

Major oil spills – possible consequences for the fish market

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Abstract

Akvaplan-niva and NORUT Social Science Research have been investigated the consequences of an oil spill in the Barents Sea based on experiences and implications from former oil spill accidents. The main goal of the study is to conclude how an oil spill might affect the fish market, and main factors identified as central to fish consumers and buyers are presented. There are produced oil spill scenarios regarding possible consequences of an oil spill near the Goliath oil field. The scenarios are based on an accident and wrecking of an oil carrier. The former accidents have given information about biological effects from an oil spill, but also shown that other commercial resources and activities are affected. Activities in this connection are fishing, fish farming/aquaculture and tourism.

Concerning the opening of the Barents Sea for petroleum activities, questions about effects for the fisheries due to an eventual oil spill are raised. One assumption has been that the fish market will react strongly towards an oil spill in this region.

The presentation starts with a description of experiences with major oil spills. The focus is on biological and economic consequences. Results from the studies of historical oil accidents make basis for different scenarios describing a hypothetical oil spill off the coast of Finnmark County, and the following effects on fishery, aquaculture industry and the international fish market.

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Introduction

So far Northern Norway has not been exposed to any large oil spills. During recent years, there has been an increasing concern for possible problems associated with increasing ship traffic along the Norwegian coast. During winter 2000 – 2001 several groundings of vessels took place along the Norwegian coastline. These were, among others, the wrecking of the cargo vessel “John R” in Troms County 25 December 2000. This accident involved oil spill to sea, which caused damage to the coastline and sea bird populations in a rather large geographical area.

The oil industry in northwest Russia is continuously announcing more and more expansive development plans, increasing transportation of oil on super tankers significantly. In the Norwegian part of the Barents Sea, the gas field Snøhvit will be in production in 2006, and the oil field Goliath may be developed during the coming years.

The coastline in North Norway is a physically complex system with thousands of islands, straits and deep fjords. This is a basis for a complex and highly productive biological system, sustaining large stocks of fish, sea mammals and sea birds. The activity in the ecosystem is strongly seasonal, and most of the production of biological energy in the system occurs during 2 – 3 months in spring and early summer each year.

The fisheries in Northern Norway are active throughout the year, but with several seasonal peaks. The most important is the cod fishery in the Vesterålen -Lofoten area during late winter and early spring (January – April). The extensive cod fishery along the coast of Troms and Finnmark follows this later in spring. In Finnmark the cod and haddock fisheries continue during the summer. Coalfish is caught during late spring and summer, while herring is caught especially in the northern part of Nordland and southern part of Troms during fall and winter. The last major fishery is the capelin fishery, taking place along the coast of Troms and Finnmark during late winter and spring.

In addition to the biological effects from an oil spill, commercial resources and activities can be damaged for a shorter or longer periods. Typical activities are tourism, fishing and fish farming. It is two severe sort/types of damage. First is a change (even potential) in the image of the product, independent of the actual oil spill consequences. For instance, is the wilderness of Finnmark still a used marketing picture when the skyline shows oil platform? And, second if the fish market still conceives the Arctic Ocean as an healthy and unpolluted food producer area, when there also is an overall picture of the ocean as a rich oil and gas-producing region? The questions are important, but the answers will vary from one interest group to another.

The publication is based on literature studies, several newspapers archive on the web, interview with fish exporters, marketing professional and others intertwined in the industry.

Experiences with major oil spills – biological and economic consequences

The effects from an oil spill on biota are depending on a variety of factors. First, which type of oil is spilled is crucial for the fate of the oil, and thereby which organisms that can be harmed. Heavy oil types are thick and sticky, but will in a larger extent stay at the surface compared to lighter oil types. Other physical aspects with the oil are also important, e.g. ability for evaporation, ability for emulsification, acute toxic effects, floor conditions etc. Second, the environmental conditions in the spill area, this can be temperature, wave activity, current activity etc. In addition to this, different organisms and groups of organisms will in various extents be influenced due to the type of oil and environmental factors affecting the spill.

Generally, the environmental effects on biota are surprisingly low, even if there was large mortality among sea birds after the described accidents. It seems that the environment has a good capability for recovery after accidents, even with large oil spills.

