for the nature managers at DN after the mid-1970s. Both bears and wolverines had become objects of growing conflict and compensation demands from livestock owners, and the managers argued that it was impossible to make regulatory decisions concerning the animals without better national population estimates. They argued that the animals' protected status depended on a certain number of the animals being alive; hence, securing the survival of the population. In consequence, they needed to know how many animals existed in the whole of Norway, in order to decide, for example, whether a bear that had killed sheep could be put to death or if its survival would be necessary to ensure the survival of the bear population (Sørensen and Kvam 1984, p.17; Schei 1979, p.6; Myrberget 1979, p.75; Kvam and Sørensen 1984, p.65). Once again, national regulation prompted biologists to make the whole of Norway their field of study.

In an attempt to mend the situation, wildlife biologists at DN initiated the first large-scale research project concerning large carnivores, in 1979/1980 (Sørensen and Kvam 1984; Sørensen, Mysterud and Kvam 1984). The study received financial support from the Ministry of the Environment and DN, and operated until 1984. Initially, as the biologists were doubtful that there were any wolves left in Norway, one of the main objectives of the project was to establish nationwide population estimates for bears and wolverines.

[19] On the relation between creating objects of government and making them amenable to intervention through the creation of numerical instruments or techniques, see Miller and Rose 2008 and Asdal 2008.

However, as wolves appeared in two different locations in 1982 and stirred up much controversy, the emphasis of the project in the final three years shifted towards producing population estimates for wolves. The other main objective of the project was to establish an infrastructure that would make it possible to maintain an overview of the numbers of large carnivores into the future (Sørensen and Kvam 1984, pp.15–21). In order to solve the practical problems that occurred after the nationwide protection of large carnivores, therefore, the nature managers and biologists at DN initiated a large-scale project to make them amenable to intervention by counting (Miller and Rose 2008).

The construction of what I have termed a nationwide "counting complex," in which ordinary people's observations were still at the core, was the means for achieving both of the study's main objectives.[20] That is, in an attempt to make wolves amenable to government and to enable protection in practice, the biologists constructed an assemblage of various agents and agencies to mobilize information from every part of the country (Miller and Rose 2008). The idea was that an institutional network of local committees for game management (of which a few hundred were scattered throughout the country) would allow the biologists to enroll ordinary people's observations more directly.[21] The new generation of wildlife biologists sought to improve and perfect the methods applied by Myrberget (Wabakken et al. 1983). The development of the counting complex can be described as a three-step process, of which the first step was making information about large carnivores available to the people who the researchers wanted to participate (through observing). This information initially consisted of a list of tracks and other signs of large carnivores, as well as the problems one could encounter at the sites of livestock carcasses when trying to identify whether large carnivores had been the cause of death (Figure 3). DN published the information in a report (Myrberget and Sørensen 1981) and distributed about 5,000 copies; the biologists later described this report as a cornerstone in the efforts to spread knowledge in order to achieve reliable observations (Sørensen and Kvam 1984, p.22).

[20] The biologists experimented with organizing direct observations in the field, but soon realized that observing wolverines in an area of 1650 km² required 50 men on ski (Kvam and Sørensen 1984, p.66).
[21] On the enrollment of ordinary people in scientific research, see Star and Griesemer 1989, and Ellis and Waterton 2005.

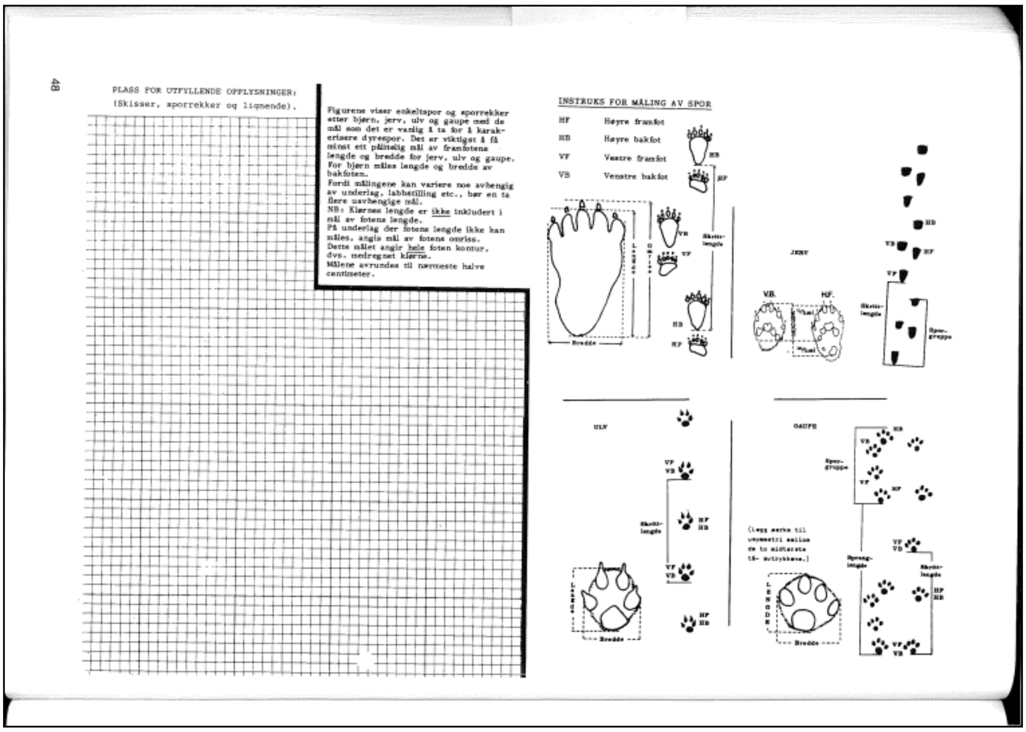


Fig. 3 Typical tracks of bear, wolverine, wolf and lynx – from a DN report published in order to make the observations of large carnivores more reliable (Myrberget and Sørensen 1981)

The wildlife biologists also conducted extensive networking, both to disseminate information and to incorporate people into the counting infrastructures they were attempting to construct. The network for wildlife management that already existed in local committees for game management, which tasks had previously consisted of facilitating hunting and maximizing fish and game populations, had to be somewhat transformed in order to become part of the new counting complex. During the project period, the biologists had regular contact with 104 local committees and 64 local contact persons. As we can see from Figure 4, the biologists spent a large portion of their time and resources arranging seminars and meetings around the country. The wildlife biologists also attempted to reach a wider public by presenting the project and information about carnivores in the media. In total, the project featured in more than 500 newspaper articles during the five-year period (Sørensen and Kvam 1984, p.25).

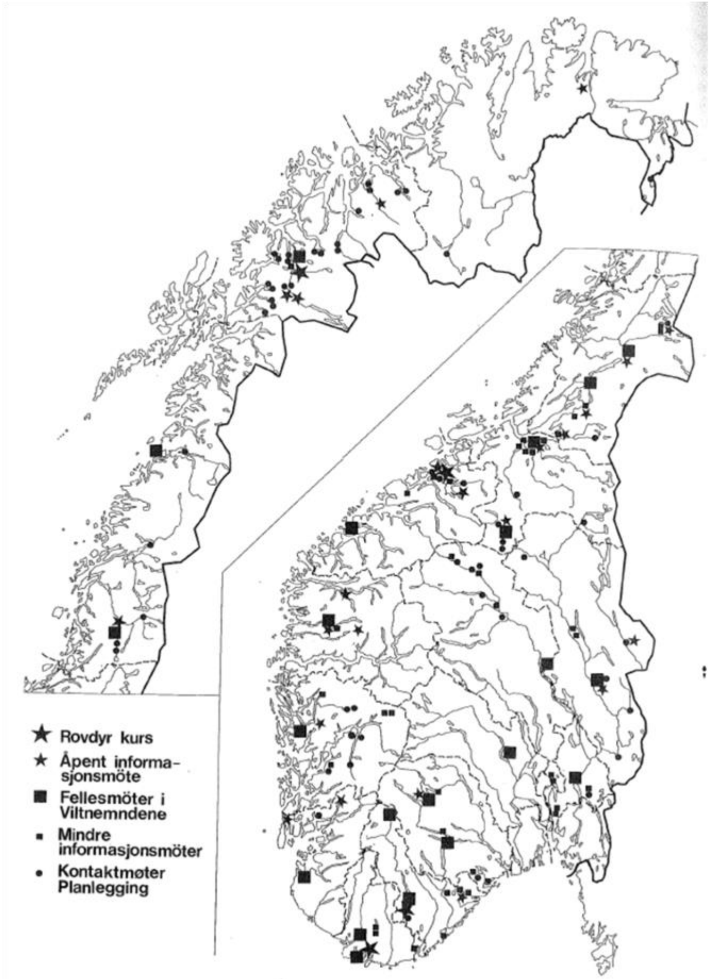


Fig. 4 Locations where the biologists arranged seminars (large stars), general information meetings (small stars), meetings for the local committees for game management (large squares), lesser information meetings (small squares), and contact meetings or planning (small circles) (Sørensen and Kvam 1984, p.24)

The second step of the construction process involved developing a system for the transference of public observations from the forests and mountains of Norway back to DN (Figure 5). In order to process the flow of incoming information, the biologists constructed an infrastructure based on that of the local committees for game management. Ordinary people were asked to make observations locally and by chance, but, once they had identified tracks, signs, or live animals, they were asked to report the observations to the local committee. The committee, in turn, was asked to report the observations to the consultant of game management at the regional level. The biologists made the local committees responsible for collecting observational data such as descriptions, photographs, drawings, hair samples (etc.), which they were asked to report through registration forms that had been designed by the biologists. The biologists designed the forms to make the registrations uniform and, hence, easier to process (Figure 6). Furthermore, the local committees, by aid of the consultant at the regional level, were meant to evaluate the incoming observations and place them in one of the following categories: accepted, assumed reliable, undetermined, or rejected. The biologists made the consultant responsible for verifying the registrations he received from the local committees before sending them on to the research section at DN. The biologists at DN were responsible for administering and archiving all of the incoming observations from different regions in a central database, as well as conducting an additional evaluation of the incoming observations. They were also meant to initiate more concentrated efforts of registration at locations with high numbers of compensation demands for killed livestock.

The third step of the construction process was evaluating the incoming data and making population or number estimates. However, this last step turned out to be problematic. The counting complex was put through the test in the case of the wolf in Vegårdshei in 1983. In line with procedures, a wildlife biologist from DN conducted a concentrated effort to register wolf numbers at the location (Landa et al. 1984). He cooperated with the consultant of game management in Aust-Agder and the local committee for game management, and arranged press conferences in which he encouraged the public to report any observations that could be relevant. He received 130 reported observations of wolves between May and November, and classified these as sight (33), tracks (36), carcass (21), killing technique (27), feces (4), sound/howl (8), and dead animal (1) (Landa et al. 1984, p.17).

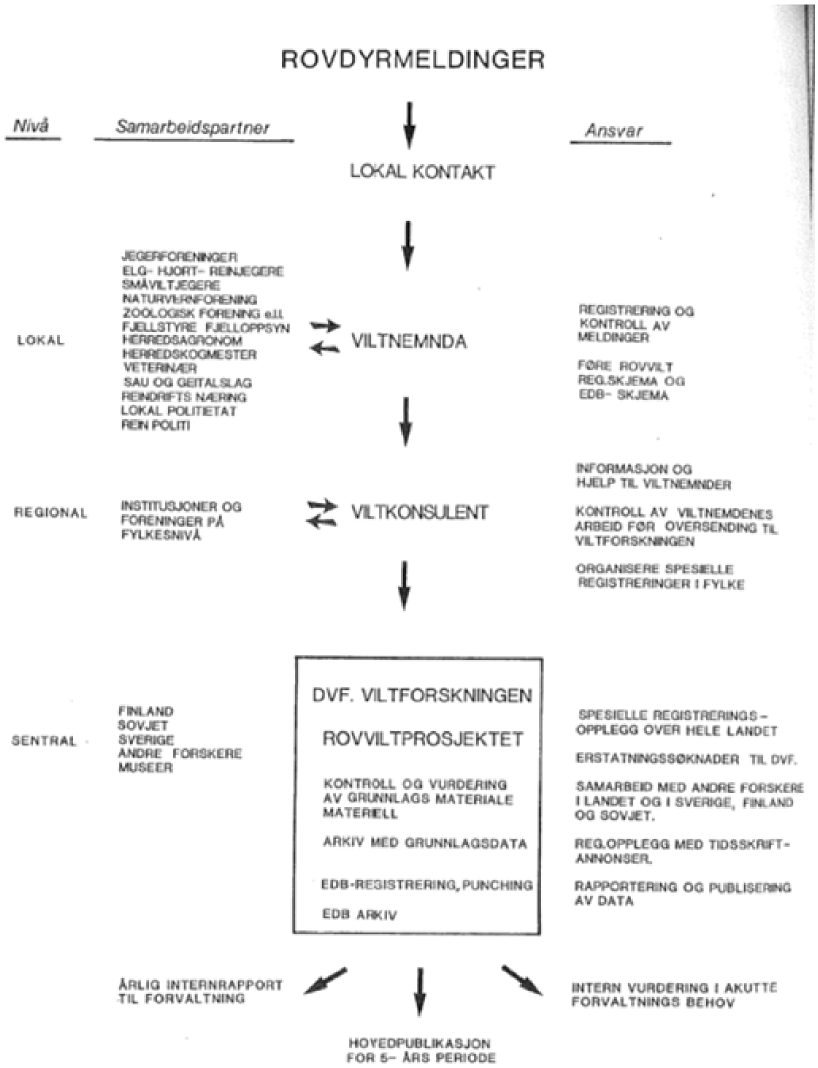
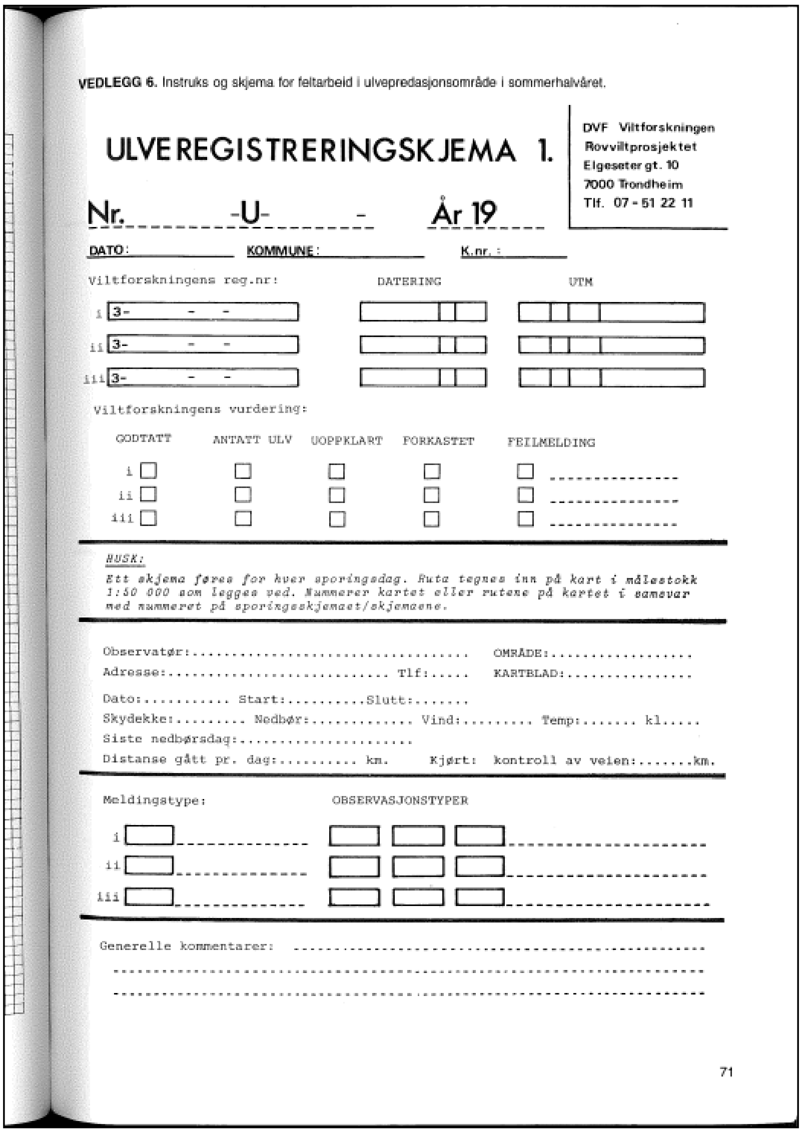


Fig. 5 Organizational model representing the biologists' intended flow of observations through the counting complex. The central line shows (with arrows) how observations were meant to travel from local contacts, through local committees of game management and regional consultants of game management, to the biologists in the bottom square. At the left side, various organizations and other institutions are represented, such as environmental organizations and associations of livestock owners or hunters, which were intended to cooperate at different levels. At the right side, the responsibilities of the institutions (i.e. collecting and verifying observations) are indicated (Sørensen and Kvam 1984, p.26)



VEDLEGG 6. Instruks og skjema for feltarbeid i ulvepredasjonsområde i sommerhalvåret.

ULVEREGISTRERINGSKJEMA 1.

DVF Viltforskningen
Rovviltprosjektet
Elgeseter gt. 10
7000 Trondheim
Tlf. 07 - 51 22 11

Nr. -U- - År 19

DATO: KOMMUNE: K.nr.:

Viltforskningens reg.nr: DATERING UTM

i 3- - -
ii 3- - -
iii 3- - -

Viltforskningens vurdering:

GODTATT ANTATT ULV UOPPKLART FORKASTET FEILMELDING

i
ii
iii

HUSK:
Ett skjema føres for hver sporingsdag. Ruta tegnes inn på kart i målestokk 1:50 000 som legges ved. Nummerer kartet eller rutene på kartet i samsvar med nummeret på sporingsskjemaet/skjemaene.

Observatør:................................... OMRÅDE:..................
Adresse:........................... Tlf:..... KARTBLAD:................
Dato:........... Start:..........Slutt:.......
Skydekke:......... Nedbør:............. Vind:......... Temp:....... kl.....
Siste nedbørsdag:......................
Distanse gått pr. dag:.......... km. Kjørt: kontroll av veien:.......km.

