Knowledge-based management of protected areas and hydropower: The case of Norway

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1. Introduction

This article presents results from a research project on scientific advice and management of protected areas and hydropower in Norway[1] in an international context Our point of departure was Norway's firm support to knowledge-based management, international environmental commitments, and the growth in international and national knowledge concerning ecosystem services and nature management (TEEB, 2010; GEO 2012; MEA 2005; White Paper 2006-2007; White Paper 2015-2020). Knowledge-based nature management is a relevant field in which to explore the relations between science and policy.

In our study we focus specifically on ecological scientific advice. Ecology is defined as the science of 'studying the relationship of organisms with their environment' (Stauffer 1957), which more specifically addresses issues relating to biodiversity and ecosystems. The reason for this focus is that ecological advice has traditionally been the key concern in Norwegian knowledge-based nature management (White Paper 2006-2007; White Paper 2015-2020) – not that ecological advice is necessarily superior to other types of environmental advice. Environmental science/advice is the broader 'multidisciplinary

[1] The project has financial support from the Research Council of Norway: *Designing Knowledge-Based Management Systems for Environmental Governance in Norway.* Project number 230374. See also Andresen et al. (2017) for an introduction to the project.

study of all aspects of the Earth's physical and biological environment' and would hence typically include scientific knowledge concerning the broad range of environmental issue areas, including both climate change and biodiversity.[2] There is a growing amount of literature on ecological management within environmental governance studies as well (Biermann et al., 2010; Chong 2014). Very few of them, except for those studying REDD+ (see e.g. Wallbott and Rosendal 2018), look at potential negative effects of following scientific advice from one environmental issue area in another (Dooley 2018). The broad range of potentially competing types of environmental knowledge and concerns relating to climate change and biodiversity can contribute to explaining the use of ecological scientific advice in nature management (Underdal 2010).

We ask whether and why ecological knowledge – nationally and internationally – has been applied in Norwegian nature management. We have selected two cases in which ecological knowledge could be expected to play a critical role for management: *hydropower* and *protected areas*.

Norway is a hydropower 'superpower'. As the top hydropower producer in Europe, Norway has taken international leadership through the UN and the World Bank to promote sustainability in water resource management standards internationally (Eikeland and Schei forthcoming 2019). Thus, we would expect Norway's *national* management of hydropower to be based on solid ecological knowledge and high priority for nature management – a potential role model for other countries contemplating hydropower as an energy solution.

[2] On terminology: In our study we use the more general concepts of environmental knowledge and scientific knowledge interchangeably and we use ecological knowledge to coin this more specific type of environmental knowledge. On the concepts of scientific knowledge and scientific advice, 'advice' is more often thought of as one step further in bridging the gap between scientific knowledge and its application in policy decisions. Regarding nature management, conservation and protection: we apply conservation as the most inclusive term, which includes management. The term protection is more specifically aimed at safeguarding species and ecosystems.

Regarding protected areas, Norway is noteworthy as a sparsely populated country with comparatively low barriers to setting aside vulnerable and representative ecosystems. Norway's tradition of profiling itself as an environmental advocate internationally, not least through the Convention on Biological Diversity (CBD) and the biodiversity issue-area (Rosendal 2004; 2007; Skjærseth 2004), makes it reasonable to expect that more ecological knowledge has led to improved nature management. On the other side, both of our selected cases are likely to invoke land-use conflicts, as any ecologically based advice for stricter protection (either of river systems or protected areas) will tend to conflict with interests in alternative types of utilization. However, the land-use conflict potential could be expected to be greater in the hydropower case, partly because the direct alternative use is evident and economically tempting (hydropower) and because a 'protected area' has already been designated a status of protection. Hence, comparing the two cases might bring interesting differences and similarities to light.

Our first case analyses Norway's local management reform, which placed responsibility for protected areas (PA) at the municipal level. The local management reform was adopted in 2009 and involves a significant shift in the management authority – from government officials representing the state at the regional level to management boards composed of local and regional politicians. The reform involves large territories, covering approximately 75% of the land area currently with PA status in Norway.

The hydropower case study documents changes, primarily during the past ten years, in integrating nature protection concerns in decisions taken by the hydropower licensing authorities regarding river ecosystems. The focus of investigation is a series of management

instruments and practices established specifically for integrating nature protection concerns into hydropower management for new licenses and re-licensing.

