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."

[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,

[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.

which had roots in 18th century scientific agriculture and forestry, 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

[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).

national parks and the future of large carnivores in Nordic countries were the main 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.

[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.

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, 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

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)

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

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 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).

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.

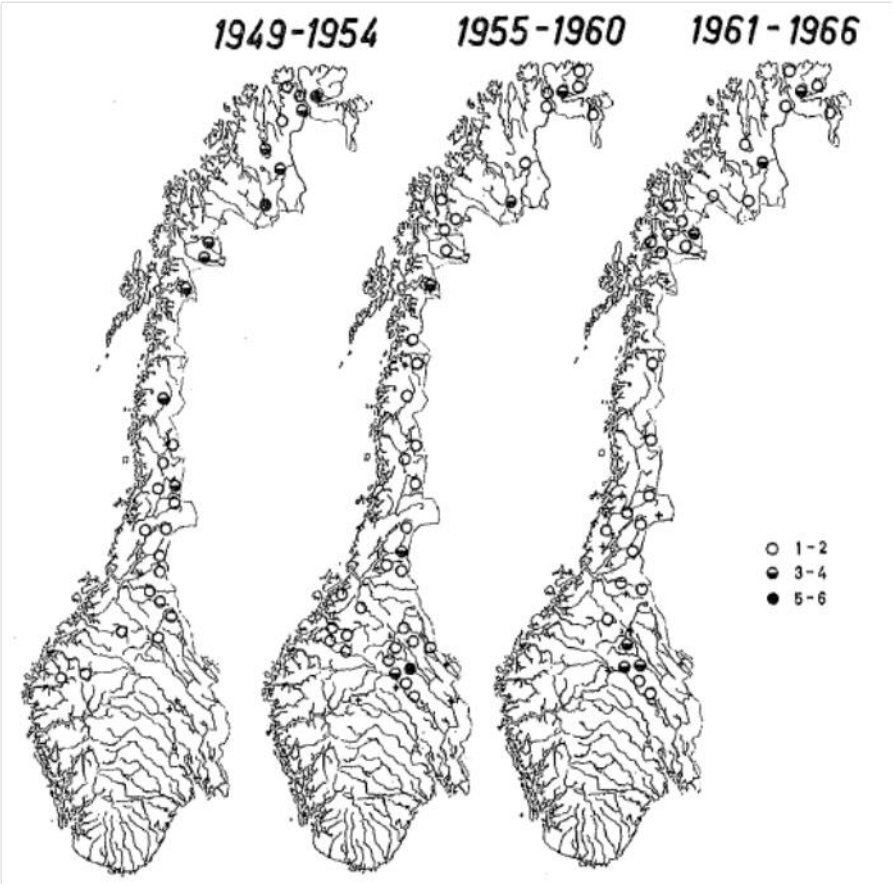


Fig. 2 Locations of wolves in Norway from 1949–1966, according to Myrberget's evaluation of newspaper notes. The different circles indicate how many of the six years in each period anyone had observed wolves. Crosses indicate dubious observations (Myrberget 1969b)

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. However, as wolves

[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.

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.