Investigations performed on the fishery and fish markets shows that local fishery suffer as results of the accidents. There were no evident signals on the European fish market due to the Braer and Sea Empress oil spills. It is assumed that other factors will override the possible effects from these oil spills. There are some signs that the fish markets have reacted towards Spanish sea products after the Prestige oil spill

The fishermen, who have suffered because of the exclusions zones, have got economic compensation. However, there are disagreements about the sizes of the compensation fund, and also critics because in some cases fishermen got bankrupt while waiting for compensation. Also in Galicia (*Prestige*) there is strong arguing, because the fishermen are given a low daily compensation, which to no extent covers up their obligations.

Information about the Braer accident is described in details in Wills and Warner (1993), MLA (1993), Ritchie and O'Sullivan (1994) and Davies and Topping (1997). The Braer accident cannot show any consequences for fish export from Shetland (Data from ICES) or any increase for Norwegian export in the same time period (Data from Norwegian Seafood Export Council). None of the reports from this accident tells about problems for the fish image, and the Norwegian newspapers does not write about destroyed fish in connection with their handling of the oil spill. The fishing exclusion zone stretched over a large area, and several salmon aquaculture farms were harmed. Also farmers onshore experienced problems due to the very light Gullfaks crude oil were dispersed into air by the wind. Problems for the fisheries connected to this accident, was that the plans and support foundation did not function as intended. Fishers got bankrupt while waiting for compensation.

The information about the "Sea Empress" accident is from SEEEC 1998, "The Environmental impact of the "Sea Empress" oil spill", Caldwell and Morgan 1997, Beaufort Research 1996 and the official web page <http://www.swan.ac.uk/biosci/empress/empress.htm>. Sea Empress does not show any statistical evidence for a reduced fish export. We have traced data from the regional level, (data from ICES), and it is not possible to identify any fluctuations that might indicate a loss in market *or* reduced export. Though, at local level (Milford Haven) actors were not satisfied because any public hearing was not held. There they invited Dr Caldwell and Dr Morgan to arrange a public seminar and write a report. According to this report local fishermen did experience significant losses (Caldwell and Morgan

1997). This reported losses might be recognised as significant due to the local dissatisfaction with the handling of the actual crises and the treatments afterwards. No document states these findings as far as we have been able to trace. The official document reports no losses directly related to the accident but excluding losses caused by the implementation of exclusion zones. However, no quantitative estimates were presented in the document.

The Prestige accident is new and the total amount of consequences are so far not documented. What one knows is that the fish and shellfish products from the Galicia coast with their fjords (rías) are famous in Spain and in many export markets. Now, the same products are met with large scepticism by the same market. Even fish landed in Galicia from elsewhere suffer by the new negative attitude. One example is the European hake fished in Irish waters by the Spanish fishing fleet. This is now auctioned at 30-40% below the former price, with severe consequences for the fishing community. Pescanova, the largest fish and Fishery Company in Spain, made guarantees before Christmas 2002 that they maintained a strong control with the product quality, and that they would complete the market needs with products from other parts of the world. So it seems that for the fisheries in Galicia, there will be great challenges in the nearest future. The short-term consequences of the Prestige oil tanker disaster was devastating for the fishing community in the regions of Spain affected by the oil spill, but the main part of activities were back to normal within the summer 2003. Though biological there has been raised questions about the long-term ramifications and the consequences to the product quality.

One purpose of this study was to establish whether one could register any fluctuations in Norwegian fish export during the Braer, the Sea Empress and the Prestige oil spill accidents. There is no statistical evidence for reduced fish consumption during oil spills (Data from ICES, Data from Norwegian Seafood Export Council). There are variations, but none that seems significant for the actual accidents; the statistics shows unexplainable variations all the time. Seeking through literature bases, existing literature on the spills and a selection on newspapers support these findings. It seems as the media focus on the accidents only for a limit period, and then on the immediate seen the consequences as harmed seabirds and polluted beaches. There has not been found any major articles focusing on destroyed fish or potential health consequences. Reports from other types of accidents launches the hypotheses that the consumers believes in their governments health organizations, and eventually stop in the delivering of the affected products.