Our analysis is guided by case-study methodology (Yin 2003), which allows the researcher to pinpoint causal mechanisms in complex cases, evaluate the quality of data, and sort out chronologies of events. Data were collected from multiple sources, including public records and secondary literature. Findings have been tested through interviews with key state actors at national, local and regional levels. These actors are from the Ministry of Climate and the Environment, the Norwegian Environment Agency (formerly Directorate for Nature Management), the Norwegian Water Resources and Energy Directorate, the Regional Water Management Unit in Agder, representatives from research communities and hydropower companies (Eikeland and Schei forthcoming 2019; Fauchald and Gulbrandsen 2012, 2014, and forthcoming 2019; L'Abée-Lund and Villar 2017).

2. Theoretical and conceptual perspectives

Most analysts consider science to be a necessary but insufficient decision-making premise for (environmental) management. Scientific knowledge is essential for diagnosing problems and prescribing cures. Informed management of the environment requires that scientific findings be applied as premises for policy decisions, and actively utilized. That does not mean that science is always the most important decision-making premise, as greater weight is often accorded to economic and political considerations. However, scientists can provide key insights into how to protect and manage nature and the environment (Underdal 2000).

Separating science from policy is not always easy. While scientific research is the major supplier of *systematic and controlled* knowledge, typically through the work of various

national and/or international scientific panels, natural scientists are obviously not the sole producers of knowledge (Andresen and Rosendal 2017). 'Knowledge' is a broad concept and is provided by a wide range of actors and stakeholders. For example, indigenous people may possess traditional knowledge and insights relevant for the management of the environment and resources at hand. It has long been convincingly argued that separating science and policy is difficult because the two processes are so intertwined (Jasanoff 1990). In principle we agree, but argue that this is essentially an empirical question. By 'policy', we here mean the decisions on management (rules, norms and practices) for governing protected areas and hydropower development.

Since Jasanoff's much cited article, a large body of research with a focus on stakeholder and citizen participation and new tools for governance has emerged (see for instance March and Olsen 1995; Smith and Ingram 2002), emphasizing but critically debating the need and modalities for including a diversity of 'knowledges' and values to environmental policy making (Reed 2008; Bell et al. 2012). The scholarly attention has been followed by a dramatic growth in the regulatory use of these new governance processes at international, national and local levels of administration. Arguably, this line of studies currently receives much more attention than the more conventional science-policy perspectives in environmental studies and, although we do not apply the stakeholder perspective, this debate represents a backdrop to our research.

The impact of scientific knowledge has been related to identifying consensual scientific knowledge about relevant physical processes, including 'epistemic communities' of physical scientists and other stakeholders that could help in forging scientific consensus and political influence (Haas 1992). This is the background for the assumption that if there is

scientific consensus on the problem at hand, that increases the chances that scientific advice may influence decision-making (Haas 2004; Mitchell et al 2006; Underdal 2000). On the same note, when national and international scientific advice concur, this would presumably strengthen the role of science. Further, it could be assumed that knowledge produced at the international level can be accorded greater legitimacy and carry more weight by being independent from national stakeholders.

Accordingly, our first explanatory variable is the state of knowledge. *We expect that the more consensual the state of scientific ecological advice, the more likely it is to be used as a decision premise for management, while uncertainty and disagreement could pull in the opposite direction* (Underdal 2000).

Consensual scientific advice can, however, be produced at various problem scales, with varying proximity and applicability to policy decisions. Vertically, knowledge produced for challenges at local levels may conflict or align with knowledge produced for challenges at global levels. Horizontally, knowledge and advice produced for one environmental challenge (e.g. ecological/biodiversity) may be at odds with another challenge (e.g. climate change). Challenges related to scale are inherent in any type of scientific environmental knowledge that purports to describe natural systems.