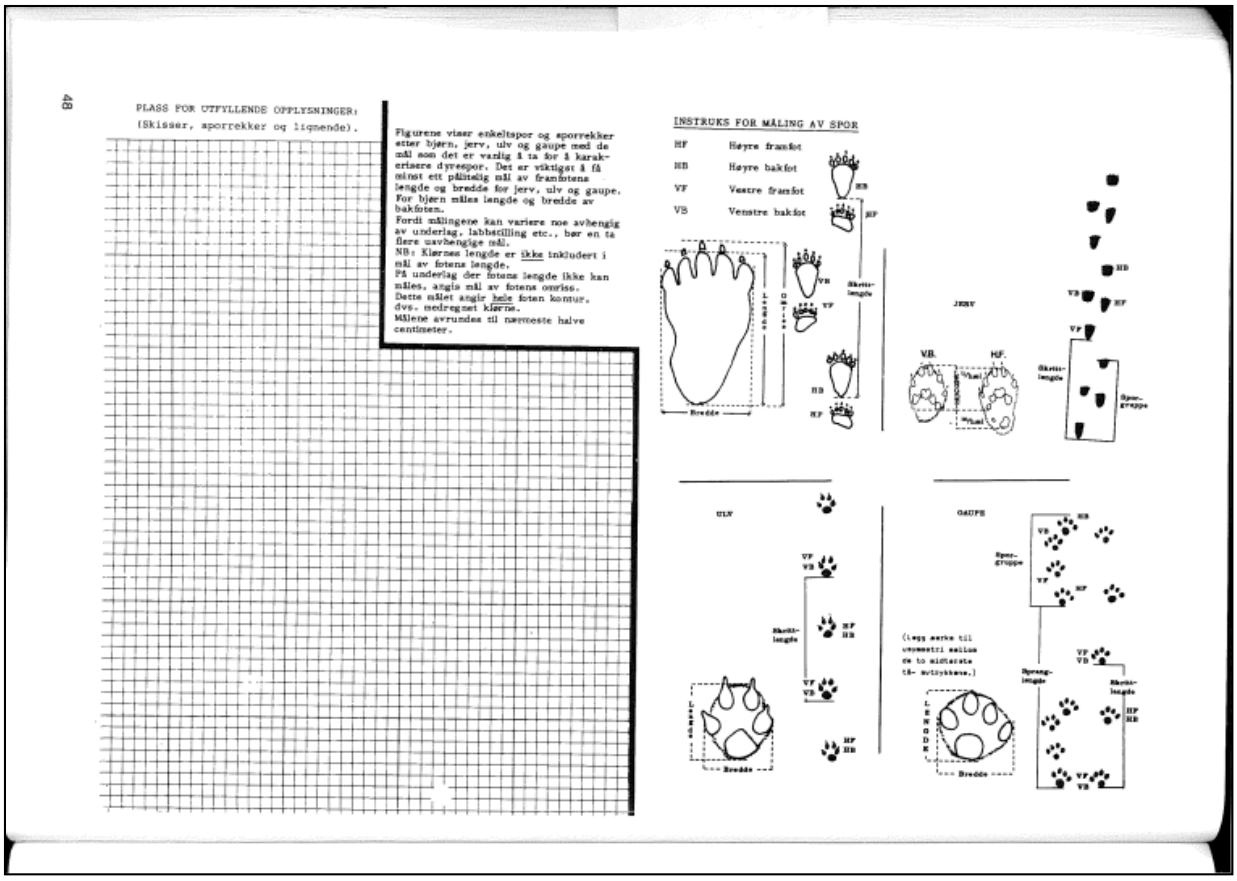


Fig. 3 Typical tracks of bear, wolverine, wolf and lynx – from a DN report published in order to make the observations of large carnivores more reliable (Myrberget and Sørensen 1981)

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).