Fish is perceived as a healthy and nutritious eating. The trend for food consumption says that the European market will let preferences decides more of their consumption pattern than price and income. This will be a question of lifestyle. The government is also trying to maintain the consumer trust in their guarantees for food safety. But the market diversifies and there are different trusts in official information. Generally in the western world there is a growing awareness in ad hoc consumer groups as the Environmental Innovation etc, - which is often connected to animals rights.

Food producers and marketing professionals know that even if risk and fear may be irrational, the painful truth is that if people lose their appetite for some kinds of food, no rational arguments and campaigns can regain it on a short-term basis. Attribution theories posit that consumers respond disproportionately to negative information. Popularity said; found that it takes about five instances of positive information to neutralise one instance of negative information.

Is it so that the public gets what it wants? The production and distribution of information by the media tend to follow the logic of the market in the pursuit of mass audiences (Golding and Murdock 1996). Therefore, the information conveyed to the public is rather streamlined, and there is a similarity rather than diversity with respect to what is presented to the public. The link between media and authorities is clear. Government departments produce large amounts of information that is selectively communicated to the public, and the government has power to police disclosure and thereby set limits to the information available in the news and entertainment media. This may compromise the ability of the public to judge the safety of foods.

The respondents in a British survey perceived food scares as having a clear beginning and end, which meant that eating habits were, in general, only altered for a time. Once the scare was reduced or disappeared from the news, there was a general return to former eating habits. When the publicity about salmonella was reduced the mass media, people thought that the public health problem had been resolved, and went back to eating eggs. We have seen that the media has much power and is able to set the agenda for discussions and concerns in society. Therefore, the government and the food industry need to counter the information conveyed through the media, and need an information strategy.

Difficulties when people perceive possible risks to health, and where the scientific evidence of harm is inconclusive. The BSE trouble showed that the Norwegians institutions dealing with food safety have legitimacy in the population. People seem to trust the information that is dispersed (Normann & Myrland 2002). According to the Norwegian research council 2001 (www.forskningsraadet.no) the consumers demand for safe and ethical food creates challenges for the aquaculture industry and research. One experience after the FMD and BSE is that the consumers to a low degree ask where the meat is produced; they just cut down on the meat consumption. The same will happen if salmon in Norway or another country get a disease, the consumers will not distinguish between different producers.

So far, there have e hardly been damage recognised for the fish market. But there is a lot of writing about the *Risk society*, which indicates a possible chance for food scares to emerge. But one also disagrees about how easy it is to *scare* the consumer in this so-called information age. The consumer receives so many food alert that it is hardly anything left to eat. For sure is the fact that the consumer forgets fast.

Accident in Northern-Norway – possible scenarios

The following is a description of two different scenarios with oil to sea, and possible effects on the fisheries from these. The scenarios comprise an accident involving an oil tanker transporting crude oil from the Goliath field. The Goliath oil has a relatively high content of wax, but not as much as e.g. Norne oil. The density of “fresh” Goliath oil is 857 g/l and the viscosity is $257 \cdot 10^{-1}$ cP at 13 °C. Maximum water uptake is approximately 70%, and natural dispersion is estimated to < 10% with 5 m/s wind, and 35% with 10 m/s wind.

In the scenarios, the type of accident leading to the chain of events is not essential. The crucial fact is the location and time of the accident, and amount and duration of oil release to the sea. It is assumed that the percentage of natural dispersion is 20%.

The following basic assumptions are made:

- An oil tanker carrying Goliath crude oil sinks just after leaving the field
- Scenario I: The date of the accident is the 20th January
- Scenario II: The date of the accident is 10th April
- The tanker carries 110 000 tons crude oil
- 70 000 tons oil is released to sea during one day. Rest of the oil will be within the wreck

In order to illustrate how oil from an accident described above will spread on the sea surface, model studies based on the scenario are performed (data from ENI Norway). 600 individual model runs are performed with historical wind data as a parameter in the model.

The 600 individual simulations give the possibility for a statistical consideration of the probability of how the oil spill will influence a given area, and thereby an influence area can be described (**Feil! Fant ikke referansekilden.**).