Meldingstype: OBSERVASJONSTYPER

i
ii
iii

Generelle kommentarer:

71

Fig. 6 Registration form for wolf observations. The observers and verifiers were meant to register all of the following information: registration number, date, location, name of observer, weather conditions, name of the person verifying the observation, time spent and distance travelled in verifying the observation, and evaluation of the observation (Sørensen, Kvam and Mysterud 1984, p.71)

The biologist, his assistant, or a local contact who had received special training in verifying observations verified 89 of the reported observations in the field or the laboratory. The biologists had carefully composed procedures for verification to ensure that they only used highly reliable observations in the population estimates (Landa et al. 1984, p.23). For example, they composed the following guidelines for the verification of observations by sight (Sørensen et al. 1986, p. 29):

> Criteria that usually will lead to the categorization of an observation as "rejected" are observations by sight at long distances (more than 200 meters), poor description of the animal, "glimpse observations," poor light conditions or first impression of a small animal.
>
> Criteria that usually will lead to the categorization of an observation as "undetermined" are observations by sight at middle range distances (100–200 meters), fairly good description of the animal and first impression of a big animal (German Shepherd size).
>
> Criteria that usually will lead to the categorization of an observation as "assumed reliable" are observations by sight at short distances (<100 meters), good description of the animal, good observational conditions and observations of longer duration, combined with findings of tracks and/or other good signs.
>
> Criteria that might lead to the categorization of an observation as "accepted" are observations by sight at short distances (<50 meters) under good observational conditions, several observers and observations of longer duration, combined with verification of the observation at the site by findings of tracks and other signs indicating wolf. Verified behavioral information, which can be obtained by snow tracking over longer distances, will often be required for the categorization of an observation as "accepted."

The biologist, his assistants, or the local contact verified most of the reported observations by interview or a written report by the observer. Additionally, in the cases of reported carcasses, they followed procedures for evaluating carcasses and sites of killed livestock: they skinned the carcass in order to make bite marks, bite placement, pattern of feeding, and other damages visible. Further, they examined the site of the carcass in order to find tracks or other signs of wolves, such as hair or scat (Landa et al. 1984, p. 12).

Out of the 130 reported observations, the biologists evaluated 5 as accepted, 41 as assumed reliable, 52 as undetermined, 23 as rejected, 7 as error reports, and refrained from evaluating one. (Landa et al. 1984, p.17). Based on findings of carcasses, tracks, hair, and scat, the biologists concluded that there was at least one wolf in the area. Based on the time and location of the accepted and assumed reliable observations – for example observations of howling wolves at the same time in distant locations – they concluded that there were most likely a minimum of four wolves in the area. After a local hunting team shot a wolf in January 1984, however, indications of wolves dropped rapidly. Reported observations kept coming in, but the biologists evaluated none as accepted or assumed reliable. Further, the killing of grazing sheep by wolves that had prevailed during the summer seasons was not repeated in the summer of 1984. In the epilogue of a report on the effort to count wolves in Vegårdshei, the biologists speculated that the other wolves might have wandered on to other locations, or that hunters might have killed them illegally. As the summer passed, however, there were still no signs of wolves in other locations, and no indications that hunters had killed them. Their concluding speculation in the epilogue, therefore, seems in retrospect to have been a rather precise diagnosis of the counting complex: "If there, despite our presumptions, were only one wolf in Southern Norway, our registrations at least show that one needs to be extremely cautious when estimating numbers of wolves based on the methods available today." (Landa et al. 1984, p.45).

Although the first efforts to count wolves were decisive in bringing wolves back to Norway, the controversy and demand for compensations that followed made clear that their return would not be easy. Biologists and nature managers soon discovered that protected wolves were challenging objects to govern, and they encountered various practical management problems in executing their protection. As has been the case in many efforts to establish regulation over new objects of government, the biologists decided that numerical knowledge of the object would be decisive for enabling regulation (Asdal 2008; Miller and Rose 2008). In an attempt to make wolves amenable to government, therefore, the biologists initiated a large-scale research project to produce population estimates of wolves and other large carnivores. This project was constructed to produce more accurate estimates than those that the newspaper notes had yielded in the 1960s. In building a nationwide counting complex, the biologists attempted to build an infrastructure that would bring wolves into their archives and statistics by way of public observations. However, as this effort was primarily made to overcome practical management problems, it was also an effort to facilitate the process of bringing wolves back to Norway.

Despite the extensive work and resources that the biologists spent on building the nationwide counting complex, it still proved challenging for them to produce accurate estimates of the number of wolves. In a later report, they identified the main problem as the mediation between wolves and wildlife biologists. Public observations, which the whole complex was based on and which was meant to facilitate representations of wolves from the forests and mountains and into the biologists' archives and estimates, were often unreliable. The report concluded that observations of wolves were particularly problematic because of the similarities between wolves and dogs, and because the biologists had no exact methods at hand to separate observations of the two, despite efforts to develop highly specific guidelines for observation verification (Sørensen, Kvam and Mysterud 1984, p.58). Several reported observations by sight on short range and under good conditions turned out to be observations of dogs and even foxes, when later examined by biologists on site. Observers also reported smooth, coated bird dogs with docked tails as big, furry animals with long tails (Sørensen et al. 1986, pp.58–59). Differentiating properly between elk and wolf tracks on deep snow was another recurring problem of observation (Wabakken et al. 1982, p.24). Further, the biologists contended that the controversy and mass media coverage of wolves had led to what they termed "wolf psychoses" at several locations, and that this led to only 11 percent acceptance of the reported observations in one instance (Sørensen et al. 1986, pp.58–59). These problems of mediation in the biologists' efforts to count from a distance led them to conclude that reliable population estimates still required "close up" investigation where the wolves lived. However, as the number of wolves stayed below 10 and the animals were mainly located in one area of southeast Norway throughout the 1980s, it was feasible for the biologists to some degree to continue to investigate observations in the field.

From counting to monitoring

Beginning in the 1990s and continuing into the 21st century, biologists at the Norwegian Institute for Nature Research[22] made a new major effort to improve the accuracy and reliability of the counting complex. This time, continual monitoring on a more intensive level

[22] The former research section at DN took the name "the Norwegian Institute for Nature Research" after it separated from DN in 1988.

was their goal, but the field of study was still the whole of Norway. The establishment of a national program for monitoring large carnivores in 2000 secured the funding of these efforts, which successfully enhanced the accuracy of population estimates by incorporating genetic techniques into monitoring methods. Several developments intertwined in the reasoning behind this new effort to monitor wolves. During the 1990s, the wolf population grew from fewer than 10 in Norway and Sweden to around 40 in Norway, and 100 in Sweden and Norway, together (Wabakken et al. 2001, p.3). As the number of wolves grew, increased cost, time, and personnel challenged the "close up" field studies that the biologists had conducted since the early 1980s.[23] Further, it led to increased losses for sheep farmers and reindeer owners, and, around the year 2000, sociologists and other social scientists began to argue that the controversy concerned more than just economic losses, but also social and cultural dimensions (Skogen and Krange 2003; Krange and Skogen 2011; Figari and Skogen 2011). Politicians at Stortinget (the Norwegian Parliament) stressed that more accurate population estimates would assure better wolf management, and, additionally, would help to reduce the controversy (Innst. S. nr. 301 1996–1997, p.12). Furthermore, Norway had signed the Convention on Biological Diversity, which was put into effect in 1993 and explicitly stated that each country has a responsibility to monitor populations of endangered species (Braa et al. 1999, p.8).[24] However, a political turn towards highly detailed regulations seems to have most concretely escalated new efforts to monitor wolves. Highly accurate monitoring was necessary in order to execute these regulations, which therefore also presumed a transformation of wolves into highly amenable objects of government (Miller and Rose 2008).

While the number of wolves increased, DN made efforts to implement the Convention on Biological Diversity. Unlike former international conventions such as the Bern Convention, the Convention on Biological Diversity elevated identification and monitoring to the heart of conservational efforts by assigning it an entire article.[25] Article 7 explicitly required each

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[23] Although this article focuses on the development of technologies for counting and monitoring wolves "at a distance," it should be emphasized that "close up" field studies have continued to play a decisive role that complement the former in these efforts (see, for example, Wabakken et al. 2013b.)

[24] On the concept of biodiversity, see Farnham 2007 and Takacs 1996. For studies on the practice of biodiversity research and regulation in Canada and the Indonesian Archipelago, respectively, see Bocking 2000 and Lowe 2006.

[25] Article 7 of the Convention on Biological Diversity (United Nations 1992, p.5):

participating state to identify and monitor its biological diversity "as far as possible and as appropriate"; this signified a shift in international conservation efforts towards intensive and extensive knowledge production. For DN and the Norwegian wildlife biologists who had strived to count wolves during the previous decades, the responsibility for monitoring the entire biological diversity of the country must have represented an immense challenge. A Norwegian white paper from 1993 concerning the convention pointed out that monitoring should be a central component in the national implementation of the convention (St. meld. nr. 13 1992–1993). In a 1995 strategy report on monitoring biological diversity, a committee appointed by DN stated, concerning article 7, that "the organization and scope of today's monitoring is unsatisfactory" (Direktoratet for naturforvaltning 1995, p.11). In order to improve the situation, they proposed a general program for monitoring various biomes. In a 1998 action plan report, DN proposed more specific measures to be taken in order to implement the convention, and singled out large carnivores as a "special object" that should be intensively monitored as a matter of urgent concern (Direktoratet for naturforvaltning 1998, p. 61). DN argued that this was necessary because large carnivores were vulnerable – scientists had listed them in the national *Red List of Threatened Species* from 1996[26] – and, hence, the Convention on Biological Diversity obligated Norway to monitor them. However, large carnivores were far from the only species included in the *Red List of Threatened Species*. The DN's justification for assigning large carnivores the status of "special object" in need of more intensive monitoring included, in addition, the need to counter practical management problems concerning conflicts with livestock and the problems wildlife biologists had encountered in attempting to monitor them.

Article 7, Identification and monitoring:

Each Contracting Party shall, as far as possible and as appropriate, in particular for the purposes of Articles 8 to 10:

(a) Identify components of biological diversity important for its conservation and sustainable use having regard to the indicative list of categories set down in Annex I;

(b) Monitor, through sampling and other techniques, the components of biological diversity identified pursuant to subparagraph (a) above, paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use;

(c) Identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques; and

(d) Maintain and organize, by any mechanism data, derived from identification and monitoring activities pursuant to subparagraphs (a), (b) and (c) above.

[26] The scientists had listed wolves as critically endangered, bears as vulnerable, wolverines as rare, and lynx as conservation dependent (St. meld. nr. 35 1996–1997, pp.49–50).

A second white paper from the Ministry of the Environment concerning the management of large carnivores, which was prepared in parallel to the implementation of the Convention on Biological Diversity, further stressed the importance of monitoring for management purposes (St. meld. nr. 35 1996–1997, p.74). The white paper stated that DN should effect the regulation of large carnivore numbers through license hunting, quota hunting, and hunting in relation to livestock damage. This would require a high level of precision in management decisions and, consequently, highly accurate population estimates for DN to base these decisions on. As we shall see later, a third white paper on large carnivores in 2004 pushed the detail in regulations and, hence, the required accuracy in monitoring, even further. In the subsequent treatment of the second white paper, however, the Stortinget Standing Committee on Energy and the Environment stated that "the management of the politics concerning large carnivores is completely dependent on better registrations and continual monitoring of the populations" (Innst. S. nr. 301 1996–1997, p.12). Further, the committee emphasized the significance of population monitoring as a means of conflict reduction, and recommended that it be given high priority. Not long after this, the Ministry of the Environment assigned DN the task of establishing a national program for monitoring large carnivores to aid management decisions, reduce controversy, and help Norway fulfill the responsibilities of the Convention on Biological Diversity.

DN assigned a group of wildlife biologists, some of whom had been involved in the construction of the counting complex in the 1980s, the task of reviewing existing literature on methods for monitoring large carnivores (Linnell et al. 1998). They studied more than 300 articles and reports, mainly from Europe and North America. The biologists argued that monitoring populations of large carnivores was one of the most difficult tasks a wildlife biologist could take on. The main reason for this, they pointed out, was the low population density that complicated statistical analysis, as small and controllable areas often did not include any of the relevant wildlife. Additionally, large predators were often nocturnal and located in areas with dense vegetation, and were therefore difficult to detect (Linnell et al. 1998, p.7). In 1998, DN assigned a group of nature managers and wildlife biologists the task of preparing a proposal for a national program for monitoring large carnivores within June 1999, based on the literature review (Braa et al. 1999, p. 8). The proposal was not radically new: "Most of the proposed methods for monitoring represent a continuation, development, and standardization of existing methods that are currently employed in Norway" (Braa et al. 1999, p.10). However, the establishment of this program institutionalized efforts to monitor wolves continually, and secured ongoing funding rather than short-term and project-based funding. The program was founded in 2000, and was acclaimed in a 2004 white paper on the management of large carnivores from the Ministry of the Environment as "one of the best in the world" (St. meld. nr. 15 2003–2004, p.116). The acclamations were, however, partly grounded in the incorporation of genetic techniques, which abruptly transformed the conditions of monitoring.

In the years following the founding of the national program for monitoring large carnivores, the biologists and nature managers obtained a new technique for registering wolves and other large carnivores: genetic identification of individual animals. In the mid-1990s, molecular biologists at Uppsala University began to test genetic techniques that had originally been developed to investigate the evolutionary history of livestock and pet animals (such as dogs and horses), on large carnivores in Scandinavia. The molecular biologists initially conducted such tests in order to check allegations that humans had released the wolves in Scandinavia from zoos, but quite soon questions concerning how in-bred the wolves were and whether they had hybridized with dogs became central to the investigations.[27] Biologists and nature managers soon recognized the potential of these techniques for improving the monitoring of large carnivores, and, as the cost of performing genetic tests decreased during the first decade of the 2000s, they managed to incorporate such techniques into the national program for monitoring large carnivores. Soon, genetic testing complemented "close up" field studies at the core of efforts to monitor wolves.

The molecular biologists initially tested the genetic techniques as aiding instruments for monitoring wolverines; they aimed to identify individual animals based on scat, as tissue and blood samples were both harder and more invasive to collect (Flagstad and Brøseth 2002, p.1). The biologists collected 243 scat samples: 211 from the north Norwegian population and 32 from a pilot project in Sarek, a national park in northern Sweden. Regional managers in the Norwegian Nature Inspectorate, an institution established by the Ministry of Environment in 1996 to unite various bodies conducting nature inspection, managed the sample collection (Falleth and Saglie 2005, p.105). They delegated the practical work to their

[27] Stokland 2013. See also Vila et al. 2002; Ellegren et al. 1996; Flagstad et al. 2003; Ellegren 1999.

own employees and to a network of local contacts and non-governmental organizations they had inherited. The collecting process was, to a large degree, based on the infrastructure of the counting complex that the wildlife biologists had built in the 1980s, and the scat samples followed much the same pathways, from local sites of detection into the biologists' laboratories and, later, maps and statistics.

In the pilot study, the geneticists established that it was necessary to run three replicas per locus per sample in order to attain the correct multi-locus genotypes, and that most individual pairs could be separated by the use of nine markers (Flagstad and Brøseth 2002, p.2). In the larger project, they were able to produce DNA profiles for about 70 percent of the collected samples. Some samples were identified as excrement from other species, such as ravens, pigs or foxes; in other samples, DNA from prey such as rabbits, mice, and reindeers dominated the isolates. The 211 samples yielded DNA profiles of 68 wolverines, and the report concluded that DNA analysis was a robust method and a reliable supplement to other techniques of monitoring large carnivores (Flagstad and Brøseth 2002, p.4).

A two-year study by the Norwegian Institute for Nature Research that started in 2007 initiated thorough employment of DNA analysis in the monitoring of wolves (Flagstad et al. 2009). The molecular biologists based their methods for this project on the DNA analyses of wolverines that had been conducted a few years earlier, with the exception that they retrieved the 17 loci used to genotype the wolves from a genome project on dogs. The biologists collected 201 scat samples between October 2007 and November 2009, of which 141 yielded DNA profiles of individual wolves (Flagstad et al. 2009, p.7). By employing DNA profiles, the biologists were able to identify and trace the movements of individual wolves, and were therefore also able to produce more accurate population estimates. The information on wolves in an Osdalen territory that the molecular biologists helped to produce illustrates how genetic techniques transformed wolf monitoring (Figure 7). The analyses of scat samples showed that a female wolf that they had labeled "V211" had remained in the territory since the previous winter, but that the male wolf that had disappeared in October 2007 had been replaced by a new male wolf. They first identified this new male ("V246") in Osdalen in December 2007, and the molecular biologists determined that it had most likely been born in Amungen, Sweden. Furthermore, DNA analyses showed that the female wolf gave birth to at least five puppies the following year, something that would have been very hard to determine by counting tracks or relying on random observations.[28] DNA profiles also enabled the biologists to trace the movements of individual wolves. For example, the scientists traced "V259," a wolf that they had identified

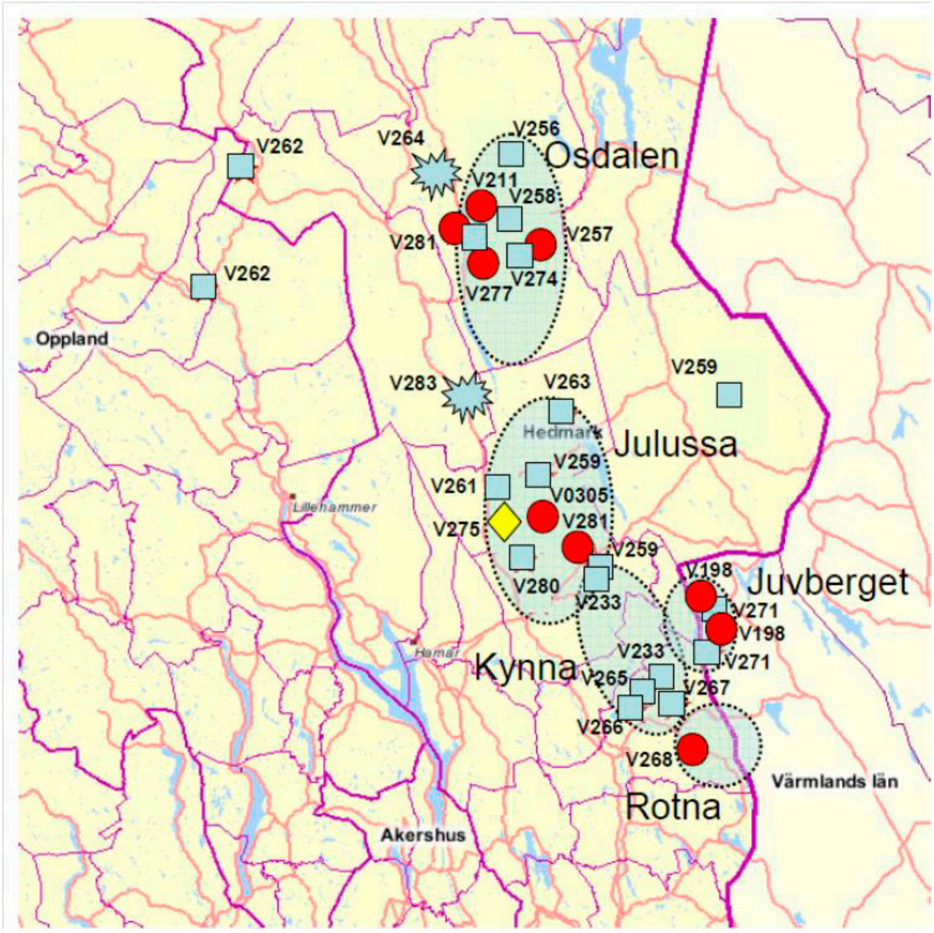

Fig. 7 Wolves identified by DNA analyses of material collected during winter 2008/2009. Blue squares indicate male wolves, red circles indicate female wolves, and the yellow diamond indicates an unidentified sex. The blue areas indicate wolf territories, and the star-like symbols represent killed wolves (Flagstad et al. 2009, p.10). © Reproduced by permission of the Norwegian Institute for Nature Research

[28] Flagstad et al. 2009, p.8. For problems concerning counting wolves in groups by snow tracking, see Liberg et al. 2012, pp.31–32.