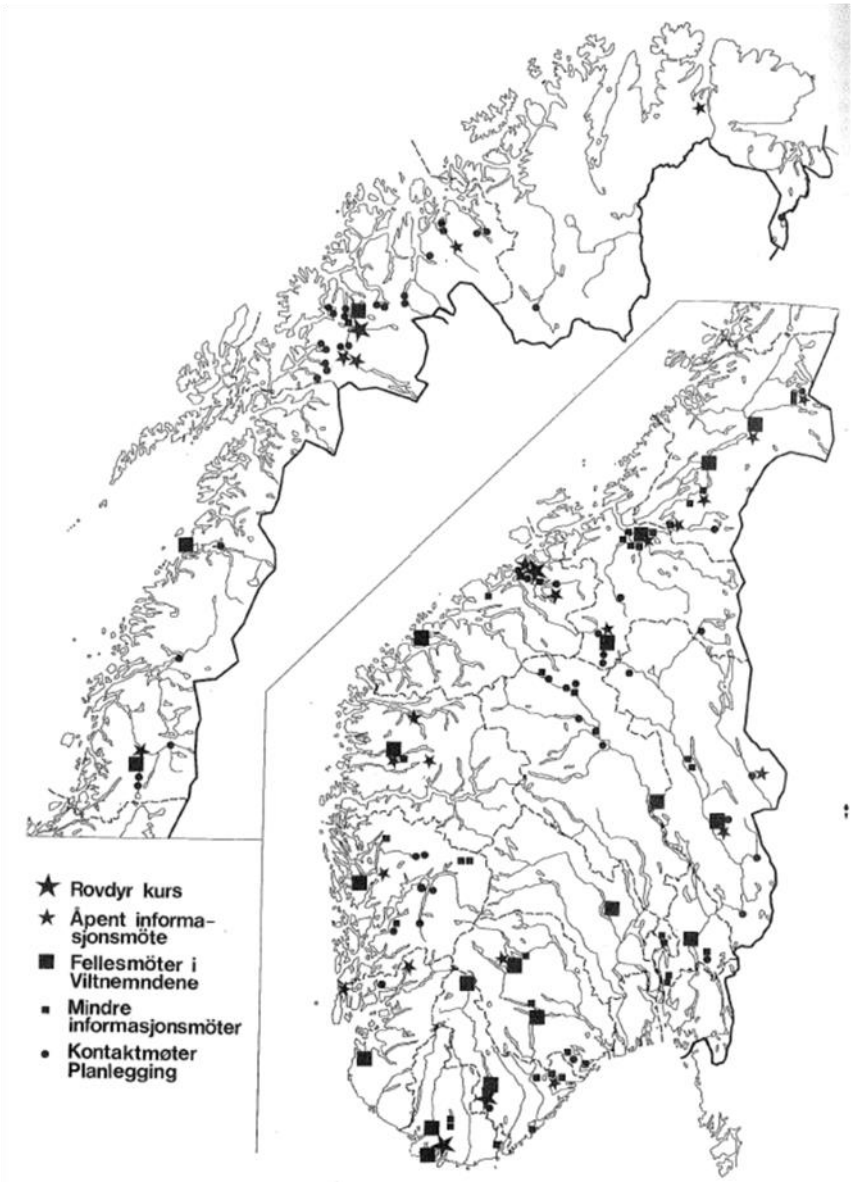


Fig. 4 Locations where the biologists arranged seminars (large stars), general information meetings (small stars), meetings for the local committees for game management (large squares), lesser information meetings (small squares), and contact meetings or planning (small circles) (Sørensen and Kvam 1984,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

