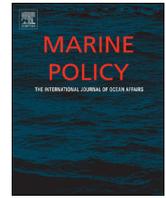




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## Marine Policy

journal homepage: [www.elsevier.com/locate/marpol](http://www.elsevier.com/locate/marpol)

# Inadequate risk assessments – A study on worst-case scenarios related to petroleum exploitation in the Lofoten area<sup>☆</sup>



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## ARTICLE INFO

## Article history:

Received 9 May 2013

Received in revised form

15 July 2013

Accepted 17 July 2013

Available online 28 August 2013

## Keywords:

Worst-case scenario

Risk assessments

Petroleum production

Uncertainty

Science for policy

## ABSTRACT

Heated debates are currently taking place on whether to open the area of Lofoten and Vesterålen in Northern Norway for petroleum production. Seismic explorations in this area have indicated promising petroleum resources. The area is known for its unique landscape and as a key spawning and nursery area for several economically important fish species. It hosts significant bird colonies and the world's largest-known deep-sea coral reef. New areas will be opened to petroleum production only if its high environmental value can be maintained. A risk analysis approach has become central to this decision, where the probability of a 'worst-case scenario' (a major oil spill) is assessed together with associated environmental impacts. This paper examines and characterises uncertainties associated with these risk assessments and some of the surrounding debates. Further, the paper reveals implications of these uncertainties: (1) potential values embedded in the risk assessments, (2) lack of validity of quantified worst-case scenarios and their probabilities and impacts, (3) limited prospects of filling addressed knowledge gaps and (4) how risk assessments restrict the debate on what issues and uncertainties are considered relevant. Taken together, this suggests that discussions on alternative approaches to decision making should be more prominent in public and political debates.

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## 1. Introduction

The question of opening Norway's northern offshore areas for petroleum production has been a long and heated political debate. The values at stake are considerable. On one hand, petroleum production promises to underpin Norway's economic wealth and people's standard of living, both locally and nationally. On the other hand, petroleum production, and in particular a major oil spill in the area off the Lofoten and Vesterålen islands and Senja (from now on referred to as the 'Lofoten area'), is feared to have the potential to significantly disturb and alter vulnerable ecosystems and thereby damage fisheries and tourism in the area.

Large areas in Norwegian waters have been opened to petroleum exploitation since the first oil field was discovered in 1971. Some areas still remain closed, as the northernmost area of the Barents Sea and the Lofoten area. The closure of these areas was

a result of political processes where the importance of ecological factors such as biodiversity and biological production played a central role. The Lofoten area holds some of the world's largest fish stocks [1] and bird colonies [2,3].

To 'open' an area means that the area is earmarked for potential oil exploitation and that petroleum companies can apply for production licenses. Before an area is opened, an impact assessment of the petroleum activities is required, including risks of pollution [4]. One of the standard elements of such risk assessments is to define a 'worst-case scenario', which is a major blowout with a specific duration, rate, oil type, location and probability, supplemented by an assessment of the associated environmental impacts. The quality and legitimacy of the produced worst-case scenarios are at the centre of political debates, reflected in newspaper headlines. In "Misleading picture of risks" [5] the Ministry of Environment criticises the petroleum sector's chosen sites for assessing potential blowouts, claiming that these sites are further away from the shore than the promising petroleum fields. The article "Refuses catastrophe scenario" [6] exposes a disagreement between petroleum authorities and environmental and fisheries' authorities on the relevance of simulating the effect of a Deepwater Horizon sized oil spill in the Lofoten area, an oil spill three times the size of the established worst-case scenario.

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The impact assessments of a worst-case scenario have also shown to be controversial. In the article “Accused of sabotaging the oil debate” [7], marine scientists are accused of taking a political position when advising against opening the Lofoten area to petroleum production, since scientific evidence suggests that the potential harm is insignificant. Also, a marine scientist is pilloried for stating that the probability of destroying a whole yearclass of cod larvae in case of a major oil spill lies between 0 and 100% [7]. In addition, the scientists were criticised for applying safety factors to each component when quantifying impacts instead of applying this to the final outcome, arguing that the risks become highly exaggerated [7].

Also in the academic literature, different views are expressed on the production of knowledge related to this policy issue. Hjermann et al. [8] point to specific knowledge gaps that need to be filled concerning the impact of an oil spill on environmental and ecological processes. Still, they argue that stochastic processes make the predictions of long-term effects impossible to achieve. Knol [9] acknowledges that there is a substantial uncertainty, but questions the usefulness of ‘filling knowledge gaps’ because it is unclear how filling such gaps will support decision-making. She further argues that natural science has dominated the process on assessing risks and that the process would have benefitted from rather being attentive to social issues and concerns [9].