FIG 1 IN HERE

It is assumed that the influence area will last in two weeks after the accident. After this it is assumed that the oil is collected, stranded, evaporated or dispersed. Using an influence area that potentially can be affected, the effects from the oil spill on fishery and aquaculture will be overestimated.

In addition to environmental resources as sea birds, sea mammals, bird cliffs and vulnerable beaches, there are large commercial fisheries taking place within the influence area.

The main fishery affected in a scenario described above is the winter capelin fishery. There is also some fishing after cod and haddock taking place in the area in the time period from end of January to beginning of February, even if the main cod fishery in this area is from March/April to the end of May.

Fisheries in the affected area

The main fisheries affected in an oil spill scenario during winter/spring on the coast of Finnmark are the winter capelin fishery and the winter/spring cod fishery. These

fisheries occur from January to May. This cod fishery is very significant for the coastal fleet, while purse seiners catch the capelin. Also line fishing for haddock and gillnet fishing for lump sucker are important spring fisheries in the area.

Capelin

Historically there has been considerable fishing of capelin in the Barents Sea (**Feil! Fant ikke referansebilden.**). However, both in the mid 80's and 90's the capelin fishery has been closed due to low capelin stock. Since 1999 a limited fishery is opened, but only in the winter season.

The start of the winter fishery after capelin varies between years. Normally it starts in early January and continue to the end of February. Early in the period, capelin is caught offshore in the central part of the Barents Sea, but later in the season the capelin migrate towards the Norwegian and Russian coastline for spawning. The fishing vessels follow the migrating capelin, and gradually move closer to the coast. For a short period, approximately two weeks, the roe of the capelin is of satisfactory quality for human consumption, and an intensive fishery for the Japanese market takes place.

FIG 2 IN HERE

Before and after this period, capelin is used for production of fish oil and fishmeal. During this period, the male part of the catches is processed into fish oil and fish meal. The prices on capelin delivered for direct consumption are far higher compared to capelin delivered for oil/meal production.

Early in the season only large sea going vessels catch capelin offshore. When the capelin have migrated closer to the coast, smaller vessels (coastal vessel group) also take part in the fishery. Approximately 13 % of the quota is reserved for the coastal vessels, while the rest of the quota is for the larger, sea going vessels. After discussions, the following assumptions are made (A. Ahlquist, pers. com.):

- The oil spill covers the period when capelin is delivered for human consumption
- The main part of the capelin stock has migrated into the area of influence
- All fishing in the area of influence is stopped
- The coastal vessel group loses the entire potential catches for that year
- The off shore vessels lose 50 % of their catches for that year

For 2001, the total catch was 369 000 tons. Of this the coastal vessels had a quota of 47 970 tons, and the open sea vessels 321 030 tons. It is assumed that the large vessels have caught 50 % of their quota before the capelin enter the area of influence, and lose 50 %, or 160 515 tons, of their catches due to the oil spill. It is assumed that 50 % of the catches are delivered for food consumption (proportion of females), approximately 100 000 tons capelin for food consumption, and the same amount for fish oil and fishmeal is lost that year.

The prices on capelin vary during the season because the catches are sold by auction both for industrial use and for food consumption. Minimum price for industrial use is 0.6876 NOK per kg. In 2003, a normal price has been 0.95 NOK per kilo. For food consumption prices have varied between 1.2 and 1.42 NOK per kilo. Assuming an average price for industrial use at 0.95 NOK per kilo and 1.35 NOK per kilo for

consumption¹, this scenario will cause a direct loss of 95 million NOK for the industrial fleet and 135 million NOK for the consumption fishery. All data are first-order values, and the total loss with respect to processing is not included.

Cod, coalfish (saithe) and haddock

Due to the large number of smaller fishing vessels participating, it is difficult to estimate how much cod and other fish are caught in the area of influence during the hypothetical oil spill. Data from Norges Råfisklag are collected on area and location level, but several smaller vessels only keep records once a week, summing up landings from several locations within the statistics area. Analyses of the fisheries within the influence area shows that there will be a total loss of nearly 10 million NOK in the two week period from 20 January.