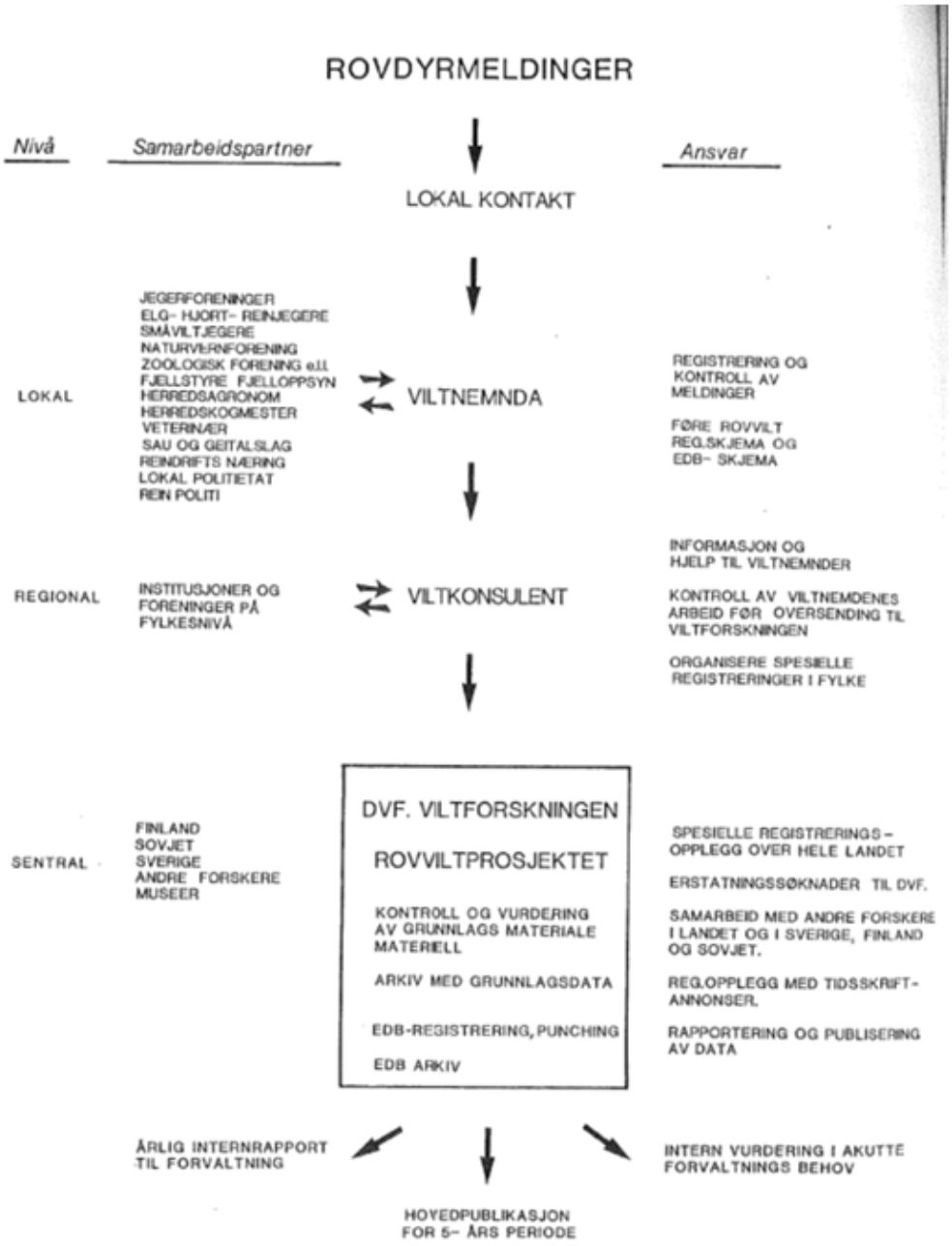
