

Areas vulnerable to acute oil pollution in the Norwegian Barents Sea

report for WWF Norway
report no.: 2005-0456
rev 1, 28 February 2005

(Translated to English by WWF)

Vulnerable areas in the Barents Sea

for

WWF Norway
Kr. Augusts gt 7A

NORWAY

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Date of Issue: 28 February 2005

Project no: 66109070

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1.0 Introduction

As an assignment for WWF Norway, areas which are vulnerable to acute oil pollution have been identified for the following types of resources:

- Sea bed /corals
- Coastal resources
- Seabirds
- Marine mammals
- Fish
- Fishing activity
- Aquaculture activity

A vulnerability map has been made for each of these categories, based on available data for the Lofoten-Barents Sea area, and which shows which areas are regarded as the most vulnerable with regard to acute oil pollution in the Norwegian area of the Barents Sea.

An overall analysis has also been made, based on the different categories' vulnerability maps. The different categories are graded so that an overall ranking system is given to which areas are considered to be the most vulnerable with regard to acute oil pollution.

1.1 Vulnerability to acute oil pollution

Vulnerability is a term for damage which can potentially be caused to a natural resource by an influencing factor (in this case oil). Vulnerability is a function of the spillage's effect on the qualities of the resources regarding physiology, nutrition, habitat and reproduction strategy, etc. (Moe et al, 1999). This means that resource groups and different developmental stages within these groups will experience different levels of vulnerability. In the present analysis, vulnerability criteria are given based on the individual species' general degree of vulnerability to oil, combined with the different areas' significance for the population of the given resource. This means that areas with high concentrations of a resource will have a higher grade than a corresponding area with lower concentrations. This involves a use of the term "vulnerability" which includes vulnerability for numbers of a resource in addition to the individual's vulnerability. Furthermore, resource use, such as aquaculture and fisheries, where the vulnerability generally is low for adult individuals, can also be affected by oil pollution to different degrees.

A scale from 1 to 3 is used for each resource type, in which 3 corresponds to the most vulnerable areas for that resource group.

2.0 Basis for Analysis

A scale of 1 to 3 is used for each resource group, in which 3 corresponds to the most vulnerable to acute oil pollution. The criteria for grading each resource group are given below.

2.1 Sea floor / corals

Corals are basically not very vulnerable to acute oil pollution in the Barents Sea. However, the vulnerability of coral reefs, their rich biological diversity and scientific value together with the assumed irreversibility of their destruction within the perspective of a millennium indicates that

any further destruction of coral reefs should be avoided. We have therefore chosen to include important coral areas, as coral reefs are probably the most vulnerable type of marine life on the sea floor. These areas, however, have been given the lowest grade in the overall vulnerability analysis.

Vulnerability criteria:

- 1: Corals – spot observations
- 2: Larger areas of coral

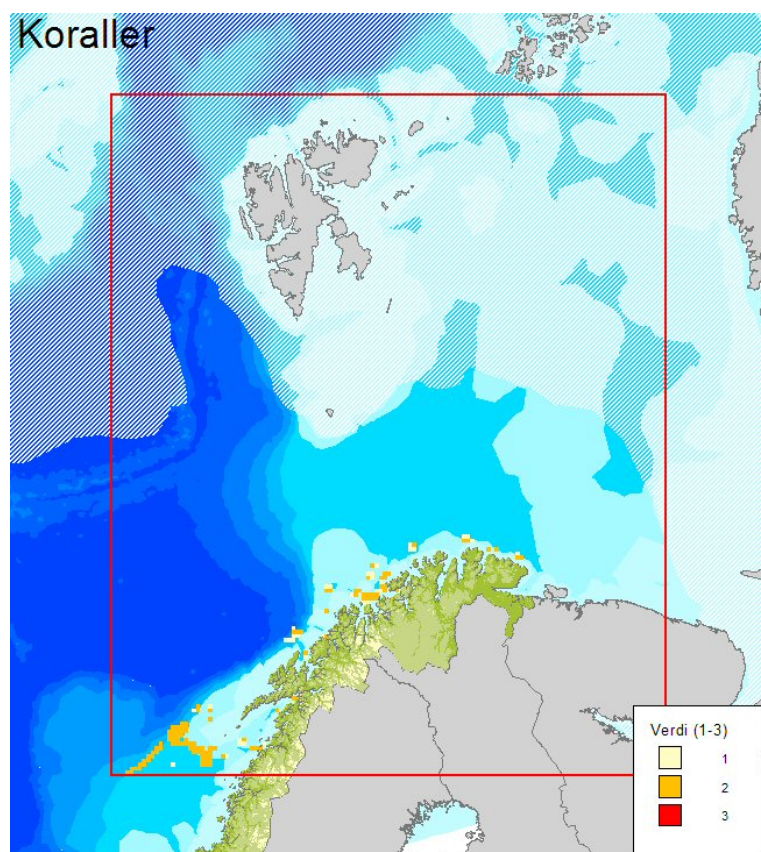


Figure2-1 Vulnerability chart for corals in the Lofoten-Barents Sea area (Norwegian region)

2.2 Coastal resources

Historical experiences of accidental oil spills show that the damage to the coastal environment can vary in size and duration: from an almost total decimation of the communities to marginal, non-fatal effects at an individual level.

The Petroleum Industry Association (OLF) has developed up a report in which the damage potential for coastal resources is expressed through a primary sensitivity index (Pi), ref. Brude et al, 2003. This has also been used to identify the most vulnerable coastal areas, and the data is weighted according to the length of vulnerable coastline within a 10x10 km square. It should be noted that the sets of data do not include Svalbard. Furthermore, MOB data (model for prioritising environmental resources in cases of acute oil spills along the coast; SFT & DN 1999) is used, with extracts from vulnerable coastal areas (seaweed coastline, sea meadow)

from MRDB (2005). In the case of Svalbard, data from Moe et al. (1999a) is used, in which the MOB model was implemented for coastal resources.

Vulnerability criteria:

- Grade 1: 10x10 km squares > 10 km vulnerable coast ($P_i > 0.5$) + MOB B areas
- Grade 2: 10x10 km squares > 20 km vulnerable coast + MOB A areas
- Grade 3: 10x10 km squares > 30 km vulnerable coast

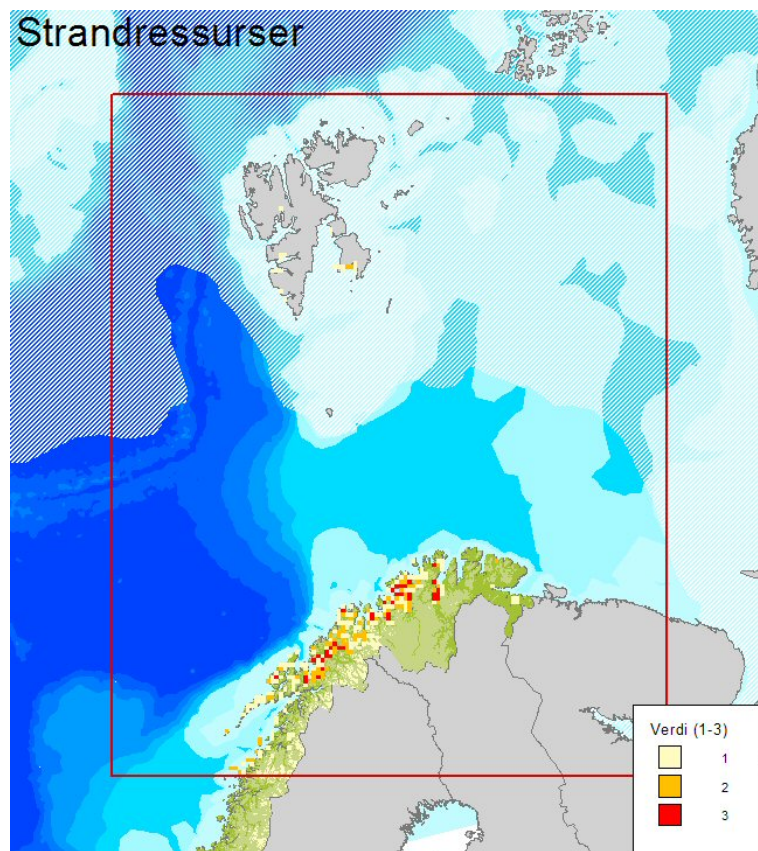


Figure 2-2 Vulnerability chart for coastal resources in the Lofoten-Barents Sea area (Norwegian region)