For catches of haddock and coalfish, the same assumptions will lead to a loss of catch value of 2.1 mill NOK for haddock, and 0.8 mill NOK for coalfish in the two weeks.

Aquaculture in the affected area

Finnmark County has become an important area for aquaculture and fish farming. At present, approximately 100 licences for ongrowing production of salmonids and different marine species are awarded in the county. In addition there are approximately 50 licences for shellfish production. Salmon is the most important species, and in 2001 farmed salmon sold for 566 mill NOK from Finnmark County (<http://www.fiskeridir.no>). Compared with salmon, all other species can be ignored per today with respect to value of sales.

Within the estimated area of influence, 16 licences for salmon/trout, two licences for blue mussel farming, four licences for crabs and sea urchins, one land based fish farm for white fish and three licenses for cod are found. It is not known if all of these farms will be in production at any time, but most likely they will. It is assumed that all of the farms are in production at the spill, and are hit by oil. One option if an oil spill is threatening a fish farm is emergency slaughtering. However, due to the short response time and the inability to cope with transportation, slaughtering and processing regulations, the total biomass of the affected aquaculture plants are calculated as lost in the scenario evaluation.

In one single licence in January, it is assumed that there are two groups of fish. First, the fish placed in the sea in May/June year before. This fish is about 1 to 1.5 kg in weight, and totally for one licence there is typically approximately 200 tons (160,000 individuals) of this group during this time of year in the cages. The other group is fish that is ready for slaughtering. This fish is about 4-6 kg, and for one licence it is about 400 to 500 tons of fish in cages in January. The value of the smaller group is assumed to be 30 NOK per fish, totally 4.8 millions NOK. The value of the fish ready for slaughtering is about 20 NOK per kg, totally 10 million NOK.

In addition to this, the technical installations will be oiled. Some parts of this (rings, floating devices, anchors etc) can be cleaned, but nets and ropes have to be destroyed. In addition to the lost fish, this will be an extra cost for the influenced fish farmers.

It can be assumed that the oil not only contaminates the fish and the equipment, but also the site itself. Depending on physical conditions (waves, current, substrate etc) at

¹ This price can be much higher due to increased export to Japan later in the season

the sites, and the combat strategy applied, the contamination can be present for years. The farmer can wait until the production site is resituated, or move the fish farm to an uncontaminated site. However, sites suitable for and available to aquaculture are sparse, and most likely no available sites can be found, particularly if a large area is contaminated. Moving to a new site will also cause infrastructure costs to increase (site surveys, applications, moorings, food-storage, transportation routes etc.).

Totally, assuming lost values in terms of fish for one fish farm are about 15 million NOK, the value lost for the 16 licences is nearly 250 million NOK only in terms of fish and only for one year. In addition, the value of technical installations has to be added to this. Also the lost income if the sites remain inaccessible over time, has to be included in the calculations.

The Finnmark spring cod fishery

If the accident happens later on in the season, the important fishery after cod would be stopped for a shorter or longer period. In this fishery, mainly smaller vessels (open boats from 5 m to vessels up to 30 m) participate. Traditionally, vessels from the entire Northern Norway carry out the Finnmark spring cod fishery. The two municipalities that are most affected by the accident are Måsøy and Nordkapp municipalities. These communities have 25 and 17 vessels, respectively, between 6 and 33 m (The Directorate of Fisheries, <http://www.fiskeridir.no/>). An important feature is that most of the vessels will deliver their catch locally, close to the area where the fish is caught. In order to approach effects of an oil spill described above on the spring cod fishery, the second scenario takes place 10 April and will influence the area in two weeks. The size of the spill is the same as for the first scenario, and the influence area is shown in **Feil! Fant ikke referansekilden.**

Data on catches of cod within the area of influence is delivered by Norges Råfisklag. Analyses of these data together with the influence area shows that the stop in the fishery in two weeks will give a reduction in total landings in April 2002 due to the oil spill of 1.5 million kilos. Assuming a price on NOK 13.25,- per kilo (Norges Råfisklag), this constitutes a value of nearly 20 millions NOK.