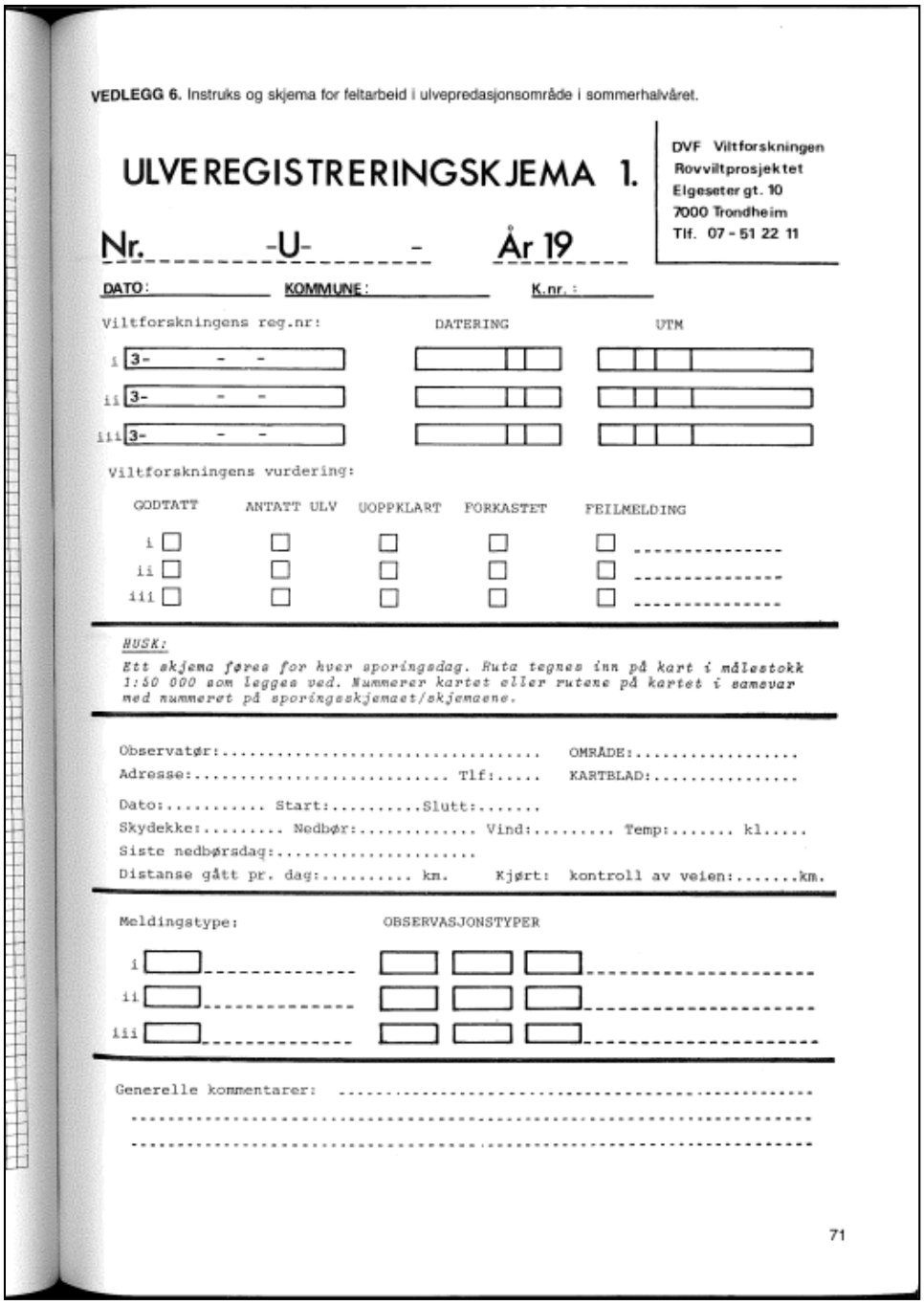