With regard to the importance of protecting ecosystems there is high ecological consensus, nationally and internationally. This is formulated most explicitly in the Aichi Targets of the Convention on Biological Diversity (CBD)[3] adopted in Nagoya in 2010. While the natural environment entails high complexity in functions and hence challenges for

[3] https://www.cbd.int/sp/targets/ The Strategic Plan for Biodiversity includes 20 time-bound, measurable targets to be met by the year 2020 (Aichi Biodiversity Targets) (adopted at the CBD COP 10 in Japan).

management, the ability of ecologists to produce knowledge that can be applied and integrated across scales has greatly improved (Thompson Hobbs 2003).

Also with regard to the protection of the global climate, scientific consensus is high internationally and in most countries (IPPC 2014). Moreover, there is considerable global compatibility between the perspectives of biodiversity *and* climate on the objectives for nature management (TEEB 2010; UNEP 2009). At local levels, however, general measures for countering climate change based on consensual environmental advice may conflict with consensual ecological advice. The sum effect of local decisions for production of renewable energy can reduce biodiversity and deteriorate ecosystems also on a global scale (FAO 2009; UNEP 2009; White Paper 2013, p. 22; Gillom 2014; Palmer 2014).

This leads us to a second and more nuanced proposition related to ecological knowledge and scales of problems: *We expect that the less conflict between consensual environmental knowledge at different scales, the more likely is ecological knowledge to be used as a decision premise for management, and vice versa.*

However, the management and regulation of environmental challenges do not necessarily follow scientific knowledge production. There is general agreement in the science-policy literature that political conflicts of interest affect the influence of science (Miles et al. 2002; Underdal 2000). If authoritative knowledge producers offer advice that is conflicting or at least non-consensual, domestic decision-makers may pick and choose from the advice given – or relevant actors may use knowledge *strategically* to strengthen specific interests (Underdal 2000). If different types of advice are provided, the politically and economically stronger actors may be expected to prevail regarding the type of scientific advice to be used. Actors that want to *utilize* the resources for economic benefits will tend

to prevail over those seeking to *preserve* or protect the relevant resource to secure biodiversity as well as provide ecosystem services. The latter actors are usually weak and dispersed; those on the other side are generally stronger, more specific and better organized (Underdal and Hanf 2000). Either way, *we expect that the lower the conflict of interest, the more likely it is that ecological advice is used as a decision premise for management, and vice versa.*

The influence of political conflicts on science may be conditioned by public saliency (Underdal 2000). It is generally assumed that for problems involving low levels of conflict, public salience or attention will tend to boost scientific influence in general. In areas with high levels of conflict, salience may on the contrary increase polarization and thereby create difficulties for rational scientific input. *The general expectation is hence that the combination of low political conflict and high public salience related to nature conservation tends to increase the impact of ecological scientific advice.*

A fourth variable relates to how the role of knowledge in national decision-making may depend on international commitments and the degree of national autonomy. The more international competence in a specific environmental issue area, the more will domestic management depend on the relationship between science and policy abroad. This is particularly true for EU members or the countries of the European Economic Area (EEA) agreement, such as Norway. *We expect that the stronger the international (ecological) commitments, the more likely it is that ecological knowledge is used as a decision premise for management, and vice versa.*

Table 1: Ecological knowledge and management

Impact of ecological knowledge:	**High**	**Low**
State of knowledge	Consensual	Disputed
Scale of knowledge	Aligned horizontally and vertically	Separated horizontally and vertically
Political conflict	Similar interests (conditioned by saliency)	Different interests (conditioned by saliency)
International commitments	Strong ecological	Weak ecological

We present and discuss the two cases of protected areas and hydropower in Norway, in light of our analytical assumptions and propositions (see Table 1).

3. Assessing and explaining correspondence between ecological knowledge and changes in management

3.1 Management of protected areas

With this reform, the Norwegian system has changed from being centralized and primarily controlled by the environmental authorities (the Ministry of Climate and the Environment (MCE) and the Norwegian Environment Agency (NEA) and has become decentralized. According to the budget proposition upon which the decision was based, the purpose of the PA reform was to contribute to management that is coordinated and as cost-effective as possible at the national level (Norwegian Ministry of the Environment 2009–2010, p. 222). One significant element in this development has been the greater decentralization of management tasks with delegation of decision-making authority to local communities and

stakeholders. Our previous research shows that the major weakness of the reform lies in its failure to develop regulatory and institutional frameworks to ensure fulfilment of environmental conservation objectives (Fauchald and Gulbrandsen 2012; forthcoming 2019).

