Constructing knowledge gaps in Barents Sea management:
How Uncertainties Become Objects of Risk

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Abstract In the assessment and management of environmental risk, scientific advisers and managers alike increasingly point at uncertainties in the 'knowledge base'. Very often, this leads to a postponement of controversial political decisions and the initiation of research programs to reduce the uncertainties. This paper is critical towards the construction of 'knowledge gaps' when risk assessment and management are contested. It shows how uncertainties are constructed and represented as knowledge needs in deciding on future petroleum activity in vulnerable areas in the Norwegian part of the Barents Sea. By doing so the paper provides insight into a disagreement about risk assessment practices among oil interests and marine scientists in Norway. It discusses the implications of diverging approaches to knowledge and the treatment of uncertainties in controversial situations when ideas about risk are contested.

Introduction

Environmental policy documents increasingly emphasize the uncertainties that underpin management decisions, especially in controversial situations with contested knowledge. Managers and scientists alike tend to believe that, in order to achieve 'best-management practices', uncertainties need to be reduced through the incorporation of more knowledge. Yet, how the reduction of such uncertainties should lead to answers to which questions, seems to be neglected. As a result, the knowledge produced for advice often remains unused to a large extent, and dilemmas in environmental management remain unsolved. This paper explores how uncertainties in environmental policy are constructed, represented as knowledge needs, and translated into objects of risk. It draws on a case study of ocean management by focusing on discussions on environmental risk related to petroleum activity in the Norwegian part of the Barents Sea.

In 2006 the Norwegian government ratified an integrated, ecosystem-based management plan for the Barents Sea and the ocean areas off the Lofoten islands. This ocean area in the Arctic has been free from year-round petroleum activity until 2007 (for the management area, see figure 1). One of the main tangible outcomes of this plan is a framework that regulates petroleum activity (figure 2) in valuable and vulnerable areas, which were identified in a scientific process during the preparation of the plan (Anon 2005). The framework for petroleum activity is an instrument that regulates the oil and gas industry through a zoning arrangement, based on ecological information and environmental assessments.

Mast Vol 9.1_4.indd 61 17-6-2010 16:46:26

The conditions are valid in the period 2006-2010. The areas considered to be most valuable and vulnerable are closed for petroleum activity (exploration drilling and production). Some of these areas are very important for the coastal fisheries of north Norway, such as the area off the Lofoten islands in the southern part of the management area (see for instance Jentoft 1989). The framework symbolizes a compromise between political, economic and environmental interests.

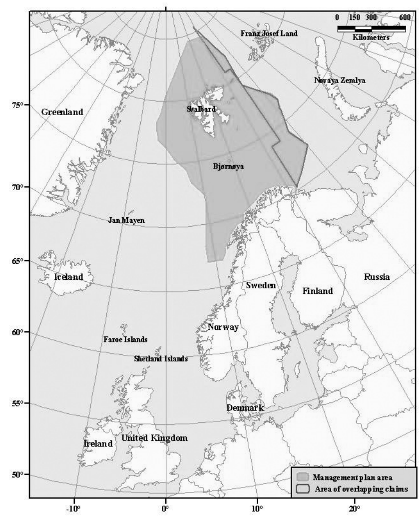

Figure 1: Management area of the integrated management plan for the Barents Sea-Lofoten area (Source: Ministry of the Environment)

An intriguing aspect of the framework is the temporary character of the conditions for petroleum activity in this controversial political playground. These conditions will be reconsidered in 2010 based on new knowledge. Since this paper was written in 2009, empirical details can only be presented of the period before the revision of the plan in 2010. In the management plan it is argued that there are too many uncertainties in the knowledge base; for this reason, it was argued to be impossible to make final decisions about the kind of activities that could be allowed. This paper will illustrate why the common perception – 'the larger the knowledge base, the easier to make decisions' – can be problematic, and obstructs the potential of achieving agreement and consensus over the level and types of risky activities to be allowed in the Barents Sea. Hence, this paper has three central and interrelated objectives, which are the following:

1. Provide insight into how uncertainties related to the risk of petroleum activity are constructed and represented as knowledge needs;
2. Explore how different views on knowledge lead to a different treatment of these uncertainties;
3. Explore the implications of these diverging approaches in the light of the environmental risk assessment.

Mast Vol 9.1_4.indd 62 17-6-2010 16:46:26

The paper will first provide a conceptual framework that presents different ways in which knowledge is treated in decision-making processes that involve environmental risks. It elaborates on the role of knowledge and uncertainties in such contexts. Subsequently, the case study will be introduced. The paper briefly presents the history of the controversy over petroleum activity in the Barents Sea, and subsequently presents the ways in which oil interests, decision-makers and marine scientists treat risks and uncertainties within the context of the Barents Sea plan. The last part of the paper discusses the implications of diverging approaches to knowledge and the treatment of uncertainties in the light of the risk assessment used in the Barents Sea case study.

