# Environmental Risk from Ship traffic along the Norwegian Coast

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## ABSTRACT

The current paper describes the methodology that was set up and implemented in order to establish an environmental risk picture for ship traffic along the coast of Norway for 2008 and prognosis for 2025. The following steps have been undertaken in order to quantify the environmental risk along 38 coastal segments from south to north: 1) establish traffic pattern by use of AIS data, 2) quantify probabilities for different spill types and volume and establish their damage potential, 3) adjust the damage potential based on distribution of vulnerable environmental resources and 4) quantify probabilities for different environmental consequences. Separate risk pictures have been established for seabirds, marine mammals and fish, while input on shoreline was not available at the proper level for use in the analysis.

The areas with the highest environmental risk are in the southern part of Norway. As further marine safety measures still could be implemented in the south of Norway, the risk in 2025 with those measures in place will be reduced, while there

will be an increase in the risk in the northern areas, especially as the large crude oil tanker volume is expected to increase. The risk increase will then mostly be for the high environmental consequence categories.

## INTRODUCTION

Oil spill contingency in Norway should be risk-based and appropriate measures should be taken based on the environmental risk picture. In order for the Norwegian Coastal Administration to prepare and understand the oil spill contingency requirements related to ship traffic, there was a need to establish an overview of the ship traffic pattern and thereby the accidental spill potential in Norwegian waters. As there would be a huge variation in actual environmental impact and consequence from an oil spill, depending on where and when the spill would happen, there was also a need to map the distribution of vulnerable biological resources in order to be able to quantify the actual environmental risk.

The current paper describes the methodology that was set up and implemented in order to establish an environmental risk picture for ship traffic along the coast of Norway.

## METHOD AND INPUT DATA

In order to establish an environmental risk picture from ship traffic, the following steps have been undertaken:

1. Establish traffic pattern – AIS data

2. Mapping of spill and impact potential
3. Mapping of vulnerable environmental resources
4. Establish the risk picture

The starting point for the risk analysis is the ship traffic pattern and recently, very good coverage of individual ship traffic movements is provided by AIS data (Automatic Identification System) on-board all vessels above 300 BT (see example in figure 1). A separate probability analysis was performed (DNV 2010), in order to calculate probabilities for different accidental releases along the coast based on the AIS data. Scenarios that were analysed included traffic pattern for both the year 2008 and prognosis for 2025, in addition to scenarios including the effect of marine safety measures as TTS (traffic separation systems), emergency towing preparedness and use of VTS (Vessel Traffic Service Centres).

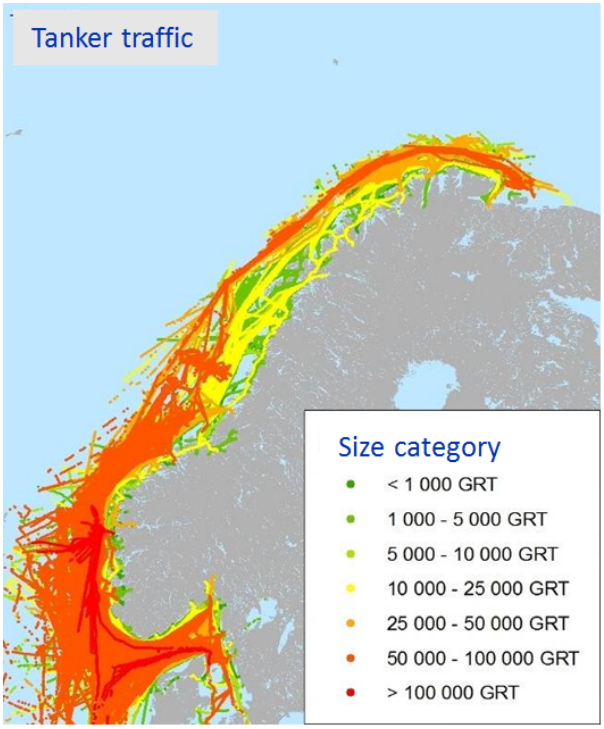


*Figure 1. AIS data showing tanker traffic for various tanker sizes along the coast of Norway accumulated for 2008.*

Based on the AIS information with movements of different ship types and cargos, potential release scenarios were categorized with regards to spill volume and spill type (crude oil, bunker spill or refined oil products). Each category was then mapped according to their damage potential (or expected consequence) as they will have different impact on different resources weather in the water column (fish), on the sea surface (seabirds, marine mammals) or on shoreline habitats. In areas with high environmental sensitivity, the damage potential would result in a higher consequence (higher than average) and likewise in areas with low sensitivity the damage potential was reduced to a lower consequence category (figure 2).

