

POLICY PERSPECTIVE

Impact of Local Empowerment on Conservation Practices in a Highly Developed Country

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Abstract

Community-based conservation, where local decision makers are responsible for balancing conservation and development, is often preferred to exclusionary conservation that prioritizes use-limitation through strict regulation. Unraveling the evidence for conservation impact of different governance regimes is challenging. Focusing on conservation practices before and after a reform can provide an early indication of behavioral changes acting as a precursor to changes in social and ecological outcomes, which generally need more time to materialize. A recent reform in Norway provides a unique opportunity to evaluate the impact of local empowerment on conservation practices in protected areas. We analyzed 1,466 decisions in 31 protected areas before and after the reform while accounting for differences between private and public property ownership. We found that the conservation practices were liberal both before and after the reform. The impact of local empowerment on conservation practices was contingent on land tenure: more use was allowed after the reform on private land. We conclude that conservation impact evaluations could benefit from a before-and-after spatial approach taking into account land tenure for analyzing the impacts of local decision making.

Introduction

The conservation impact of protected areas depends on their governance, but the effect of different governance regimes on conservation remains uncertain (Macura *et al.* 2015). Exclusionary conservation where power is held with national authorities and enforced through strict legal regulations is, on the one hand, thought to favor conservation through use-limitation (Bruner *et al.* 2001; Locke & Dearden 2005), but too strict or poorly devised rules that fail to account for social impacts can reduce local support and rule compliance over time (Agrawal & Chhatre 2007; Chan *et al.* 2012). Community-based conservation attempts to address these challenges by combining local development with conservation, including stakeholders as active participants and/or devolve control over natural resources (Robinson & Redford 2004; Brooks *et al.* 2013). Local involvement is expected to gain support for conservation, foster stewardship, and provide

both ecological and social benefits through better use of local knowledge in policy implementation (Ribot 2002; Van Laerhoven 2010; Brooks *et al.* 2013).

The term community-based conservation represents various forms of local involvement depending on the sociopolitical context. It includes cases where: (1) the government grants decision making to local governing bodies, (2) the local communities own or have usage rights in the conserved area due to collective land tenures, and (3) the "local residents exercise de facto control in the absence of formal rights" (Poteete & Ostrom 2004; Hausner *et al.* 2012). Community-based conservation could further be understood as a bottom-up process where decision making starts at the local level and involves interactions at multiple levels (Berkes 2006; Baral 2012). This perspective reflects the fact that local decision making is constrained by conservation policies and rules originally crafted at higher levels of governance and depends on financial support from external sources.



Figure 1 Conservation objectives of Norwegian protected areas. The purpose of Norwegian protected areas is to safeguard areas of vulnerable and threatened nature, cultural heritage and cultural landscapes, and give the public the opportunity to experience nature through simple recreation. Here, illustrated by pictures of wild reindeer, recreation, and livestock grazing. Photos top, middle-right, and bottom by Morten Kielland and middle-left by Jørn Eriksson.

Other institutions, such as land tenure, add to the complexity of protected area governance (Ostrom 2007). Land tenure comes with a different set of values than conservation—values that are tied to the control of, access to, and extraction of resources (Berge 2006), rather than to the preservation of natural values for the general public associated with conservation (Figure 1). Society has generally been organized around these institutions for a much longer period than protected areas, providing them with a high degree of local legitimacy. Protected areas in Norway are designated on both private and public land, including land managed as commons, and a recent study has found that land tenure is more important compared with protected areas in determining how local residents value the landscape (Hausner *et al.* 2015). The

above suggests that land tenure could be an important factor affecting the impact of protected area governance.

A recent reform toward community-based conservation of Norwegian protected areas provides a unique case for studying the impact of governance using a before-and-after spatial design. Establishing protected areas in Norway has resulted in local resistance because residents feel their rights to use, access and decide are, or will be, limited by national authorities. To reduce local conflicts and improve integration between conservation and development the government decided, in 2009, to transfer decision-making authority to local protected area boards composed mostly of elected local representatives. The reform distributed the main responsibility for protected areas over a larger number of decision-making