The cod spring fishery starts often in March and lasts until the end of June. In 2002, total landings from the area of influence during these months were 10.6 million kilos. A reduction on 1.5 million kilos due to the spill in April will reduce the total landings by approximately 14 %.

Given the above assumptions and scenarios the loss in value from the different fisheries and aquaculture are more or less similar for capelin fisheries and aquaculture with approximately 200 million NOK each, and spring cod fishery will have a smaller reduction. However, during the spring cod fishery the main part of the catches are delivered locally. This is in contrast with the capelin fishery where a large part of the catches are delivered to a few large processing plants along the coast. However, also a large part of capelin for consumption is delivered locally. Nevertheless, we believe that a stop in the cod spring fishery will have the largest influence for the communities along the coastline. First, there are many vessels involved in this fishery, and secondly, the major part of these vessels will deliver their catches locally and keep a high activity level in the local land based fish industry.

In addition to the larger towns (Hammerfest/Rypefjord and Honningsvåg), the fish processing plants are located in rural areas and smaller villages. All these will normally

get the fish for production from the area of influence. While Hammerfest/Rypefjord and Honningsvåg have large harbours with capacity for large trawlers, the rest of the fish processing plants are more dependent on smaller vessels fishing locally. It is believed that the smaller communities are more (totally) dependent on the local fishery compared to the larger towns and, and will therefore be more affected by a reduction of landings compared to Hammerfest/Rypefjord and Honningsvåg.

Possible effects on the fish market

The extent of the impact is somewhat between what one experienced in Wales and Shetland, but not as extensive as experienced so far with the “Prestige”. The described scenario says that it is catches of capelin, cod and the fish farming in Finnmark County that will be harmed. Since the different fish represent very different markets, one has to differentiate between them.

Capelin is the most important species caught with respect to volume in Finnmark in the time period described in the scenario. Capelin has two major markets; it is either for export; mainly to Japan and Ukraine. Or it is delivered for domestic processing; and becomes fishmeal/fish oil or food for aquaculture farms. As shown in **Feil! Fant ikke referansekinden.**, there are large fluctuations in the total stock and the total annual landings. These fluctuations are caused by biological factors within the capelin stock and fishing pressure. The price per kilo (for food consumption) is in average between 0.95-1.35 NOK.

Given an oil spill, the demand for raw material for food could easily and not especially more expensive be substituted by Icelandic capelin or other types of food. The image for Norwegian fish might get some scratches. Probably the lack of capelin from Norway could easily be replaced by capelin caught elsewhere, or the market will substitute other fish species during periods with no deliveries. The catch of capelin is most important for Norwegian fishers in years with low stocks of the more valuable fish stocks as cod, coalfish or haddock. The processing industry in Finnmark is therefore built to handle also capelin, and in times of need they do. Therefore capelin is of some importance to both the fishers and the processing industry, since it represents an opportunity in times and seasons with low amounts of other fishes.

But when it comes to Norwegian reputation as a deliverer of pure fish, from an unpolluted ocean, the stop in delivery of capelin would probably not harm appreciably this reputation.

Cod, coalfish and haddock, are fish types of economic importance in *normal* seasons in Finnmark. During winter cod migrate from the Barents Sea to the spawning areas from western Finnmark to mid Norway. The main part spawns in the Lofoten area. During this period the cod is caught close to the coast by smaller vessels. The main fishery is performed in Lofoten area. These catches are reported to Nordland County and not Finnmark. The winter/spring cod fishing, in Norwegian called *skeifiske*, has an important place in the minds of Norwegians and the visual picture of the fishing is often used in fish promotion campaigns and even in tourism advertisements. The economic value of this fishery is great, even if it has been gradually reduced due to lower stocks.

The oil spill scenario happens late January, which means in the beginning of this fishery. If the oil spill happened in Lofoten or Vesterålen, one could imagine enormous consequences for the image and also for tourism. Finnmark is geographically too far

away to be associated with this fishery. And the fact that the cod is passing the area of influence, is probably a fact that most consumers or media journalist are not aware of.