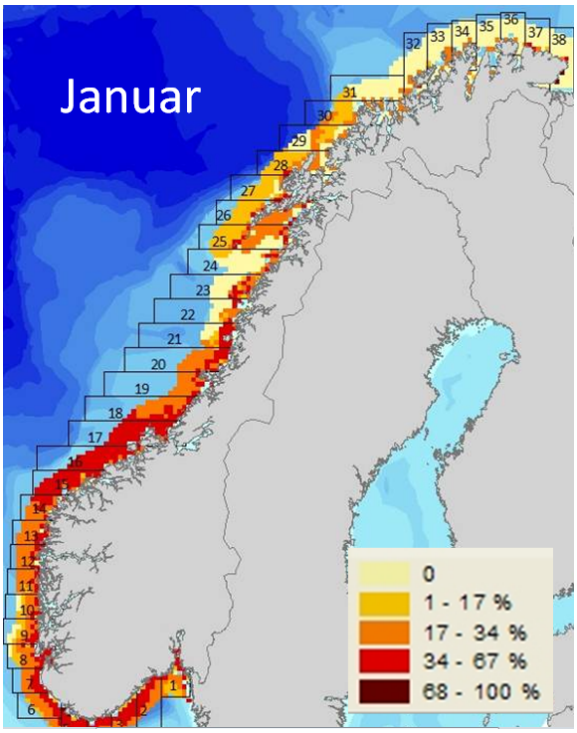


*Figure 2. Seabird vulnerability map (percentage of maximum sensitivity towards oil pollution) for January in different coastal segments.*

Figure 3 shows a sketch of the risk methodology. The end result is presented as probabilities for different environmental consequences.

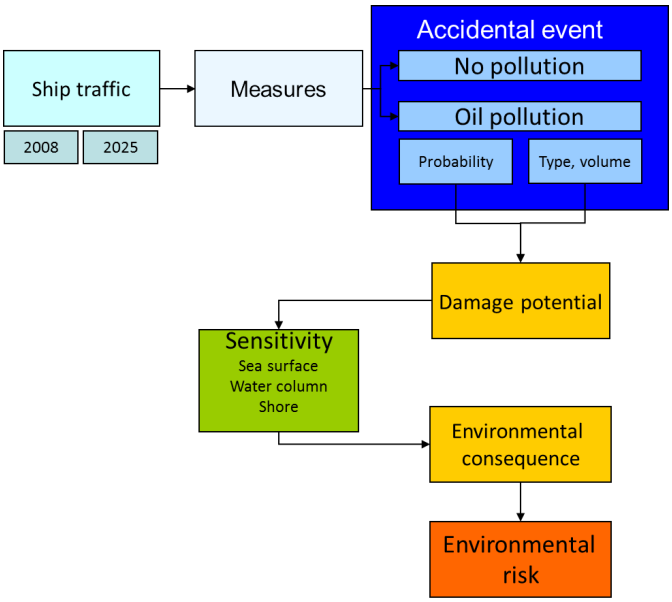


*Figure 3. Sketch of the methodology and the different steps undertaken in the environmental risk analysis.*

The mapping was performed in 38 coastal segments along the Norwegian coast from south to north both with regards to the traffic pattern, but also for the environmental resource data. Data input to the environmental sensitivity mapping were made available from a currently on-going project at the Norwegian Directorate of Nature Management (DN 2011), developing a tool for environmental value assessment and vulnerability criteria for different impact factors (oil spills, physical disturbance and others). Data on seabirds, marine mammals and fish were used in the analysis, while the shoreline data was not ready for use within the time frame of this study. Neither were the results from the final vulnerability analysis on oil spill, so data from the value assessment were used as input to the sensitivity mapping.

Table 1 shows the categorisation of the damage potential (DP) from the different spill type and volume categories. A separate look-up table was made for the damage potential for fish (oil in the water column), with higher damage related to lighter products and light bunkers that for the heavy products/ bunker oil.

*Table 1: Categorisation of the damage potential (DP) from the different spill type and volume categories for oil at the sea surface impacting seabirds, marine mammals and also shoreline*

| ***Sea birds / marine mammals*** | Spill volume (tons) | *DP1* | *DP2* | *DP3* | *DP4* | *DP5* | *DP6* |
|---|---|---|---|---|---|---|---|
| *Crude oil* | 100-2000 | | | X | | | |
| | 2000-20000 | | | | X | | |
| | 20000-100000 | | | | | X | |
| | > 100000 | | | | | | X |
| *Light refined oil products* | 100-2000 | X | | | | | |
| | 2000-20000 | | X | | | | |
| | 20000- | | | X | | | |
| *Heavy refined oil products* | 100-2000 | | | X | | | |
| | 2000-20000 | | | | X | | |
| | 20000- | | | | | X | |
| *Light bunker oil* | < 400 | X | | | | | |
| | 400-1000 | X | | | | | |
| | 1000-5000 | | X | | | | |
| *Heavy bunker oil* | < 400 | | X | | | | |
| | 400-1000 | | | X | | | |
| | 1000-5000 | | | | X | | |

In order to adjust the damage potential into a consequence category based on the environmental sensitivity in the different coastal segments, spills with the smallest damage potential (DP1 and DP2) were said only to impact one coastal segment. Spills with damage potential in category 3 or 4 were assumed to impact 3 segment (the one in which the spill would occur and the neighbouring segments to the north and south). Spills in the highest category were assumed to impact 5 coastal segments (2 neighbouring on each side). Spills were assumed to be located very near the coast (as ship-to-ship collisions off coast had very little probability) and assumed to mainly impact biological resources within 40 km from the coastline.