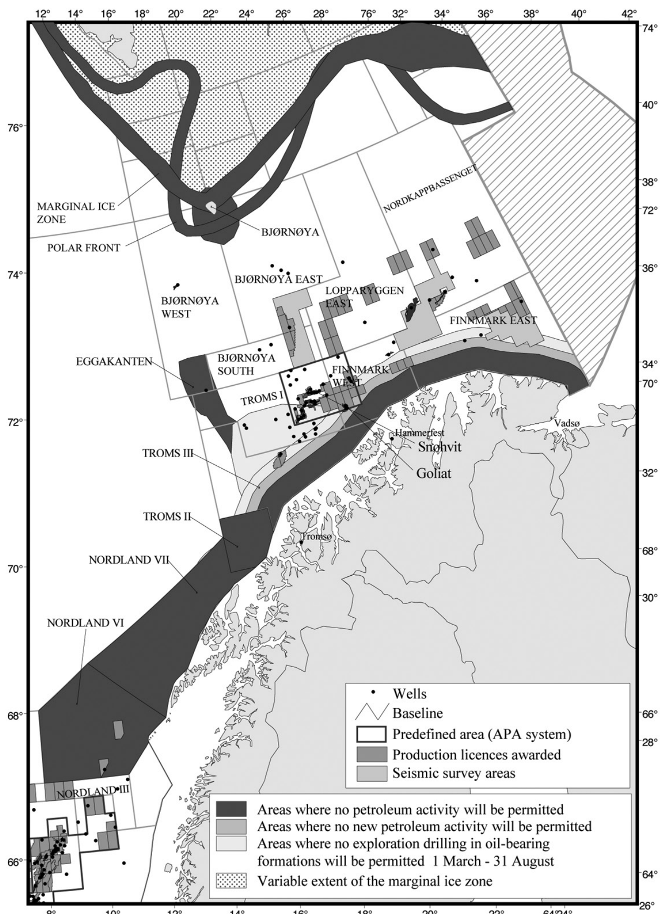

Figure 2: Framework for petroleum activity in the Barents Sea-Lofoten area for 2006-2010 (Source: Integrated management plan for the Barents Sea)

Mast Vol 9.1_4.indd 63 17-6-2010 16:46:27

Handling Environmental Risk and Dealing with Uncertainty

In general, planning for petroleum activity is to a large extent based on expert knowledge from a variety of disciplines. Norway, in particular, has a tradition in which expertise receives a key role in designing policy. Slagstad (2004) writes about positivism as the 'hegemonic ideology' of the Norwegian state from the 1950s onwards, and emphasizes the reinforcement of expert power and state power. Although he mentions the historical role of economists and social scientists in particular, the natural sciences receive a key role in, for example, Norwegian natural resource management. In planning for oil and gas activity, expert knowledge has become a basis of Norwegian petroleum management.

It could be argued that the types of risks related to petroleum activities are late-modern risks (Beck 1992; Giddens 1998). The scientific and technological progress of society has contributed in shaping those risks. Paradoxically, such risks can only be identified and grasped through scientific methods, and science and technology receive an important role in managing late-modern risks (Beck 1992). For instance, ecological risk can only be understood and managed on the premise that there is a certain understanding of the scientific notion of 'ecosystem'.

Since this paper analyzes the ways in which risk is understood and uncertainties are treated, it is necessary to look more closely into the practices of risk assessment. Risk assessment is directed at understanding risk and the related uncertainties. Conventional models of risk assessment suggest that the way to better control risk is to intensify the knowledge of a system and narrow the supposed uncertainties (Wynne 1992). Risk assessment is an attempt to make incalculable uncertainties calculable; however, controversies often arise out of disagreement about which uncertainties can or cannot be made calculable.

As a consequence, most worries about risk lie in the contested nature of risk assessments and risk management, where scientists often dispute correct risk figures and assessment methods (Jasanoff 1987). As Latour argues, the closer we approach the places where facts or machines are made, the more controversial they become. And the longer controversies go on, the more they focus on 'technicalities' (Latour 1987:30), as we shall see in this paper. In relation to environmental risk assessments, controversies (or disputes) often have to do with what knowledge is made calculable in these assessments and how that is done. Disputes result from the interpretation of information, the uncertainties that are identified, and the way these are dealt with consequently. The scientific knowledge which is constructed of risk and environmental systems is also 'pervaded by tacit social judgment, which cover indeterminacies in that knowledge itself' (Wynne 1992:116).

As a result, there is an increasing focus on the importance of the process of risk assessment and risk management instead of on the outcomes (Jasanoff 1999; Munnichs 2004; Power 2007). Advisory science related to environmental risks is always biased, and therefore – to create public trust – it is crucial that the expert dispute is emphasized and played out in public (Munnichs 2004). According to Jasanoff (1999) this is the only way to unveil the uncertainties in risk assessments,

Mast Vol 9.1_4.indd 64 17-6-2010 16:46:27

because of the different foci and cultures of the scientific institutions that work on mandated exercises. It is however important that uncertainties are accurately described, when considered as knowledge need. It should be clear *what* new knowledge should answer *which* specific question.

Hence, there are different ways in which experts and managers deal with uncertainties and their translation into knowledge needs. Since this paper follows the construction of knowledge gaps in relation to risk, it will now discuss two opposing perspectives on knowledge that are relevant to the topic of this paper.

Two Views on Knowledge in Dealing with Environmental Risk

The first idea in dealing with environmental risk, and the most common one, is that knowledge is quantifiable and reduces uncertainty. Consequently, it is believed that a better picture of risk can be achieved when more research is carried out. There is an inherent belief in this view that knowledge gaps will be filled in the end, and do not unveil new uncertainties. Hence, reducing uncertainty through building more scientific knowledge about a particular system is argued to be the route to better control of risks. This view fits with a positivistic view on science, in which knowledge represents and reflects an objective, external reality that is uncontested. This fits neatly with a technocratic approach to environmental management, in which scientific knowledge can be translated into policy in a linear manner. Unsurprisingly, such a view leads to a focus on reducing uncertainty, which is a widely used theme in research agendas of environmental assessments (Shackley and Wynne 1996). However, such attempts to reduce uncertainty often lead to increased focus on methodological conflicts and disagreements about the appropriate criteria for evidence.

The alternative, but much less propagated idea in management circles is that knowledge, or knowing, is performative (Wehling 2006; Ibert 2007), and that knowing cannot exist in a completed status but is in constant flux. A performative understanding of knowledge implies that truths are not universal, but that different realities are enacted in different places and practices (Law and Mol 2001). Such notions of reality are thus not only describing, but enact their objects through calculating practices and artefacts. As a consequence for management issues, 'there is no final state demanding no further effort' (Latour 1991) and accumulating more knowledge cannot solve complex problems. Some would even argue that through the accumulation of more knowledge, uncertainties will be transformed into and replaced by new uncertainties. Urry calls this 'regressive uncertainty': the more we know, the more uncertainty grows (Urry 2004:10; cited in Mol 2006). A result would be that pictures of risk become increasingly complex, and risk assessment and management need to take into account many more factors.