Estimates show that 3 - 4,000 tons of cod will not be caught in Finnmark due to the accident. This does not represent a large volume, and the media attention is not likely to be recognisable, if one can transfer the experience from the case studies. For the fishers it represents some value, but the exclusion zone will only force fishing boats to outside the zone. It might cause trouble for the smaller boats that can't leave the coastal area. The weather in this area can be very rough, and two – three weeks of being weather-bound each winter is not unusual. The fishers are used to variations and external factors influencing their livelihood.

The same goes for the small amount of coalfish and haddock that are normally caught in this area at this time of the year.

As described before an oil spill at the Goliath field in April will mainly affect the cod fisheries. For the cod spring fishery the reduction in the total fishery with approximately 14 % probably will have large economical effects on the already heavily regulated fishing fleet. Especially the smaller vessels that have limited opportunities to change their catch areas will suffer. Besides the direct economic effect from the loss of fish sold, there will be major consequences for the societies where the fish are landed and eventually processed. This impact will naturally be greatest in smaller places with a major dependency on fisheries. We still do not find any argument for a damaged reputation/image in the fish market due to this kind of accident, but the fishing industries of Finnmark have for long experienced a terrible economic situation, and an oil spill catastrophe will further increase the perceived idea about an industry in major trouble. Effective compensation models have to be found.

Aquaculture and fish farming represents a large volume and value in Finnmark County. It is also an industry in growth and is assumed to grow intensively the next decades. There are especially large expectations connected to cod farming. The image situation for farmed fish is somewhat different for captured wild fish. There have been scandals associated with farmed fish, for instance the use of antibiotics, the possibility for gene modification (gene modified food is largely feared by consumers), ILA and most recently the ethical considerations about the living conditions in farms. All together it have given farmed fish a very vulnerable image. An oil spill and some media attention related to that, for instance black oiled fish caught in fences, will certainly affect the image of the fish.

The location of farmed fish is not specified to consumers, but the ongoing EC Trace programs will for the future demand an identification of this. The consumers' attention towards origin will probably be awakened and more discerning. Fish derived from different areas might be given more value and attention.

Farmed fish cannot escape from an oil spill. Given an oil-spill, some fish, and some installations will suffer negative consequences. The duration will depend on the type of oil, the amount, the weather, and, not least, the substrate conditions. The "Braer" case study shows that oil and its unwanted components were mixed into the sediments and caused long lasting problems for benthic fish and shellfish. If one should estimate the consequences one must examine each farm and its value. Before an oil spill occurs, it is impossible to consider the potential long lasting effects.

Based on the oil spill scenario at Goliath in January we believe it is possible to conclude that the disturbance to the fish market will be minor. There are factors that

can escalate the disaster and therefore affect the consumers to a higher degree. Based on the circumstances of the case studies presented in this report, the market impact will be minor, basically because the media typically does not focus on fish, and consumers will mainly trust the public information provided by the relevant authorities. There is a large BUT, and that is what we already are seeing through the signs of the “Prestige” accident. Groups with a variety of objectives are using the “Prestige” accident as a reference to *what might* happen outside Finnmark. The forthcoming discussion about whether the Norwegian Parliament allows further petroleum activities in this area will also be based on the experiences from “Prestige”. The next 5-10 years will be crucial for the possible petroleum development. A tanker accident in the Barents Sea will be used, and opposition groups will definitely use visual means to make their point. This might affect the market to a greater degree, than if we were in a region with a mature petroleum industry.

General concerns

The scenario shows effects directly related to one specific accident. An accident might happen at other times, and on other locations in Northern Norway. We have already indicated that an oil spill closer to the Lofoten Islands will affect markets and consumers much more; this region is recognized for its fishing traditions and is also a well-known tourist destination. Its attractiveness is largely based on the fishing history. There are also other points we find worth mentioning;