RESULTS

Separate risk results were quantified for seabirds, marine mammals and fish and no attempt was made to merge these together. The environmental risk for seabirds, based on the traffic in 2008 is presented in figure 4 (left graph), together with the change in risk from 2008 to the prognoses for traffic in 2025. The areas with the highest environmental risk for seabirds can easily be identified in the southern part of Norway (especially in segment 1-12). As further marine safety measures still could be implemented in the south of Norway, the risk in 2025 with those measures in place will be reduced, while there will be an increase in the risk in the northern areas as especially the large crude oil tanker volume is expected to increase (figure 4 – right graph). The risk increase will then mostly be for the high environmental consequence categories (blue categories K4 to K6). The risk results has been utilized by the Norwegian Coastal administration in order to ensure that the emergency response system shall be in reasonable proportion to the probability of acute pollution and the extent of the damage and environmental impact that may arise.

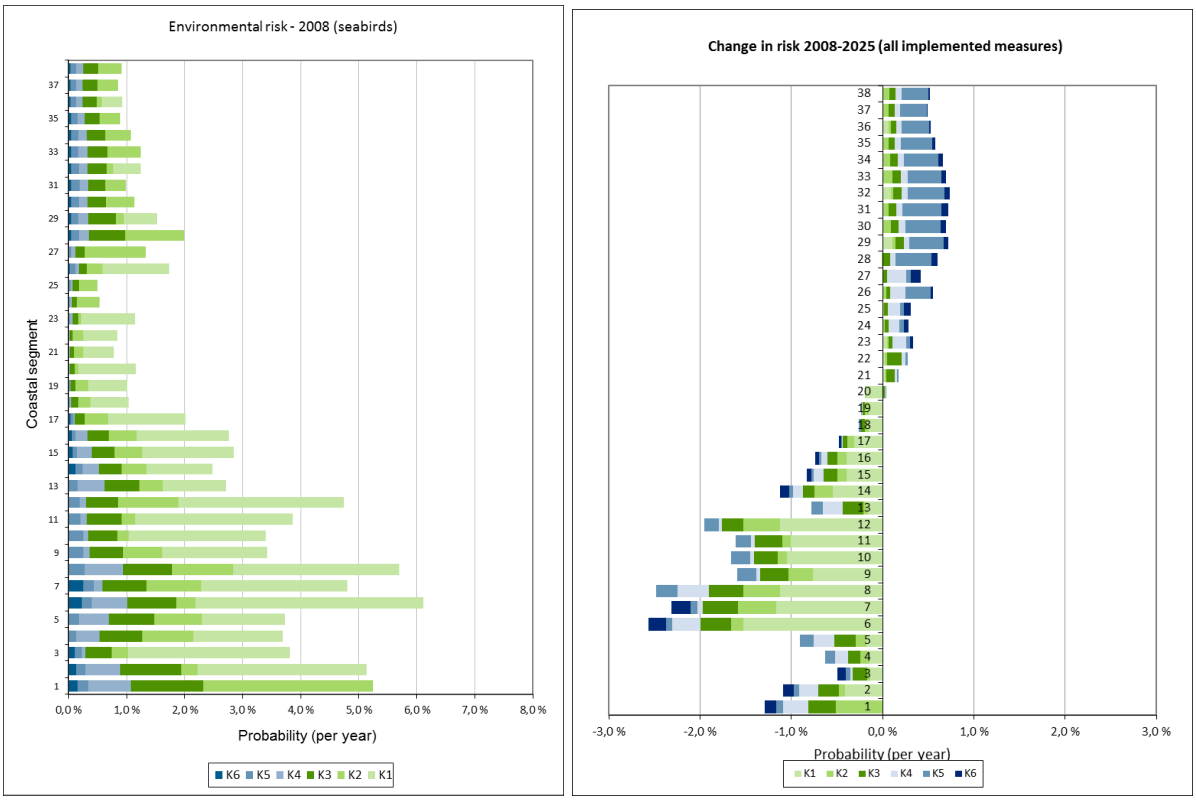


*Figure 4. Environmental risk for seabirds presented as probability for different consequences (in categories from K1 - least consequence to K6 - highest consequence) for different coastal segments along the Norwegian coast. Risk for 2008 is presented to the left and the change in risk from 2008 to 2025 is shown to the right.*

REFERENCES

DN 2011. Environmental value assessment and vulnerability criteria for marine species and habitats. On going project headed by The Norwegian Directorate for Nature Management, a government agency under the Ministry of the Environment.

DNV 2010. Analysis of probability for acute oil releases from ship traffic along the Norwegian coast. Det Norske Veritas (DNV) report No. 12NA8X8-3. Rev 06. 16.11.2010. *In Norwegian*

DNV 2011. Environmental risk from acute oil pollution from ship traffic along the Norwegian coast for 2008 and 2025. Det Norske Veritas (DNV) report No. 12U006N-2. Rev 00. 10.10.2011. *In Norwegian*