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CURRENT PROBLEMS AND RESEARCH RELATED TO  
INTERACTIONS BETWEEN MARINE MAMMALS AND  
FISHERIES IN NORWEGIAN COASTAL AND  
ADJACENT WATERS

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ABSTRACT

Current research and provisional results on the food items and feeding rates of killer whales, minke whales, grey seals, common seals and harp seals are presented. Commercial fish species constitute the major part of the stomach contents in all five species. An average 64% of examined cod fishes from Norwegian coastal waters were infested by cod-worm. Mean infestation was 8.5 cod-worm larvae per cod.

Data on the value of economic losses due to gear and catch damage by marine mammals and cod-worm infestation in Norwegian coastal and inshore waters are presented, but the total impact on fisheries cannot be quantified yet.

## INTRODUCTION

Twentyfour species of marine mammals have been recorded along the coast of Norway or in adjacent oceanic waters. Legislative protection or restrictive catch quotas for species which were heavily exploited, have contributed to recent increases of some of these stocks.

Many of the species are known to predate on commercial fishes, and their food requirements cause a growing concern related to the intensive fisheries in the same areas. In oceanic waters the mammals interfere with fisheries mainly through their impact on the size and behaviour of fish stocks. Gear damage and cod-worm infestation are additional problems in coastal and inshore waters.

Investigations on the interactions between marine mammals, fish stocks and fisheries now have a high priority in the research program of the Sea Mammal Section of the Institute of Marine Research, Bergen. Studies of coastal seals (grey seals, *Halichoerus grypus*, and common seals, *Phoca vitulina*) and their interactions with fisheries have been carried out since 1975 and corresponding investigations of killer whales (*Orcinus orca*), minke whales (*Balaenoptera acutorostrata*) and harp seals (*Pagophilus groenlandicus*) have been initiated. This report gives a summary of preliminary results and of current and planned research.

## KILLER WHALES

Killer whales are present in all areas along the Norwegian coast throughout the year, but the greatest numbers occur in the Lofoten and Møre areas and off the southern West coast. An average catch of 57 killer whales per year over the period 1938-1968 has not changed the length distribution of the catches. In 1980 and 1981 Norwegian authorities established catch quotas of 52 killer whales per year.

Stomachs from 95 killer whales caught in the Lofoten area in 1979-1980 have been examined. Contents were present in 87 stomachs (91.6%). Herring (*Clupea harengus*) only was found in 84 stomachs (79.8%), a mixture of cephalopods and herring in two stomachs and a mixture of codfish and herring in one stomach. Information on the volume of stomach contents is available for 41 stomachs. The volumes varied between 15 l and 150 l, with a mean of 70 l per stomach.

Norwegian killer whale research is based on whales from commercial catches and studies of the stomach contents will be continued if and when catch is permitted. It is planned to put emphasis on quantitative measurement of the different food items. Further data on the status and biology of killer whales in Norwegian waters are given CHRISTENSEN (1981).

#### MINKE WHALES

Norwegian coastal waters, the North Sea and the Barents Sea are the major feeding grounds of about 120,000 minke whales (RØRVIK and CHRISTENSEN 1981). This Northeast Atlantic stock is close to its upper asymptotic level (RØRVIK 1981) and the annual catch quota is 1,790 whales.

The minke whale is known to feed on fish as well as pelagic crustacea. CHRISTENSEN (1974) found that the stomach contents of minke whales examined in 1973 in the Barents Sea and off East Greenland mainly consisted of capelin (*Mallotus villosus*), but krill and a mixture of krill and capelin also occurred frequently. A whale caught in the Barents Sea contained 50 l haddock (*Melanogrammus aeglefinus*). At West Greenland sand eels (*Ammodytes* sp.) and krill were the chief food items (sand eels in 34 whales, krill in 20, pteropods in 4 and capelin in 1 whale. Two stomachs were empty). JONSGÅRD (1981) examined the stomach contents from 237 minke whales caught in Norwegian coastal waters (107), the Barents Sea - Spitsbergen (94), East Greenland (31) and West Greenland (5).