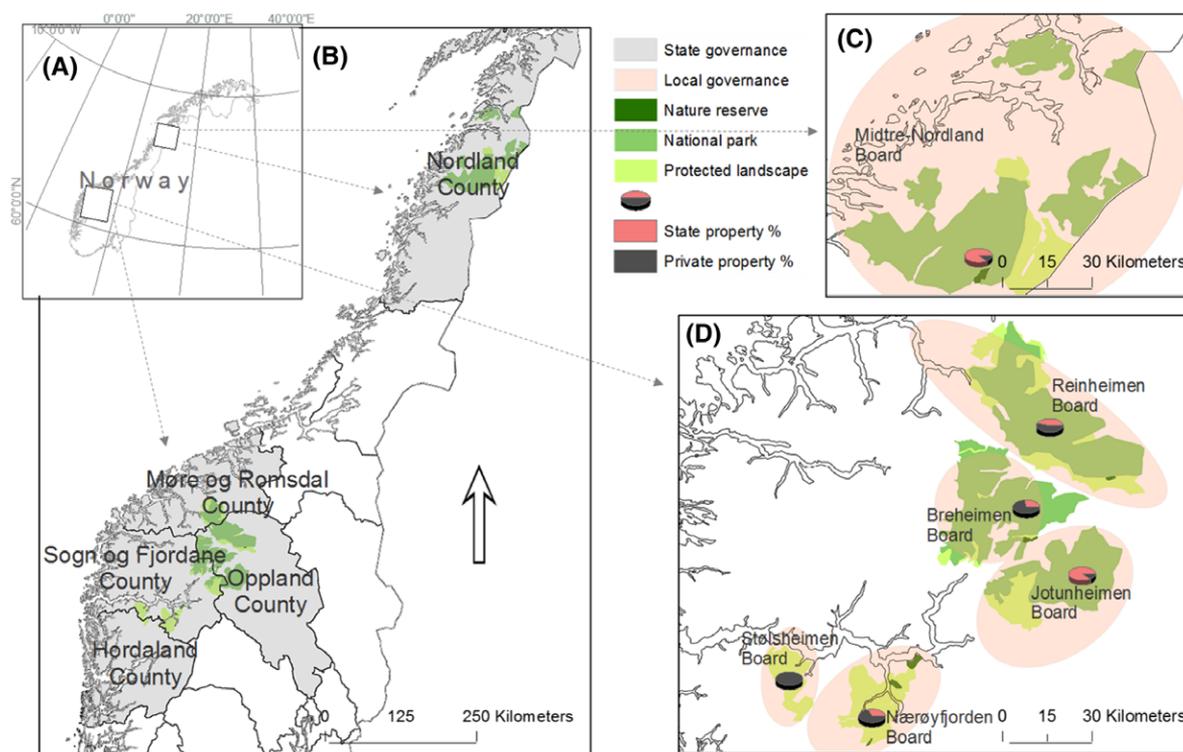


Figure 2 Protected area governance in Norway before and after the reform. (A) The location of the protected areas included in our study. (B) Before reform: the regional government responsible for the protected areas in each county are marked in gray and labeled. (C & D) After reform: local protected area boards manage clusters of protected areas, which are encircled. Protected area designations (IUCN categories) are shown in different shades of green. The proportion of public and private land managed by each protected area board is shown as pie charts.

bodies operating at a local scale (Figure 2). The reform is too recent to evaluate the impact of local empowerment on ecological or social outcomes, but it is possible to isolate the effect of governance on behavioral outcomes, such as the decisions made by local protected area boards regarding the use of protected areas. By investigating conservation practice before and after the reform, the effect of local empowerment can be evaluated at an early stage.

Our main research question relates to whether conservation practices of decision makers have changed because of local empowerment. To answer this question we analyzed conservation decisions associated with permits. Permits are the main tool for regulating activity in Norwegian protected areas and the most immediate way that local boards can influence the level of use. Each protected area has a set of rules (protection regulations) tailored to the local conditions which stipulates the activities that are prohibited, restricted, allowed, or require permits (Hausner *et al.* 2017). By investigating permits, we can assess which activities are deemed most threatening to conservation and how strictly the protected areas are protected. Ultimately, permit decisions reflect interactions between the different levels of governance, because decisions made by local boards that are perceived

incompatible with conservation objectives can be appealed or simply overturned by national authorities. Stakeholders can also appeal permit decisions if they disagree, reflecting their degree of acceptance of the decisions.

We ask:

- (1) Has local empowerment led to a more liberal conservation practice (i.e., are more permits granted)?
- (2) Has local empowerment led to an increased acceptance of conservation decisions?
- (3) Is the impact of local empowerment contingent on land tenure or protected area designations?

Before-and-after spatial design and analysis

Before-after studies are vulnerable to influences from confounding factors, which could be causing the observed difference apart from the intervention (i.e., local decision making; Ferraro 2009). Adding control sites, such as protected areas that match the characteristics of our study sites but where centralized governance has continued, is difficult because the reform has been extensive and includes most national parks (34 out of 37). Using a spatial design to control for other governance influences, such as

private and public land ownership, could reduce the risks of confounding factors in the before-after analysis.

