Effects of acute oil spills on the Norwegian marine environment

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1. Introduction

A number of small-to-medium size acute oil spills have occurred in Norwegian waters in the latter years. The Institute of Marine Research (IMR) has performed damage assessment studies after several recent oil spills. Measurements of the levels of oil-related organic contaminants have been carried out in seawater and various biota samples after the spills, with follow-up investigations undertaken later when necessary. The objectives of the studies were to assess the degree of contamination in the marine environment, to monitor the contamination with time, and to quantify the possible damage inflicted on shellfish and commercially important fish stocks.

Oil spills taking place at three locations in Norway in the period 2007-2009 will be discussed:

1. Cargo vessel *Server*, ran aground near Fedje, Hordaland in Western Norway in January 2007. The total amount of oil spilled to the environment was 380 tons.
2. The discharge of 4000 tons crude oil at the Statfjord A oil platform in the Tampen region of the North Sea was the second largest discharge till now in Norway after 40 years of exploration. A second, minor spill of 70 m^3 oil occurred at the same platform in May 2008.
3. Cargo vessel *Full City* ran aground near Såstein, Telemark in Southern Norway in July 2009, spilling 300 tons of oil. The spill has caused a considerable contamination of the nearby coastal area. The study of the consequences of the spill was one of the most detailed undertaken in Norway.

2. Materials and methods

Sampling was carried out at several locations in the vicinity of the oil spills and at reference locations unaffected by oil 1 to 5 weeks after the spills. Follow-up samplings were carried out 4 and 8 months after the accident in case of *Full City* spill. Geographical location of the spills is shown in Figure 1.

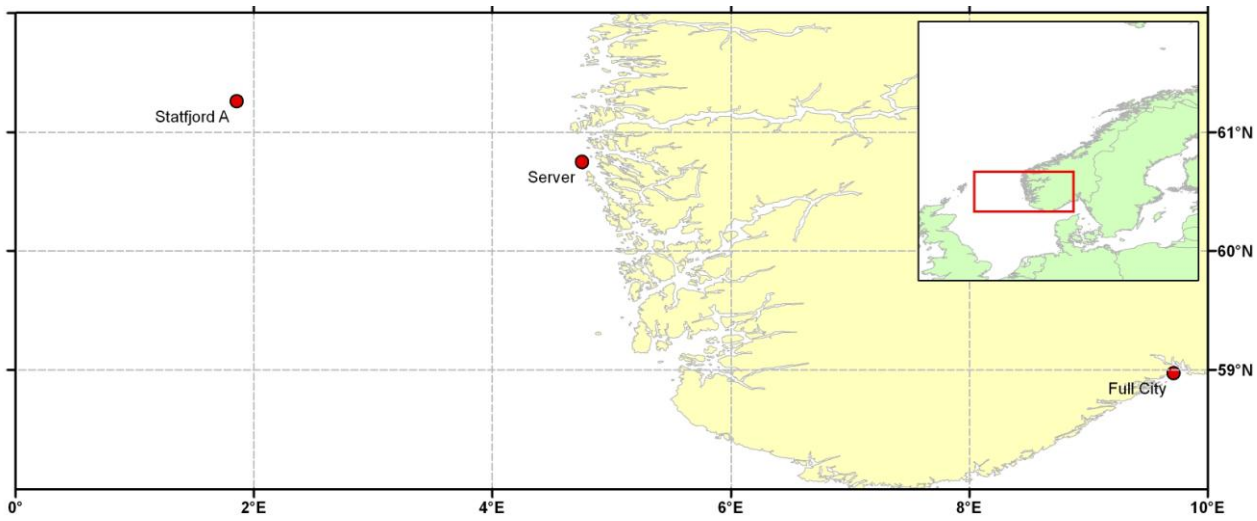

Figure 1: Geographical location of the oil spills.

Samples of seawater and fish were collected after each accident, while samples of shellfish, crabs and/or shrimps were collected in coastal areas. Seawater was analysed for total hydrocarbon contents (THC). Fish muscle and liver and shellfish/crab/shrimp meat were analysed for polycyclic aromatic hydrocarbons (PAH). Fish bile was analysed for PAH metabolites. Biomarker analyses were carried out on fish samples in the case of the Statfjord A spill.

3. Results and discussion

3.1. *Server*

Levels of THC in water and PAH in fish liver were only slightly elevated in the samples from the contaminated area, while fish muscle and bile, crab and shellfish exhibited no apparent contamination. Poor weather may have contributed to the rapid weathring of the oil. However, codfish trapped in the net in the contaminated area for several days have shown strong contamination in liver and bile, indicating a high degree of exposure.

3.2. Statfjord A

Levels of THC in water were elevated right after the accident but were back to normal within a month. Levels of PAH in fish liver was found to be elevated in some species after the accident. Levels of PAH metabolites in codfish bile as well as the biomarker response were studied in fish sampled one month after the accident and no significant differences were found. The condition of the environment thus seemed to be back to normal within a short time after the discharge, possibly aided by the strong storms in the area at the time of the spill. No negative effects were found after the second spill in May 2008.

3.3. *Full City*

Fish liver and water samples from the contaminated area exhibited moderately elevated levels of PAH and THC. No significant contamination was found in crab meat or in fish from outside the immediate vicinity of the shipwreck. However, the oil contaminated a large part of the coast nearby. Mussels collected at the most contaminated coastal site had strongly elevated PAH levels, above 10 µg/kg wet weight benzo[*a*]pyren, which is the food safety limit set by EU authorities for mussels [3]. A consequent study of the area 4 months after the spill has revealed a return to background levels in fish, shrimp and water, but not in mussel samples from the same area. A more detailed study of mussel samples, and a new sampling of mussels along the coast of South-Eastern Norway 8 months after the spill, demonstrated the contamination to be largely due to non-oil related sources.

4. Conclusions

The results of these studies largely lead to the same conclusions. In all cases, an increase in oil-related contaminants was demonstrated in various compartments of the environment. The levels in the water and mobile biota were not alarmingly high and went relatively quickly back to background levels. The highest levels were found in the organisms that could not escape from the contaminated area (trapped fish, mussels). The degree of contamination caused by the spill to the marine organisms further depended on the external factors such as the weather during the spill or the pre-existing contamination from other sources.

5. References

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[2] Boehm PD, Neff JM, Page DS. 2007. Assessment of polycyclic aromatic hydrocarbons exposure in the waters of Prince William Sound after the *Exxon Valdez* oil spill: 1989-2005. Mar. Poll. Bull. 54: 339-367.

[3] Commission Regulation (EC) No 208/2005 amending Regulation (EC) No 466/2001 (setting maximum levels for certain contaminants in foodstuffs) as regards polycyclic aromatic hydrocarbons.

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