Constructing Knowledge Gaps

It is not surprising that the first view fits more comfortably with experts who carry out risk assessments, and policy makers and politicians who have to decide on risk management. It is comfortable to point at knowledge needs that require to be covered, before controversial decisions can be made. Moreover, for scientific insti-

Mast Vol 9.1_4.indd 65 17-6-2010 16:46:27

tutions their right to exist is confirmed when society affirms the need for more research and is willing to spend financial resources for that task.

The process of identifying uncertainties and constructing knowledge needs fits within what Power calls the 'managerial turn in risk management', in which demands for trust create corresponding demands for evidence (Power 2007:39). Science lends authority to politicians, when the latter can show that they rely on well-founded scientific knowledge. In other words, it is believed that knowledge production renders legitimacy. Here, a focus on facts rather than on values solves controversies. This, again, fits neatly with the first view on knowledge in which more knowledge is believed to reduce uncertainties and hence create a better picture of risk.

The opposite is to follow Beck's argument in his most recent work, that 'the world risk society' is the precise opposite from a knowledge society: it is a *non-knowledge* society (Beck 2009). Beck argues that the risk society cannot be overcome by more and better knowledge or science. *Nichtwissen* (non-knowing) is what rules the risk society. And therefore 'living in the milieu of manufactured non-knowing means seeking unknown answers to questions that nobody can clearly formulate' (Beck 2009:115). Precisely this is a dilemma in environmental management: the relevance of attempting to formulate the important questions is sometimes painfully neglected.

Having these opposite viewpoints in mind, this paper follows the argument laid out by Shackley and Wynne (1996) and Power (2007). Shackley and Wynne argue that uncertainty is only interesting if we can document and interpret its construction, representation and translation. Complementary to that, Powers work focuses on how uncertainties become risk objects in a management process, which demands a study of how uncertainties are represented and constructed within organizational and managerial fields (Power 2007:8). Uncertainties in the form of possibilities of danger or damage do not exist *sui generis*, Power argues, but they must 'of necessity be organized, ordered, rendered thinkable and made amenable to processes and practices of innovation' (2007:9).

In the process towards the management plan for the Barents Sea, and throughout its implementation, uncertainties related to the environmental risk of petroleum activity are constructed, represented as knowledge gaps, and transformed into knowledge needs. The next sections describe the positions of oil interests, decision-makers and marine scientists in the process of constructing knowledge gaps and transforming uncertainties into objects of risk. However, (the history of) the controversy over petroleum activity in the Barents Sea will first be presented briefly.

Petroleum Activity in the Barents Sea: A Controversial Issue

Petroleum activity in the Barents Sea dates back to the 1970s in the form of seismic surveys. Before 1980, the areas north of 62° North were fully closed for exploration drilling due to economic and environmental constraints. Parts of the Barents Sea were carefully opened for exploration drilling in 1980 and only selected areas that

Mast Vol 9.1_4.indd 66 17-6-2010 16:46:27

the authorities considered both appropriate and mature for commercial exploration were opened (Al-Kasim 2006:64). Since then the Barents Sea has had a history of opening and closing for petroleum activity. However, it was the government's long-term intention for the northern areas to provide the resource basis for continued activity beyond what the North Sea alone could sustain (Al-Kasim 2006:65). The first gas fields in the Barents Sea were found in the early 1980s (Askeladd, Albatross and Snøhvit).

Since the 1970s, there has been a significant resistance against petroleum activity in the Barents Sea. The main concerns were about the potentials for conflict between petroleum activity and fisheries (and consequently the fisheries dependent coastal communities) (Andresen and Underdal 1983; House 1986). In the years thereafter, environmental concerns increased, and opponents of petroleum activity pointed to the Barents Sea as one of the remaining 'pristine' oceans. Currently, environmental and climate concerns are the most important elements in the arguments of those critical towards petroleum activity in the northern areas.[1]

Due to environmental opposition, the Norwegian government enacted a full moratorium on oil and gas activity in the Norwegian part of the Barents Sea in 2001. The moratorium lasted three years. It was a direct consequence of the political statement of the Bondevik government in its Sem-declaration in 2001, where it was stated that the Barents Sea would not be opened for new petroleum activity before a comprehensive impact study of year-round petroleum activity in the Barents Sea was carried out. The declaration committed the government to a proactive environmental and resources policy based on the principle of sustainable development, which prioritizes research and development. Furthermore, it stated that the government should establish an integrated management plan for the Barents Sea that values environmental, fisheries, petroleum, and maritime transport considerations comprehensively. This declaration established a leading role for the Ministry of the Environment, which received the task to head the process towards the integrated management plan of the Barents Sea-Lofoten area.

Currently, most controversy over petroleum activity centers on the area off the islands of Lofoten and Vesterålen (Nordland VI, Norldand VII and Troms II; see figure 2). A number of key species of the Barents Sea ecosystem are found there, and it is a main breeding and nursery area for many of those species.[2] Importantly, the area provides the largest spawning ground for Arctic Cod. The Lofoten area is ecologically valuable and has since long been known for its traditional seasonal cod fisheries (see Jentoft 1989). However, oil companies argue that the narrow continental shelf off the Lofoten islands contains the most promising structures of the yet undiscovered petroleum resources. Petroleum activity would necessarily take place very close to the shore and to the most valuable natural resources. The area is a key element in the lobby of the oil interests, but renders great political and societal controversy.