Developments in ecological scientific advice

Our PA study found very little correspondence between ecological knowledge stemming from national and international sources and the resultant local management reform. There was a consensual body of international knowledge available, notably from the International Union for the Conservation of Nature (IUCN) and the Convention on Biological Diversity, regarding the consequences of local management reforms. According to the IUCN, 'the classic form of governance for protected areas has been and continues to be decision-making by the state for all aspects of acquisition, establishment and management of areas designated as formal protected areas' (IUCN 2011, p. 75). Several meta-studies that were available in 2009 had concluded that effective and legitimate PA management requires collaboration with local people and stakeholders (Agrawal and Ribot 1999; Lane 2001). While recommending that local stakeholders be included in the management of protected areas, the IUCN, however, stops short of recommending that actual decision-making power be transferred entirely to local stakeholders (IUCN 2011, pp. 45–46 and 89–90). Concern for avoiding piecemeal deterioration of habitats and for achieving a representative selection of ecosystems also speak in favour of retaining centralised decision-making (Rosendal, 2004).

Domestic environmental knowledge concurred with that at the international level. The advice from IUCN is echoed in the Norwegian White Paper on ecosystem services (2013) which concludes that decentralization is more likely than central management to lead to

piecemeal reduction of protected species and ecosystems (White Paper 2013). Knowledge about effects of delegation of authority to the local level had also been sought by conducting and evaluating four domestic trial schemes. Following up on an initiative from the Norwegian Parliament, between 2001 and 2008 the government tested and evaluated four trial schemes for alternative management models for larger protected areas (Innst. O. nr. 64, 1995–1996). An independent research report, commissioned by the Directorate for Nature Management (DN), identified several concerns: this included the steady increase in exemptions granted, several violations of regulations, neglect of local minority interests, and that many local management boards tended to give precedence to the interests of landowners, resource users and tourist businesses 'to a much higher degree than is usual for protected areas' (Falleth and Hovik 2008 pp. 8–10). In Norway, indigenous people's interests and need for reindeer pastures are accommodated in PAs and tend to draw in the same direction as ecological knowledge and advice (Riseth 2006).

The DN shared most of the concerns expressed in the reports (DN 2008, p. 20), and the concerns were presented in the budget proposal. However, despite the significant environmental scientific advice and concerns revealed by these trial schemes, the government decided to carry out the reform without major changes. The implication of the budget proposal was that there were no requirements concerning collection of knowledge or of a public hearing. Fauchald and Gulbrandsen (2012; forthcoming 2019) conclude that national- and international-level knowledge and scientific advice about ecological problems related to the local management reform were in consensus, but that neither were heeded during preparation of the PA reform. Further, there were no vertical or horizontal challenges between different types of environmental knowledge at different scales. Nevertheless, ecological advice had little impact on the decision to go ahead with the reform.

We hence conclude that the application of ecological advice and insights would have led to a different management system, a system that would still invite stakeholder participation, but without delegating actual decision-making power to local levels.

Conflicts of interest and public saliency

The backdrop for Norway's local management reform seems in fact to have been the political motivation to reduce the conflict levels associated with protected areas. Available knowledge was clearly subordinated to conflicting interests. Landowners, resource users and tourism businesses pushed for decentralization and lax protection (Fauchald and Gulbrandsen forthcoming 2019). Competition for land on which to produce food, build homes and cabins, fell timber, and extract minerals frequently obstructs the allocation of land for strict nature protection. Not all these other uses are ruled out from co-existing with protection, but each presents a challenge. The actors pushing for centralization and strict protection – including scientists, ecologists, some NGOs and the subordinated Directorate for Nature Management – were the weaker side. Protected areas mean high costs for local users and landowners, whereas the benefits from protection are widely dispersed in society or are difficult to determine. Moreover, nature conservation is weakly professionalized and institutionalized in Norwegian municipalities, compared to the state level. When authority is delegated to the local level, stronger economic interests have greater influence than the more weakly represented environmental interests in management decisions.[4]

[4] This trend was evident already in the deployment of local-level environmental experts, a policy that was introduced around 1994 with Agenda 21 and then discontinued, as central funding for these experts was terminated a few years later (Bjørnes and Lafferty 2000).