2.3 Seabirds

Seabirds are implicitly vulnerable to acute oil pollution, with pelagic diving and coast-bound diving species as the most vulnerable. During the study of the consequences for the petroleum industry in the Lofoten - Barents Sea area (ULB) it became clear that there is insufficient knowledge regarding occurrences of seabirds on the open sea. Current analyses are therefore correspondingly sketchy. In shallow waters near the coastline, the study material is based on results from the project “especially environmentally sensitive areas and the petroleum industry” (SMO) (Moe et al. 1999b), in which the vulnerability to oil pollution as well as the aggregation of numbers form part of the analysis, so that the results can be used directly in the current analysis. Additionally, colony data is used with a weight given corresponding to the size of the colonies. Furthermore, the polar front is identified as especially vulnerable with regards to seabirds, and is included in the criteria (ref. Especially valuable areas in ULB).

Vulnerability criteria:

- Grade 1: regional SMO + seabird colonies with > 25000 ind.
- Grade 2: national SMO + seabird colonies with > 100000 ind. + polar front
- Grade 3: international SMO + seabird colonies with > 300000 ind.

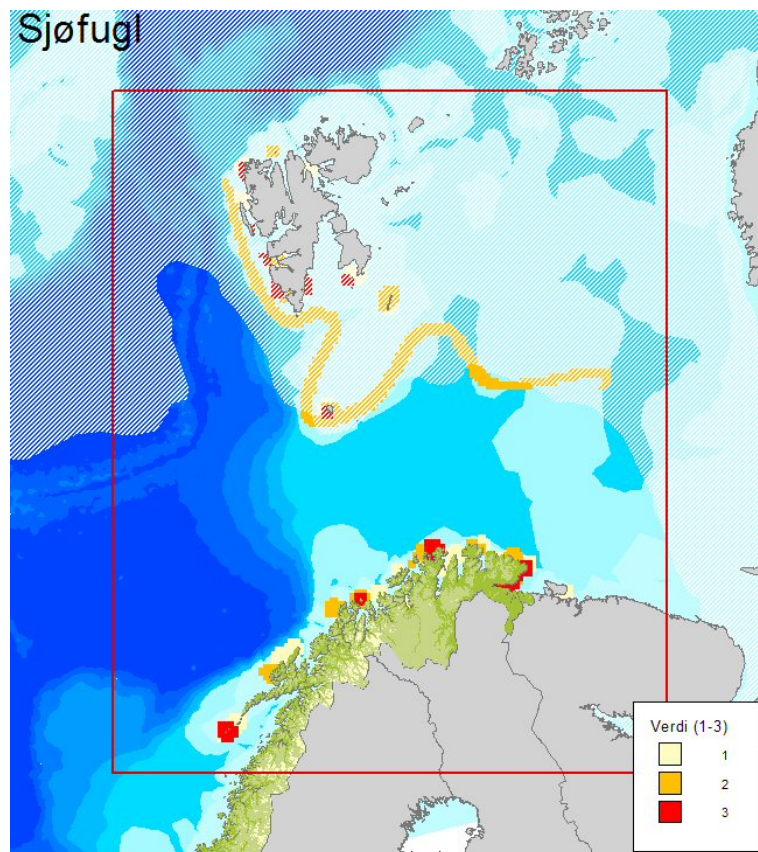


Figure 2-3 Vulnerability chart for seabirds in the Lofoten – Barents Sea area (Norwegian region)

2.4 Marine mammals

Marine mammals are, to varying degrees, vulnerable to acute oil pollution. The potential for damage is greatest for coastal seals when the animals gather in large numbers during shedding and moulting periods. If oil gets into a seal colony, it is reasonable to assume that several individuals will die. This is particularly the case if the oil is relatively fresh and has not begun to disintegrate. Otters, with their fur as heat insulation, are also especially vulnerable to oil, but the data sets on the distributions of otters are inadequate.

In shallow waters near the coastline, the study material is based on results from SMO (Moe et al. 1999b), in which the vulnerability to oil pollution as well as the aggregation of the population is a part of the analysis, so that the results can be used directly in the current analysis. The following criteria are used:

- Grade 1: regional SMO
- Grade 2: national SMO
- Grade 3: international SMO

The SMO analyses include coastal seals (harbour seal and grey seal), as well as polar bear and walrus.