However, the controversy is not limited to Lofoten and Vesterålen, but signifies a broader concern about petroleum activity in areas where fossil fuel extraction has not started yet. The controversy about petroleum activity is especially large when it concerns the Arctic areas, such as the Barents Sea. According to

Mast Vol 9.1_4.indd 67 17-6-2010 16:46:27

those critical to oil and gas developments in the Barents Sea, future developments cannot be legitimized by the decades of experience of the industry in the North Sea, or by high technological standards. This has much to do with climate change and the growing awareness that co2 emissions – of which the petroleum industry is a large contributor – need to be reduced drastically. Energy security and environmental protection are becoming stronger counterparts and the balancing between the two is a very sensitive political issue (see also Kristoffersen and Young 2010). It is beyond the scope of this paper to elaborate on this broader discussion. However, it is necessary to realize that environmental concerns develop and transform, and thereby influence knowledge claims and discussions on risk related to oil and gas activities in diverse ways. The subsequent sections illustrate the ways in which a variety of actors, throughout the process towards the Barents Sea plan and its revision, treated scientific knowledge and its uncertainties about the environmental risks connected to further developments of the oil industry in the Norwegian Arctic, with a prolonged controversy as end-result.

Dealing with Knowledge, Risk and Uncertainty in the Barents Sea

Oil Interests: We Know Enough

This section describes the risk conceptions brought forward by those with a current interest in petroleum activity, such as the Norwegian Petroleum Directorate and actors within the Norwegian Oil Industry Association,[3] for example the Norwegian oil company StatoilHydro. The section presents the assessment of year-round petroleum activity in the Barents Sea (referred to as ULB in Norway and in the rest of this paper). It should be noted here that there is a history of scientific assessments and reports on the consequences of petroleum activity in the Barents Sea (for example Anon 1989). The 1985 *Petroleum Act* established the requirements for environmental assessments of petroleum activity (exploration and production) on the Norwegian Continental Shelf.

The ULB was carried out in 2002-2003 and was part of the scientific process that resulted in the background material for the management plan (see Knol 2010). Currently, actors with an interest in petroleum activity often refer to this assessment; for example the oil companies and the Norwegian Oil Industry Association (OLF). The Ministry of Petroleum and Energy held the main responsibility for the ULB, but it was carried out with the involvement of many institutions.

The ULB uses a rather conventional risk assessment, defining risk as the product of probability and consequence. A distinction is made between 'normal operations' and 'accidental events'. With regard to normal operations, stricter requirements apply for petroleum activity in the Barents Sea than on other Norwegian Continental Shelf areas. Importantly, there is a zero-discharge requirement for petroleum activities: during ninety-five per cent of the time, operations should emit no produced water or drill cuttings to the environment. These should be re-injected or taken to land for further processing and treatment.[4] Such requirements involve technological challenges, which should be met with use of 'exist-

Mast Vol 9.1_4.indd 68 17-6-2010 16:46:27

ing technologies and methods, and technologies still under development' (Anon 2004).

There is a strong emphasis on the management of risk related to acute pollution from accidental events. The ULB uses scenario studies, with fictional oil and gas fields covering the period 2005-2020, with different levels of activity (basic, medium, high), production volumes and production rates.

What creates this picture of risk in more detail? As mentioned earlier, risk is regarded as the product of the probability of an event and its consequences. Probability is calculated based on historical statistics of oil spills, both on the Norwegian continental shelf as well as in other countries. Where the international statistics deviate from the Norwegian statistics, an adjustment is made (Anon 2004: 67). Then, finally, a precautionary margin is built into this formula (Anon 2004). Following the ULB, during a highest level of activity a blow out can be expected once every 460 years. During medium activity a blow out will statistically occur once every 630 years, and during low activity once every 1300 years (Anon 2004:69).

Consequence is dependent on many factors: the magnitude of a spill, its geographical position in relation to vulnerable areas and resources, when it occurs in relation to periods when ecological vulnerability is particularly high, and spill trajectory (the direction in which the oil flows) (Anon 2004). Consequences are measured for different components of the ecosystem, such as ecologically or economically significant fish species, seabirds, marine mammals, the ice edge, and the beach areas. Moreover, the consequences are highly dependent on the effectiveness of an emergency response system: how quickly is it possible to respond to an oil spill (after the spill is discovered) and how do weather conditions and light enable cleaning operations?

The report gives little attention to the consequences of small oil spills (smaller than 1000 cubic meters), which happen more frequently on the Norwegian Continental Shelf. It is argued that the effects of such smaller spills are insignificant. To the contrary, there is much emphasis on a worst-case scenario, which implies a large and long-lasting accident during the spawning season in the middle of a spawning area (for example in the area off the Lofoten islands). Such a worst-case oil spill, according to the report, can have impacts on fish stocks up to fifteen per cent of the biomass.[5] These consequences will demand a restitution time of up to eight years. It could harm the fisheries in several indirect ways, as for instance temporary reduced catches and issues of food safety. Additionally, a large oil spill can have major impacts on seabirds, mammals, and beach areas (Anon 2004:107-108). These consequences are considered to be 'significant' and to have large impacts on the ecosystem. The potential effects on all environmental components and resources are highest for Nordland VI and Nordland VII (Anon 2004).

Despite the potentially large consequences the ULB emphasizes that the probability for such a worst-case scenario is very small and 'in no way representative for the petroleum industry'. Its probability is calculated to be 0.01 per cent in a period of fifteen years. This means one incident per 10,000 years. (Anon 2004:78). The report affirms that there is uncertainty related to the 'threshold values' of harm to fish eggs and larvae. Such an uncertainty is taken into account through the use of a 'precautionary margin' (Anon 2004:78). The ULB mentions other uncer-

Mast Vol 9.1_4.indd 69 17-6-2010 16:46:27

tainties, for example concerning the seabird population, the seabed fauna and the existence and location of corals. Seabirds deserve special attention, because of their vulnerability to oil spills and other sources of pollution. The report furthermore emphasizes that more attention needs to be directed to emergency response systems and the risk related to marine transport, which is considered high and will significantly increase with the growth of oil activities both on the Russian and Norwegian side of the Barents Sea.