Stomach contents were present in 193 whales (81.4%). Fish only was found in 104 stomachs (43.9). The species identified were cod (*Gadus morhua*), haddock, coalfish (*Pollachius virens*), herring, capelin and sand eel. Pelagic crustacea only (euphausiids and *Calanus finmarchicus*) were recorded in 74 stomachs (31.2%). Mixtures of fish and pelagic crustacea were found in 15 stomachs (6.3%).

Further research on the food items and feeding rates will be continued with field work carried out by institute personell on board commercial small-type whaling vessels.

#### GREY SEALS AND COMMON SEALS

Grey seals and common seals are frequent all along the coast of Norway. Grey seals are most abundant in South Trøndelag and Nordland counties, but they are also numerous in the counties of Rogaland and Finnmark. Observed pup production in Trøndelag and Nordland correspond to a total stock of about 3,400 grey seals in these counties in 1979. This probably represents about half the total Norwegian stock of grey seals.

The greatest numbers of common seals have been observed in Møre and Romsdal county where there is an estimated minimum of 1,200 common seals.

Coastal seal abundance appears to have increased since 1973, when all seals were protected throughout the year in southern Norway and protected from 1 May to 30 November north of 62°N (Royal Decree of 13 April 1973).

In South Trøndelag a local protection of grey seals had been in force since 1953. A subsequent growth of the Froan grey seal colony increased pup production from about 50 per year in 1953 to a minimum of 300 pups per year in 1979. From 1975 to 1980 a growth rate of 13% per year have been observed in some local grey seal stocks.

In areas where both species occur large and increasing stocks of grey seals have a detrimental effect on the common seals through competition for food. However, where the numbers of grey seals are small, there is evidence of increase also in common seal stocks.

Provisional analyses show that fish remains make up more than 80% of the stomach content in grey seals. Gadoid fishes are most abundant. Cod, coal-fish, cat-fish (*Anarchichas lupus*), red-fish (*Sebastes* spp.) and sand eels have been identified. Herring was the most frequently occurring species in the stomach contents of 71 common seals, and constitute 37% by volume of the fish remains. Gadoid fishes make up 25%, red-fish 8%, flat-fishes (Pleuronectidae) 5% and 25% were unidentified.

Cod-worm (*Phocanema decipiens*) constitute about 90% of the nematodes identified from 35 grey seals. The rest is made up by two other ascaroids: the herring worm (*Anisakis* sp., 8%) and *Contracaecum osculatum* (2%). The recorded average incidence of all nematodes was 1,430 per seal in stomachs from 52 grey seals of all age groups. Nematode infestation in 93 common seal stomachs varies between 0 and 400, with an average of 36 per seal. The same three nematode species were identified as in grey seal, but with a more equal relative abundance. This difference in nematode infestation and species abundance between the two seal species probably reflects a difference in food preference or availability, herring being more frequently eaten by the common seal.

Interactions between coastal seals and fisheries have been investigated through questionnaires distributed to fishermen and processing plants from Møre and Romsdal to Finnmark county. Quantitative data on cod-worm infestation in cod were collected by counting larvae in fish filets in samples from commercial catches.

By March 1981, 151 fishermen and 34 processing plants or dealers had replied to the questionnaires. Replies were most frequent

from areas with high concentrations of grey seals, in particular from the Trøndelag counties and the southern part of Nordland county.

Direct damage to fishing gear has been evaluated by 27 fishermen, who report annual losses varying between N.kr. 120 and 30,000 with an average of N.kr. 2,900. Most damage occurs on net-gear like gill-nets and trap-nets. Buoyed salmon trap-nets and cod-traps appear to be particularly exposed to damage. However, losses by direct damage are small compared to catch losses during the time required for repairs, and these cannot be evaluated. The highest economic losses are experienced when bag-nets for storage of sprat or cultured salmon are damaged.

Damage to catches was specified by 34 salmon fishermen. The reported percentage of damaged fish varied between 5% and 25% with an average of about 15% in areas with concentrations of either grey seals or common seals.

The greatest problems and economic losses to fishermen and processors alike are caused by codworm infestation in the fish, in particular cod. Effects on sales or prices are reported by 48% of the fishermen and 22 of the processors. The average annual lost value reported by 16 fishermen was N.kr. 3,900, while 7 processors or dealers reported annual losses averaging N.kr. 50,000. Several fishermen claim that actual losses are significantly higher because part of the catches cannot be sold at all. The greatest losses are experienced by dealers in fresh fish and plants producing fish fillets.