The case of protected areas also directs attention to the interaction between high conflict level and low public saliency related to nature conservation. The government decided to present the local management reform as a budget proposal, which meant that there were no specific requirements concerning collection and presentation of environmental impact assessments, and no requirement for a public hearing. That contributed to the low saliency of the enactment of the local management reform: with the proposal presented in a budget proposition, the reform attracted very little public or media attention. Basically, the central environmental authorities and more general environmental interests lost out to a much stronger alliance of political and economic interests keen to protect local property rights and control over areas and normative ideas regarding local stakeholder participation. This finding could help clarify the analytical assumption that the impact of science might increase in cases involving low political conflict and high public salience. It visualises that this effect can hardly be expected to work the other way around; that in the face of conflict, salience (either high or low) may not matter much for the impact of scientific advice.

International commitments

International ecological advice and information come primarily from scientific panels linked to the CBD and the IUCN. The knowledge applied in the local management reform seems to have been limited to evaluation of the four trials and anecdotal experiences concerning the effects of the 1998 reform regarding local management of small protected areas. Fauchald and Gulbrandsen's study (2012) found no references to research and information regarding local management reforms in other countries, or any signs that such insights were collected

or used during the decision-making process. Much of the explanation may be that the nature management commitments stemming from the CBD do not fall within the scope of the EEA arrangement – and, with no legally binding obligations, it was easier to disregard international scientific knowledge. Norway's PA management reform was hence essentially a national matter, only weakly linked to international commitments. As argued by Fauchald et al. (2014), "with greater weight given to local user interests, it might be harder to accept international protection status".

Ecological knowledge did not figure in the reform of nature protection management in Norway. Stronger economic interests won through over environmental concerns.

3.2 Hydropower management

The hydropower study shows a steady increase in consensual ecological knowledge, which played an increasing role in the 1990s and early 2000s, but which has been applied less and less since then (Buan et al. 2010). After a long-term trend where ecological advice was increasingly noted and heeded, the most recent practices indicate a shift in priority regarding ecological knowledge. The first change came with the series of small hydropower plants that were allowed to be developed in protected rivers, without thorough environmental impact assessments (EIAs). Next, the 2000 Water Resources Act failed to provide legal security for 'strict' upgrading of nature protection clauses in connection with re-licensing of existing plants. Administrative guidelines and individual re-licensing cases show that nature protection clauses became less strict than those required for new plants. Thirdly, the central government/administration overruled the higher-standard nature

protection measures in the Regional Action Plans (Buan et al. 2010; Eikeland and Schei forthcoming 2019).

Most important among these three emerging practices is the recent boom in allowing the construction of new hydropower plants (Norwegian Ministry of Petroleum and Energy 2015). This boom in small-scale projects challenged nature protection interests in Norway and the traditional management model for hydropower development in various respects. First, it undermined the river protection plan instrument, as the Norwegian Parliament (first with the fourth river protection plan in 1993, then restated in 2004) opened for allowing the development of small-scale projects in protected rivers only if such plants would not conflict with nature protection interests. Secondly, the legal procedures for permitting small-scale hydropower were weaker concerning nature protection interests; the guidelines stated that projects generating less than 40 GWh/year would not need an EIA unless the project would have substantial consequences for the environment, nature resources and society. For projects with investment costs less than 50 million NOK (approx. 6–7 million USD), no formal pre-notification would be needed, unless the project was expected to create such substantial impacts. These leaner procedures for permitting small-scale projects were from the early 2000s challenged by Norway's commitments under the CBD. Why, then, has ecological knowledge been less and less important in hydropower management decisions?

Developments in ecological scientific advice

For hydropower, the ecological knowledge base documents general and site-specific mechanisms through which the construction of dams and the diversion of water-flows have affected hydrological, chemical and biological processes that challenge the sustainability of

river ecosystems. Consensual national and international ecological advice prescribe how damage to ecosystems may be averted by modifying the design and operational methods of hydropower plants (Josefsson 2015; NEA 2012; IEA 2012). These issues have become increasingly relevant with the projected international boom in hydropower development aimed at increasing the share of renewables to fight global climate change.