The ULB does not give any advice on keeping certain areas closed. Instead it points at the low probability of acute pollution and the further development of technology. Importantly, the ULB confirms that during normal operation petroleum activity will not lead to significant environmental consequences in the management area. Despite the fact that the ULB discusses knowledge needs in its last chapter, it implicitly presents the idea that enough knowledge is available to make decisions by emphasizing the large knowledge base that already exists parallel with the almost negligible probability of acute pollution. How does the management plan deal with this scientific advice?

The Plan: More Knowledge will Reduce Uncertainty

The management plan strongly focuses on human pressures, risk, reducing risk, and managing risk. In the plan, risk is also perceived as the product of probability and consequence; however, the interpretation of the knowledge base and uncertainties differs from the ULB. It is emphasized that risk is dynamic and changes over time: it can decrease through the introduction of measures or the development of new technology, or it can increase when the level of activity grows.

One of the priorities with the implementation of the plan in 2006, until its first evaluation in 2010, is to reduce the uncertainties in the knowledge base by carrying out more research. Currently, the main measure to 'reduce risk' is the zoning system that conditions petroleum activity, which will be revised in 2010 with the update of the management plan.

It is no surprise that the temporary restrictions for petroleum activities in the vulnerable areas lead to discussion and conflict. During the process towards the management plan, scientists were commissioned to 'prioritize knowledge and monitoring needs in relation to management and decision-making relevance' (Anon 2005). The construction of knowledge gaps started with the explication of specific uncertainties in the different reports and assessments underlying the management plan for the Barents Sea; one of these was the ULB. The overall criterion used to prioritize knowledge needs was decision-relevance (Anon 2005).

The resulting document sums up a whole array of knowledge needs, which are further distinguished as monitoring needs, research needs, and mapping needs (Anon 2005). In each of these areas, a subdivision is made in eight categories/groups.[6] The types of knowledge gaps are extremely varied. Table 1 shows the number of gaps identified in each category. It distinguishes 'prioritized gaps' (based on decision-relevance) from the total amount of identified gaps. The expert group formulated a particularly large number of research needs.

Mast Vol 9.1_4.indd 70 17-6-2010 16:46:27

Table 1: the number of knowledge needs identified in the process towards the integrated management plan for the Barents Sea (Anon 2005)

	Monitoring needs	Research needs	Mapping needs
Prioritized	15	23	5
Total	37	77	23

Consequently, the management plan states that there is a particular lack of knowledge about the conditions on the seabed, the distribution of seabirds, the impacts of long-range transboundary pollution, climate change, and the overall level of pressure on different parts of ecosystems (Ministry of the Environment 2006). Since the process before the plan strongly focused on the production of natural scientific knowledge, there has hardly been any focus on knowledge needs relating to social and socio-economic issues.[7] As a result, a broader discussion on the social acceptance of petroleum activity or the different risk perceptions among the public is largely absent.

In response to their self-prepared list of knowledge needs, the expert group (assigned by the governmental steering committee) proposed to carry out two large research programs: MAREANO and SEAPOP, which together cover a number of mapping and research needs. MAREANO is a large integrated scientific program to map the seabed and its topography. SEAPOP is a research program that is intended to improve knowledge of seabirds' distribution and population size, and attempts to provide a basis for distinguishing between natural variations and human induced impacts.

Decision-makers added a third program (and thereby an extra knowledge gap): the geological state of these particular regions. Consequently, seismic activities were carried out between 2006 and 2010. Seismic activities are used to assess the oil and gas potentials in these areas and have not remained free from strong societal discussion.[8] The government has allocated resources in order to carry out the three programs (MAREANO[9], SEAPOP and the seismic surveys) in geographically prioritized areas: Nordland VI, Nordland VII and Troms II (three of the areas considered to be most valuable and vulnerable). With the initiation of seismic activities in the areas off the Lofoten and Vesterålen islands, the government has made clear that petroleum interests should be able to proceed with their preparations for oil and gas activities in these areas.

With the plan, new forms of organization are established at various levels: 1) at the level of research institutions, 2) at the level of administrative bodies and 3) between research institutions and administrative bodies. New tasks and roles for each of them are inscribed in the plan. The inter-ministerial steering committee has established a scientific forum, which is responsible for the 'successful' achievement of new knowledge upon which policy makers and politicians can base new management decisions in 2010, as well as for updating the steering committee with this new knowledge. The scientific forum consists of a management forum, a forum on environmental risk management, and an advisory group on monitoring. Each consists of a variety of experts from governmental directorates and research institutions, and each of these groups is concerned with advice on the implementation of ecosystem-based management and the management of

Mast Vol 9.1_4.indd 71 17-6-2010 16:46:27

risk and uncertainties. Hence, with the implementation of the plan, which primarily means a further definition of objectives and thresholds, the steering committee has redefined and re-established its connections to the scientific institutions.

In short, through the management plan, decision-makers strongly express the belief that more knowledge reduces uncertainty, which leads to better ways to 'picture' and manage risk. The plan is nonetheless imprecise in explaining what specific knowledge should lead to the answers to which specific questions. However, it represents the idea that knowledge is quantifiable and additive, and that new knowledge will provide a basis for well-informed solutions in 2010.

Reaching the Crossroads: The Viewpoint of the Marine Scientists While Approaching the Revision of the Plan

Although many institutions are involved, a good deal of the research in the implementation phase falls under the umbrella of the Institute of Marine Research (IMR).[10] The revision of the plan will take place in 2010 and the positions of marine scientists on the one hand, and oil interests on the other, are strengthened and made more explicit in the run-up towards this revision.