More recent data on grey seal and harbour seal have been included (Nilsen et al, 2004), in addition to the important area for killer whale in Tysfjord, with the following grading:

- Grade 1: Colonies of >50 grey seal or >100 harbour seal + killer whale area in Tysfjord + resting areas / shedding areas for walrus
- Grade 2: Colonies of >100 grey seal or >200 harbour seal
- Grade 3: Colonies of > 200 grey seal or >300 harbour seal

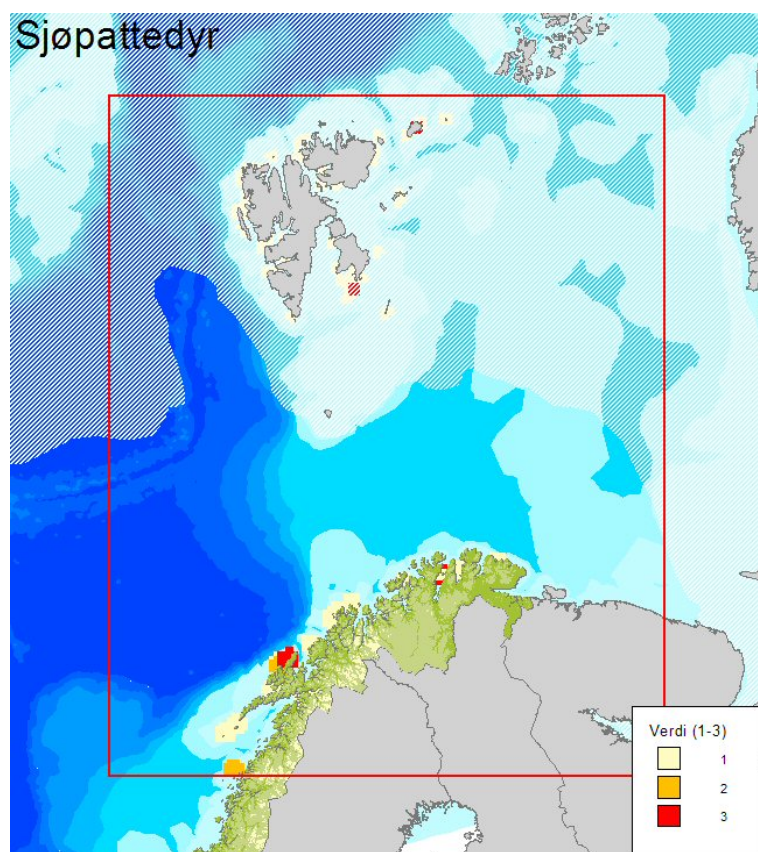


Figure 2-4 Vulnerability chart for marine mammals in the Lofoten – Barents Sea area (Norwegian region)

2.5 Fish

Damage to fish and other marine organisms as a result of oil pollution can arise if exposure is great enough. The most important factor is therefore the overlap in time and space between the oil spill and the resources. Fish are most vulnerable during the egg and larval stages, when they gather in large concentrations in small areas. The Institute of Marine Research has made a report on valuable areas for cod, haddock, herring and capelin in the Lofoten – Barents Sea area in connection with this (Aglen et al, 2005), in which they have identified the most important egg and larvae areas distributed over the seasons. This data forms the basis for the following vulnerability criteria for fish where the "overlap" shows the areas which overlap for the different species being studied:

- Grade 1: areas of larvae (medium overlap)
- Grade 2: spawning areas (small overlap) + larvae areas (large overlap)

- Grade 3: spawning areas (medium/large overlap)