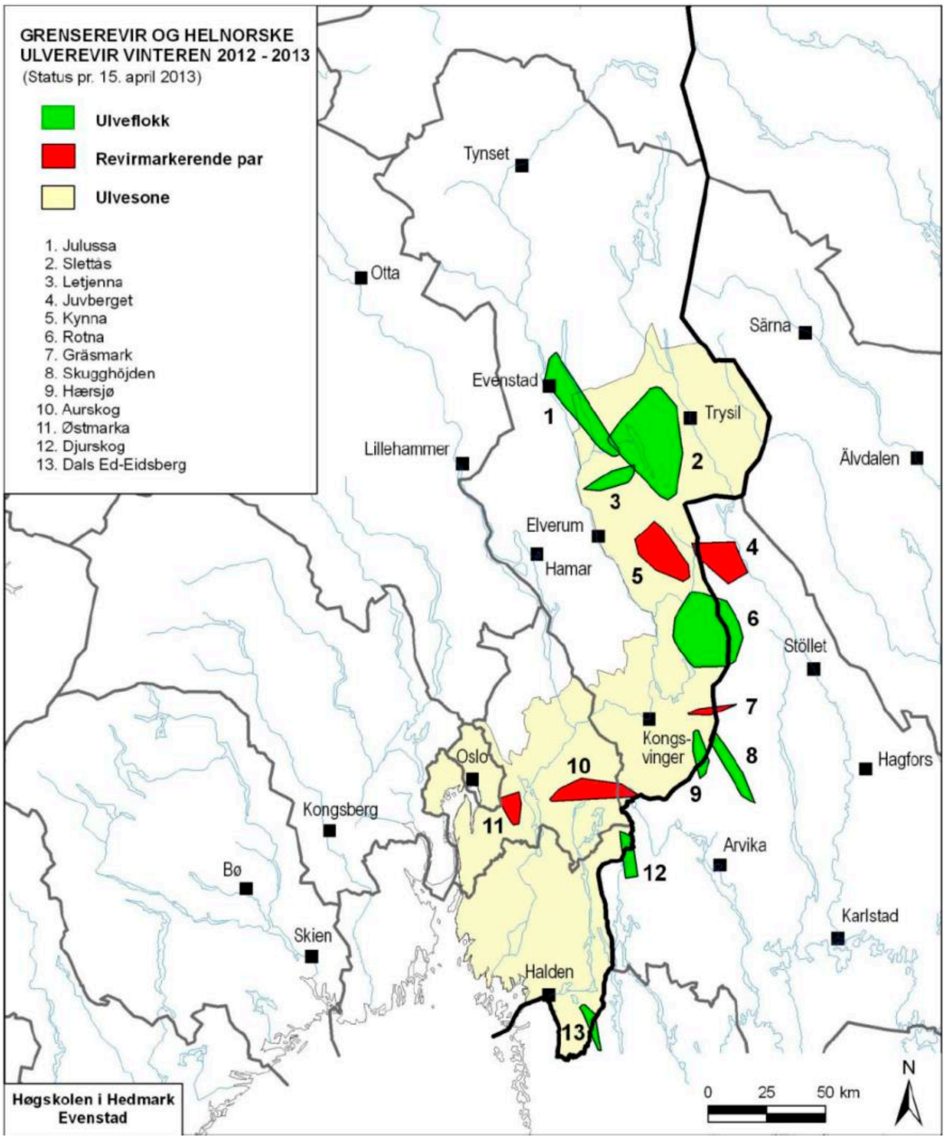

Fig. 8 Wolf territories in Norway in the winter of 2012/2013, according to a preliminary report. Green areas represent areas of residence for packs of wolves in which cubs were born in 2012, while red areas represent pairs of wolves marking territory. The yellow area indicates the current "wolf zone," while the thick black line indicates the border between Norway and Sweden (Wabakken et al. 2013a, p.4). © Reproduced by permission of Hedmark University College

as an immigrant from a Fenno-Russian wolf population, from its emergence in Norway to its subsequent residence as alpha-male in the Julussa territory. By collecting and analyzing scat samples, the molecular biologists were able to trace the wolf "from [when] he was observed for the first time in Trysil November 2008, via a fight at the border between the territories of Kynna and Julussa in the beginning of January … until he was identified by five samples at the core of the [Julussa] territory together with the alpha-female at the end of January" (Flagstad et al. 2009, p.9).

The biologists' incorporation of genetic techniques into wolf monitoring coincided with a new and much more detailed approach by politicians and bureaucrats to regulate wolves. A 2001 white paper from the Ministry of Environment concerning the government's environmental policy established an area in southeast Norway in which wolves were to be prioritized over grazing livestock.[29] In 2004, Stortinget reduced the area of the so-called "wolf-zone," while simultaneously setting a population goal of three new litters of cubs each year within the zone (Innst. S. nr. 174 2003–2004, pp.17–18). That is, the goal was that exactly three pairs of wolves, which resided exclusively on the Norwegian side of the Swedish border and occupied a territory of which more than 50 percent was situated within the zone, would produce litters each year (Forskrift om forvaltning av rovvilt 2005). Stortinget still maintain these regulations, which require the responsible biologists to monitor the number and movement of wolves intensively and highly accurately, in order to enable DN to execute them. In other words, biologists have been put in charge of making wolves highly amenable to government (Miller and Rose 1998). A preliminary report on the status of wolves in winter 2012/13 illustrates the monitoring accuracy that these regulations require (Wabakken et al. 2013a). The biologists identified 13 wolf territories within the zone, of which cubs were born in eight (Figure 8). In five of these territories (6, 8, 9, 12, and 13), some of the wolves had spent time in Sweden, which meant that they did not count in the population goal. Two of the territories with cubs (2 and 3) were situated exclusively within the zone, but the wolves occupying the final territory (1) had partly resided outside the zone. In order to determine whether this group of wolves was compatible with official regulations, the biologists had to determine exactly how much of the area the wolves had ever visited

[29] St. meld. nr. 24 2000–2001, pp.37–42. Geographically differentiated management of wolves has been a major controversial issue since protection was established in 1971. See, for example, NOU 1977, pp. 45–47; Vaag et al. 1986, pp.138–141; St. meld. nr. 35 1996–1997 p.75.

was situated within the border of the zone. In the preliminary report, the biologists estimated that 51 percent of the area occupied by the group of wolves was situated within the zone, and so it seemed that the population goal had been achieved in that year.[30]

The incorporation of genetic techniques into the counting complex that wildlife biologists developed in the 1980s led to some decisive transformations. By gathering genetic material from the wolves instead of unreliable observations from the public, but still depending on much the same infrastructure as in the counting complex, the biologists in large part overcame the problems of human mediation and thus became able to produce much more accurate population estimates. By developing a new form of field study, in which they mobilized the relevant parts of the field through the counting complex infrastructure, they became able to monitor wolves throughout Norway, from a distance (Miller and Rose 2008). The biologists developed this form of field study in response to national and international regulatory requirements that determined the whole of Norway as their field of study. However, by bringing in wolves from a distance to their laboratory and, further, to their maps and statistics, the biologists also attempted to bring wolves back to Norway. The controversy over wolves had shifted from a concern over the economic losses of livestock owners in the 1980s to a concern over the attitudes of a much larger public in the 2000s. Perhaps one response to this was the attempt to transform wolves into creatures that were more amenable to government and enable detailed regulation, through continual and intense monitoring of their number and movement. However, it is also possible to discern a new turn in the efforts to count and monitor wolves in this period, associated with the Convention on Biological Diversity and institutionalized by the national program for monitoring large carnivores. In the intensification and methodological success of monitoring, the objectives to monitor continually and enable detailed regulation sometimes seems to take on the role as ends in themselves; from employing counting as a tool to influence politics or to solve specific conflicts, the current effort to count wolves has been designed as a system of permanent monitoring.

[30] Wabakken et al. 2013a, p.2. A final report concerning the status of wolves in winter 2012/2013 was published later in 2013 (Wabakken et al. 2013b).

Conclusion

The history of counting and monitoring wolves in Norway illuminates how national protection of species and international conventions are transforming the places in which biologists attempt to conduct field studies, and, simultaneously, how the very extensiveness of these places is transforming the way in which they are conducted. These developments have prompted field studies of a new sort; rather than studies in the field in which the aim is to get close to the objects of study, these studies resemble accounting practices conducted by nation–states in order to render objects amenable to government (Miller and Rose 2008). Clearly, if researchers are to monitor the biological diversity of entire nations, *in situ* field studies must be complemented by techniques of mobilization that allow biologists to monitor their objects of study from a distance. In the case of monitoring wolves in Norway, the biologists constructed a counting complex to allow them to do so.

Thus, the effort by the individual biologist Myrberget to count wolves by newspaper notes 50 years ago developed into an extensive complex of people and infrastructures that continually monitor the number and movement of wolves in the forests and mountains of Norway. Throughout the period, the main motive for biologists to count wolves has been to make wolves amenable to government, in order to ensure their protection in practice. Hence, biologists constructed the infrastructure of the counting complex not only to bring wolves into their statistics and maps, but also to bring wolves back to Norway. In the latest period, however, efforts to count wolves intensified, as they became incorporated into a new conservational regime that was set in motion, in particular, by the Convention on Biological Diversity, which aims to monitor wildlife and other species continually for precautionary purposes.

Methodologically, the biologists overcame the problem of keeping account of the number of wolves throughout Norway by bringing leftover genetic material from the distance into their laboratories. Genetic techniques allowed the biologists to modify the entities travelling through the counting complex; rather than mobilizing observations made by the public, which turned out to be highly unreliable, the biologists could now conduct their own observations in the laboratory by mobilizing material from various parts of the country. By bringing in scat samples from a distance, by way of the extensive infrastructure of the counting complex, the biologists could conduct the nationwide field studies required of them – *in absentia*.

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How many wolves does it take to protect the population? Minimum viable population size as a technology of government in endangered species management (Norway, 1970s–2000s)[1]

Abstract:

The article investigates how the protection of wolves in Norway has been conducted in practice since the legal protection of wolves was enacted in the early 1970s, by tracing how political decisions to regulate the number of wolves Norway should protect have been determined. The scientific concept of a 'minimum viable population size' (MVP size), which the article construes as a technology of government, has been a central instrument in these processes. The article examines how biologists, nature managers, bureaucrats, politicians and others have attempted to define and employ MVP size through the period, and how many of the political negotiations concerning Norwegian wolf numbers have played out as controversies over what constitutes a viable population. The major issues have concerned how a viable population should be theoretically defined, how many wolves this would mean in practice, and whether a viable population could be shared with other countries. The article identifies two decisive moments of transition in the way MVP size has been employed in the protection of wolves in Norway, in which the authority to define its content was transferred first from biologists to nature managers, and later to politicians. These shifts involved major transitions in the practice of determining MVP size and in the number of wolves considered necessary for protecting a viable population. In a larger perspective, the article argues that environmental historians have much to gain from delving deeper into the practices and technologies of government, in terms of the histories of endangered species management and nature management, more generally.

[1] Stokland, Håkon B. (forthcoming). Accepted for publication in *Environment and History*. This is the author's current version of the work, as accepted for publication following peer review. The final version may not be identical, due to potential minor revsions.

Introduction

Since the legal protection of wolves in Norway was enacted in the early 1970s, there has been much controversy over the population size of wolves and which number of this protected species that should be allowed to live within our borders. The political goals of protecting a viable population of wolves and continuing the practice of largely unattended livestock grazing in remote areas[2] have proven controversial. Additionally, social and cultural dimensions have intensified the controversy.[3] These developments have led biologists, nature managers, bureaucrats, politicians, NGOs, and others to ask: How many wolves are required to protect the population? This number has been produced as a population goal, and is currently set as three new litters of cubs each year. The Norwegian government has argued that this population goal is sufficient for protecting a viable population of wolves. The article traces the historical development of this number – how it was produced and negotiated, and who took part in these activities – and examines the central role of the concept of 'minimum viable population size' (MVP size) in this development.

Kristin Asdal argued in 2003 that environmental historians could benefit from taking what she called 'post-constructivism' into account, in order to avoid basing histories on dichotomies such as nature–culture and science–politics, and to become aware of the role of science in the construction of various 'natures'. Rather than seeking nature through sciences such as ecology, as Worster argued, Asdal argued that we should pursue a more radical historicity in which the scientific construction of nature is part of its history, rather than its truth-base. In her argument, Asdal drew on Latour and Haraway, in particular, but also referred to the constructivist methodology of the larger field of science and technology studies (STS).[4] Therefore, one aspect of what Asdal termed 'the post-constructivist challenge to environmental history' is, as Latour put it, to 'open the black box of science'.[5] The 'black box' refers to the reduction of complicated mechanisms in cybernetics or genetics to a black box, by focusing only on its input and output. In Latour's approach to studies of science, the black box designates how the complex process and context of the creation of scientific knowledge is often forgotten or neglected, once the knowledge has been accepted as true.

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[2] Forskrifter om forvaltning av bjørn, jerv og ulv 1983, § 1; St. meld. nr. 27 1991-1992, pp. 33–34; St. meld. nr. 35 1996-1997, p. 59; St. meld. Nr. 15 2003-2004, pp. 7–9.
[3] Skogen and Krange 2003; Krange and Skogen 2011; Figari and Skogen 2011.
[4] Asdal 2003.
[5] Latour 1987.

Nevertheless, the process and context often have a decisive impact on how we later understand and treat the object of knowledge. Scholars of science – and indeed environmental historians, one might add – should therefore attempt to open the black boxes of nature to understand how the scientific construction of knowledge about nature is part of the history of this nature. Since 2003, the number of environmental history publications that have engaged in STS literature have increased; one example is the recently edited volume, *New Natures – Joining Environmental History with Science and Technology Studies*.[6]

In a similar line of argument, but with greater emphasis on politics, Sörlin and Warde argued that environmental history could make great gains by considering 'the roles of *knowledge* and *science* in relation to environmental politics'[7], and how science-based environmental policy has recently shaped (or even created) nature. They drew on Asdal's studies of Norwegian environmental politics and her emphasis on 'technologies of government'. The concept of 'technologies of government' was developed by Peter Miller and Nikolas Rose, in their investigations of how government is conducted in practice. Partly inspired by STS, Miller and Rose argued that studies of government should focus on the actual mechanisms, or 'technologies', that enable government in practice. These often include 'apparently humble and mundane mechanisms' such as techniques of notation, computation, calculation, and assessment.[8] In short, how various objects are made amenable to government. Similar to what STS scholars have argued in relation to science, the work behind such aspects of government tend to be forgotten or left out of both public debates and historical narratives concerning the politics of, for example, nature. We could perhaps speak of a black box of government, as well, that environmental historians should be more aware of and attempt to open in their studies.

The history of endangered species literature illustrates this. In relation to nature reserves, Sörlin argued that 'research on preservation and on natural and national parks is among the few areas in the history of science that have been almost untouched by the rolling wave of STS work crashing on our shores since the late 1980s', and one could be tempted to add endangered species to this list. Much of the historical literature has focused on the

[6] See also the introductory chapter of the volume for a discussion of the degree to which STS has influenced environmental history, and vice versa (Pritchard 2013).
[7] Sörlin and Warde 2007, p. 124.
[8] Miller and Rose 2008, p. 32. See also Rose 1989; Porter 1995; Barry 2001; Dean 2010.

protective status of endangered species – including if and how this status was achieved. For example, who was responsible for discovering and providing knowledge about endangered species[9], ideas of conservation[10], and controversies and battles to protect particular species or establish particular regulations[11]. Similarly, the historical literature about wolves typically focuses on eradication measures[12] and subsequent transformations in attitudes towards wolves[13]. There are certainly exceptions to this very brief and rough outline of wolf and endangered species literature, and the literature cited here can, of course, not be reduced to the labels I give it.[14] I will argue, however, that the general trend in these two fields of literature has been to employ science as a truth-base or to avoid scientific knowledge, altogether. In other words, the trend has been to leave the black box of science unopened. Another general trend in these fields has been a preoccupation with the general political status of endangered species, including eradication plans and legal protection. This is not surprising, and as it should be. However, I will argue that we should also investigate what happens beyond the political realm as it is commonly perceived – how political decisions and ideologies are put into practice by various means. It is particularly important to employ this approach when studying the aftermath of public or legal protection, considering the massive and complex problems that have been encountered by biologists, nature managers, bureaucrats, and others when attempting to conduct protection in practice. By opening the black box of government, environmental historians can contribute to a more comprehensive understanding of how various actors have sought to accomplish the protection of endangered species in practice, often through complex scientific-bureaucratic technologies of government intended to render the objects of protection amenable to intervention. We should not overlook this part of the history of endangered species, as it is often through such obscure and technical arrangements that the very concrete politics of endangered species is determined.