During a formal meeting in March 2009 the Norwegian oil company StatoilHydro accused marine scientists of IMR of carrying out unprofessional assessments and of mixing up science with politics. The work of the marine scientists is unscientific in the opinion of the oil company, and StatoilHydro accused IMR of carrying out amateurish risk assessments (FiskeribladetFiskaren 2009). According to the oil industry

> The conflict is about the possibility to calculate risk. Gulbrandsen (StatoilHydro) is of the clear opinion that this is possible and that nobody has better conditions to present numbers than the marine scientists, based on methods that have already been used, also in the Barents Sea. Even though there was partial disagreement in those [earlier] assessments. (FiskeribladetFiskaren 2009)

Currently the Institute of Marine Research advises against oil and gas developments in the areas of Nordland VI, VII, and Troms II: the areas considered to be most vulnerable. IMR argues that there is too little knowledge, especially about the consequences of an oil spill on fish mortality in an ecosystem perspective. As explained, in the risk assessments carried out in the ULB, a 'precautionary margin' was built into the formula to calculate the consequences of an oil spill on fish eggs and larvae, in order to cope with uncertainty about ecosystem dynamics. According to IMR, these scenarios are still too optimistic, and the consequences of a worst-case oil spill can be between zero percent and hundred percent: in other words, the consequences are incalculable with the current knowledge base. The uncertainties are too large. StatoilHydro is of the opinion that IMR uses worst-case scenarios that are too dramatic.

During an interview with the head of the Oil and Fish research program in IMR, it becomes clear that IMR supports the numerical risk assessment. However, it should be part of a broader process in which acceptable levels of risk are defined

Mast Vol 9.1_4.indd 72 17-6-2010 16:46:27

a priori. Furthermore, IMR is not so much critical to the risk methodology used in the assessments, but argues that the inputs used in the model are contested. To the question how the risk assessment could be improved, IMR's representative argues that it is necessary

> To use correct input data that describes both the system variability and the mortality correctly. And secondly to have models ... that realistically convey the functioning of the ecosystem key parameters; and in this case how survival of fish egg and larvae vary by spawning location throughout the season and between seasons (personal communication 10/09/09).

Crucially, there is a difference between IMR and the oil industry in how ecosystem dynamics are perceived, and how one should consequently deal with these dynamics. IMR's representative describes the aspect of fish mortality to be the epicentre in the disagreement between the oil industry and the marine scientists (personal communication 10/09/09). This conflict is reinforced with the preparation of the management plan for the Norwegian Sea, which was adopted by the Norwegian Parliament in the spring of 2009 (Ministry of the Environment 2009), and in which the scientific disagreement is spelt out (76). Why is it impossible for IMR to calculate fish mortality as a result of an oil spill? The representative of IMR explains:

> We have shown certain scenarios using situations in the past, where one single oil spill could affect a whole year class easily. That would, in our view, be a worst-case scenario ... but we need more quantitative tools to model fish larvae survival from when they spawn until when they join the adult stock in the Barents Sea. We need a quantitative tool that can make us simulate these things. (personal communication 10/09/09).

The scientific advisers from IMR point at the strong spatial and temporal differences in ecosystem functioning and productivity. According to these advisors, the ULB does not give a sound view on the long-term ecosystem-effects of accidents during oil and gas operations. A harsh critique comes again from the petroleum-side: is it not strange that IMR can provide fisheries advise that includes many uncertainties, but that it is not able to advice on the risk of petroleum activity?[11] Following the head of the Oil and Fish research program (IMR), these two activities are incomparable:

> The most important difference is that the oil industry has the potential to have catastrophic effects for the whole ecosystem, from one single accident ... which means that you have to put the level for precaution higher when you manage petroleum activities, than when you manage fisheries (personal communication 10/09/09).

Hence, in IMR's view, precautionary advice should be given, meaning that precaution should not be solely a political tool through which scientific information is interpreted in the end of the process.

Mast Vol 9.1_4.indd 73 17-6-2010 16:46:27

With the focus on fish mortality and the discussion around it, IMR has identified a rather specific knowledge gap. Still, more knowledge on fish mortality within a long-term ecosystem-perspective would not settle the controversy. While more specific knowledge is needed, IMR also argues that the results of MAREANO prove that the area is unique and highly bio-diverse: beyond the expectations of the marine scientists. One should not forget, IMR maintains, that the oil and gas industry has never operated so close to the shore, in such an ecologically important area (personal communication 10/09/09). IMR's advice against petroleum activity in these areas is nevertheless not set in stone: 'it is not a matter of principle that we are against oil and gas exploration outside Lofoten-Vesterålen', however, 'offshore oil and gas activities are unacceptable given the current premises and the level of current technology' (personal communication 10/09/09).

Discussion

This paper has attempted to provide insight into how the uncertainties related to the risk of petroleum activity are constructed and translated into knowledge needs. This process took place throughout different phases, involving a variety of actors, each with their own (shifting) viewpoints. The assessment of year-round petroleum activity (ULB), headed by the Ministry of Petroleum and Energy, made clear that the knowledge base is large enough to decide on petroleum activity in vulnerable areas. Despite a range of uncertainties, the ULB does not suggest that certain areas of the Barents Sea-Lofoten area should remain closed for petroleum activity.

In the next round, when scientific advice was translated into the management plan – a process headed by the Ministry of the Environment – decision makers took a more careful position: the most vulnerable areas would not be opened before there is more knowledge on the aspects that we know too little about. The management plan represents the idea that more knowledge reduces uncertainty, and that knowledge enhances pictures of risk and the ability to deal with risk. To some extent, all interests found common ground in the plan, which in the end was a compromise between the different parties. Such a compromise has various dimensions. For the oil interests, the compromise is seen as a road to opening these areas on the basis of more information.

In the process towards the revision of the plan, however, the marine scientists of IMR attempt to gather the necessary facts for keeping the controversial areas closed. They claim that it is impossible to make statements about the environmental risk of petroleum activity through calculations, since today's knowledge base is too small. More insight is needed into ecosystem functioning and dynamics in combination with an oil spill. Marine scientists thereby open up a larger area of non-knowledge (or *Nichtwissen;* Beck 2009) and reopen the process of identifying and making explicit knowledge gaps. In that respect, IMR's approach also comes close to the first view on knowledge: more knowledge reduces uncertainty and makes way to a more objective reality. Only after the gaps have been covered, can the controversy be settled.