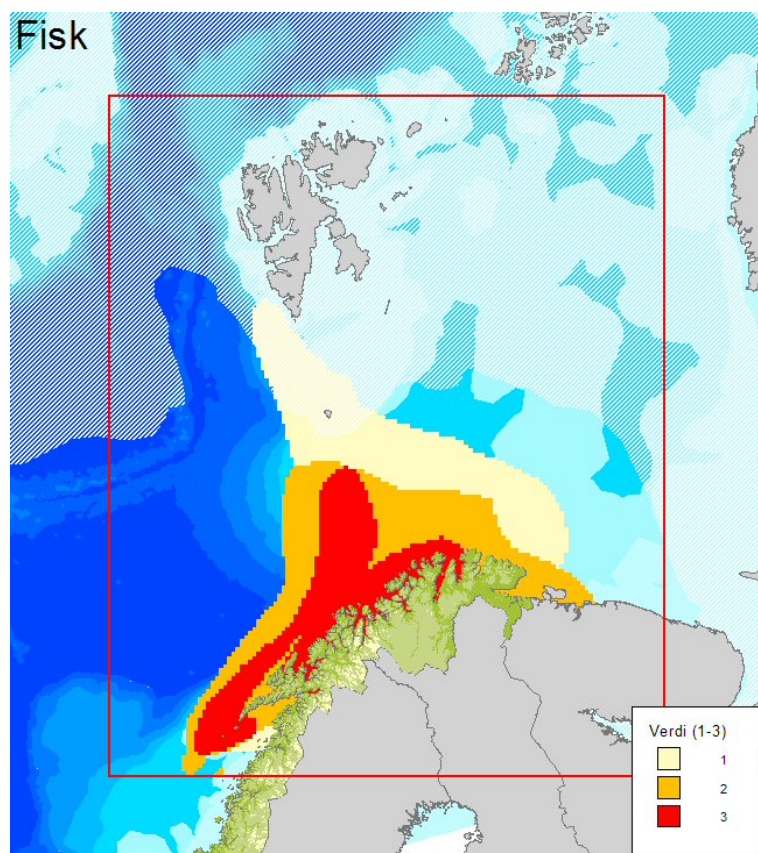


Figure 2-5 Vulnerability chart for fish eggs and larvae in the Lofoten – Barents Sea area (Norwegian region)

2.6 Fishing activity

Fisheries are not especially vulnerable to direct effects of acute oil pollution. However, the issue is included here, as oil pollution can affect breeding products and thereby cause reductions in the stocks of fish. It is noteworthy that even if the entire scale is used, fisheries and aquaculture are given the lowest grading on the overall vulnerability analysis in chapter 3.

The Directorate of Fisheries' satellite tracking system provides a very good overview at all times of where fishing activity is carried out by vessels over 24 metres in length. The data does not provide a historical picture of the situation, but does form the basis for the significance of each different area. The data are also used in ULB for fishing activity.

Vulnerability criteria for fisheries:

- Grade 1: 14-26
- Grade 2: 26-39
- Grade 3: >39

The unit is the number of positions from vessels with a speed of under 4.5 knots within a square of 11x11 km within a given period of time.

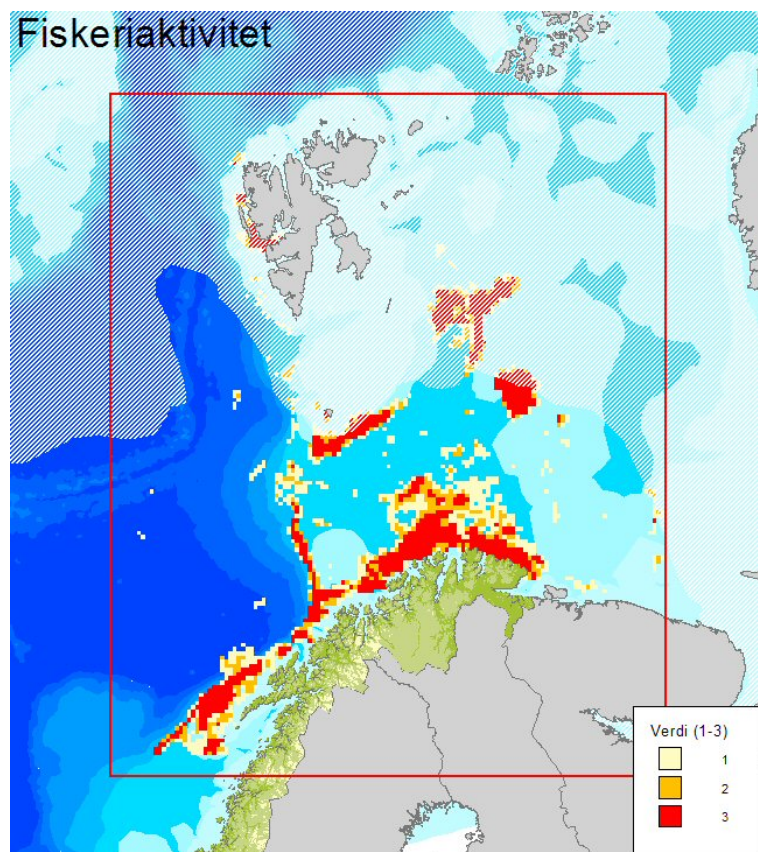


Figure 2-6 Vulnerability chart for fishing activity in the Lofoten – Barents Sea area (Norwegian region)