We analyzed 1,466 decisions made before the reform by the government (i.e., the regional environmental authorities) and after the reform by local protected area boards (see supplementary material for more information about the reform, a description of the study areas and details on data collection). The 31 protected areas included in this study (Figure 2, Table S1) make up ~20% of the protected land area (kilometre²) of the mainland. National parks (IUCN II) make up 75% of the area, protected landscapes (IUCN V) 24.5%, and nature reserves (IUCN Ia) 0.7%. The proportion of public land is 68% in National Parks, 43% in Protected Landscapes, and 58% in Nature Reserves. The decisions analyzed span a 9-year period, from 2006 to 2014 (Table S2).

We used mixed logistic regression to test the conservation impact of local empowerment. We looked at the probability that an individual application was granted (GRANT), with decision-making authority (REFORM) as the predictor variable. Other variables that could determine the probability of a successful application were included as covariates. These were the different local protected areas boards included in the study, shown in Figure 2C and D (AREA; included as a random factor), the activity applied for (CATEGORY; since some activities conflict more with protection objectives than others and are therefore more likely rejected), PROTECTED_LANDSCAPE specifying whether the application involved an activity in protected landscapes or not (since protected landscapes allow more activities than national parks and nature reserves) and TENURE (as different property ownership can affect the decision maker's room for manoeuvre; see Table 1 for details about model terms).

The response variable y_{ij} , for application i in AREA $_j$ was denoted 1 for a granted application and 0 for reject. The probability of a granted application ($\Pr [y_{ij} = 1]$) is p_{ij} . Since the effect of the reform is the main focus of the analysis, the full model contained all the two-way interaction terms between REFORM and the covariates. We fitted a random intercept model with a logit link, with AREA as a random intercept, a_i .

$$\begin{aligned} \text{logit}(p_{ij}) = & \alpha + \beta_1 \times \text{PROTECTED_LANDSCAPE}_{ij} + \beta_2 \\ & \times \text{CATEGORY}_{ij} + \beta_3 \times \text{TENURE}_{ij} + \beta_4 \\ & \times \text{REFORM}_{ij} + \beta_5 \times \text{REFORM} \times \text{TENURE}_{ij} \\ & + \beta_6 \times \text{REFORM} \times \text{PROTECTED_LANDSCAPE}_{ij} \\ & + \beta_7 \times \text{REFORM} \times \text{CATEGORY}_{ij} + a_i \end{aligned}$$

We performed model selection using single-term deletion minimizing the AIC. We inspected the model fit

from simulated residual plots with values simulated both at the population level (i.e., without the random effect) and also taking into account the random effect, and tested for overdispersion. For the analyses, we used the software R (R Development Core Team 2016) and the libraries lme4, DHARMA, piecewiseSEM, AICcmodavg, and blmeco (Bates *et al.* 2015; Korner-Nievergelt *et al.* 2015; Hartig 2016; Lefcheck 2016; Mazerolle 2016).

Results

Model selection

The most parsimonious model was PROTECTED_LANDSCAPE + CATEGORY + TENURE + REFORM + REFORM:TENURE (see Table 2 for model output). The model was not overdispersed (dispersion_glm = 0.66). Marginal pseudo- R^2 (proportion explained by the fixed factors) of the final random effects model was 0.16 and conditional pseudo- R^2 (proportion explained by the both fixed and random factors) was 0.19. The main effect of REFORM and the interaction between REFORM and TENURE were statistically significant (Table 2).

Conservation practices before and after the reform

We found that the local protected area boards allowed slightly more use after the reform, but this effect was restricted to private land (Figure 3, Table 2). The conservation practices were liberal, in the sense that most permit applications were granted, both before and after the reform. Regional authorities granted 92% of the applications on both public and private land, whereas local protected area boards granted 92% on state land and 97% on private land.

The majority of the applications concerned motorized vehicle use (69%), most of which were on snow-covered ground. Property owners and other rights holders (land owners, cabin owners, usufruct right holders, hunters, fishers, farmers, reindeer herders) were responsible for the majority of the applications (53%) and recreation and tourism (trekking associations, extreme sport actors, sports clubs, dog clubs, tourism facilities) was the second most dominant stakeholder group (23%). Different categories of use were stricter than others. Figure 3 shows that the probability of a rejected application was highest for activities like buildings, industry development, and motorized vehicle use on bare ground.