It has long been argued that policy problems characterised by high stakes, uncertain facts and conflicting values, need to place uncertainty in science at the centre of the debates (see for example [10–15]). Uncertainty makes different interpretations possible, and values may be embedded in the knowledge production. The choice of scope of an investigation, the choice of method and presentation of results can favour one policy outcome over another.

The aim of this paper is to examine key uncertainties associated with defining the risk assessment of a worst-case scenario for the Lofoten area and to discuss how they affect the relevance of such assessments. It starts by presenting some historical background on the development of worst-case scenarios for petroleum production in Norwegian waters together with management policies to help us understand the situation on risk assessments today. The paper then seeks to characterise main uncertainties related to the worst-case scenario in the Lofoten area concerning: (i) the estimated probability and characteristics of a worst-case scenario and (ii) the modelled impacts of such an oil spill. In parallel, the paper shows how uncertainty has allowed different interpretations of ‘facts’ among experts. Uncertainties are further discussed whether they can be reduced and/or resolved, and whether values are embedded in the knowledge production. In light of the discussed uncertainties and the narrow scope of discussed environmental impacts of a blowout, the paper finally questions the relevance and role of risk assessments based on the worst-case scenarios: what kind of public debate and decision-making are they able to support?

## 2. Background

### 2.1. Opening areas in the north

The search for petroleum on the Norwegian continental shelf started in the 1960s. Exploration was only allowed south of the 62°N due to unsettled border issues. Environmental concerns and consequences for the fisheries were not central political topics until the 1970s. When the government in 1974 started the discussion on opening areas in the north, it was recommended that this would require concern for the environment and existing enterprise [16]. From that time on, there has been disagreement on whether to open which areas, based on the different perceptions

on whether the implied risks were acceptable or not. In 1988, a large part of the Barents Sea was opened [17], while areas south of Lofoten were opened in 1994 [18]. The Lofoten area, Nordland VII and Troms II (see Fig. 1), remained closed and still are. Nordland VI (a part of the Lofoten area) was closed again in 2001, when the preparation for the Management plan for the Barents Sea and the Lofoten area (from now on referred to as the ‘Management plan’) was initiated [19].

### 2.2. The development of risk assessments

A blow-out on the Bravo platform in the North Sea in 1977 put worst-case scenarios at the forefront of the debate, with a particular focus on the probability of a blowout. Impact assessments and estimated probability of accidents became mandatory for the petroleum industry in the Pollution Control Act of 1981 [20]. The act articulates that potential polluters need to undertake an impact assessment of realistic accidents and estimate the probability of these. Impact assessments of petroleum activities in a broader sense were made mandatory through the Petroleum Act of 1985 [21].

As a consequence of the Alexander Kielland accident in 1980, the petroleum authorities required that risk assessments had to include risks with a probability larger than once every 10,000 years [22]. This criterion was abandoned in 1990 [23,24]. Instead, the industry was given the responsibility to minimise any risk by addressing potential risks, assessing them and specifying acceptance criteria [23].

Models for assessing worst-case scenarios were developed and used routinely by the industry. Their purpose was to improve oil well dimensions and oil spill protection systems. The more recent model versions consider how a set of possible future oil spills may disperse (by simulating currents, winds, petroleum composition, volume of spill, etc.), together with their possible environmental impact (toxicity of oil, overlap with fish eggs and larvae, seabirds, type of seashore it could hit) [25].

### 2.3. Cross-sectoral cooperation leading to shared responsibilities

The Norwegian government decided in 2001 to develop an integrated ecosystem-based Management plan for the Barents Sea and the Lofoten area [26]. Environmental impact assessment and assessments of socioeconomic impacts were developed for all sectors of human use. The resulting Management plan aims to balance industry interests with environmental sustainability [19]. It was ratified in 2006 and updated in 2011, where part of these processes required public hearings. Three cross-sectoral forums were appointed to annually update status reports for the Management plan: the Management Forum for the Barents Sea–Lofoten Area, the Advisory Group on Monitoring, and the Forum on Environmental Risk Management. The members of the latter include state research institutes and directorates, representing various disciplines and industry sectors related to the Barents Sea and Lofoten area. Their mandate has been to work with risk issues associated with acute pollution in the Management plan area [27]. For example, as a consequence of the Deepwater Horizon blowout in the Gulf of Mexico in 2010, the forum was asked to evaluate the relevance of this blowout to the knowledge basis for establishing the worst-case scenario for the Lofoten area [28].

The cross-sectoral forums constitute arenas for discussing claims and methodological approaches that previously belonged within the domain of a single sector. For instance risk assessments were previously the responsibility of the petroleum sector. The development of research projects has been another arena for contact between sectors. The Research Council of Norway has financed

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