2.7 Aquaculture

Aquaculture, just like fisheries, is also generally considered not to be especially vulnerable to oil pollution. However, aquaculture sites and fish can be affected and with today's product quality demands, any oil spills may have a wider ripple effect in areas where aquaculture activity is concentrated. The issue is therefore addressed and graded along the same lines as fisheries, even though it adds little weight to the overall vulnerability analysis. (chapter 3).

According to the Norwegian Aquaculture Register, the number of locations with edible fish, shellfish as well as hatchery fish, distributed along segments of coastline form the basis for the vulnerability criteria:

- Grade 1: 35-122 locations in a segment of coastline
- Grade 2: 123-204 locations in a segment of coastline
- Grade 3: > 204 locations in a segment of coastline

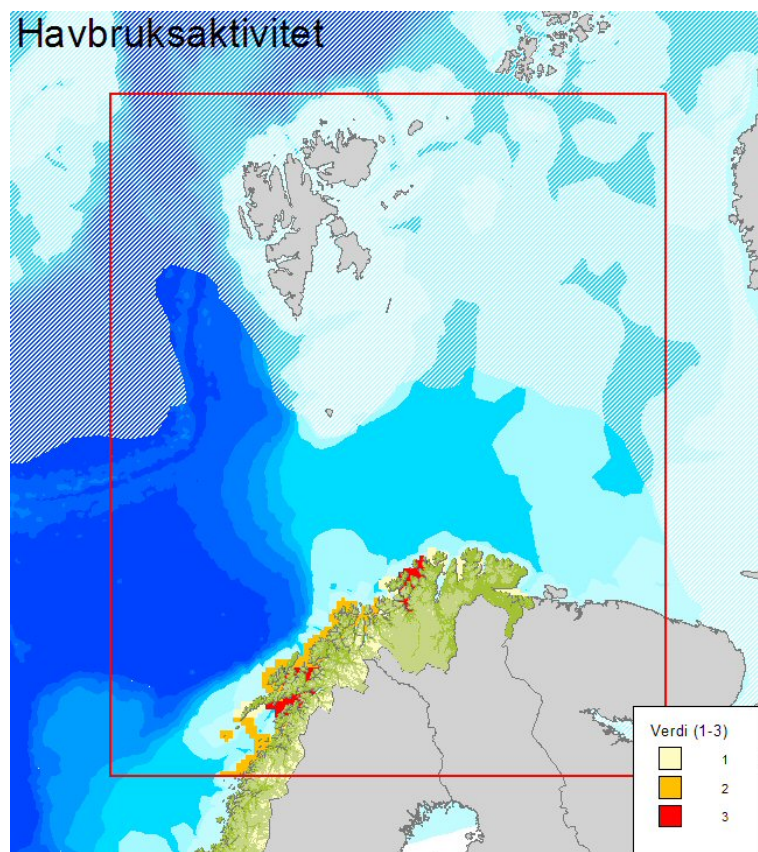


Figure 2-7 Vulnerability chart for aquacultural activity in the Lofoten – Barents Sea area (Norwegian region)

3.0 Results

A grading system and summary of the vulnerability values per 10 x 10 km square has been worked out, based on the different vulnerability analysis.

The different vulnerability charts have been combined according to the following formula, based on ecological interactions and an overall assessment of vulnerability between different trophic levels:

$$\text{Overall degree of vulnerability} = (3 \cdot S_{\text{fish}}) + (2 \cdot S_{\text{seabirds}}) + (2 \cdot S_{\text{marine mammals}}) + (2 \cdot S_{\text{coastline}}) + (S_{\text{corals}}) + (S_{\text{fisheries}}) + (S_{\text{aquaculture}})$$

The results, which indicate the most vulnerable areas are shown in figure 3.1.