Eikeland and Schei (2019) document how knowledge-based environmental arguments concerning renewables and climate change were applied politically by stakeholders in order to stop additional rivers from being listed in the protection plan, to motivate the construction of new hydropower plants, and to stop efforts aimed at improving the ecological condition of damaged rivers by allowing larger water flows. The latter entailed releasing more water into the primary river and at the same time transferring water to the main reservoir from nearby river systems or tributaries. This would cause a degrading of adjacent natural areas, and hence an extension of the area affected by hydropower development. For decisions on the re-licensing of old river plants, ecological advice to ensure higher flows of water was set aside in order to minimize losses in hydropower production. This was justified by noting the broader need for climate-change mitigation and new national goals for renewable energy. This indicates that horizontal challenges of different knowledge scales increasingly impeded ecological knowledge from being applied as a decision premise, even though this knowledge was closer (with greater geographical proximity) to the decisions at hand, averting the need for more qualitative site-specific assessments.

The increase in the construction of small-scale power plants represented a challenge to nature protection in Norway. First, because new management practices allowed

development in protected rivers; second, due to insufficient documentation of nature protection values in the rivers subject to hydropower development. Hindsight assessments by the Norwegian Water Resources and Energy Directorate (NVE) (1993) pointed to the low quality of pre-development studies of biological diversity in the areas that had been granted approval for development of small-scale hydropower (L'Abée-Lund and Villar 2017). Seen in isolation, these findings indicate a break with the trend of greater priority to nature protection and ecological knowledge in Norwegian hydropower management (L'Abée-Lund and Villar 2017).

Conflicts of interest and public saliency

The hydropower case study revealed that political conflicts cut across different interests and actors. First, for hydropower investors there is an economic interest in profiting from the development of hydropower dams – but also the risk of lower electricity prices, as Norwegian domestic electricity production is based nearly 100% on hydropower. More hydropower will reduce the electricity price unless new cables for greater export to the continent are built. The electricity producers favour a high price, whereas the main consumers – Norway's energy-intensive industries – favour a low price. Second, the environmental movement is split. Environmentalists who advocate for more renewables tend to see the increased construction of hydropower dams as an environmental victory. Other environmentalists prioritize nature protection and recognize the potential trade-off between hydropower, wind power and biodiversity, along with the need for better environmental assessments regarding site-specific decisions. Third, the regulatory authorities are split. For example, there was a deep conflict between Norwegian Water

Resources and Energy Directorate and the Norwegian Environment Agency over the re-licensing procedures, with a compromise solution finally reached in 2014.

Concerning public saliency related to nature conservation, gradual changes in licensing procedures and practice have not attracted significant public or media attention. Media attention in Norway regarding environmental problems has increasingly focused on climate change and the importance of renewable power supplies. In a situation of political conflict, low attention might arguably have lessened the scope for nature concerns to achieve a more prominent place on the political agenda.

International commitments

There are binding obligations for Norway to increase the share of renewable energy consumption (EU Renewable Energy Directive RED), and to improve the ecological status of its river systems (EU Water Framework Directive WFD). However, these two directives pull in opposing directions. The 2009 RED obliges Norway to increase its share of renewable energy consumption from 60.1% in 2005 to 67.5% by 2020 (Norwegian Ministry of Petroleum and Energy 2015, p.14). The Norwegian government did not welcome the Directive, as greenhouse gas (GHG) reduction could not be achieved in the already hydro-based domestic electricity sector. The RED is implemented through a Swedish/Norwegian green certificate market with the common target of 28.4TWh by 2020. Thus far, Sweden has taken on the greater burden (or opportunity), mainly through more wind power, whereas Norway has increased production mainly through more hydropower. Although the green certificate market has eased the GHG reduction pressure on Norway, the mandatory RED based on a

specific and binding EU target has clearly led to pressures for more hydropower within a short time frame.

The EU Water Framework Directive obliges Norwegian managers to improve the ecological status of the country‘s river systems (including in the revision of old hydropower plants). This is essentially a management reform which has resulted in new regional management areas and Regional Plans involving more ambitious river restoration efforts than the guidelines from 2014, which were formed through negotiations between the NVE and the DN. This has strengthened obligations to ecological management, but in practice protection has been subordinated to pressures for more hydropower.