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[9] Barrow 2009a, 2009b.
[10] Farnham 2007; Takacs 1996.
[11] Cioc 2009; Petersen 2002; Holdgate 1999. See also a forum on wildlife in America in *Environmental History*, volume 16, number 3 (Alagona 2011).
[12] Robinson 2005; Walker 2005; Coleman 2004.
[13] Jones 2010; Worster 1994, pp. 258–291; Dunlap 1988.
[14] Some examples are Alagona 2004, 2013; Bocking 2000; Lowe 2006. These researchers have focused more on the practice of protection.

In this article I will illustrate how crucial technologies of government can be for the practice of protecting endangered species, by examining the protection of wolves in Norway since legal protection was enacted in the early 1970s. I will focus on the decisive question of how many wolves Norway should protect – a controversial question that has occupied many since protection was put in place. The scientific concept of a 'minimum viable population' (MVP) size, originally from the field of conservation biology, has been a central technology of government employed to deal with this problem. The concept was developed in the early 1980s as an approach to estimating the smallest number of individuals required for an isolated population to persist.[15] Small and isolated populations are, for many reasons, more vulnerable to extinction, and the MVP size approach has mainly consisted of mathematical estimates of future population numbers based on variables such as birth rates, density dependence, catastrophe stochasticity, inbreeding depression, and so forth. It has been extensively used in species recovery and conservation management programs, but has also remained controversial among biologists, due to concerns over its accuracy and applicability.[16] This article examines the ways in which biologists strived to make use of MVP size as a technology of government in wolf management, and how other actors, such as NGOs, international conventions, bureaucrats, legal researchers, and politicians, eventually joined them in attempting to define how many wolves a 'viable' population would constitute. As such, the article represents an investigation of the function, weaknesses, and unintended consequences of MVP size as a technology of government.

I identify two decisive moments of transition in the employment of the governmental technology of MVP size in the practice of protecting wolves in Norway. I describe these moments of transition as 'translations', inspired by actor-network theory (ANT) from STS. In ANT, 'translation' describes the various processes of transformation in the power-relations of actor-networks, denoted problematisation, interessement, enrolment, and mobilisation.[17] In this article, I will employ the concept in a narrower and simpler sense, to denote how technologies of government often transform when put to practical use in management or politics. In the case of MVP size, I argue that the two translations noted here involved alterations in both the content of the technology of government and the persons who

[15] Shaffer 1981.
[16] Traill, Bradshaw, and Brook 2007.
[17] Callon 1986.

defined this content: the power of definition was first transferred from biologists to nature managers, and secondly from nature managers to politicians. These shifts involved major transitions in the practice of determining MVP size, and in the number of wolves considered necessary for protecting a viable population.

The article construes these translations as intrinsic to the process in which MVP size became what could be called an 'obligatory passage point' in the negotiations concerning wolf numbers.[18] After regulations established that Norway should protect a 'viable' population of wolves, all arguments concerning population size had to relate to viability in order to be considered valid. This prompted stakeholders, NGOs, bureaucrats, legal professionals, and politicians, in addition to biologists and nature managers, to attempt to define what would constitute a viable population of wolves. As a consequence, a large proportion of the political negotiations concerning the number of wolves Norway should protect played out as a controversy over this definition. The three major issues in this controversy were: How should a viable population be theoretically defined? How many wolves would that mean in practice? and Could this viable population be shared with other countries?

Methodologically, the article investigates how political documents such as management plans, white papers, and regulations have established the number of wolves Norway should protect. The decisions have often been based on studies or reports by biologists, nature managers, and others, and the article examines how the question has been understood and treated by these, as well. The major political documents of Norwegian wolf management have included a proposition to a national plan as well as a national plan in the 1980s, two white papers in the 1990s, a third white paper and two parliamentary conciliations in the new millennium, and the legal protection from 1971, as well as subsequent alterations of these regulations.

[18] 'Obligatory passage point' is another concept from ANT that I employ in this article to denote governmental technologies that have achieved a position in which statements and actions must relate to them in order to be considered valid (Callon 1986).

Historical background

After varying highly in numbers since at least the sixteenth century – most historical accounts identify three periods of high numbers interrupted by periods of low numbers[19] – the population of wolves in Norway significantly decreased in the second half of the nineteenth century and into the twentieth century.[20] The latest decrease in numbers, which coincided with the government's establishment of public bounties and other measures to eradicate wolves (such as the publication of a book on methods for killing wolves[21]) from the 1840s, lasted until wolves were protected by law in 1971. This decrease made it possible for livestock owners to reduce their level of attendance at summertime grazing in outlying fields and remote areas, and the practice of continual herding was abandoned in the twentieth century.[22] Efforts to eradicate wolves in Norway were part of an international trend of utilitarian conservation in game management, which prevailed in much of the Western world in the nineteenth century and into the twentieth century.[23] This rational approach, which had roots in eighteenth century scientific agriculture and forestry, prescribed that eradicating large predators would maximise game populations and reduce livestock losses.[24] A few of the most influential Norwegian foresters of the nineteenth century had been educated at the influential German school of scientific forestry at Tharand.[25] The efforts to eradicate carnivores peaked in the first decade of the twentieth century, when the government supported a 'war' on carnivores conducted by the Norwegian Association of Hunters and Anglers.[26]

In 1914, the internationally renowned explorer and scientist Fridtjof Nansen argued that Norway would benefit from a more systematic and scientific approach to game

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[19] Myrberget 1969a, pp. 3–9; Johnsen and Myrberget 1969, pp. 197–198; Vaag et al. 1986, p. 119; Drabløs 2003, pp. 135–140; Collett 1912; Johnsen 1928.

[20] Myrberget 1969a, pp. 3–9. See also Collett 1912; Helland 1914; Aaseth 1935; Olstad 1945; Johnsen 1957. These crude accounts of the changes in wolf numbers were made in general books on the status of wild animals or carnivores in Norway, and were based on the number of granted wolf bounties.

[21] Asbjørnsen 1840.

[22] St. meld. Nr. 35 1996-1997, pp. 54–55. See also Drabløs 2003.

[23] Walker 2005; Robinson 2005; Coleman 2004; Lopez 1978; Jones 2002.

[24] Worster 1994, p. 256; Scott 1998, p. 11; Dunlap 1988, p. 48.

[25] Berntsen 2011, p. 32.

[26] The association waged war by various means, including importing traps from Germany and supporting the education and costs of a teacher travelling throughout Norway to teach methods of trapping and killing carnivores (Søilen 1995, p. 95).

management.[27] Statens viltundersøkelser [the Government's Game Research], which would later become part of the Directorate for Nature Management (DN)[28] was established in 1936 for this purpose.[29] A move away from utilitarian conservation and towards a more ecologically-based conservation ideology, in line with international trends, occurred in the decades following World War II.[30] Yngvar Hagen, the leader of Statens viltundersøkelser from 1955 to 1977, criticised the eradication campaigns in an extensive book called *Rovfuglene og viltpleien* [Raptors and Game Management]. The book (first published in 1952) is currently considered a classic in Norwegian nature management, and Hagen has been credited as one of the most important characters in the move towards a more ecological management and public understanding of nature.[31] According to Hagen, the complexity of ecological mechanisms has often meant that eradication measures have not led to the anticipated increases in game populations.[32] This line of reasoning implies that the eradication campaigns had been responsible for killing a great number of carnivores in vain. While Hagen mostly concerned himself with raptors, other wildlife biologists would soon draw similar arguments for the protection of wolves.

The wolf population kept decreasing further into the twentieth century, and, by the 1960s, wildlife biologists assumed that the population was almost extinct.[33] In an effort to save the very few wolves remaining, the wolves were protected by law in 1971, after wildlife biologists called for their legal protection in a report on the status of wolves in the Nordic countries.[34] Due to immigrant wolves from Finland and Russia, the numbers started to rise again – mostly from the 1990s. Today, there are about 30 wolves in Norway, 300 in Sweden,

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[27] Hagen 1952, p. 17.
[28] The Directorate for Nature Management changed title several times during the period covered by this article. It was founded in 1964 as the Directorate for Hunting, Game Management and Freshwater Fishing, and was renamed in 1974 to the Directorate for Game and Freshwater Fish, as it was transferred from the Ministry of Agriculture to the Ministry of the Environment. In 1985, the name changed to the Directorate for Nature Management, and, in 1988, the research section was separated out as NINA (the Norwegian Institute for Nature Research). In July 2013, the name was changed to the Norwegian Environment Agency, as it merged with the Norwegian Climate and Pollution Agency. To facilitate the readers, however, I refer to the institution as simply 'DN,' or 'the Directorate for Nature Management,' throughout the article.
[29] Skavhaug 2005, p. 69.
[30] Berntsen 2011; Worster 1994.
[31] Mysterud 2001.
[32] Hagen 1952, pp. 558–598.
[33] Myrberget 1969a, 1969b.
[34] Stokland 2014.

and 50 residing on both sides of the border.[35] In this regard, the protection of wolves in Scandinavia has been successful, at least to some degree. However, as in many other places where wolves have returned or been reintroduced, this has led to controversy. There have been conflicts with the livestock owners of sheep and reindeer, as well as with hunters, and also social conflicts relating to social transformation processes and cultural and economical power-relations.[36] A recurring issue specific to Norway has been the extensive number of sheep grazing largely unattended in remote areas – a tradition that originated in the period after most of the large predators had been decimated. Livestock owners release about two million sheep to graze in the mountains and hills of Norway each summer, and this, of course, is not easily combinable with a protected population of wolves.[37]

Practical problems of protection

The regulatory text from the legal protection in 1971 granted wolves strict protection. At the time, nature managers and bureaucrats debated – to some degree – whether the protection should be 'total', or whether a potential growth of the population should be restricted. Although they agreed that the population should not be allowed to grow uncontrollably, they did not deem it necessary to incorporate any restrictions into the regulations at the time, as biologists considered the population to be almost extinct.[38] However, bears and wolverines were also granted legal protection in the early 1970s, and the challenges of managing the rising numbers of these large carnivores became gradually clearer for nature managers at DN as the animals became the objects of growing controversy and compensational demands from livestock owners.[39] In order to deal with these problems, the Storting [the Norwegian Parliament] loosened the regulations for bears and wolverines in 1979, stating that DN could grant permission to cull animals if they caused serious damage.[40]

[35] Wabakken et al. 2013.
[36] Skogen and Krange 2003; Krange and Skogen 2011; Figari and Skogen 2011.
[37] St. meld. nr. 15 2003-2004, p. 46.
[38] DN archive: I. e. Vern av de store rovdyr [Protection of large carnivores]. Utkast til kongelig resolusjon, statsrådsak nr. 4.5.73, p. 6; Fredning av ulv, bjørn og jerv [Protection of wolves, bears, and wolverines]. 30.8.71. 3329/71 – 761.545. Both in archival box: 761.545. Fredning av ulv, bjørn, jerv, gaupe 1966-75 [Protection of wolf, bear, wolverine, and lynx 1966-75].
[39] Sørensen and Kvam 1984, pp. 15–17.
[40] The protection regulations for bears and wolverines were loosened in 1979, while those for wolves were loosened in 1983 (Vaag et al. 1986, pp. 20–21).

This led to a practice in which nature managers granted applications for hunts on an ad-hoc basis without always having a good overview of the populations.[41] In order to improve management practices, DN initiated the first large-scale research project on large carnivores in Norway, which was conducted between 1980 and 1984.[42] Additionally, arguing for a more systematic management of large carnivores, which was thought to aid both the protection of large carnivores and the continuation of grazing livestock by establishing clearer objectives, DN proposed (in 1981) that a national plan be composed.[43] The construction of national plans for the protection of wild flora and fauna was also in accordance with the Bern Convention, which Norway had signed in 1979 but had not yet ratified.

As the wolf population started to grow slightly in the 1980s, and a single wolf became the centre of a nation-wide controversy after killing a number of grazing sheep in 1982/1983, the regulation of wolves – often referred to as 'total protection' – was also loosened by the Storting in order to allow a hunt for this wolf.[44] The concept of a viable population of wolves was used for the first time in the Norwegian regulation of wolves in the legal text granting this loosening, which also replaced the former regulations on bears and wolverines: 'The purpose of these regulations is to keep the damages on livestock at an acceptable level while simultaneously securing viable populations of bear, wolverine and wolf in Norway.'[45] At this time, wildlife biologists assumed that there were fewer than 15 wolves in Norway[46], and the new regulations raised the question of how many wolves Norway should protect, and, more specifically, how many wolves would constitute a viable population. How should one determine, in practice, whether culling a wolf would be incompatible with the objective of protecting a viable population? The question was raised in the context of practical management problems in relation to a particular wolf, and the nature managers sought a

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[41] Direktoratet for naturforvaltning 1987, p. 11.
[42] Stokland 2014.
[43] DN archive: Forslag til elementer i en landsplan for forvaltning av bjørn og jerv [Propositions to elements in a national plan for management of bear and wolverine]. Internt notat [Internal note]. 18.09.81-JS/mb, pp. 1–2. Folder: Forvaltningen av de store rovdyr [Management of the large carnivores]. 1981. Archival box: Forvaltning av store rovdyr 1980-1981 [Management of large carnivores 1980-1981]. 461.545. At first the plan was to address only bears and wolverines, as these species had increased most in number and caused the most conflict at the time. However, when wolves appeared in two different locations by 1982 and sparked a nation-wide controversy, they were also included in the subsequent proposals for a national plan concerning large carnivores. See also Vaag et al. 1986, p. 15.
[44] Vaag et al. 1986, p. 21.
[45] Forskrifter om forvaltning av bjørn, jerv og ulv 1983, § 1. Author´s translation – this applies to all citations of Norwegian documents in the article.
[46] Sørensen and Kvam 1984, p. 59.

fairly quick answer. The license for hunting this wolf was issued by DN only three weeks after the new regulations were approved by the Storting.[47] However, the new regulations also initiated controversy over what would constitute a viable population – a question that is still intensely debated to this day. Permitting wolf culls while simultaneously maintaining the protection of a viable population, the regulations begged for a definition and measure of viability in order to facilitate the practical decisions concerning wolf numbers. In other words, it was very difficult for nature managers to enforce the new regulations without a well-functioning instrument that could determine when the viability of the population was secure. It is not clear from the archival material whether use of the term 'viable' in the regulations was related to the two prior years' presentation of MVP size within the field of conservation biology. This is plausible, however, as the term had not been employed in previous regulations and is not a commonly used term in Norwegian. The answer that biologists and (later) others attempted to provide to the question of viability was, in any case, the governmental technology of MVP size. However, as we will see in the next section, it was not easy to put it into practical use.

The regulatory framework of the Bern Convention on the Conservation of European Wildlife and Natural Habitats also prompted biologists and others to search for a measure of viability. In 1986, Norway ratified the convention, which had been open for signature since 1979. It required participating nations to protect the listed species, including wolves, but also allowed for exceptions for various reasons according to Article 9, 'provided that there is no other satisfactory solution and that the exception will not be detrimental to the survival of the population concerned'[48]. The Storting treatment of the ratification of the convention, conducted by the Committee for Foreign and Constitutional Affairs, emphasised the extensive use of unattended grazing in Norway and stated that this could cause problems for the protection of large carnivores such as wolves, wolverines, and bears. It also stated – by reference to Article 9 in the convention – that DN could be assigned the tasks of monitoring populations and estimating the level and vitality necessary for their survival, as well as regulating the size of the populations if they were to become so numerous that they would

[47] DN archive: Pressemelding [Press release]. 25.02.1983. Folder: Ulv som gjør skade [Wolf that causes damage]. ¼ 1982-1983. Archival box: 462.444. Felling av ulv som gjør skade [Culling of wolf that causes damage]. ¼ 1982-1990.

[48] Council of Europe 1979, Article 9.

inflict serious damage on livestock.[49] The Bern Convention, therefore, in addition to the legal regulations specific to Norway, prompted biologists and others to search for a measure of what would and would not be detrimental to the survival of the wolf population.

Searching for a scientific measure of viability

In the first years after the regulations were loosened, the task of defining a viable population of wolves was given to wildlife biologists. This is perhaps not surprising, as the concept of a viable population had originated from the field of conservation biology and involved calculations of population dynamics. The biologists' first attempt was made with reference to the regulations' stated intention to protect a viable population. In a 1986 report on the status of large carnivores in Norway, which was the final report of the first large-scale research project on large carnivores in Norway, they classified the population by employing this definition:

> A 'viable' Norwegian population is a population with a minimum number of 15-50 animals. Verification that at least 3 female wolves capable of reproduction are accompanying male wolves is required for this category, as well as verification that reproduction occurs at a regular basis. The habitats of the population should to a very large degree be restricted to Norway, and the area of critical habitat and pray animals should be large enough to carry the size of the population (5000-25000 km²).[50]

When proposing this definition, the wildlife biologists stated that no specific calculations of minimum viable population size based on the reproductive biology of wolves had been published. Therefore, they based their definition on David Mech and Rolf Peterson's studies of wolves on Isle Royal in Lake Superior. Mech and Peterson had established that a group of about 25 animals (up to 50 for a short period) had survived in packs of one to five animals for 35 years. Based on this, the American biologists had presumed that a viable population of wolves could consist of three to five pairs that reproduced on a yearly or semi-yearly basis, assuming that hunting and other human-induced causes of death were kept under control. Given an average litter size of six cubs, a 50 per cent death rate in the first year, and two to four older wolves in each pack, the population was determined to vary between 15

[49] Innst. S. nr. 92 (1985-1986), p. 2.
[50] Sørensen et al. 1986, p. 35.

and 50 animals. According to the biologists, the viability of such a population would precondition immigrations from a larger population on a regular basis. This definition of MVP size was related to the international community of wildlife biologists – not only through the employment of Mech and Peterson's study, but also through viability discussions at an IUCN wolf specialist group's meeting in Edmonton, Canada.