Mast Vol 9.1_4.indd 74 17-6-2010 16:46:27

Simultaneously, IMR moves towards the second view on knowledge, in which knowledge is considered to be performative and embedded in practice. The institute is critical towards the narrow approach that the numerical risk assessment represents and argues that there should be a broader assessment that incorporates societal values and future challenges. As such, IMR implicitly draws in a wider agenda with the process leading towards the revision of the management plan. It does not accept the straitjacket of the numerical methodology that it is forced into. With that, IMR connects the development of petroleum activity in vulnerable areas to a discussion on the wider development of society.

The conflicting risk assessment practices and diverging ways of dealing with uncertainties as described in this paper are not merely an example of the different preferred practices that are unveiled when studying a risk dispute. The paper has shown that the diverging ideas about the 'right' risk assessment practices are embedded within different notions of ecosystems. These preferred practices shifted throughout the process. While there was common ground with the management plan, the marine scientists have shown that they do not agree anymore on the issues that they largely agreed on earlier in the process. And as such, the risk assessment and management cycle has reversed. While the ULB transformed the incalculable uncertainties into calculable objects of risk, in the process towards the revision of the plan marine scientists tend to re-make calculable objects of risk into incalculable uncertainties.

It is rather technocratic to perceive risk as the product of probability and consequence solely. In such approaches, only values that can be accounted for through calculation are in the picture. Following the logic of the type of assessment used, the rational path seems to allow petroleum activity in sensitive areas. The statistical probability 'device' will wipe out the more elaborate scientific inputs on the consequence-side of the assessment. In other words, the assessment method is asymmetric: probability is disproportionably low in comparison with the consequences. As a result, settlement of the controversy (Latour 1987) will not take place by accumulating more knowledge.

Furthermore, outcomes of the risk assessment do not provide insight into how boundaries of acceptable activity should be set on the basis of the available information. Such questions can only be answered following an approach that allows for the incorporation of qualitative considerations. Management questions are thus more complex than the management plan for the Barents Sea makes us believe. With the plan's focus on knowledge gaps there is not much specificity on how new information could lead to a better decision basis. Thus, what is needed is a more thorough discussion on the applicability of knowledge, when dealing with the risk related to offshore oil and gas activities.

Conclusion

Differences in risk perceptions are embedded in different views on knowledge, and in diverging ideologies about ecosystem use and management. This paper has highlighted the implications of diverse ways in which experts and decision-

Mast Vol 9.1_4.indd 75 17-6-2010 16:46:27

makers perceive the role of knowledge and uncertainties in risk assessment and management. The Barents Sea management plan is premised on the idea that more knowledge will translate uncertainties into calculable risks. Thereby it is assumed that science can provide a neutral ground for enlightened decision-making: when the experts have filled the knowledge gaps, the next step is for the politicians to decide on which level of risk they are willing to accept.

This paper demonstrates that such a restricted approach is misleading. It does not capture the tensions built into the planning process and it disregards what is at stake. More knowledge does not necessarily lead to final answers to the perplexing challenges of environmental management. In the case of the Barents Sea management plan, the experts have not managed to reach unanimous conclusions. Instead, new 'black holes' of knowledge have been identified, making the need for more knowledge an endless quest. Moreover, the planning process has been heavily dominated by natural scientists, while societal issues have been largely neglected. This means that the decision-makers, who finally must take many aspects into consideration in the revision of the plan, still have to make their decisions under high uncertainty.

The paper has not contested the notion that decisions on risky activities require a scientific base. However, there seem to be two crucial questions that need to be answered before a process of knowledge gathering is initiated: *How* does the reduction of *which* uncertainty lead to better pictures of risk, and how can new knowledge contribute to risk management that finds a wider area of legitimacy? If these questions are not taken seriously, then the notion of knowledge gaps draws away attention from crucial questions about the applicability of scientific advice for political decisions. As a consequence, arguments of knowledge gaps will largely contribute to the postponement of controversial decisions.

The paper has stressed the importance of a more reflective approach to environment assessment and management in marine areas. Scientific advisers should not be expected to provide definite answers in the context of controversial management decisions. As Wynne has pointed out:

> It is more accurate to say that scientific knowledge gives prominence to a restricted agenda of defined uncertainties – ones that are tractable – leaving invisible a range of other uncertainties about the boundary conditions of applicability of the existing framework to a new situation. (Wynne 1992:115)

Beck (2009) also raises important questions when he claims that we live in a non-knowledge society. In this case study, we have seen that the attempts of scientists to turn uncertainties into objects of risk have been in vain: the objects of risk have become incalculabilities again. As a consequence, the major contribution of science in the heated societal debates on petroleum activity in the Barents Sea-Lofoten area has been to help making those controversies more productive and constructive.

Mast Vol 9.1_4.indd 76 17-6-2010 16:46:27

Notes

1 Groups that are outspokenly against the opening of the areas outside the Lofoten and Vesterålen islands are diverse in nature and scale and include environmental organizations as WWF, Bellona, Nature and Youth (Natur og Ungdom); political parties as the Socialist Left party and the Center party; and regional mobilizations such as 'The people's movement for an oil-free Lofoten, Vesterålen and Senja' (Folkeaksjonen oljefritt Lofoten, Vesterålen og Senja).

2 Most important species in the Barents Sea ecosystem are polar cod, capelin, herring, blue whiting, haddock, redfish, Greenland halibut

3 www.olf.no

4 For *new* activities further south on the Norwegian Continental Shelf (NCS) this rule applies as well – however there zero discharge should be met 85% of the time, which is a considerable difference. Compared to existing activities on the southern NCS, the environmental regime for petroleum activities is considerably stricter in the Barents Sea.

5 Assessments were carried out for capelin, cod, herring and haddock. These choices were based on the following criteria: 1) the species had to be significant both economically and ecologically; 2) their spawning area had to be concentrated at a distinct geographical area; species with egg and/or larvae in the higher water layers, which are concentrated in distinct geographical areas

6 1) Physical environment, 2) ecology, 3) distribution, basic biology and behavior, 4) ocean bed, 5) economic sectors, 6) pollution, 7) methods and 8) socio-economic aspects. Each specific knowledge gap is consequently embedded in a theme, such as oceanography, introduced species, seabirds and marine mammals, climate, etcetera.