Disappointment with the outcome of the license revision cases was an important background when the Association of Hydropower Municipalities in March 2011 sent a letter of complaint (jointly with Norwegian nature protection organizations) requesting the EFTA Surveillance Authority (ESA) to investigate whether Norwegian national hydropower management practices were in compliance with the provisions of the EU WFD. The letter noted how the Ministry of Petroleum and Energy (and the energy companies) had utilized Norwegian obligations under the EU Renewable Energy Directive as an excuse for holding back new license clauses for minimum flow of water and for ecological restrictions on hydropower reservoirs.

The documented changes by the hydropower licensing authorities indicate lower priority to nature protection compared to renewables – in turn implying less emphasis on ecological principles as a premise for management.

Thus, the hydropower case displays a pattern different from that of protected areas. The use of ecological knowledge has been de-emphasized, mainly due to increasing

attention to climate-related knowledge and greater external EU pressure to develop more hydropower at the cost of nature protection concerns.

4. Discussion

We began by asking whether ecological knowledge/advice has affected management in two specific issue areas in Norway: protected areas (PAs), and hydropower. We first expected *that the more consensual the state of ecological knowledge, the more likely it is to be used as a decision-making premise for management, while disagreement is expected to pull in the opposite direction.* Neither case has supported this expectation. In the PA case, the local management reform was decided and implemented in opposition to growing and consensual ecological knowledge (national and international) about the need to counter increasing human pressures and how to achieve this. In the hydropower case, we have seen how consensual ecological knowledge has been applied less and less as a decision premise in recent years. These observations are surprising, given the increase in knowledge on the importance of preserving ecosystems, and Norway's emphasis on ecosystem management (White Paper 2006-2007; White Paper 2015-2020).

The second expectation brought in the challenge of knowledge scales and competing environmental knowledge. We expected that *the less conflict between consensual environmental knowledge at different scales, the more likely it is that ecological knowledge is used as a decision premise for management, and vice versa.* Scale challenges have both a horizontal dimension (e.g. protection of ecosystems vs climate) and a vertical one (local vs global). Hydropower licensing supports the scale expectation. In this case, consensual knowledge on the need to protect local river ecosystems competed with knowledge on the

need for climate mitigation and more renewable energy. In the PA case, there was no competing environmental knowledge, and vertical knowledge alignment was high: international and national ecological knowledge pointed in the same direction. Still, ecological knowledge was not used as a decision premise for the PA management reform.

Environmental knowledge in general and ecological knowledge in particular is not necessarily the most important decision-making premise. We therefore introduced a third expectation related to the level of political conflict: *the lower conflict of interest, the more likely it is that ecological knowledge is used as a decision premise for management, and vice versa.* This expectation assumes that those seeking to promote nature protection tend to be weaker and less organized than the actors favouring the utilization of natural resources for economic reasons. If there are conflicting types of environmental knowledge, strong economic actors may employ knowledge strategically to influence political decisions. In Norway, the PA case represents a classic conflict between strong economic interests represented by landowners, resource users and the tourist business, and weaker agents for nature protection as represented by scientists, ecologists, some NGOs and the environmental authorities. This has interesting implications considering the increased scholarly emphasis on stakeholder participation, which could be interpreted as an alternative to the more traditional science-policy approach to study environmental management and policies. If scientific advice is reduced to, and allotted the same status as, 'any other stakeholder view' to be considered in environmental policy making, this is likely to decrease concerns for nature protection in environmental politics. When scientific advice is ranked on par with the (vested) interests of all other stakeholders, knowledge-based management may be interpreted as 'whatever you like'.

In the hydropower case, political conflict cuts across different interests and actors. Two perfectly legitimate environmental concerns, albeit with varying proximity (and relevance of scale) to actual decision-making have split the environmental authorities and the environmental movement. Even economic stakeholders have mixed interests, as Norwegian domestic electricity production is based nearly 100% on hydropower. Thus, the hydropower case does not appear to be in line with our expectations regarding political conflict.