In agreement with the Ministry of the Environment (ME) and the Ministry of Agriculture (MA) in 1983, DN assigned a small working-group that consisted of one representative from each institution. These representatives were to provide a proposition for a national plan concerning the management of bears, wolverines, and wolves.[51] The proposition, which was made public in 1986, drew heavily on the first large-scale research project on large carnivores in Norway. In their proposition, the nature managers from DN and the two bureaucrats repeated the biologists' evaluations of a viable wolf population, and, based on these evaluations, proposed that a viable Norwegian wolf population should consist of three to five family groups of wolves within the country's borders.[52]

When DN published the national plan for the management of bears, wolverines, and wolves in 1987, it was in large part based on the proposition of the small working-group. However, they ordered an additional study concerning the dynamics of small populations. This was a theoretical study conducted by biologists at the University of Oslo, which specifically addressed the dynamics of the populations of bears, wolverines, and wolves in Norway at that time.[53] The main purpose of the study was to produce a tool that nature managers and others could use to predict the probabilities of different future population sizes – that is, a technology that could aid DN in answering the question of what would constitute a viable population of wolves. This might indicate that DN was not satisfied with the working-group's definitions, or that they followed up on the lack of specific calculations addressed by the group. The tool would base its estimates of viability on the probability of future population increase or decrease, rather than on numbers of animals alone. The study argued that it was very hard to translate rates of reproduction and survival into factors of population dynamics such as population increases or decreases, and especially so in small populations.[54] They

[51] Vaag et al. 1986, pp. 15–17.
[52] Vaag et al. 1986, pp. 132–137.
[53] Stenseth and Steen 1987.
[54] Stenseth and Steen 1987, p. 5.

argued that stochastic modelling was necessary to predict probability for small populations, in order to incorporate the possibly larger effects of random events.[55] The two biologists working on the project created a software programme called PREDATOR, which could simulate the future development of 500 hypothetical populations based on the same original population. By doing this, it could produce pA, which represented the probability of a population decrease after a chosen number of years. For example, a result of pA = 0.65 would indicate that there was a 65 percent probability for a population decrease after *x* years.

In attempting to calculate the viability of the Norwegian wolf population, however, the biologists were confronted with the complexity of estimating population dynamics. The tool that was meant to aid nature managers in their practical decisions was completely dependent on the parameters used in the programme. The tool preconditioned accurate knowledge of parameters such as birth rates, death rates, litter sizes, and reproduction probability, including specific rates for each year in a wolf's life. Such rates varied between populations and habitats, and there was no exact knowledge of these rates for the recently returned Norwegian population of wolves. Instead, the biologists had to employ demographical parameters that were estimated on the basis of studies of wolves in North America.[56] Additionally, they could not find any studies containing data for the distribution of litter sizes, and therefore assumed that the probability of four cubs was 0.25; five cubs 0.5; and 6 cubs 0.25. The biologists also noted that they had not included parameters for density dependence, as theirs was mainly a study of small populations. Therefore, the simulations became less valid as the population numbers increased. The bigger issue at stake here, as they also pointed out in their study, was that the choice of parameters had a major impact on the probable future population sizes. The other major input the model required was current population sizes. The biologists emphasised that the validity of their results depended on the accuracy of these preconditioned estimates: 'If these are wrong, everything must be reconsidered.'[57] However, while the wildlife biologists had attempted to

[55] Stenseth and Steen 1987, p. 14.
[56] Stenseth and Steen 1987, p. 29.
[57] Stenseth and Steen 1987, p. 41.

provide such numbers for wolves, bears, and wolverines in their research project, they had encountered difficulties in achieving accurate estimates.[58]

Based on the assumed parameter values and population size, the programme estimated that the south-east population of wolves in Norway had a pA of 0.14, which designated that there was a 14 per cent probability of a decline in population within the following 20 years (without human intervention). In order to estimate the minimum viable population size of Norwegian wolves, however, the model was dependent on a limit that would designate the specific probability of a population decrease that would indicate the population was viable. The two biologists proposed that a population should be considered viable if the probability for a decline in numbers in the following 20 years was less than 5 per cent.[59] They emphasised, however, that these numbers had to be determined by politicians, rather than biologists. In other words, in their opinion, it was politicians, and not biologists, who should determine what constituted a viable population of wolves. This might indicate that the biologists felt uncomfortable being responsible for such a controversial decision, or – perhaps more likely – they considered it a political decision. The limit was, after all, intended to determine the number of wolves Norway should protect. It is clear from this that, although biologists had been given the authority to define viability and determine the number of wolves that Norway should protect, they were not fully inclined to accept the task as one that was purely scientific. In the end, the programme produced a seemingly accurate probability for a future decline in the wolf population that was contingent on several highly uncertain assumptions. This was, however, merely a first attempt to create a model for calculating such probability, in the hope that applicable parameter values, population sizes, and a limit for viability could be produced at a later point of time.

First translation: From biologists to nature managers

The national plan that was published by DN in 1987 restated that the main objective was to protect viable populations of bears, wolverines, and wolves.[60] The plan did not mention the wolves on Isle Royal, which had been used in the proposition in the working-groups' attempt

[58] Stokland 2014.
[59] Stenseth and Steen 1987, p. 9.
[60] Direktoratet for naturforvaltning 1987, p. 20.

to define viability. Rather, the final plan treated the viability of large carnivores as the more theoretical and specific concept of future population-size probabilities, through reference to the theoretical study of the dynamics of small populations.[61] It stated that the data required for the model was inadequately known at that time, but argued that a management plan should nevertheless include a concrete definition of what would constitute a viable population, in order to make the political decisions concerning viability measureable when compared to the development of the populations. DN did not agree, however, with the definition proposed by the biologists at the University of Oslo. As we have seen, they proposed that the probability for a decline in numbers during the following 20 years should be less than 5 per cent in order for a population to be defined as viable. Arguing for an adjustment of this definition based on the high level of conflicts caused by large carnivores and the proximity of other populations in Fennoscandia, DN proposed that a Norwegian population should be accepted as viable if the probability for a decline in numbers during the following 20 years was less than 15 per cent.[62] By altering the limit for viability, nature managers at DN took the first step in the translation of MVP size from the domain of biologists to that of nature managers.

ME followed the national plan with a white paper concerning the management of large carnivores to the Storting, in order to put it into political effect.[63] They based the white paper on the national plan, and repeated DN's definition of viability as a probability of less than 15 per cent for a population decline over the following 20 years.[64] ME also noted that the PREDATOR model had been constructed by theoretical biologists to translate this probability into a specific number of wolves, and hence to enable management decisions on a practical level. However, as the Ministry of Environment stated in their white paper, the data required of the model to calculate probable future population sizes did not exist. This data included, as we have seen, current population size, reproduction rates, death rates, habitat requirements, and more. The white paper, therefore, concluded that more research was needed.[65] What this also indicated, of course, was that, regardless of who defined the viability limit or what exact percentage they decided on, no one would know how to

[61] Direktoratet for naturforvaltning 1987, p. 22.
[62] Direktoratet for naturforvaltning 1987, p. 22.
[63] St. meld. nr. 27 1991-1992.
[64] St. meld. nr. 27 1991-1992, p. 35.
[65] St. meld. nr. 27 1991-1992, p. 35.

translate this percentage into a minimum number of wolves required to satisfy it. The question of how many wolves Norway should protect was, therefore, not brought significantly closer to conclusion.

While the 1992 white paper concluded that more research was needed in order to determine a minimum viable population, and as the wolf population and controversy started to grow in the early 1990s, the nature managers at DN sought to coordinate the management of large carnivores with Sweden. DN drafted a proposition to a common strategy document for management of wolves in 1993, which Naturvårdsverket, their Swedish counterpart, largely approved of.[66] This document represented a loose agreement between DN and Naturvårdsverket and was not sanctioned by the Storting or made legally binding.[67] One of the purposes of cooperation was to determine common population goals in order to reach common objectives and strategies to achieve them. Cooperation was also part of the implementation of Article 11 (1) in the Bern Convention. DN and Naturvårdsverket agreed with the biological studies and the white paper that the wolves in Scandinavia were critically threatened at the time, and that they should be given strict protection. They were, however, also confronted with an intensifying controversy over the slightly rising number of protected wolves. As a means to alleviate controversy – by giving those opposed to the protection some relief for the future – they sought to set a limit for the number of wolves needed to end the strict protection. It is also probable that the nature managers felt a need for a concrete measure, or a technology of government, to base their often controversial practical decisions on from case to case. They labeled the situation of critically threatened and strictly protected wolves 'phase one', and stated that they would initiate a 'phase two' when they considered the wolf population viable. The second phase would constitute a normalised situation, in which wolves would be regulated on par with other large carnivores (for example, through legally permitted license hunting). As the biological studies concerning viability had not been conclusive, however, the nature managers did not have any concrete numbers to employ in determining when phase one would end and phase two would begin. Therefore, they decided on a number of eight to ten family groups in Scandinavia as the limit between phase one and phase two. This number

[66] Direktoratet for naturforvaltning 1993.

[67] When DN and Naturvårdsverket established cooperation more formally in 1998, the goal of eight to ten family groups was taken out of the strategy plan (Direktoratet for naturforvaltning 1998).

was not based on any studies of viability, but on the general judgment of nature managers regarding the number of wolves that would be required to secure their survival.[68] The population goal of eight to ten family groups was not, therefore, intended to constitute an accurate limit for the viability of wolf populations. Rather, it was intended to be a technology for alleviating controversy and for lightening practical decisions, based on the knowledge available at the time.

In 1997, the Ministry of Environment published a second white paper concerning large carnivores, in order to adjust the regulations according to new scientific knowledge and regulatory experiences.[69] It stated that extensive research had been conducted both nationally and internationally over the previous five years, and that it was easier at that time to set criteria for the viability of the large carnivore populations.[70] The major development they referred to was the International Union for Conservation of Nature's (IUCN) new classification system for threatened species in 1994, developed for the Red Lists that IUCN produced partly in relation to the Convention on Biological Diversity (CBD) from 1992.[71] To improve the precision and objectivity of the categorisation of species according to vulnerability, and to counter the obstacles many countries had encountered in their efforts to protect threatened species due to vague and conflicted definitions of what should specifically be protected, IUCN had made quantitative criteria based on theory from modern conservation biology that applied to all species. IUCN had based their new definitions of viability on an accurately defined risk for extinction, regardless of species, observer, or geographical region.[72] The Ministry of Environment adopted these criteria, and the new evaluation criteria for the viability of Norwegian wolves became that they should not be classified as critically endangered, endangered, or vulnerable according to the following definitions (which they reproduced from IUCN in the white paper):

> A species is critically endangered if the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer.
>
> A species is endangered if the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer.

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68 Direktoratet for naturforvaltning 1993, p. 17.
69 St. meld. nr. 35 (1996-1997), p. 5.
70 St. meld. nr. 35 (1996-1997), p. 48.
71 See also Holdgate 1999 and Gustafsson and Lidskog 2013.
72 St. meld. nr. 35 (1996-1997), p. 49.

> A species is vulnerable if the probability of extinction in the wild is at least 10% within 100 years.

From this point on, therefore, Norwegian wolves were considered viable if they had a 'less than 10 % chance of extinction within 100 years'. With the IUCN definition, which has largely remained authoritative since the mid-1990s, questions concerning the definition of viability and the probability for population decline came to a temporary conclusion. The question of how many wolves Norway should protect, however, was far from settled: the problem of translating such general criteria to the minimum number of wolves required to ensure the viability of the Norwegian population, remained. And this was exactly what nature managers had called for in order to make management decisions on a very practical level.

Biologists created a Norwegian Red List based on the IUCN criteria in 1996, in which they classified wolves as critically endangered.[73] Based in part on this, ME stated that, at the time, Norwegian wolves were not viable.[74] They proposed that wolves be strictly protected in Norway until a population goal of eight to ten family groups in Scandinavia was achieved, and until the wolves had reproduced within the borders of Norway.[75] The population goal of eight to ten family groups was based on the 1993 agreement between DN and Naturvårdsverket, which had established this number as a goal. The majority of the Storting committee agreed to these propositions.[76] The bureaucrats at ME and the politicians at the Storting, therefore, composed the practical politics and regulations based on the general judgment of nature managers, rather than biological studies or IUCN's standard of viability, as the latter did not provide any concrete numbers to base regulations on. In this way, the authority of defining what would constitute a viable population of wolves, in practice, was effectively transferred from biologists to nature managers. It is not evident that the biologists struggled to keep this authority, or that nature managers struggled to get it. Rather, the first translation of MVP size as a technology of government seems to have been the consequence of two main factors: the unsuccessful efforts by biologists to provide an accurate MVP size for Scandinavian wolves and the practically experienced need of nature managers for a measure to base their management decisions on from case to case.

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[73] St. meld. nr. 35 (1996-1997), p. 50.
[74] St. meld. nr. 35 (1996-1997), p. 59.
[75] St. meld. nr. 35 (1996-1997), p. 61.
[76] Innst. S. nr. 301 (1996-1997), p. 15.

The Bern Convention and the question of viability

Another process concerning viability and the number of wolves required to protect the population – running parallel to the process of finding a measure of viability – concerned the question of whether Norway should protect a viable population of its own, or whether the population could be shared with neighboring countries. If the latter was found to be the case, this raised the additional question of how the responsibility for protection should be shared between countries. The question was first taken up by the Board of Nordic Farmers' Organizations, and mainly revolved around the Bern Convention requirements for Norway.

When DN published the national plan for large carnivores in 1987, some livestock owners did not approve of the plan's objective of protecting viable populations of large carnivores. As a countermeasure, they proposed an alternative plan through the Board of Nordic Farmers' Organizations in the following year.[77] In this plan, they argued that it would be extremely difficult for Norway, Sweden, and Finland to maintain carnivore populations that would satisfy the strict international criteria for viability. The best solution to this problem, they argued, would be what they termed a Nordic 'package deal'. Their proposal was that Fennoscandia, consisting of Norway, Sweden and Finland, should be treated as a continuous management zone, with the obligations of the Bern Convention applied as if they were one country. The status of this Fennoscandian management zone, according to the proposition, would be as follows:

> By current day population distributions, preservation responsibilities would be evenly spread among the three countries Norway, Sweden and Finland. Norway currently has the largest wolverine population, and would therefore have the primary responsibility for this species. Sweden has the primary population of brown bears, and would therefore be the central land for maintaining a viable bear population. Finland is today the only country in Fennoscandia which has a viable wolf population. With all the commercial activity in Norway and Sweden, it would be logical for Finland to take the chief responsibility for the primary wolf population in Fennoscandia in the future.[78]

In other words, they argued that the obligation to protect a viable population of each species should be distributed, such that only Finland would have a responsibility to protect

[77] Nordens bondeorganisationers centralråd 1988.
[78] Nordens bondeorganisationers centralråd 1988, p. 8.

wolves, and not Norway. However, according to the Board of Nordic Farmer's Organizations, this would nevertheless ensure that the region had large enough numbers of all of the large carnivores necessary for satisfying the demands of viability. This was perhaps an effort to minimise the number of large carnivores in each country, but it might be worth considering that this distribution of responsibility would have been fully compatible with the Bern Convention if the geography of the Nordic countries had constituted only one country. The alternative national plan did not gain broad political support in Norway, and it seems to have had little impact on the development of the first white paper concerning large carnivore management, which was largely based on the original national plan by DN. A proposition for a common Nordic management zone, which was based on the alternative plan, was also submitted to the Nordic council by five politicians from Norway, Sweden, and Finland.[79] However, after the council's legal committee argued that the proposition might reduce the nations' obligations as stated in the Bern Convention, the council voted it down.[80] Although the alternative national plan of the Nordic Farmer's Organizations did not have a significant impact on the management of large carnivores, the emphasis it put on the concept of viability shows how central this concept was in the political negotiations. The efforts they made to reinterpret what it would mean for Norway to protect viable populations of large carnivores, rather than to argue against the objective (as some farmer organizations had done earlier), further indicates that MVP size had become an 'obligatory passage point' in the negotiations.[81] It seems that, in order to be considered valid arguments in the political negotiations, statements had to acknowledge the basic objective of protecting viable populations of large carnivores.

The idea of a common management zone for large carnivores in the Nordic countries was, despite the initial rejection by the Nordic Council, not entirely put to rest. It still figured as a realisable and favourable management solution among farmer organisations and in media debates.[82] As a response to the continued presence of the management propositions from

[79] The National Archives, Sweden: Nordiska rådet [The Nordic Council]. 04. September 1989. A 895/j. Medlemsförslag [Member proposition].
[80] The National Archives, Sweden: Nordiska rådet [The Nordic Council]. Protokoll. 38:e sessionen 1990. 28. Februari. A 895/j.
[81] Callon 1986.
[82] See for example Bondebladet, July 10 1996.

the alternative national plan in debates concerning large carnivores, the Secretariat of the Bern Convention sent a letter to DN in 1996, stating that:

> Any kind of plan for 'management coordination' between different countries which imply that each of the Fennoscandian countries have a responsibility to protect viable populations of only one of the species (brown bear for Sweden, wolf for Finland, or wolverine for Norway) would be a definite misinterpretation of the Parties' obligations under the Bern convention. *All* Nordic countries have obligations to protect populations of all species that inhabit their territory, regardless of positive protective measures implemented in neighboring countries.[83]

In the following year, the majority of the Storting standing committee on Energy and the Environment stated, based on this letter, that Norway had an evident obligation to protect the viability of threatened species within its borders.[84] It also explicitly stated that the Bern Convention could not be interpreted such that it allowed for the transfer of one country's independent responsibility to a neighbouring one. This was stated in the Storting treatment of the second white paper concerning large carnivores. A minority of the committee, however, stated that Norway emphasised an intention to cooperate with neighboring countries in the management of large carnivores in the Storting treatment of the Bern Convention. The proposition of sharing responsibility for protecting a viable population of wolves with Sweden and Finland in such a way that Norway would not be required to protect any wolves, therefore, was rejected by reference to the Bern Convention. However, the letter from the Secretariat of the Bern Convention did not explicitly state that Norway was required to protect a viable population of its own, and the Storting treatment merely stated that the responsibility to protect large carnivores could not be transferred to other countries. Cooperation between Nordic countries in the protection of wolves was, therefore, still a possibility, as long as each country took part in the protection of a viable population. The Secretariat of the Bern Convention did not specify how such cooperation should be conducted in practice, however, and this left, as we shall see, the issue open for interpretation by the cooperating parties.

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[83] Innst. S. nr. 301 (1996-1997), p. 8.
[84] Innst. S. nr. 301 (1996-1997), pp. 8–9.