7 Gaps that relate to socio-economic questions relate to IUU fishing, the use value of the management area, societal consequences of accidents, and 'aggregated consequences' of petroleum activity for the Sami population.

8 There has been a significant discussion between petroleum and fisheries interests about the acceptability and allowance of seismic surveys in the controversial areas, which largely focused on the effects of seismic surveys on fisheries, including the *timing* of the surveys in relation to the spawning season, the effects of seismic surveys in scaring away fish, area conflicts, etcetera.

9 For the MAREANO program a total amount of over ten million Euros was allocated for the years 2006, 2007 and 2008.

10 IMR is linked to the Ministry of Fisheries and Coastal Affairs and receives around fifty per cent of its funding from this ministry. Most of the scientific advice for fisheries management in Norway comes from IMR.

11 See a critical text by representatives of the Oil Industry Association 'Arrogant to use knowledge?' which appeared in the fisheries newspaper and can be found at: www.olf.no/debattinnlegg/arrogant-aa-bruke-kunnskap-article19112-234.html (in Norwegian)

References

Al-Kasim, F.
2006 *Managing petroleum resources: the 'Norwegian Model' in a broad perspective*. Oxford: Oxford Institute for Energy Studies.

Andresen, S., A. Underdal
1983 Norsk oljepolitikk og fiskerinæringens interesser. Oslo, Aschehoug.

Anon
2005a Arealvurderinger – sårbare områder – interessekonflikter, Institute of Marine Research & Norwegian Polar Institute.

Mast Vol 9.1_4.indd 77 17-6-2010 16:46:27

2005b Kunnskapsbehov i Barentshavet: En sammenstilling og prioritering av identifiserte overvåkings-, forsknings og kartleggingsbehov i forbindelse med utarbeidelsen av forvaltningsplanen for Barentshavet, Expert group for the Barents Sea plan.

2004 Utredning av konsekvenser av helårig petroleumsvirksomhet i området Lofoten-Barentshavet. Oslo, Ministry of Petroleum and Energy.

1989 St. meld. Nr. 40 (1988-89) Åpning av Barentshavet syd for letevirksomhet.

Beck, U.

2009 *World at risk*. Cambridge: Polity.

1992 *Risk society: towards a new modernity*. London: Sage.

FiskeribladetFiskaren

2009 Oljekrig mot havforskerne. 18 March 2009.

Giddens, A.

1998 *The third way: the renewal of social democracy*. Cambridge, Polity Press.

House, J.D.

1986 *Fish versus oil: resources and rural development in North Atlantic societies*. St. John's.

Ibert, O.

2007 Towards a geography of knowledge creation: the ambivalences between 'knowledge as an object' and 'knowing in practice'. *Regional studies* 41(1):103-114.

Jasanoff, S.

1999 The Songlines of Risk. *Environmental Values* 8(2):135-152.

1987 Contested Boundaries in Policy-Relevant Science. *Social Studies of Science* 17(2):195-230.

Jentoft, S.

1989 Fishermen's Co-management: The Case of the Lofoten Fishery. *Human organization* 48(4):355-365.

Knol, M.

2010 Scientific advice in integrated ocean management: the process towards the Barents Sea plan. *Marine Policy* 34(2):252-260.

Kristoffersen, B., S. Young

2010 Geographies of security and statehood in Norway's 'Battle of the North'. Forthcoming in Geoforum.

Latour, B.

1991 Technology is society made durable. In: J. Law. (Ed.) *A sociology of monsters: essays on power, technology and domination*. Oxford: Blackwell:103-131.

1987 *Science in action: how to follow scientists and engineers through society*. Milton Keynes: Open University Press.

Mast Vol 9.1_4.indd 78 17-6-2010 16:46:27

Law, J., A. Mol
2001 Situating Technoscience: an Inquiry into Spatialities. *Environment and Planning D: Society and Space* 19:609-621.

Ministry of the Environment
2009 St. Meld. Nr. 37 (2008-2009) Helhetlig forvaltning av det marine miljø i Norskehavet (forvaltningsplan). Oslo.
2006 Report No. 8 to the Storting (2005-2006) Integrated Management of the Marine Environment of the Barents Sea and the Sea Areas off the Lofoten Islands. Oslo.

Mol, A.P.J.
2006 Environmental governance in the Information Age: the emergence of informational governance. *Environment and Planning C: Government and Policy* 24:497-514.

Munnichs, G.
2004 Whom to Trust? Public Concerns, Late Modern Risks, and Expert Trustworthiness. *Journal of Agricultural and Environmental Ethics* 17(2):113-130.

Power, M.
2007 *Organized uncertainty: designing a world of risk management.* Oxford: Oxford University Press.

Shackley, S., B. Wynne
1996 Representing Uncertainty in Global Climate Change Science and Policy: Boundary-Ordering Devices and Authority. *Science Technology Human Values* 21(3):275-302.

Slagstad, R.
2004 Shifting Knowledge Regimes: the Metamorphoses of Norwegian Reformism. *Thesis Eleven* 77:65-83.

Urry, J.
2004 *Introduction: thinking society anew.* Conversations with Ulrich Beck. U. Beck and J. Willms. Cambridge: Polity:1-10.

Wehling, P.
2006 The Situated Materiality of Scientific Practices: Post-constructivism – a New Theoretical Perspective in Science Studies? *Science, Technology and Innovation Studies Special Issue* 1:81-100.

Wynne, B.
1992 Uncertainty and environmental learning: Reconceiving science and policy in the preventive paradigm. *Global Environmental Change* 2(2):111-127.

Mast Vol 9.1_4.indd 79 17-6-2010 16:46:27

Mast Vol 9.1_4.indd 80 17-6-2010 16:46:27