We were also interested in how political conflict might interact with public saliency. Saliency was assumed to increase the demand for information, while the impact on the utilization of knowledge would be contingent on political conflict. High public salience and high conflict levels were assumed to increase polarization and decrease the impact of knowledge. The findings related to the impact of ecological knowledge are indeterminate. In the case of protected areas, saliency was low, political conflict high, and ecological knowledge did not prevail as a decision premise. The management reform proceeded largely under the public radar as no open hearings were required. The low public attention may even have prevented ecological advocacy groups from invoking public support for more stringent protection. In the hydropower case, saliency related to nature conservation was low as well, and may have negatively affected the use of ecological knowledge as a decision premise. This would seem to be in line with the Verissimo et al (2014) argument that global concerns about climate change have taken prominence over local-level nature conservation and management concerns.

Finally, we assumed that the impact of ecological knowledge might be conditioned by international commitments linked to international knowledge production and Norway's

room for manoeuvre. As differing environmental concerns are linked to different commitments, the balance between ecological and other environmental obligations may be important. Our expectation was that *the stronger the international ecological commitments are, the more likely it is that ecological knowledge is used as a decision premise for management, and vice versa.* The hydropower case is partly in line with this expectation. The EU Water Framework Directive (WFD) and the Renewable Energy Directive (RED) pulled in opposite directions. However, the RED has tilted the balance towards hydropower, probably at the expense of river protection. The RED requires Norway to achieve a specific renewable target within a short time, whereas the WFD is largely a management reform that needs to be filled with practice. In the case of protected areas, international ecosystem commitments from the CBD and IUCN dominate. However, these commitments are significantly weaker than binding obligations under the EEA. International ecological commitments have not had the muscle to promote ecological knowledge as a decision premise.

The combinations of explanations in each of these two cases indicate that case-specific qualities are more important than general explanations in clarifying the weak impact of ecological knowledge. Explanations for the limited and reduced impact of ecological knowledge differ in these two cases. We should also bear in mind that one case (PA) concerns a single reform, whereas the other (hydropower) involves changes in micro-decisions over time. In the PA case, economic interests opposing protection, combined with low saliency and lack of binding international commitments appear to be the central explanations for the lacking application of ecological knowledge. In the case of hydropower, low salience combined with other concerns account for the same result: increasingly competing types of environmental knowledge and binding international commitments (with EU pressures for hydropower expansion).

5. Concluding remarks

In Norway, ecological knowledge has had weak impact in the management reform of protected areas and has been reduced as a decision-making premise in hydropower management. These findings may seem surprising, as Norway accords significant rhetorical weight to ecology and biodiversity, at home and abroad. We have searched for common explanations based on the quality and scale of knowledge, conflict of interests and saliency, and the weight of international commitments and knowledge production. However, our main conclusion is that differing combinations of case-specific factors have produced the outcomes in the two cases examined here.

In the case of protected areas, ecological knowledge was suppressed by opposing economic interests. The hydropower case showed how ecological knowledge provided relevant insights with direct proximity to the management of the specific ecosystem in question, whereas environmental advice concerning renewable energy came from climate change concerns. In Norway, this competing environmental knowledge is mirrored in the national media, which gives significantly more attention to climate change issues than nature conservation challenges. Reinforced by strong EU climate/renewable energy commitments, it has become more difficult for ecological insights to penetrate decision-making. EU legislation is stronger than commitments emanating from international environmental agreements such as the CBD.

The observation on competing environmental knowledge stems from our distinction between ecological advice and other environmental advice included in the concept of different knowledge scales. Previous research on environmental science and politics has

largely treated 'environmental knowledge and advice' as one undifferentiated phenomenon, possibly competing with other types of knowledge. Future research should examine whether, how and why competing types of environmental knowledge at different scales represent a challenge also in other countries and sectors.

PA and hydropower management in Norway may well be knowledge-based, albeit perhaps by a different interpretation of knowledge than is originally understood by the term in the science-policy school. The hydropower case was found to invoke different types of conflicting scientific environmental knowledge at different levels and this aspect has received little scholarly attention. In the PA case, the delegation of management authority to the local level was not explicitly intended to weaken the role of environmental scientific knowledge, but this was clearly the result as economic interests gained more leverage. Hence, it could be argued that the PA case showed signs of applying different principles for what mix of interests and 'knowledges' to include in knowledge-based management. Analytically, the different perceptions of knowledge as seen in the stakeholder-school and the science-policy-school may warrant more academic attention to the mix between environmental knowledge and interests.

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