The scientific measure of viability revisited – in court

The problem of translating abstract definitions of viability into a concrete MVP size for wolves came to the fore of the controversy when DN, in 2001, decided that the Scandinavian population of wolves was large enough for nine wolves to be culled; seven of these wolves constituted an entire family group. DN based the decision on the achievement of the population goal of eight to ten family groups in Scandinavia, and argued that the culling would not jeopardise the survival of the population.[85] The decision turned out to be highly controversial, evoking international media attention[86], and led to another attempt by biologists to determine a scientific measure of viability – only this time, in court. Environmental organisations contested the decision, and, after ME rejected the contestation, they took it to court. The court stated that the question of the population's survival was the determining issue according to Norwegian law and the Bern Convention. An alteration of the Norwegian regulations for large carnivores in 2000 had replaced the objective of protecting viable populations of the animals with an objective of securing the survival of the populations.[87] The latter term had also been employed in the Bern Convention, which contained no mention of the term 'viable'. The court further stated, however, that the objective of securing the survival of large carnivore populations was related to the question of viability, in that it implied that culling should not be allowed if it would obstruct the possibility of achieving a viable population in the longer term. The court summoned four biologists – three ecologists and one (population) geneticist – to expertly assess DN's decision and to consider whether culling nine wolves would jeopardise the survival and long-term viability of the population.[88] It turned out, however, that the experts held considerably differing views concerning this question. The three ecologists stated that it was not likely that the single-time culling of nine wolves would jeopardise the population's survival. One of them further noted that it would delay, but not obstruct, the goal of establishing a viable population of wolves in Norway.[89] The geneticist, however, argued that it would have grave consequences for the survival of the population, and that several hundred wolves would be required before the population could be considered viable. The

[85] Oslo namsrett 2001, p. 7.
[86] See, for example: BBC News 2001; CNN 2001a; CNN 2001b.
[87] Forskrift om forvaltning av bjørn, jerv, ulv og gaupe, 2000.
[88] Liberg 2003, p. 36.
[89] Oslo namsrett 2001, pp. 15-16.

stark difference in estimates of viability and survival potential – even between biologists – made the governmental technology of MVP size weak in practice, as it did not provide a concrete or even consistent answer to the court's question. The court decided to follow the advice of the majority of the biologists, stating that DN had not made the decision to cull nine wolves on an insufficient basis regarding the survival of the population. Since the court judged in favor of DN, they conducted the wolf cull in the following weeks.

Biologists at SKANDULV, a project established in 2000 to improve cooperation between Norwegian and Swedish wolf research, saw the difference in estimates of viability revealed in court as highly problematic.[90] In response, they made another attempt to scientifically determine the minimum viable population size of Scandinavian wolves. SKANDULV organised a closed workshop on viability and the Scandinavian wolf population in 2002. They specifically intended to address potential differences between genetic and demographic analyses of viability, because genetic aspects had become more central to MVP size analyses since the 1980s, and this seemed to be at the core of the expert disagreement in court. The panel consisted of international expert biologists: three geneticists, one population biologist, and two wolf ecologists. In addition, Scandinavian biologists, nature managers, and NGO representatives participated. The whole panel agreed that the often approximate nature of the criteria used for estimating minimum viable populations represented a problem. This had, for example, led to several different estimates of viability in small wolf populations in the United States.[91] One of the participants commented, however, that conservation biology would continue to be confronted by the question of what number of animals would be sufficient to secure their long-term survival, and that they simply could not avoid it. He argued that biologists were responsible for estimating minimum viable population sizes, but also for describing the weaknesses of the estimates.[92] From the workshop conclusions, which included an estimated MVP size for Scandinavian wolves, it seems that the panel agreed to the latter argument, as well.

The genetic aspects of viability were central to the discussions at this workshop, and the loss of genetic variation in terms of heterozygosity was a topic at the core of these discussions. The geneticists stated that a common criterion for genetic viability was protection of 95 to

[90] Liberg 2003, p. 36.
[91] Liberg 2003, p. 43.
[92] Liberg 2003, p. 44.

98 per cent of the genetic variation of a population over 100 years, and the panel agreed, in the end, to a definition of genetic viability of protecting, at minimum, 95 per cent of the genetic variation over 100 years. There was some debate over this percentage, in which the ecologists seemed ready to accept a lower percentage (as low as 75 per cent). The geneticists, however, argued that empirical data from captive populations indicated a critical limit of 95 per cent.[93] Another issue was that the Scandinavian wolf population had recovered from near extinction in the 1970s, and the new population was based on the genetic material of only three wolves that had migrated from the Finno-Russian population.[94] This meant that the genetic variation of the population was considerably lower than an average population. What did it mean, then, to protect 95 per cent of the genetic variation – would this designate 95 per cent of the current or the original variation? The geneticists emphasised that the most important goal was to maintain as much of the remaining variation as possible, and to monitor the population with particular attention to indications of inbreeding.

The panel agreed, in the end, to a definition of viability that entailed protecting a minimum of 95 per cent of the genetic variation over 100 years. Employing a principle from population genetics, they also translated this definition to a concrete number of Scandinavian wolves. Protecting 95 per cent of the genetic variation presupposed that a total of 800 wolves would be protected if the population was isolated, or a total of 200 wolves with satisfying immigration. The population at that time consisted of about 100 wolves, and the definition of viability they provided therefore entailed doubling the population, in addition to securing the immigration of at least one to two wolves for each generation (about every fifth year). The workshop also concluded that culling one to two wolves of the Scandinavian population per year would not be threatening to the survival of the population, but that population viability analyses should be conducted if there were plans to cull more than two wolves. Although the biologists' estimates were not in unison, they provided a concrete MVP size for the Scandinavian population. The MVP size concerned the population that was common to Norway and Sweden. Thus, as in the case of the Bern Convention, it was not clear what the political responsibility of each country would be, even if they decided to take the MVP size as a common population goal.

[93] Liberg 2003, p. 44.
[94] Liberg 2003, p. 44.

The report from the international workshop concerning the viability of the Scandinavian wolf population was published in Norway as part of a series of studies conducted in preparation for a third white paper concerning large carnivores.[95] ME also made reference to it in the list of reports associated with the preparation of the white paper, which led to a broad Storting conciliation that established new directions and regulations for the management of large carnivores.[96] As we will see in the next section, however, it is not evident that the Norwegian Parliament employed this MVP size as a basis for their new population goal, which they determined as 'three new litters of wolf cubs each year'.

Second translation: From nature managers to politicians

Before the most recent white paper concerning large carnivores in 2004, the Ministry of Environment commissioned a legal study, in addition to several biological studies of Scandinavian large carnivores and social scientific studies of the controversy. The legal study, conducted by a legal researcher from the University of Oslo, examined Norway's obligations in the management of large carnivores according to international conventions, including the Bern Convention.[97] As the Storting committee argued in the treatment of the second white paper, the study concluded that Norway and Sweden had a common responsibility for protecting wolves, and that this responsibility could not be transferred to the other country. Similarly, it concluded that Norway did not have an obligation to protect a viable population within the borders of the country; rather, the responsibility should be shared with Sweden. As the convention did not dictate how this shared responsibility should be distributed, however, the juridical study introduced some new possible interpretations of this specific issue:

> When no previous agreement exists … an obvious starting point would be even distribution [of responsibility between the countries]. An even distribution might designate that the number of animals in the population is distributed somewhat evenly between the countries, but it might also designate that the burden of keeping carnivores is distributed evenly. In this

[95] Liberg 2003.
[96] St. meld. nr. 15 (2003–2004), p. 134.
[97] Schei 2003.

> regard, it might matter where carnivores have caused most controversy and conflict, where the most suitable habitats are, and the sizes of the countries.[98]

ME repeated this interpretation of Norway's responsibilities according to the Bern Convention in the white paper, and employed it in their justification of a proposed new population goal.[99]

The new population goal that ME proposed in the white paper was 'some' new litters of cubs each year in Norway. According to the new interpretation of the Bern Convention, and provided that Sweden protected a larger number of wolves on their side of the border, ME argued that Norway, by this population goal, would cover their responsibility for protecting a viable population of wolves:

> The Government has determined the national [population] goals in the understanding that Norway share populations of carnivores with neighboring countries, and that the estimates concerning the different populations' viability in the long term must primarily be based on these continuous populations. Norway differs from Sweden in that we have extensive numbers of sheep grazing unattended in remote areas. This is an important reason why Norway cannot have the same goals as Sweden concerning the different carnivore species … Norway will nevertheless cover their share of the responsibility to protect this important part of our natural heritage and our biological diversity for the future through the proposed goals.[100]

In their treatment of the white paper, however, the politicians at the Storting changed the population goal that ME had proposed from 'some' new litters of cubs each year to exactly three new litters of cubs each year.[101] This was part of a political conciliation of government and opposition parties that secured a solid majority for new directions and regulations concerning the management of large carnivores.[102] The negotiation process between the parties that led to this conciliation was, in large part, hidden from the public, but it is clear that the Labour Party and the Socialist Left Party – at the time not part of government – criticised the inaccurate population goal of 'some new litters each year' and argued that it

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[98] Schei 2003, p. 14.

[99] St. meld. nr. 15 (2003-2004), p. 84.

[100] St. meld. nr. 15 (2003-2004), p. 114.

[101] Innst. S. nr. 174 (2003-2004), p. 18. (The population goal did not include litters of cubs that were born in family groups that resided on both sides of the border between Norway and Sweden.)

[102] The government consisted of the Conservative Party, the Liberal Party, and the Christian Democrats, while the Labour Party and the Socialist Left Party participated as opposition parties in the conciliation.

should be changed to ‘four new litters each year’.[103] In the end, however, the parties compromised and settled on a population goal of three new litters each year.[104] As part of the conciliation, the parliamentary committee proposed that legal regulations should be established that would allow for license hunting of wolves when the population goal was exceeded.[105] ME established regulations that carried the new population goal into effect and allowed for license hunting in the following year.[106] Three new litters each year is still Norway’s population goal; it was prolonged in a new parliamentary conciliation in 2011, and it was reached in later years but never exceeded.[107] The population goal is, according to the 2011 Storting conciliation, supposed to be revised again soon.[108]

It is not immediately evident that the new population goal determined by the Storting politicians constituted a translated version of MVP size. When they treated the white paper, the parliament committee decided to omit the objective of protecting a viable population of wolves, which ME had included in the white paper. Instead, the parliament committee stated that the objectives of Norwegian large carnivore management were to ‘secure survival’ and conduct ‘sustainable management’.[109] These terms were also used in the new regulations of large carnivore management that were established after the Storting conciliation.[110] Although it might be difficult, at first, to see how it would be possible to secure the survival of a population without securing its viability, we have seen that a Norwegian court previously interpreted ‘securing survival’ as a responsibility for protecting the viability of a population only in a longer perspective. This might indicate that the new regulatory phrasing established a weaker responsibility for the protection of wolves. More specifically, the alteration of terms weakened the link between regulations and the scientific

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[103] Aftenposten, April 29 2004.
[104] Innst. S. nr. 174 (2003-2004), p. 13.
[105] Innst. S. nr. 174 (2003-2004), p. 13.
[106] Forskrift om forvaltning av rovvilt 2005.
[107] The population goal was reached in 2008 (Wabakken et al. 2009, p. 17), 2009 (Wabakken et al. 2010, p. 18), 2010 (Wabakken et al. 2011, p. 18), 2011 (Wabakken et al. 2012, p. 16), 2012 (Wabakken et al. 2013, p. 15.), and 2013 (Wabakken and Maartmann 2014, p. 1).
[108] The initial goal was to establish an agreement with Sweden concerning the distribution of wolves residing on both sides of the border, before determining new national population goals. Norway´s starting position in these negotiations would be that litters of cubs born in family groups residing on both sides of the border would count as 0.5 litters in each country´s national population goal. Norway and Sweden have not come to an agreement on this issue, and the conciliation document stated that if an agreement was not reached in 2013, the parties in Norway should consider a new population goal (Stortinget 2011, p. 4).
[109] Innst. S. nr. 174 (2003-2004), p. 7.
[110] Forskrift om forvaltning av rovvilt 2005.

concept of viability, and one might speculate whether this alteration of terms represented an avoidance of any obligations to the concrete MVP size that the biologists had provided two years earlier. The term 'secure survival' had, however – as we have seen – also been preferred over 'secure viable population' in the regulations for large carnivores that were established in 2000, and had also been employed in the Bern Convention. In a larger perspective, the general principle of establishing a lower limit for the number of wolves it would take to protect the population was directly prolonged, even if the alteration of terms shifted the content of the governmental technology to some degree.

In addition to the change in terminology, three other aspects of the new population goal made it appear to be something very different from what the conservation biologists had in mind when they created the governmental technology of MVP size in the 1980s. Firstly, politicians, rather than biologists, determined the number of wolves needed for Norway to protect the population. Secondly, the MVP level of three new litters of cubs each year was set as a maximum level as well as a minimum level. Thirdly, the exact population goal left the number of wolves in the current population fixed; this was in contrast to the historic population, which was highly varied in number.[111] I will now consider each of these aspects in more depth.

In this second translation of MVP size as a governmental technology, politicians at ME indirectly determined what a viable population would constitute by asserting, in the white paper, that the population goal of 'some litters of cubs each year' was sufficient to cover Norway's responsibility for protecting a viable population of Scandinavian wolves. Earlier, they had granted this responsibility to biologists and nature managers. We have also seen that biologists were not always keen to take this responsibility, and often emphasised that, in the end, it was the responsibility of politicians to determine population goals. It is not easy to identify why politicians chose to take this responsibility, but it is evident that they became more active in wolf regulation as the numbers and the controversy continued to rise from the early 1990s into the 2000s. One might speculate whether politicians found it difficult to reconcile the MVP size of 200 wolves (which the biologists had finally provided) with their objective of mitigating controversy. We have seen, however, that the biological MVP size

[111] A fourth consequence of the new and exact population goal, which might have been anticipated by the creators of MVP size, was that it required highly detailed monitoring of the wolves in order to be successfully effected (Stokland 2014).

concerned the Scandinavian population, and that it left the question of Norway's responsibilities open for interpretation. The Norwegian population goal that the politicians determined by aid of the legal study could, therefore, still be justified with reference to viability.

The most crucial transformation in the second translation of MVP size as a governmental technology was, however, that the new population goal was set as an exact goal, rather than a minimum goal. This constituted a fundamental alteration of the governmental technology, which effectively transformed the lower limit of viability into a higher limit of the number of wolves that would be necessary to protect, as well. Kristin Asdal found a similar dynamic in her study of the acid rain issue and a governmental technology that designated the 'critical levels of nature'.[112] In her study, she examined how ME and Norwegian scientists had established levels in the 1980s and 1990s that designated how much pollution nature could withstand. The critical levels of nature started out as a successful governmental technology, which persuaded other countries to commit to reductions in their own emissions. Quite soon, however, economists and politicians translated the difference between the current state and the lower limit into economic potential. Understood as such, the critical levels of nature turned into a question of how much more it would be possible to pollute without causing critical damage to nature. In Asdal's interpretation, the transformation of a governmental technology that had been created to protect nature by assigning it a lower limit into one that also constituted a higher limit, was made possible by the cost-efficiency language of economics. In the case of Norwegian wolves, the transformation of the governmental technology was the result of an arduous political compromise. Economic considerations do not seem to have been decisive for the translation of the MVP size for wolves in Norway, although the translation was related to the economic question of grazing livestock and game. It seems, to a larger degree, to have been guided by controversy mitigation considerations, but still with the more general logic of cost-efficiency in play: If a limit shows us how far we can go until nature is irrevocably defunct, then why not go there? The two cases suggest that one should be conscious of a certain dynamic when creating and employing governmental technologies that designate lower limits to what nature can withstand, because the limits might transform into higher limits when employed in practice.

[112] Asdal 2011, pp. 139–173.

Thirdly, the accurate population goal of three new litters of cubs each year led to a more substantial transformation of the wolf population than had occurred through the adjustment of the number of wolves. Compared to the historic population, which has varied highly in number throughout the centuries, the current population is regulated to stay at a fixed number. It is possible to envision a future – on the basis of a general agreement over the MVP size for wolves and the dynamics of governmental technologies that designate limits for nature – in which every country with wolves protects exactly the same number of them at a fixed level within their borders. If (however unlikely) a broad scientific and political agreement over the specific number of wolves required to secure the viability of a population were to be reached – be this three new litters of cubs each year or a population of 200 wolves – then all countries that struggle with controversies and loss of livestock might decide to follow the logic of cost-efficiency and protect this exact number, and not even one more wolf. Wolves are not the only endangered species with which modern societies struggle to coexist (as this is very often the reason why species become endangered), and the future vision can therefore be extended to encompass a multitude of previously endangered species that exist on the brink of viability. The vision does not entail a probable future, but the unexpected ways in which a governmental technology might transform the nature it was created to protect could be worth considering when discussing or employing it.

Conclusion

The case of Norwegian wolf protection shows that governmental technologies such as MVP size, created to achieve certain political objectives such as protecting a viable population of wolves, might transform when they are employed in practice. This might produce unexpected consequences. While MVP size was created to let biologists determine a lower limit for the number of individuals of a specific population that are necessary to protect, the problems Norwegian biologists initially encountered when they attempted to translate MVP size to a particular number of wolves opened the concept for others to interpret. As nature managers, bureaucrats, legal researchers, politicians, and NGOs brought their own interpretations of the number of wolves needed to protect the population, the political negotiations concerning the number of wolves Norway should protect played out, to a large degree, as technical arguments concerning MVP size, rather than political arguments. During these negotiations, MVP size as a governmental technology was altered by two translations, which transferred the authority to define it firstly to nature managers and, secondly, to politicians. These shifts involved major transitions in the practice of determining MVP size, and in the number of wolves considered necessary for protecting a viable population. The governmental technology that was created to determine a lower limit for the number of protected wolves was transformed, in one of these shifts, to function as a higher limit, as well. Controversy mitigation considerations and the general logic of cost-efficiency seem to have been decisive for this shift, which fundamentally altered MVP size as a governmental technology. Further, the accurate population goal of three new litters of cubs each year led to an even more substantial transformation of the wolf population than did adjustment of the number of wolves. Compared to the historic population, which varied highly in number, the current population is regulated to stay at a fixed number.

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The New Norwegian wolves – Preserving by transforming in the age of biodiversity?

Abstract

This article investigates the construction of instruments and techniques employed in the management of Norwegian wolves since the early 1980s by construing them as technologies of government. It asks whether the proliferation of such instruments and techniques, which have been constructed in order to effect protection in practice, have also transformed the wolves in significant ways. Unlike the historic population of wolves, the New Norwegian wolves are highly amenable to detailed government and are regulated to stay at a fixed number and within a relatively small wolf-zone. The article further explores whether nature management, in general, has substantially transformed in the period to warrant the label 'the age of biodiversity', and whether issues of naturalness, wildness and authenticity are new and typical management challenges of the period, due to the proliferation of technologies of government.