The probability of allowing an activity was higher (marginally significant) for applications that concerned activities in protected landscapes compared with national parks and nature reserves. In total, 43% of all applications

Table 1 Variables included in the conservation practice analyses

Variable	Categories/levels	Explanation
Community-based conservation (REFORM)	After Before	After reform = local protected area board consisting mainly of local politicians. Before reform = regional environmental authority is the state's regional branch of the national government that held management responsibility in the study areas before the reform.
AREA	Breheimen, Jotunheimen, Nordland, Nærøfjorden, Reinheimen, Stølsheimen	Each local protected area board is responsible for clusters of protected areas, except Stølsheimen that consists of one protected landscape.
CATEGORY	Consists of the following seven categories: Industrial development Buildings Bare-ground motor Visitor facilities Local use facilities	Modern installations like power plants, micropower plants, and power lines. New buildings, expansion or restoring/maintenance of existing buildings. Motorized vehicle use on bare ground including mainly ATVs, but also cars, excavators, and other tracked vehicles. Bridges, paths, roads, signs, campsites, benches where the main purpose is stated as visitor use or the applicant is a stakeholder grouped as recreation and tourism. Bridges, paths, roads, signs, fences, docks, boxes for storing equipment, benches, boat storage, campsites, salt for free-ranging livestock where the main purpose is local use or the applicant is a stakeholder grouped as property owner and/or user rights holder.
PROTECTED_LANDSCAPE	Local resource use Organized activity Research Snow, air, and water motor A dichotomous variable reflecting if the application concerns a protected landscape (yes) or a stricter designation (no).	Extracting wood, rock, turf. Releasing hatchery-produced fish. Competitions, festivals, dog tries, camping, horseback riding. Research activities like sampling plants, catching wildlife, installing instruments like cameras, thermometers, etc. Motorized vehicle use on snow-covered ground, in the air or on water.
TENURE	A dichotomous variable specifying whether the application involves protected areas where the public owns less than (private) or more than 50% of the area (public).	The protected areas in the study area consist of national parks (NP), nature reserves (NR), or protected landscapes (PL) as defined by IUCN criteria. An application may concern more than one protected area, and the variable only specifies whether a protected landscape is included or not.
GRANT	A dichotomous variable saying if the application was granted or not.	In cases where the application concerned more than one protected area, the area owned by the state was summed across these protected areas and divided by their total area, giving an overall proportion of state versus private land for all the protected areas included in the application. Applications that were granted and partly granted were defined as granted.

Table 2 The most parsimonious mixed logistic regression model of the probability of a granted application. Model parameter estimates on a logit scale

	Estimate	Std. Error	z-value	P-value	
REFORM (after), PROTECTED_LANDSCAPE (no), CATEGORY (organized activity), TENURE (private)	2.94	0.65	4.50	0.0000	***
PROTECTED_LANDSCAPE (yes)	0.49	0.29	1.70	0.0899	.
CATEGORY (bare-ground motor)	-1.08	0.62	-1.74	0.0819	.
CATEGORY (buildings)	-0.83	0.60	-1.38	0.1672	
CATEGORY (local use facilities)	-0.45	0.65	-0.70	0.4850	
CATEGORY (industrial development)	-0.99	0.71	-1.39	0.1638	
CATEGORY (snow, air, and water motor)	0.77	0.57	1.35	0.1779	
CATEGORY (visitor facilities)	-0.25	0.75	-0.33	0.7414	
CATEGORY (research)	1.52	1.15	1.32	0.1885	
CATEGORY (resource use)	-0.49	0.76	-0.64	0.5239	
TENURE (public)	-0.65	0.49	-1.32	0.1884	
REFORM (before)	-0.98	0.35	-2.77	0.0056	**
REFORM (before): TENURE (public)	1.18	0.48	2.47	0.0135	*

Random effects (AREA): variance 0.1146, $n = 1,466$, dispersion_glm = 0.66.