Fig. 5 Organizational model representing the biologists' intended flow of observations through the counting complex. The central line shows (with arrows) how observations were meant to travel from local contacts, through local committees of game management and regional consultants of game management, 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)

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).

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 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,

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

[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.)

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 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

[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):

> 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.

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.

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

[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).

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 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

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

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 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

[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.

samples at the core of the [Julussa] territory together with the alpha-female at the end of January" (Flagstad et al. 2009, p.9).

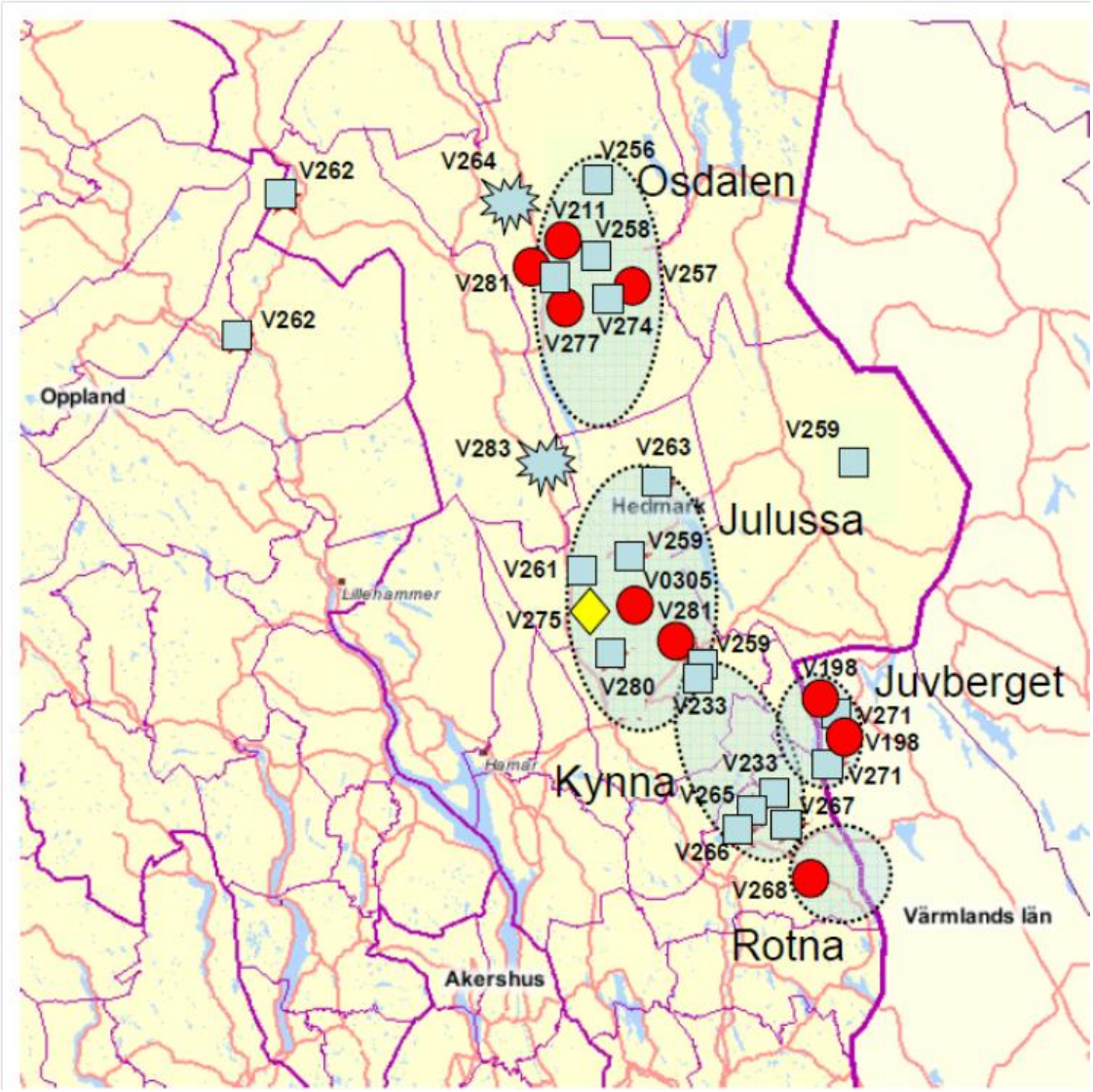


Fig. 7 Wolves identified by DNA analyses of material collected during winter 2008/2009. Blue squares indicate male wolves, red circles indicate female wolves, and the yellow diamond indicates an unidentified sex. The blue areas indicate wolf territories, and the star-like symbols represent killed wolves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

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 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

[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.

[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).