Keywords: biodiversity, conservation biology, endangered species, technologies of government, wildlife management, wolves

The New Norwegian wolves

The current population of Scandinavian wolves is commonly described as 'new' because wolf numbers remained at a minimum between the last decades of the nineteenth century and the 1990s. Molecular biologists have identified that the current population is genetically distinct from the previous one by establishing that all the founders of the current population were immigrants from a Finno-Russian population (Vila et al. 2003). The current population of wolves in Scandinavia is, therefore, 'new' in a genetic sense as well. It is, however, also distinct from the previous population in the way in which the wolves have been moulded as objects of government. This article examines how the proliferation of management instruments and techniques, constructed by biologists, nature managers and others in order to effect protection in practice, has transformed the wolves in significant ways. In particular, the article investigates the construction of a population goal, a wolf-zone, genetic techniques and a monitoring system, by construing them as technologies of government.

After varying highly in number since at least the sixteenth century – most historical accounts identify three periods of high numbers interrupted by periods of low numbers (e.g. Collett 1912; Johnsen 1928) – the population of wolves in Norway significantly decreased in the second half of the nineteenth century and into the twentieth century (Myrberget 1969, pp. 3–9). The latest decrease in number coincided with the government's establishment of public bounties and other measures to eradicate wolves from the 1840s. The wolf population kept decreasing into the twentieth century, and, by the 1960s, wildlife biologists assumed that the population was almost extinct (Myrberget 1969). In an effort to save the very few wolves remaining, the wolves were protected by law in 1971. Due to immigrant wolves from Finland and Russia, the numbers started to rise again – mostly from the 1990s (Wabakken et al. 2001, p. 3). Today, there are about 30 wolves in Norway, 320 in Sweden and 50 that reside on both sides of the border (Wabakken et al. 2014). In this regard, the protection of wolves in Scandinavia has been successful, at least to some degree. However, as in many other places where wolves have returned or been reintroduced, this has led to controversy. There have been conflicts with the livestock owners of sheep and reindeer, as well as with hunters, and also social conflicts relating to social transformation processes and cultural and economical power-relations (Skogen and Krange 2003; Krange and Skogen 2011; Figari and Skogen 2011).

Technologies of government

Peter Miller and Nicholas Rose argued that studies of government should focus on the actual mechanisms, or 'technologies', that enable government in practice, rather than restrict themselves to the 'actions of a state … construed as a relatively coherent and calculating political subject' (Miller and Rose 2008, p. 27). Modern government is not only constituted by grand political schema and negotiations between politicians, they argue with inspiration from Michel Foucault, but, in practice, is dependent on 'apparently humble and mundane mechanisms' such as techniques of notation, computation, calculation and assessment.[1] It is often such techniques and instruments that make objects amenable to government, and therefore enable the interventions of practical politics. Miller and Rose designated such techniques and instruments 'technologies of government'.

To describe the conduct of government that is enabled by technologies of government, Miller and Rose coined the term 'government at a distance'. In this, they drew on Bruno Latour's notion of 'action at a distance' and Latour and Michel Callon's studies of 'the complex mechanisms through which it becomes possible to link calculations at one place with action at another … through a delicate affiliation of a loose assemblage of agents and agencies into a functioning network' (Miller and Rose 2008, p. 34). Although it is not possible to absolutely separate the two in practical government, for analytical purposes it can be beneficial to separate technologies of knowledge production from technologies of intervention. While technologies of knowledge production make an object amenable to government from a distance (by producing information, calculations and so forth), technologies of intervention employ this knowledge to intervene upon the object and effect politics in practice. For practical purposes of this article, I sometimes designate technologies of government (both of intervention and of knowledge production) that are specific to the management of endangered species as 'technologies of protection'.

The purpose of studying technologies of government is to understand how government is conducted in practice, as well as to understand how objects of government are created, shaped or transformed by these technologies (Miller and Rose 2008, e.g. p. 32). Such studies of public government have often concentrated on the government of subjects and 'social'

[1] See also Rose 1989; Porter 1995; Barry 2001; Dean 2010.

objects of government, such as the marked, populations and mental illness, and hence on the production of knowledge and instruments by professionals such as psychologists, social workers, accountants and factory managers.[2] In this article, I argue that governmental technologies of knowledge production and intervention have also been decisive for the management of wolves in Norway, and that studies of endangered species management and nature management, generally, could benefit from this approach.

The findings and discussion of this article are based on extensive studies of political and scientific documents, as well as the historical archives of the Norwegian Environment Agency (NEA) and the Ministry of Climate and Environment (MCE). I reviewed a large majority of the several hundred major political and scientific documents that had been produced in relation to the management of wolves in Norway since the 1960s. This included white papers, national plans, regulatory documents, scientific reports and articles. I examined in more detail the most central documents, and those concerning the construction of technologies of protection. I also traced the internal processes of governmental technology construction in archival material from the NEA and MCE, of which I copied and reviewed more than 20,000 pages. Further, I interviewed six biologists and one nature manager who were central in efforts to effect the protection of wolves in practice.

Technologies of intervention

After the legal protection of wolves, bears and wolverines in the early 1970s, the challenges of managing protected large carnivores became gradually clearer for nature managers at the Norwegian Environment Agency. Bears and wolverines became objects of growing conflict and compensation demands from livestock owners in the 1970s. By 1982, wolves had returned at two different locations in Norway, due to long-distance dispersal from Finland and Russia (Flagstad et al. 2003; Vila et al. 2003). As has been the case in most places where wolves have returned by migration or reintroduction, their renewed presence turned out to be highly controversial (Mech and Boitani 2003; Hayward and Somers 2009; Skogen et al.

[2] Kristin Asdal's history of Norwegian environmental politics in the twentieth century, which draws in part on such literature, is one notable exception (Asdal 2011).

2013; Nie 2003). Sheep killed by a wolf in the municipal Vegårdshei soon made national headlines, along with calls to cull the wolf.

The legal protection established in the early 1970s – often referred to as 'total protection' – was challenged by this controversy. After the Norwegian parliament loosened regulations in order to allow this wolf to be culled, nature managers decided that it was necessary to establish a lower limit for the number of wolves Norway should protect. In order to counter controversy and ensure wolf protection in practice, they initiated a process of defining the lowest number of wolves a protected population could constitute. Early on, this number was produced as a population goal, which was based on the concept of 'viability' from conservation biology. However, biologists found it difficult to establish the exact number of wolves that should constitute the limit of viability. A first estimation by wildlife biologists assumed that three family groups of wolves would be necessary to ensure the viability of the population and, hence, protection in practice. This definition of viability was not, however, stable, and was debated and negotiated widely over the following decades. In this process, bureaucrats, politicians and NGOs brought their own interpretations of viability. In the end, it was politicians who set a population goal of three new litters of cubs each year, and stated that this was sufficient to secure the viability of the population.[3] This was not a minimum goal, but an exact goal (Forskrift om forvaltning av rovvilt 2005). The three litters would need to be born by family groups residing exclusively on the Norwegian side of the border, which meant that litters born by family groups that had been observed in Sweden would not count. Further, if a family group were to reside partly outside of a wolf-zone (the construction of which is described in the next paragraph) on the Norwegian side of the border, at least 50 per cent of the territory would have to be within that zone. This has been Norway's population goal since 2004.

A recurring issue specific to the Norwegian wolf controversy has been the extensive number of sheep grazing largely unattended in remote areas – a tradition that originated in the twentieth century after most large predators had been decimated. Livestock owners release about two million sheep to graze in the mountains and hills of Norway each summer, and, in addition, about 200,000 reindeer graze largely unattended in areas farther north (St. meld.

[3] This short account of the process that led to the current population goal is based on Stokland (forthcoming), which examines the process in detail.

nr. 15 2003-2004, pp. 46–49). These practices have complicated the return and protection of wolves, and one technology of intervention has been constructed to specifically address this problem. As early as the 1970s, a committee appointed by the Ministry of the Environment and the Ministry of Agriculture discussed whether Norway should establish separate areas for large carnivores and sheep and reindeer, respectively, in order to reduce livestock losses (NOU 1977, pp. 45–47). The idea of separate areas has been a recurring and contested issue since the number of large carnivores began to rise. In 2004, however, parliament established the current borders to a so-called wolf-zone in south-east Norway, along the border with Sweden (Figure 1) (Innst. S. nr. 174 (2003-2004), p. 17).[4] The location was chosen for its absence of reindeer and its relatively low numbers of grazing sheep, as well as for its proximity to the larger part of the Scandinavian population of wolves in Sweden. The borders of the zone, which is formally referred to as 'the management area for breeding wolves', are not absolute. The area designates, rather, an area where wolves are prioritised over grazing livestock, while the opposite applies outside of the area. Thus, some wolves reside outside of the zone, and some livestock graze inside it. As specified by the population goal, however, established family groups that deliver cubs are only permitted inside the zone. Culling in order to uphold these regulations is effected by license hunting, quota hunting and culling in cases of serious damage or defense.

Technologies of knowledge production

The establishment of wolves as objects of protection in Norway in many ways resembles the process of 'problematizing' described by Miller and Rose (Miller and Rose 2008, p. 14). Miller and Rose argued that, when something appears to require government, this is because it appears problematic to someone. One should, therefore, ask how this rendering of things problematic first occurs. Miller and Rose argued that such problems are never pre-given or self-evident, but that they must be constructed and made visible by someone through a process they denote 'problematizing'. The events that led to the legal protection of wolves in 1971 were, of course, parts of a complex process, and it is no coincident that these events occurred at the height of 'the age of ecology', which was characterised by broad public

[4] Areas where established family groups of wolves have been allowed to reside have been restricted since 1997, with varying sizes and locations.

awareness and acts to protect nature. However, a single document seems to have had a decisive impact on the abrupt shift in government of wolves from public bounties to total protection.

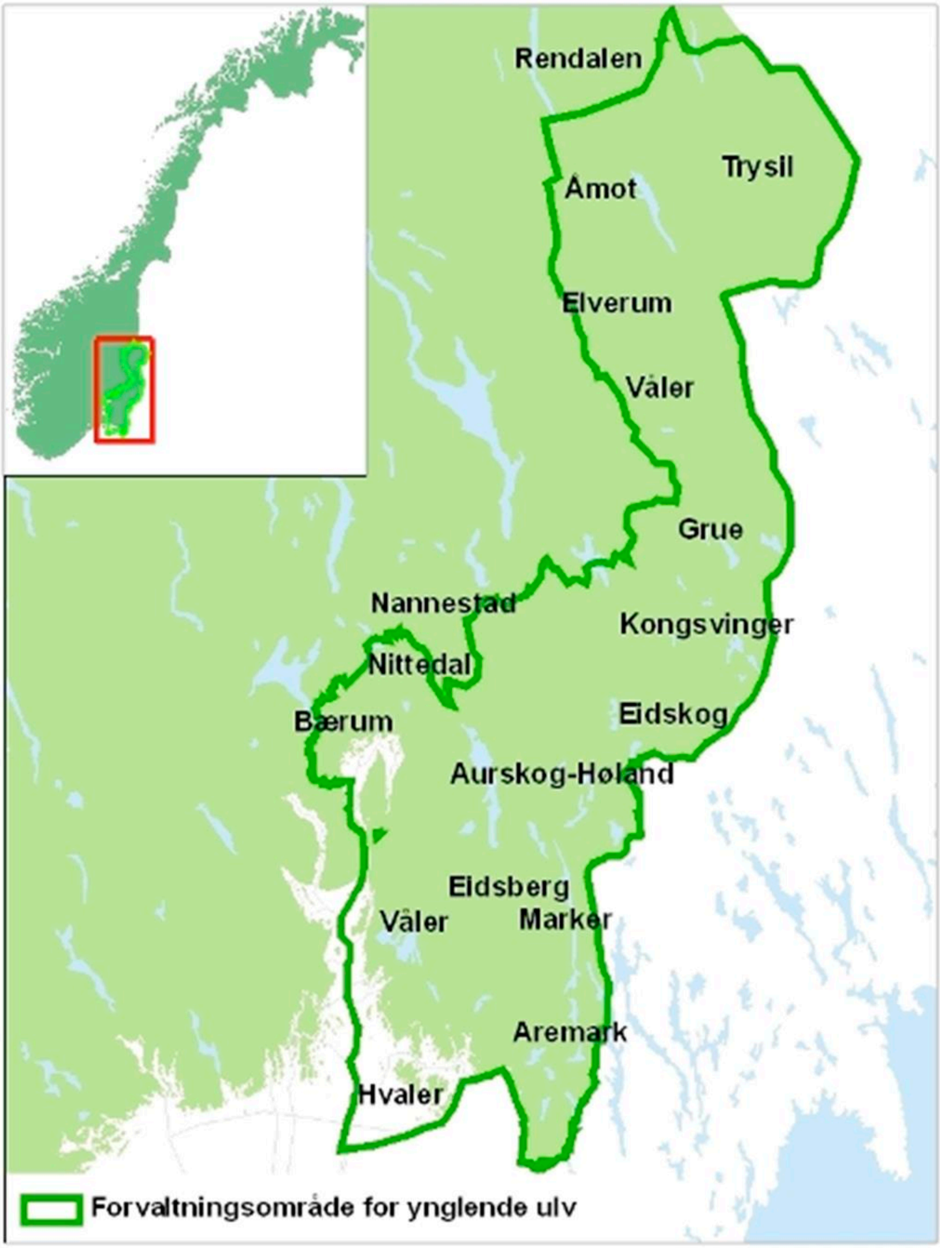

Figure 1: The wolf-zone is situated in south-east Norway, along the border with Sweden. © Miljødirektoratet.

A report by wildlife biologists on the status of wolves in Norway and other Nordic countries, which produced very low estimates of their numbers, described the situation as disastrous and called for immediate protection. The subsequent treatment of this case within the political system invariably took the report as its base of knowledge and as a guide for management regulations (Stokland 2014). One reason for this is, of course, that the report drew attention to the endangered status of wolves. If we construe the process through the lens of 'problematizing', however, we become aware of how the biologists constructed endangered wolves as problematic objects that required government. Through this perspective, it becomes clear that protected wolves as objects of government were constructed through number estimates from the very beginning. Miller and Rose argued that the activity of problematizing is intrinsically linked to the activity of devising technologies of intervention. Part of the process of problematization is therefore rendering the object amenable to intervention, because a problem that cannot be acted upon is never (or rarely) considered politically relevant (Miller and Rose 2008, p. 14). By proposing number estimates of the wolf population, therefore, the report might not only have attempted to show that the population was endangered; through a problematization perspective, one could argue that it also rendered the population governable as an object of protection, by illustrating that it was possible to produce knowledge about the number of wolves. Without this knowledge, it would have been very hard to imagine how legal protection could have been effected in practice, or even been known to have any actual effect on the population.

When wolves returned to Norway in the early 1980s and nature managers faced the task of effecting protection in practice, their efforts soon revolved around questions of wolf numbers. After parliament loosened the 'total protection' of wolves, the new regulations, which allowed for culling, stated that their purpose was to secure a viable population of wolves (Forskrifter om forvaltning av bjørn, jerv og ulv 1983). The question nature managers faced, then, was: How should one determine, in practice, whether culling a wolf is incompatible with the objective of protecting a viable population? One part of the answer, as we saw in the previous section, was determining the number of wolves that would constitute a viable population. Once this was generally agreed upon – or determined by someone without general consent – another part of the answer still remained. In order to answer the question, nature managers also needed to know the number of wolves that resided in Norway, in order to compare this number to that of the viability limit. As the population goal became more specific over the following decades, the detail of knowledge required to effect it increased dramatically.

Since wolves returned to Norway, wildlife biologists have constructed an extensive infrastructure to count them and monitor their movements.[5] DN initiated the first large-scale research project on large carnivores in the early 1980s, in response to the management challenges of effecting protection in practice. Later, this was followed up by increasingly intensive efforts to monitor the number, as well as the locations, migration, genetic health and more, of the wolves. Today, the improved infrastructure enables monitoring throughout the whole of Norway. Extensive field studies of snow tracks by wildlife biologists – sometimes with the aid of lay people's reported observations, the Norwegian Nature Inspectorate or GPS collars – is one component of this infrastructure. Since the 2000s, these studies have been complemented by genetic studies that have constructed DNA profiles for almost every wolf that has resided in Scandinavia since the early 1980s. Genetic studies were initially conducted in an effort to study inbreeding in the population, as well as to establish whether the wolves had been illegally introduced, or if they were hybrids.[6] As the identification of specific wolves through collected feces proved very helpful for monitoring efforts, however, it was established as a central component of the activity. These genetic studies have resulted in an almost complete pedigree of every wolf that has resided in Scandinavia since the early 1980s (Åkesson 2013). Figure 2 depicts the pedigree back to 1983 of two adult wolves currently residing in Østmarka, near Oslo.