Cod-worm infestation was reported to be an increasing problem along most of the outer coastline from Møre and Romsdal to the southern part of Nordland county. The infestation was investigated in a total of 704 cod in 19 samples from commercial catches along this stretch of the coast.

In several areas with concentrations of seals, more than 90% of the cod was infested with average numbers of codworm larvae of up to 32 per fish in individual samples. Maximum infestation (177 codworm larvae) was recorded in a single cod caught close to a grey seal colony. An average 64% of the fish in all samples were infested. The mean infestation per fish was 8.5 codworm larvae.

Preliminary results from coastal seal investigations from Møre to Lofoten have been reported by ØRITSLAND and BJØRGE (1981), while a more detailed analysis of the data is still in preparation.

#### HARP SEALS

Since 1968 the harp seal stock in the Barents Sea has increased by about 5% per year (BENJAMINSEN 1979) and in 1981 the stock probably exceeds 1 million animals. The sustainable yield for 1978 was estimated at 98 thousand pups and 8 thousand one year and older animals (BENJAMINSEN 1979). However, the total catch quota remained at 50,000 seals, and was increased to 60,000 for 1981.

The major feeding grounds of this stock are found in the northern Barents Sea, towards the edge of the pack-ice. The occurrence of harp seals is related to the distribution of capelin, but our knowledge about the feeding biology of harp seals in the Barents Sea is far from complete.

Contrary to their usual migration pattern, harp seals in 1978, 1979, 1980 and 1981 followed the capelin spawning migration all the way into the fjords of eastern Finnmark. Immature harp seals and pregnant females appeared in February. The females disappeared in early March while the immatures stayed close to the coast until late April and were joined by adult males in mid-March. From medio April to medio May adult females dominated among seals drowned in gill nets.

At the same season (February-May each year) a migration of cod feeding on capelin form the basis of a gill-net fishery in the Varangerfjord. This is the most important fishery to the local fishing fleet in the Varanger area.

There is evidence that more than 10 thousand harp seals drowned in gill-nets in each of the years from 1979 to 1981. The costs of gear damage were evaluated at N.kr. 610,000 in 1979 and N.kr. 980,000 in 1980. The value of lost catches was estimated at N.kr. 610,000 in 1979 and to N.kr. 490,000 in 1980 (information from Finnmark fishermen's union). In 1981 the Norwegian government paid damage to the fishermen by a compensation for each seal landed.

The stomach contents of harp seals drowned in gill nets in the Varanger area consist mainly of capelin. After spawning the seals also feed on the spawn. Cod, shrimp (*Pandalus borealis*) and squid (*Todarodes sagittatus*) also have been identified in stomach contents from these seals.

Investigations of the feeding biology of the harp seals in the Barents Sea were initiated in 1981. The plans are to capture harp seals in feeding situations at different seasons and in different areas of the Barents Sea, and study stomach contents and condition in relation to age, reproductive status and season.

#### WHITE WHALES

Invasions by schools of white whales (*Delphinapterus leucas*) with significant if temporary consequences for local fisheries were reported from Finnmark county in the summer of 1981. Such aberrant migrations of this arctic whale to Norwegian coastal waters are also known from previous years. They have not been investigated, but appear to cause less extensive disturbance to fisheries than the repeated invasions of harp seals. There is no Norwegian harvest of white whales, but a small-scale fishery in the White and Kara Seas is continued (ANON. 1981).



## CONCLUDING REMARKS

Interactions between stocks of marine mammals and fish populations or fisheries in Norwegian waters cannot be quantified at the present stage of knowledge.

Measurements of maximum volumes of stomach contents and the frequencies of empty or partly filled stomachs will contribute to estimates feeding rates, but information on the turnover time of different food items are needed. Supplementary data on the energetics of marine mammals in the sea also are necessary and an experimental study of the metabolism of swimming seals is in progress (A.PÄSCHE, personal comm.). However, seals take only bits and pieces from large-sized prey and therefore only minimum estimates of the impact on fish stocks can be drawn from measured feeding or metabolic rates of seals.

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