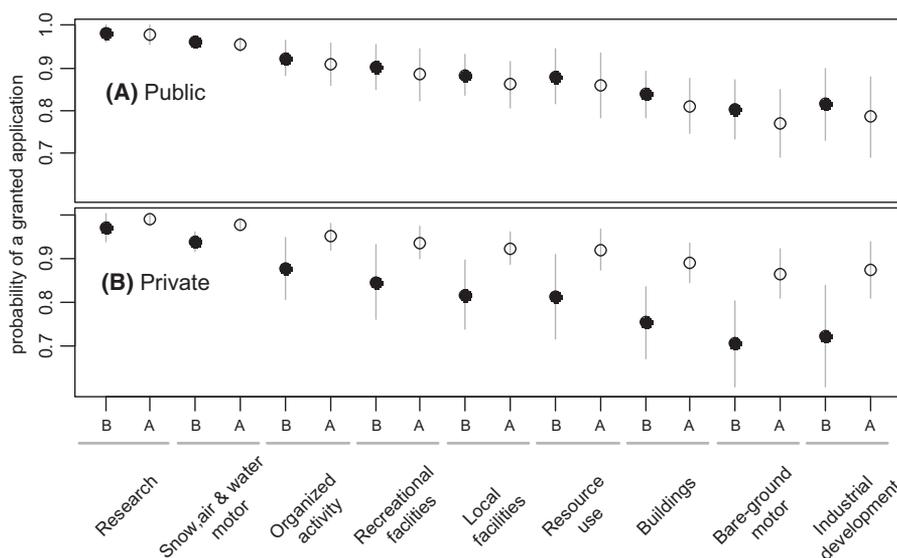


Figure 3 Strictness level before and after the community-based conservation reform: The probability of a granted permit-application (± 1 SE) before and after (the reform for the different use categories, and by land tenure. Filled and hollow circles separate between before and after, respectively. Plot A and B separate between the probability of a granted decision depending on whether more than 50% (public) or less than 50% (private) of the protected area(s) (kilometre²) affected by the permit application was on public land. Estimates are predictions from a mixed logistic regression model when the model term PROTECTED_LANDSCAPE has been defined as no, meaning that probabilities reflect applications that involve nature reserves and/or national parks (see text for details).

concerned activities in a protected landscape even though protected landscapes only make up 24% of the total area. The number of permits for buildings and industrial development relative to the total area was higher in protected landscapes than in national parks (Figure S1).

National authorities only appealed or overturned local board decisions on five occasions. Stakeholders also seemed relatively pleased with the decisions since they appealed a slightly lower portion of permit decisions after the reform (3.95% before compared with 2.50%

after the reform). Permit applications that concerned buildings, motor use on bare ground, and industrial development were appealed most often relative to the number of applications in these categories (Table S3).

Evaluating the impact of local empowerment on conservation practices

The conservation impact of local empowerment is challenging to evaluate empirically. Site comparisons are

frequently used to evaluate whether community-based conservation or centralized governance is more effective in terms of attaining conservation impact. The use of before-and-after spatial designs that allow for the assessment of alternative explanations of the pattern observed is less common (Nolte *et al.* 2013; Macura *et al.* 2015). A before-and-after design allowed us to control for the influences of protected area designation and land tenure to detect the impact of local empowerment on conservation practices. The analyses of the reform showed that conservation practices were slightly more liberal on private land after the reform. Conservation is a national undertaking and restricting use on public property is often considered more legitimate than on private property. Conflicts with property owners was one of the main reasons for embarking on this reform, and we found indications of a higher acceptance of conservation practices as a result of local empowerment, at least as suggested by the slight reduction in the number of appeals on conservation decisions.

Most studies on community-based conservation are from developing countries (Brooks *et al.* 2013; Macura *et al.* 2015). In highly developed countries, such as Norway, fewer people rely on local resource utilization for their livelihood, and conservation conflicts are more often rooted in the right of self-determination over properties owned through generations (Hausner *et al.* 2015). Our results suggest that local decision making could alleviate conflicts, but at the expense of more use of protected areas designated on private property. Aichi target 11, aiming at conserving 17% of terrestrial areas and inland waters means that more private land is likely to be conserved in the future, resulting in similar conservation challenges as in Norway.

A premise of community-based conservation is that communities should receive socioeconomic benefits from conservation, either directly by linking conservation with development or indirectly through compensation (Brooks *et al.* 2013). Because environmental authorities before the reform already granted most uses, it is at present, difficult to see how conservation impact can be improved through local empowerment, since there seems to be little room left for local boards to increase benefits to local stakeholders. There are limits to how lenient it is possible to get without turning the protected areas into “paper parks”—i.e., protected areas that are protected on paper but not managed nor enforced in practice and Norwegian protected area governance is already less strict than other countries with similar socioeconomic and ecological conditions (Fauchald *et al.* 2014; Hausner *et al.* 2017). Preferably, impact assessments should be performed before embarking on widespread reforms. This way it is possible to better understand where

the opportunities to achieve conservation impact are, and institutions can be designed with a clearer assumption on what to expect from governance interventions.

The lack of any substantial change in conservation practices also points to the fact that reforms often tend to build on each other rather than replace each other (Driessen *et al.* 2012) and that including counterfactual scenarios of continued centralized governance and “no protection” is needed to better establish causal relationships and assess conservation impact. The next steps should be to analyze avoided use by comparing protected sites with sites that match in all other aspects related to use, but which are not protected. One way to do this is to extend our analysis of conservation practices to compare protected areas with sites subject to municipal planning outside protected areas. Another more common approach is remote sensing to assess long-term ecological impact of protected areas (e.g., Nelson & Chomitz 2011). A limitation of before-and-after spatial design using quantitative analysis of conservation decisions is that we cannot rule out a possible change in behavior of the applicants, for example, through better communication with park managers during the decision process. According to a few other studies there are, however, few signs that conservation practices have changed much in terms of involvement of local stakeholders in decision making (Overvåg *et al.* 2015; Hovik & Hongslo 2016).