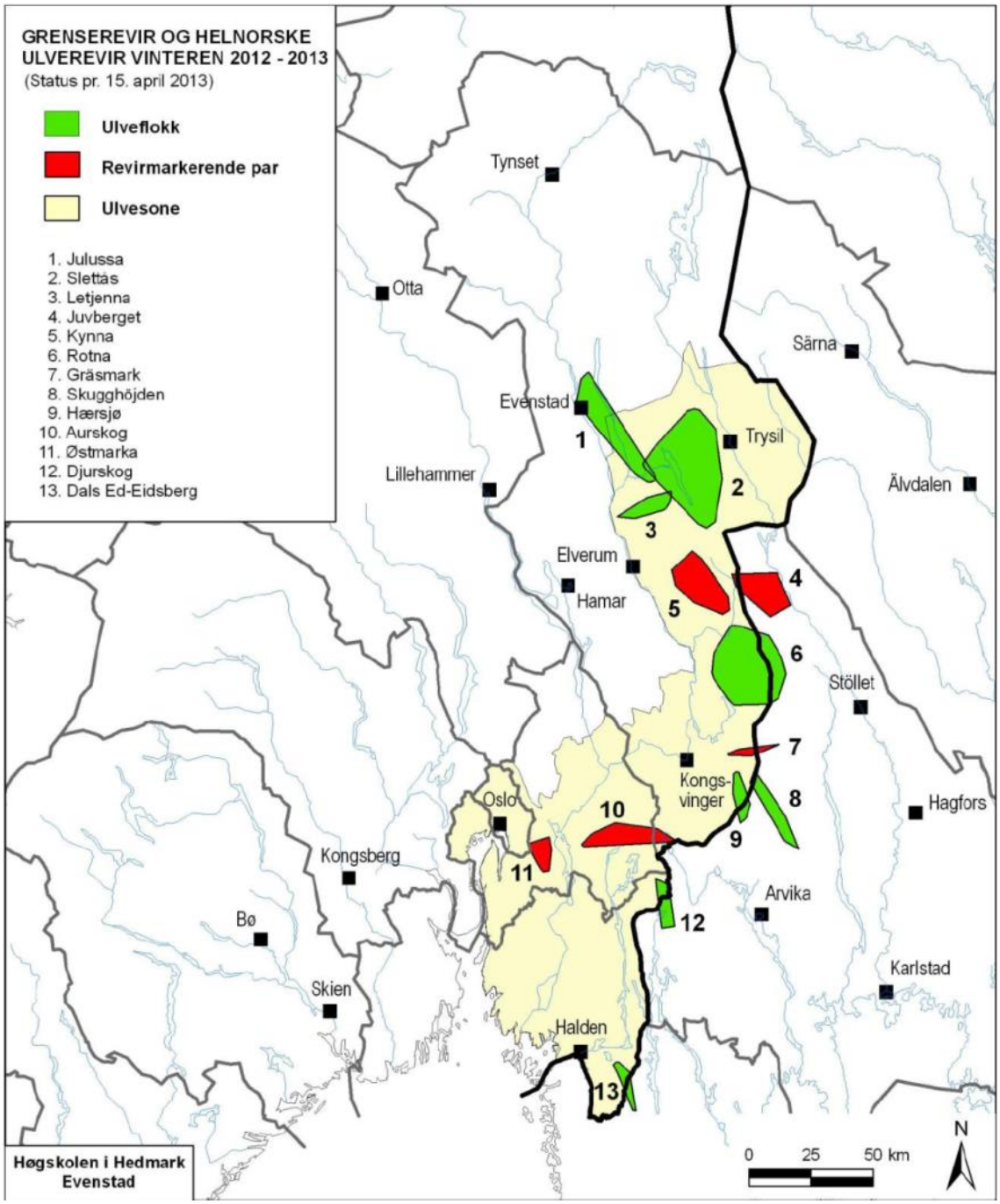


Fig. 8 Wolf territories in Norway in the winter of 2012/2013, according to a preliminary report. Green areas represent areas of residence for packs of wolves in which cubs were born in 2012, while red areas represent pairs of wolves marking territory. The yellow area indicates the current "wolf zone," 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

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.

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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