- Some of the fish exporters are not worried for an single oil spill in the Barents Sea. They claim that consumers are not aware of where the fish is caught, as long as they trust in their deliverers. The aspect of food safety will be maintained both by public institutions and major supermarket chains. For instance the major customer ‘Unilever’ has already established a programme for safeguarding their fish deliveries. The fish exporters also intend to substitute contaminated fish with fish from other regions. The fishing fleet is flexible, and the price decides who is the buyer.
- The fishing fleet will find other regions outside the exclusion zone to catch fish, and the fish too will probably escape. The most affected group is the small fishermen who operate small boats that are not able to go far seaward or long distances. The numbers of fishermen in these small boats are few, even though most of them actually live in Finnmark. The most affected ones will be the aquaculture farms that are not able to move or protect their installations. Depending on the amount and type of oil, physical factors and substrate conditions, sites might be destroyed for years.
- The affected fish farms will probably get compensation enough to survive, but the implications for these small segments of societies, should they loose their livelihood for a couple of year, is impossible to assess – but certainly will result in damaging their culture and new recruitment to the industry. This scenario: fishing grounds closed for years and the processing industry on shore forced to close down for a similar time period, is the worst case scenario. On the other hand, the only place this has happened as a result of an oil spill is some fishing villages in Galicia. We are then talking about fishing villages depending on harvesting of shellfish in the coastal zone (and the processing of the product) and some straits depending on fish farming, and where the substrate is destroyed.

- The media will react, but they will stay for only a few days, reporting what is seen, e.g. dead seabirds. The problem for the media is their dependency on sensations and newer news, and their low competence on what might be the effects of an oil spill. See for instance Anderson 2001 for a good review on how media treats oil spill disasters.
- If the crisis is limited and the exclusion zone lasts for only a two week period, the case studies suggest that there will be no severe damages to either the fish market or fishing societies. It can be different however if an accident occurs early in the petroleum era of the Barents Sea, then the fishing organisations will have reasons for being sceptical against further development and the environmentalists will use even the smallest accident to support their positions. When the Navion owned oil carrier in 2001 lost 550 tons of oil from Norne (Statoil owned oil producing vessel outside Bodø) the Miljøhjemmevernet reported the oil company to SFT and attempted to produce serious consequences for the oil company. However, very little consequences eventually resulted from these efforts.

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Captions to figures

Figure 1.

Probability of hit (percent of cases of hits) of oil (>5 %) in an areas in the southern Barents Sea as a result of a large oil spill from an oil carrier at the Goliath oil field given for January and April. The statistical result has the basis in 600 individual simulations.(Data from ENI Norway).

Figure 2.

Barents Sea Capelin. Development in total stock size (total columns) and the maturing component (solid columns) in the autumn, and total annual landings 1973-2001 (solid line). (Data from Institute of Marine Research, Bergen).

Figure 1

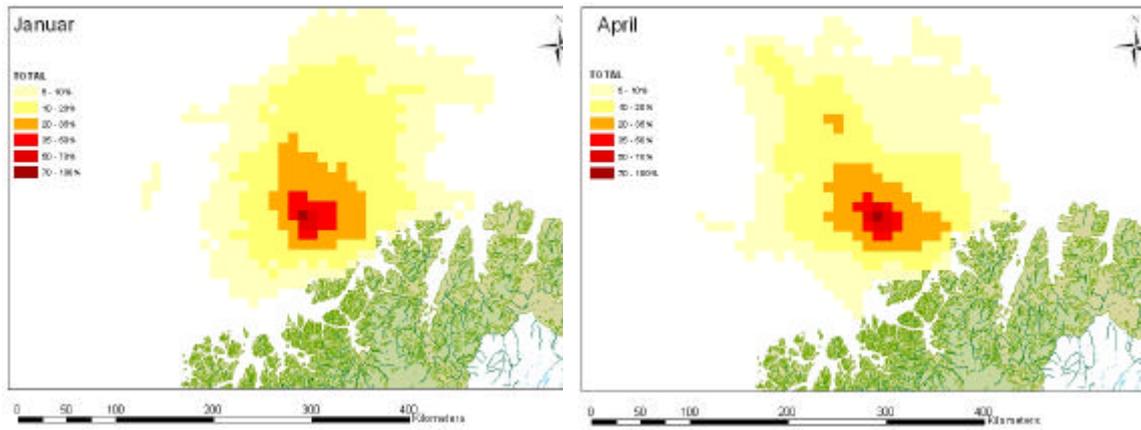


Figure 2