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

This section includes a more detailed overview of Norwegian protected area governance before and after the community-based conservation reform, a description of the study areas, a methods section describing data collection, and an overview over appeals made by stakeholders and environmental authorities during the study period.

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Supporting material

Study areas

Nordland protected area board managed eight protected areas during the study period, covering an area of around 4000 km² (recently the board became responsible for six additional nature reserves not included here). This includes five national parks (NP), two protected landscapes (PL) and one nature reserve (NR). Junkerdal NP (2004), Sjunkehatten NP (2010) and Láhko NP (2012) are relatively recently established parks, whereas the other protected areas were established between 1971 and 1998. The interests of the indigenous people, the Sami, in the areas are catered by the appointment of board-members selected by the Sami Parliament. Sjunkehatten NP stands out in that it targets children in particular and Junkerdal NP because it explicitly states in the protection regulation that the area's natural resources is safeguarded for commercial interests. The processes of establishing both Sjunkehatten NP and Junkerdal NP were based on a successful partnership approach initiated by the County Governor (Bay-Larsen, 2012 ; Bay-Larsen & Sandersen, 2005). The County Governor in Nordland managed the areas up until the protected area board was established in 2010.

Reinheimen protected area board manages eight recently established protected areas (2006-2009) covering an area of 2600 km² that consist of one national park, six protected landscapes and one nature reserve. The flagship species wild reindeer *Rangifer tarandus tarandus* is an important reason for protecting these areas. Ottadalen Wild Reindeer Committee therefore has one representative on the protected area board. The County Governor in Møre og Romsdal and Oppland held the management responsibility the first year of establishment. After that, a municipal board was formed in 2008 as a first attempt at local management. Here the

municipals decided separately in matters that affected the area within each municipality and coordinated efforts in matters covering several municipalities.

Breheimen protected area board manages seven recently established protected areas (2009) covering an area of 1800 km² that consist of one national park, five protected landscapes and one nature reserve. Preserving wild reindeer habitat is also important here. Approximately 70% of the national park lies on private property and most of it belonging to Skjåk Village Commons. Skjåk Village Commons therefore has one representative on the protected area board. The County Governor in Oppland and Sogn og Fjordane managed the areas the two first years (2009-2010) and in 2011 the protected area board took over.

Jotunheimen and Utladalen protected area board manages Jotunheimen NP and Utladalen PL, covering an area of 1465 km². Both are relatively old (1980) and well-established protected areas. Jotunheimen is one of the iconic parks in Norway with strong ties to the Norwegian culture of traditional outdoor recreation and cabin-to-cabin hiking. Norway's tallest mountains are found here. The County Governor in Sogn og Fjordane and Hordaland managed the areas before the protected area board was established in 2011.

Nærøyfjorden protected area board manages two protected landscapes and three nature reserves, covering an area of 650 km². Nærøyfjorden PL, Bleia-Storebotnen PL and Bleia NR are recently established (2002-2004) whereas Grånosmyrane NR and Nordheimsdalen NR were established in 1995 and 1999, respectively. The whole area is also a part of a UNESCO natural heritage site. A separate foundation, Nærøyfjorden World Heritage Park, is in charge of local community- and commercial activity development in the world heritage area, whereas the protected area board holds the management responsibility. The uniqueness of the area lies

in part in its mountain and fjord landscape with a prominent cultural landscape supporting elevated, inaccessible mountain farms. The County Governor in Sogn og Fjordane and Hordaland managed the areas before the protected area board was established in 2012.

Stølsheimen protected area board manages Stølsheimen PL of 380 km², established in 1990. The PL shares some characteristics with the Nærøyfjorden area in that they both share the coastline of Norway's longest and deepest fjord, Sognefjorden. Maintaining the characteristic cultural landscape created through generations of outfield-based farming and traditional farm buildings is an important part of the protection. The County Governor in Sogn og Fjordane and Hordaland managed the area before the protected area board was established in 2012

Table S1. Overview over protected areas, year of protected area designation (NP=National Park, NR=Nature Reserve, PL=Protected Landscape) and their size and location by county and municipality for the different protected area boards included in the study (source: Multiconsult 2014).