The monitoring results are published in annual reports that identify the number and locations of wolves in Norway. Figure 3 shows wolf territories in Norway in the winter of 2012/2013, as identified in a preliminary report that also illustrates the monitoring accuracy that the current regulations require (Wabakken et al. 2013). The biologists identified 13 wolf territories within the zone, of which cubs were born in eight. In five of these territories (6, 8, 9, 12 and 13), some of the wolves had spent time in Sweden, which meant that they did not count in the population goal (as described in the previous section). Two of the territories

[5] This short account of the construction of a monitoring system for wolves in Norway is based on Stokland 2014, which examines the process in detail.
[6] See Stokland 2013 for an account of how genetic techniques were incorporated into Norwegian wolf management.

with cubs (2 and 3) were situated exclusively within the zone, but the nine wolves occupying the final territory (1) had partly resided outside the zone. In order to determine whether this group of wolves was compatible with official regulations, which stated that at least 50 per cent of the territory must be within the zone in such cases, the biologists had to determine exactly how much of the area the wolves had ever visited was situated within the border of the zone. In the preliminary report, the biologists estimated that 51 per cent of the area

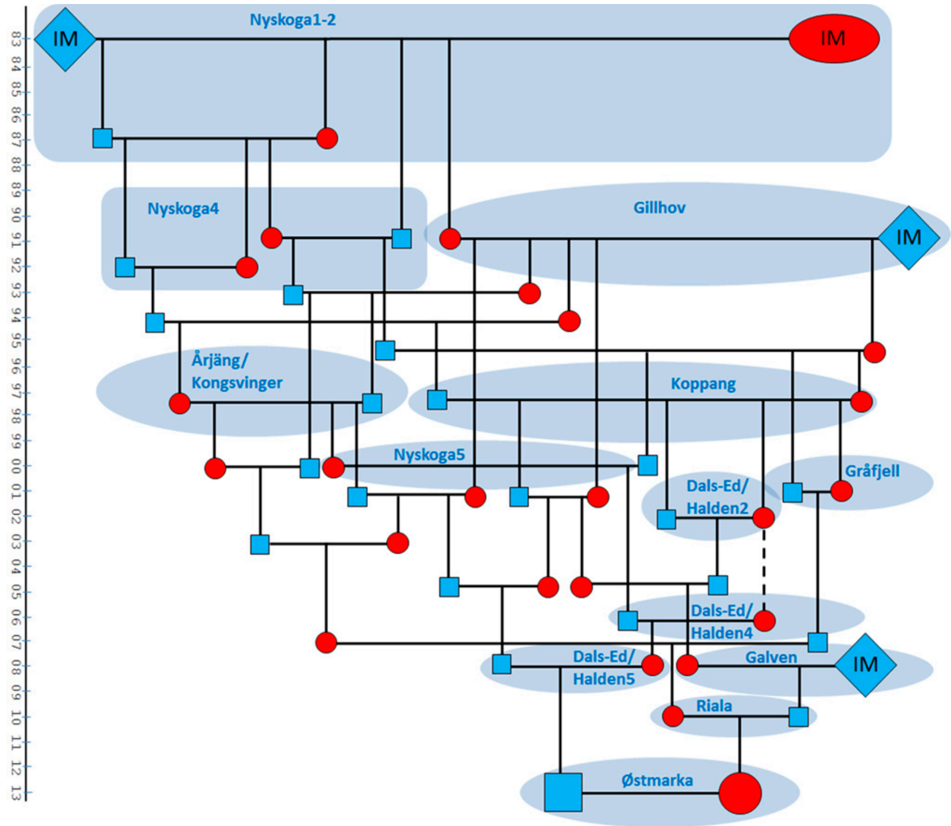

Figure 2: Pedigree of two adult wolves currently residing in Østmarka near Oslo. Molecular biologists have constructed DNA profiles for nearly every wolf in Scandinavia since the early 1980s, and have gained detailed knowledge about how they are related. Blue squares represent male wolves, while red circles represent females. IM represent immigrant wolves from the Finno-Russian population. The light blue background designates the geographical areas in which cubs have been born, while the numbers to the left represent the years of birth. © Reproduced by permission of the Norwegian Institute for Nature Research.

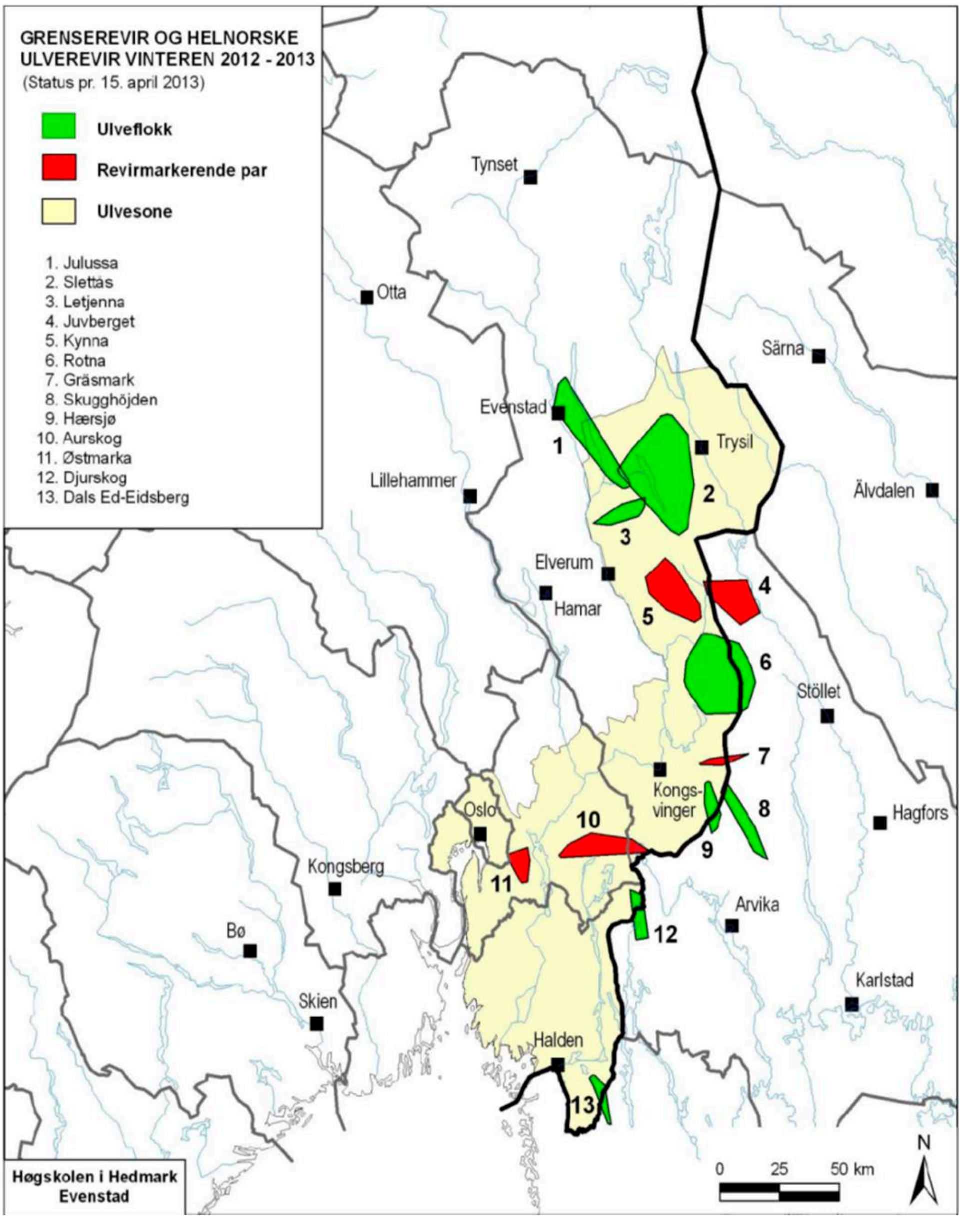

Figure 3: Wolf territories in Norway in the winter of 2012/2013, according to a preliminary report. Green areas represent areas of residence for packs of wolves in which cubs were born in 2012, while red areas represent pairs of wolves marking territory. The yellow area indicates the current wolf-zone, while the thick black line indicates the border between Norway and Sweden (Wabakken et al. 2013a, p. 4). © Reproduced by permission of Hedmark University College.

occupied by the group of wolves was situated within the zone, and therefore that the group was compatible with the population goal by a hair (Wabakken et al. 2013, p. 2).

Preserving by transforming

The wolves currently residing in Norway are, in many ways, similar to those of the historic population: they hunt elk, kill sheep, mate and live in family groups. A governmentality approach that focuses on the way in which the wolves have been moulded as objects of government, however, illuminates that they have undergone significant transformations that have made key aspects of the current population appear very different from those of the historic population. Management problems, controversy, international conventions and more have prompted biologists, nature managers, bureaucrats and politicians to produce a host of political technologies in order to enable and execute protection in practice. The highly specific population goal, the wolf-zone and the extensive monitoring system treated in the previous two sections are only a few, although among the more decisive, examples of such technologies.

The population goal and wolf-zone are typical technologies of intervention: instruments that were constructed to intervene upon an object and effect politics in practice. In this case, the technologies of government were constructed in order to effect protection in practice. The purpose of employing a technology of government approach is, however, not only to understand how government is conducted; a vital aim of the approach is also to understand how objects of government are created, shaped or transformed by such technologies (Miller and Rose 2008, e.g. p. 32). By employing this approach, and a larger historical framework, it becomes clear that the technologies of intervention have also induced some fundamental transformations of the Norwegian population of wolves. Unlike the historic population of wolves, which often went through large variations in number, the current population is regulated to stay at a fixed number (of three new litters of cubs each year). This number further constitutes what parliament considers the lower viability limit of the population, which means that the purpose of the protection is to keep the wolf population in a fixed state at the brink of survival. This fixed state is further regulated to perpetuate new litters of cubs only within a relatively small area in south-east Norway. The historic population of wolves, in contrast, was spread throughout large parts of the country until it was decimated.

Detailed knowledge of wolf numbers, as well as particular wolves' genes and geographical movements, are typical technologies of knowledge production. Such knowledge enables nature managers to effect the regulations that I have construed as technologies of intervention in practice, thus enabling the protection of wolves in practice. Also in this case, however, a technology of government approach combined with a larger historical framework illuminates that the technologies of protection have induced some more fundamental transformations of the Norwegian wolves. The extensive and detailed monitoring system, constructed to monitor the wolves permanently and in detail, has transformed the wolves into objects that are highly amenable to detailed government. The wolves' number and locations, and even genetic composition over the longer term, can be reconfigured in detail, if deemed necessary. The novelty of this aspect of the current population is highlighted when compared to that of the historic one. The only systematic knowledge production of the latter was statistics of the number of bounties the authorities had paid for killed wolves. Besides this, the authorities knew little of the state of wolves in Norwegian forests and mountains. The historic population, therefore, was significantly less amenable to detailed government.

These transformations resulted from efforts to effect protection in practice. The reintegration of wolves into modern Norwegian society was possible only by such technologies of protection as a population goal to determine the number of wolves that should be protected and a wolf-zone to determine where they should be allowed to reside. It is certainly possible to imagine that the population goal or the borders of the wolf-zone could be set differently, but it is harder to imagine the protection, in practice, of such a controversial species without more general technologies to effect government of the wolves' number and locations. Similarly, it is possible to imagine that other technologies of knowledge production than those specific to the current monitoring system had been employed to enable government of the wolves, but harder to imagine how protection, in practice, could have been achieved without the wolves being made amenable to government to a certain degree. In sum, the proliferating technologies of government that were constructed to effect protection in practice have, in many ways, transformed the wolves into new objects, which appear in a new way and with new properties.

The age of biodiversity?

The 1960s and 1970s are often referred to as the height of 'the age of ecology', and were characterised by broad public awareness and acts or regulations to protect nature (Barrow, jr. 2009, 301–345; Worster 1994, pp. 339–435). In the following period, 'biodiversity' became a crucial concept in nature conservation and management. The term was coined in the 1980s (Farnham 2007), made politically decisive through the Rio Convention on Biological Diversity established in 1992, and further institutionalised by the recently established Intergovernmental Platform on Biodiversity and Ecosystem Services. The concept of biodiversity is often described as a successful instrument in conservational efforts, even 'the leading paradigm for nature conservation' (Farnham 2007, p. 15) since the 1980s.[7] The strength of the concept has been understood as its ability to encompass previously separate environmental movements in a common issue (Farnham 2007) and its rhetorical effect on how lay people, politicians and others conceive of nature (Takacs 1996). From this perspective, 'the age of biodiversity' might be a fitting characterisation for the period following 'the age of ecology'.

If we consider this period an age of biodiversity, however, we should not only include in this concept its rhetorical success and ability to unite environmental movements; we should also emphasise the transformations in nature management that have occurred in this period and been associated with the concept of biodiversity. A distinctive trait of this period is the extent to which a host of political interventions, knowledge production and detailed regulations has been generated in order to effect protection in practice (sometimes out of frustration over the lack of actual effects from the general protective regulations established in the age of ecology). The case of Norwegian wolves indicates this, although it is not an average case in terms of the number and intensity of governmental technologies. In the previous section, we saw that the historic population of wolves was significantly less

[7] Since the book's publication, however, various signs indicate that ecosystem services might complement or challenge biodiversity as the leading paradigm for nature conservation (e.g. Turnhout et al. 2013).

amenable to detailed government than is the current population. The effort to eradicate the historic population was, nevertheless, successful. This might indicate that the practice of protecting endangered species requires knowledge production on a much more intensive level than does eradication, and thus objects that are significantly more amenable to government. Technologies of intervention such as the detailed population goal and wolf-zone further indicate that protection is a much more complex management objective to effect than is eradication. The latter was mainly accomplished by the single governmental technology of public bounties, in addition to relatively modest efforts to disseminate techniques and equipment for killing wolves (Søilen 1995, pp. 95–115). The proliferation of technologies of protection after wolves returned to Norway, which nature managers constructed to counter practical management problems, further indicates that protection might often be a much more complex management objective to effect in practice than to establish by law or general regulation.

A quick review of the number of published articles concerning endangered species management, or even the number of journals addressing this issue,[8] suggests that the proliferation of technologies of protection in recent decades has not been restricted to those addressing the management of Norwegian wolves. Bowker (2005), Turnhout and Boonman-Berson (2011) and Turnhout et al. (2012) have noted a general increase since the early 1990s in efforts to collect data on biodiversity and archive it in databases (i.e. technologies of knowledge production, in the terminology of this article), by a wide variety of institutions and initiatives such as the World Conservation Monitoring Centre, the Global Biodiversity Outlook, the European Biodiversity Observation Network and the Global Biodiversity Information Facility. In particular, the Convention on Biological Diversity elevated monitoring to the heart of conservation efforts by assigning it an entire article (United Nations 1992). Nations that have ratified the convention are required to identify and

[8] *Conservation Biology* (established in 1987), *Journal for Nature Conservation* (established in 1991), *Biodiversity and Conservation* (established in 1992), *Animal Conservation* (established in 1998), *Biodiversity: Journal of Life on Earth* (established in 2000), *Conservation Genetics* (established in 2000), *Conservation in Practice* (established in 2000), *Ecological Management & Restoration* (established in 2000), *Endangered Species Research* (established in 2004), *International Journal of Biodiversity Science, Ecosystem Services & Management* (established in 2005)*, Journal of Biodiversity and Endangered Species* (established in 2013), *Journal of Biodiversity Management and Forestry* (established in 2013) and *International Journal of Biodiversity and Conservation* (established in 2014) are only some examples of journals that address the conservation and management of endangered species. The number of more specialised journals that address conservation and management of, for example, insects or wildlife, have also increased significantly over the period.

monitor their biological diversity, assess which organisms are threatened and create national plans or strategies to ensure their protection. This implies the construction of a multitude of technologies of protection – extensive monitoring systems, detailed assessment criteria, numerous regulations and other instruments of intervention. Technologies of protection that are constructed to effect protection in practice, but that might also transform the objects to be protected.

New management challenges

Some of the transformations Norwegian wolves have undergone due to the proliferation of technologies of protection seem to have led to some new management challenges. Helene Figari and Ketil Skogen showed that both supporters and adversaries of conservation in the Norwegian wolf controversy share a basic understanding of wolves as wild, authentic and natural animals (Figari and Skogen 2011). While supporters of conservation conceptualise the natural environment where wolves live as untouched nature (or wilderness), adversaries conceptualise it as a productive landscape for activities such as logging, grazing and hunting. As the social representation of wolves is inextricably linked to the idea of wilderness for both groups, Figari and Skogen concluded that the differing opinions on wolf conservation are grounded in differing conceptualisations of the natural environment, rather than wolves. Crucial for this article, Figari and Skogen argued that intensive regulation and monitoring of wolves makes them less favourable in the eyes of both supporters and adversaries, since it undermines their wildness and naturalness (Skogen et al. 2013, pp. 121–122).

The idea of wilderness has been thoroughly examined in the field of environmental history since the early 1990s (e.g. Callicott and Nelson 1998; Nelson and Callicott 2008). William Cronon, who was decisive in initiating these investigations, argued that the problem with the idea of wilderness is the dualistic vision it embodies, 'in which the human is entirely outside the natural' (Cronon 1996, p. 80). According to Cronon, the dualistic vision obstructs critical examination of what an ethical and sustainable human place in nature might actually look like, and hence poses a serious threat to responsible environmentalism (Cronon 1996, p. 81). He admits that the concept has some merits, however, such as the respect for nature's autonomy and otherness it can evoke in people. Based on this, Cronon argued that we should attempt to overcome its embodied dualism by extending the experiences of respect and otherness embodied in the concept to things and creatures that are not usually considered wild, but rather artificial and unnatural. That is, we should become aware of the wildness and autonomy of the tree in the garden, as well as the tree in the wilderness. Can we also become aware of the wildness of a wolf carrying a GPS collar, which is part of an intensively monitored and regulated population?

Scholars in the field of science and technology studies (STS) have also criticised the nature–culture dualism. This is not the place to go into the specificities of these complex interpretations of modern societies, suffice to state that Bruno Latour and Donna Haraway (and others) have criticised the dualism for creating numerous political problems (broadly defined). Latour employed the concept of hybrids in his criticism (Latour 1993), while Haraway employed that of 'naturecultures' (Haraway 2003). Both concepts designate entities that combine aspects of what is conventionally considered natural and cultural, to illuminate that nature and culture are not separate spheres in practice, nor should they be. The New Norwegian wolves could be construed as such a hybrid (or natureculture) that combines aspects of nature and culture, and that enables protection in practice. Through this perspective, we could embrace the transformation of the New Norwegian wolves rather than lament their differences from the historic population. A wolf with a GPS collar, in this line of reasoning, would not be inferior to the latter due to a loss of wildness or naturalness. It might even be hailed as an entity that illuminates that the dualism of nature–culture is not real in any absolute sense, and that the presumed dualism only makes the conduct of practical politics such as protection more difficult.

Even if nature managers were ready to embrace the New Norwegian wolves as objects that transcend the nature–culture dualism, however, they would still face some practical management problems. The very real social representations of wolves, which Figari and Skogen described as stable and non-negotiable (Skogen et al. 2013, p. 76), are not likely to change in the near future, even if confronted with the academic criticism of the nature–culture dualism. One could also speculate – based on this case and what seems to be a larger international trend of proliferating technologies of protection in endangered species management – that issues of naturalness, wildness and authenticity might constitute new types of management challenges that are typical for the age of biodiversity.[9] The prospect of enrolling the majority of lay people in academic initiatives that champion naturecultures, hybrids or even the wilderness in the garden, however, seems doubtful at best in the short term. Nature managers (and others who partake in efforts to improve nature management) might therefore consider developing new strategies or technologies of government to counter the new challenges of the age of biodiversity.

[9] I do not mean to claim that the management challenges treated here are 'new' in an absolute sense – issues concerning the naturalness, wildness and authenticity of endangered species existed before the 1980s. The number and extent of technologies of protection constructed in the age of biodiversity might, however, have led such management challenges to become a new and more common type.

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