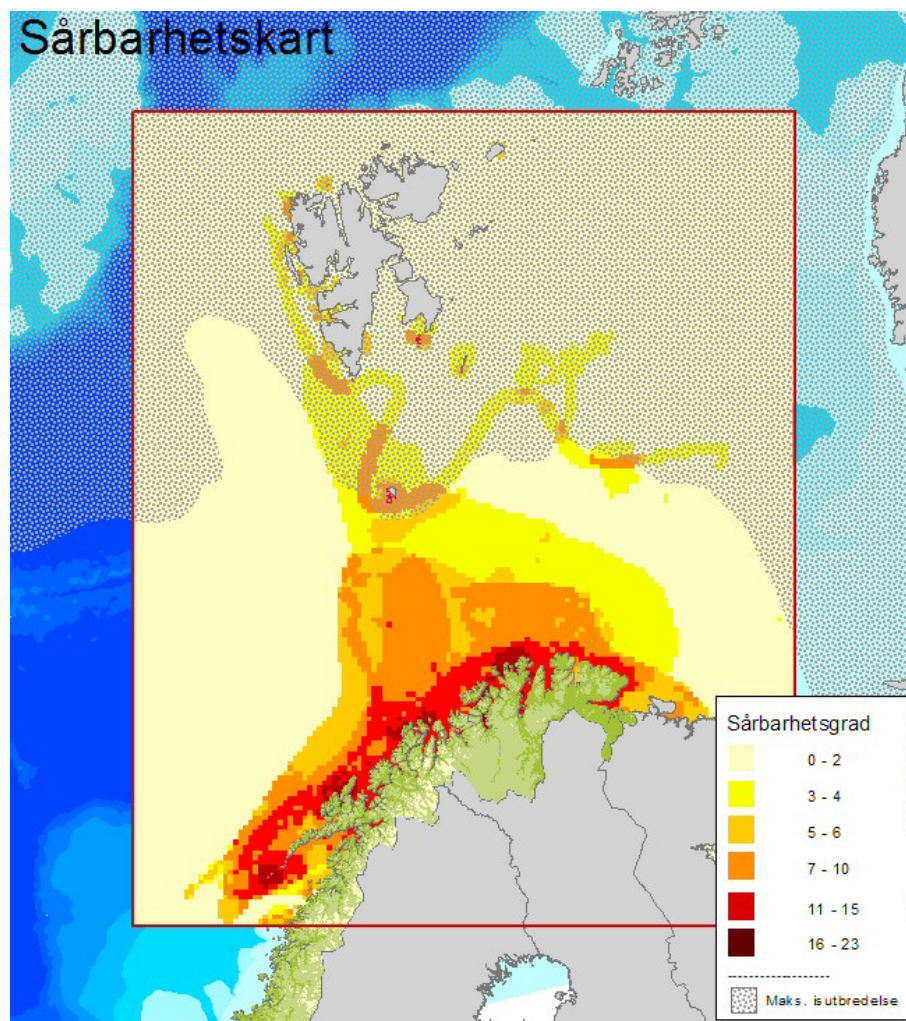


Figure 3-1 Summarising vulnerability chart for acute oil pollution in the Lofoten – Barents Sea area (Norwegian region)

The results show some definite "hot spots" along the coastline, with high overall vulnerability values:

- The area around Røst
- The area around Andøya in Vesterålen
- The area around Ringvassøy and Fugløy/Arnøy (Lopphavet)
- The area from Rolvsøy to Magerøya

What is common for these areas is the high occurrence of seabirds and/or marine mammals (Andøya), as well as the fact that the coastal areas are important egg and larvae areas for the most important fish species in the Barents Sea. It should be emphasised that the results are limited as regards input data, because elements such as seabirds in the open sea are not included (with the exception of the polar front), but they are considered to be well-covered for the coastal areas.

4.0 References

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er et annerledes konsultentselskap som tilbyr avansert tverrfaglig kompetanse innen ledelse og teknologi. Vi er solid forankret i Det Norske Veritas og basert på DNVs omfattende teknologikompetanse, internasjonale erfaring og unike uavhengighet som en stiftelse. Våre 400 konsulenter betjener internasjonale kunder fra kontorer i Norge, Storbritannia, Tyskland, Belgia og USA med full tilgang til DNVs verdensomspennende nettverk.

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