<i>Protected area board</i>	<i>Protected area</i>	<i>PA designated</i>	<i>km²</i>	<i>County</i>	<i>Municipality</i>
<i>Breheimen</i>	Breheimen NP	2009	1691	Oppland, Sogn og Fjordane	Skjåk, Lom, Luster
<i>Breheimen</i>	Vigdalen PL	2009	29	Sogn og Fjordane	Luster
<i>Breheimen</i>	Mørkridsdalen PL	2009	35	Sogn og Fjordane	Luster
<i>Breheimen</i>	Strynefjellet PL	2009	12	Oppland	Skjåk
<i>Breheimen</i>	Mysubytta PL	2009	6	Oppland	Skjåk
<i>Breheimen</i>	Høydalen PL	2009	11	Oppland	Lom
<i>Breheimen</i>	Høyrokampen NR	2009	10	Oppland	Lom
<i>Jotunheimen and Utladalen</i>	Jotunheimen NP	1980	1151	Oppland, Sogn og Fjordane	Lom, Vågå, Vang, Årdal, Luster
<i>Jotunheimen and Utladalen</i>	Utladalen PL	1980	314	Sogn og Fjordane	Årdal, Luster
<i>Midtre Nordland</i>	Saltfjellet- Svartisen NP	1989	1850	Nordland	Bodø, Rana, Rødøy, Meløy, Beiarn, Saltdal
<i>Midtre Nordland</i>	Junkerdal NP	2004	682	Nordland	Saltdal, Fauske
<i>Midtre Nordland</i>	Rago NP	1971	171	Nordland	Sørfold

<i>Midtre Nordland</i>	Sjunkhatten NP	2010	418	Nordland	Bodø, Fauske, Sørfold
<i>Midtre Nordland</i>	Láhko NP	2012	188	Nordland	Beiarn, Gildeskål, Meløy
<i>Midtre Nordland</i>	Gåsvatnan PL	1989	119	Nordland	Bodø, Beiarn, Saltdal
<i>Midtre Nordland</i>	Saltfjellet PL	1989	508	Nordland	Rana, Saltdal
<i>Midtre Nordland</i>	Storlia NR	1989	24	Nordland	Rana, Saltdal
<i>Nærøyfjorden</i>	Nærøyfjorden PL	2002	547	Hordaland, Sogn og Fjordane	Voss, Vik, Aurland
<i>Nærøyfjorden</i>	Bleia-Storebotnen PL	2004	66	Sogn og Fjordane	Aurland, Lærdal
<i>Nærøyfjorden</i>	Bleia NR	2004	22	Sogn og Fjordane	Lærdal
<i>Nærøyfjorden</i>	Grånosmyrane NR	1995	4	Sogn og Fjordane	Aurland
<i>Nærøyfjorden</i>	Nordheimsdalen NR	1999	13	Sogn og Fjordane	Aurland
<i>Reinheimen</i>	Reinheimen NP	2006	1969	Møre og Romsdal, Oppland	Lesja, Skjåk, Lom, Vågå, Norddal, Rauma
<i>Reinheimen</i>	Tafjorden-Reindalen PL	2006	74	Møre og Romsdal	Norddal
<i>Reinheimen</i>	Trollstigen PL	2006	146	Møre og Romsdal	Norddal, Rauma
<i>Reinheimen</i>	Romsdalen PL	2006	136	Møre og Romsdal	Rauma

<i>Reinheimen</i>	Lordalen PL	2006	21	Oppland	Lesja
<i>Reinheimen</i>	Finndalen PL	2006	34	Oppland	Lom
<i>Reinheimen</i>	Ottadalen PL	2006	223	Oppland	Skjåk, Lom, Vågå
<i>Reinheimen</i>	Brettingsmoen NR	2009	6	Oppland	Lom
<i>Stølsheimen</i>	Stølsheimen PL	1990	373	Sogn og Fjordane, Hordaland	Voss, Vaksdal, Modalen, Høyanger, Vik

Data collection

A database over decisions about permit applications in all the 31 protected areas was developed. Decisions made by protected area boards and the municipal board in Reinheimen were downloaded from nasjonalparkstyre.no (a site where each protected area board has its own page), miljovedtaksregisteret.no (a register over all public decisions made in the area of environmental management and protection), and OEP.no (the central governmental agencies' electronic public records). Decisions made by the County Governor before the reform was provided by the staff at the County Governor's Office in the counties Sogn og Fjordane, Nordland, Hordaland, Oppland and Møre og Romsdal, as well as by online request through OEP.no. Our study period was limited to the years from 2006-2014, ensuring that we captured years before and after the reform for all the study areas (Table S2). The database should be considered complete, with one exemption for Nordland where decisions made between 2008-2010 are missing.

The decisions were categorized according to management authority (REFORM), the study areas currently managed by the different boards (AREA; Fig. 1), the nature of the application (CATEGORY), the strictness level of the affected protected area(s) (PROTECTED_LANDSCAPE), a variable categorizing the applicants in stakeholder groups (APPLICANT) and whether or not the application was granted (GRANT; Table 1). In the cases where the application covers more than one category we chose the category reflecting the "main" purpose of the application. Meaning that if an application concerned both buildings and motorized vehicle use for transporting the equipment needed, the application was categorized as building. Some applications resulted in two or more separate permit-decisions. In these few cases we treated them as individual applications in the statistical analyses, assuming that the individual decisions can be considered independent.

Table S2. A) Study overview, showing the protected area clusters, their decision-making authority at different periods (local protected area board=light grey, regional environmental authority, the County Governor= grey, municipal board= black) and the date of protected area board establishment. B) Distribution of permit-applications. The protected areas in Breheimen were established in 2009 and the low number of applications this year is potentially a reflection of that. Similarly, in 2008-2010 in Nordland the numbers do not reflect total number of applications. Applications concerning the national parks Sjunghatten (n=61) and Lahko (n=2) are not included since these protected areas were established after the reform.

a)	2014	2013	2012	2011	2010	2009	2008	2007	2006	
<i>Breheimen</i>	Jan. 19 th				<i>PAs established 2009</i>					
<i>Jotunheimen</i>	June 14 th			<i>County Governor</i>						
<i>Nordland</i>	Protected area board			June 11 th	<i>No permits available</i>					
<i>Nærøyfjorden</i>	Aug. 30 th									
<i>Reinheimen</i>	March 6 th	Municipal board						<i>PAs established 2006</i>		
<i>Stølsheimen</i>	Aug. 30 th									
b)										
<i>Breheimen</i>	52	77	68	55	65	10				
<i>Jotunheimen</i>	23	31	30	6	16	26	12	30	30	20
<i>Nordland</i>	44	70	61	65	-	23	36	20	<i>No data available</i>	
<i>Nærøyfjorden</i>	25	26	23	22	24	9	13	11	15	
<i>Reinheimen</i>	85	44	26	52	89	51	55	43	64	
<i>Stølsheimen</i>	13	19	7	18	14	11	13	15	7	

Results

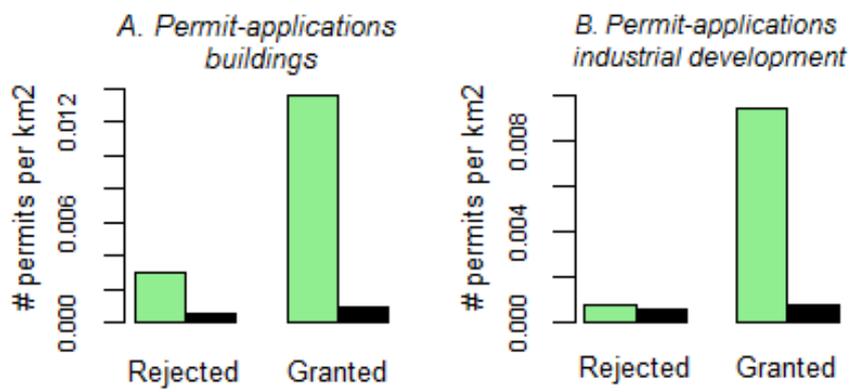


Figure S1. Plot A and B show the number of rejected and granted applications per km² for building new buildings and facilities for industry over the course of the study period for the different protected area designations (IUCN V in green and IUCN I & II in black).

Appeals

The applicant, the affected third parties or the County Governor can appeal decisions made by the protected area boards. The boards subsequently decide whether new information has come to light that allows them to alter their decision in favor of the appellant (i.e. person/organization that made the appeal). If this is not the case then the appeal is forwarded to the Environmental Agency. Originally, with the new reform, the Environmental Agency formulated an initial recommendation and the Ministry made the final decision. This practice was changed in January 2015 so that the Environmental Agency is currently the highest appellate authority, which is similar to the situation before the reform when decisions made by the County Governor and the municipal board in Reinheimen were appealed to the Environmental Agency.

Table S3. Appeals over the study period by category and the percent appealed out of the total number of applications. Ordered from highest portion appealed to the lowest. The appeals were made by stakeholders (n=39) and environmental authorities on both granted and rejected applications. .

Category	Appeals	Applications	% Appealed
Industrial development	7	38	18.42
Bare	8	73	10.96
Building	12	128	9.38
Organized activity	2	54	3.70
Visitor facilities	1	56	1.79
Snow, air & water motor use	14	944	1.48
Local use facilities	0	95	0.00
Research	0	42	0.00
Resource use	0	36	0.00
Totalsum	44	1466	3.00

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