

FFI FACTS

Scientific tests. Killer whales with sensors that record the animals' response to sonar signals. The tags are attached to the whale with suction cups. (Photo: Sanna Kuningas)

Sonars and the marine environment

FFI is studying the effects of Nansen class sonars on fish and marine mammals.

The objective is for the Royal Norwegian Navy (RNoN) to be able to operate its sonars in an environmentally safe manner with as few operational restrictions as possible. Active sonars transmit powerful sound pulses (pings) under water. Reflected signals (echoes) can be used to determine the presence of for example submarines. The Nansen class frigates will be equipped with sonars that transmit at lower frequencies – and thereby over greater ranges – than the Navy has operated before. These sonars will transmit sound in

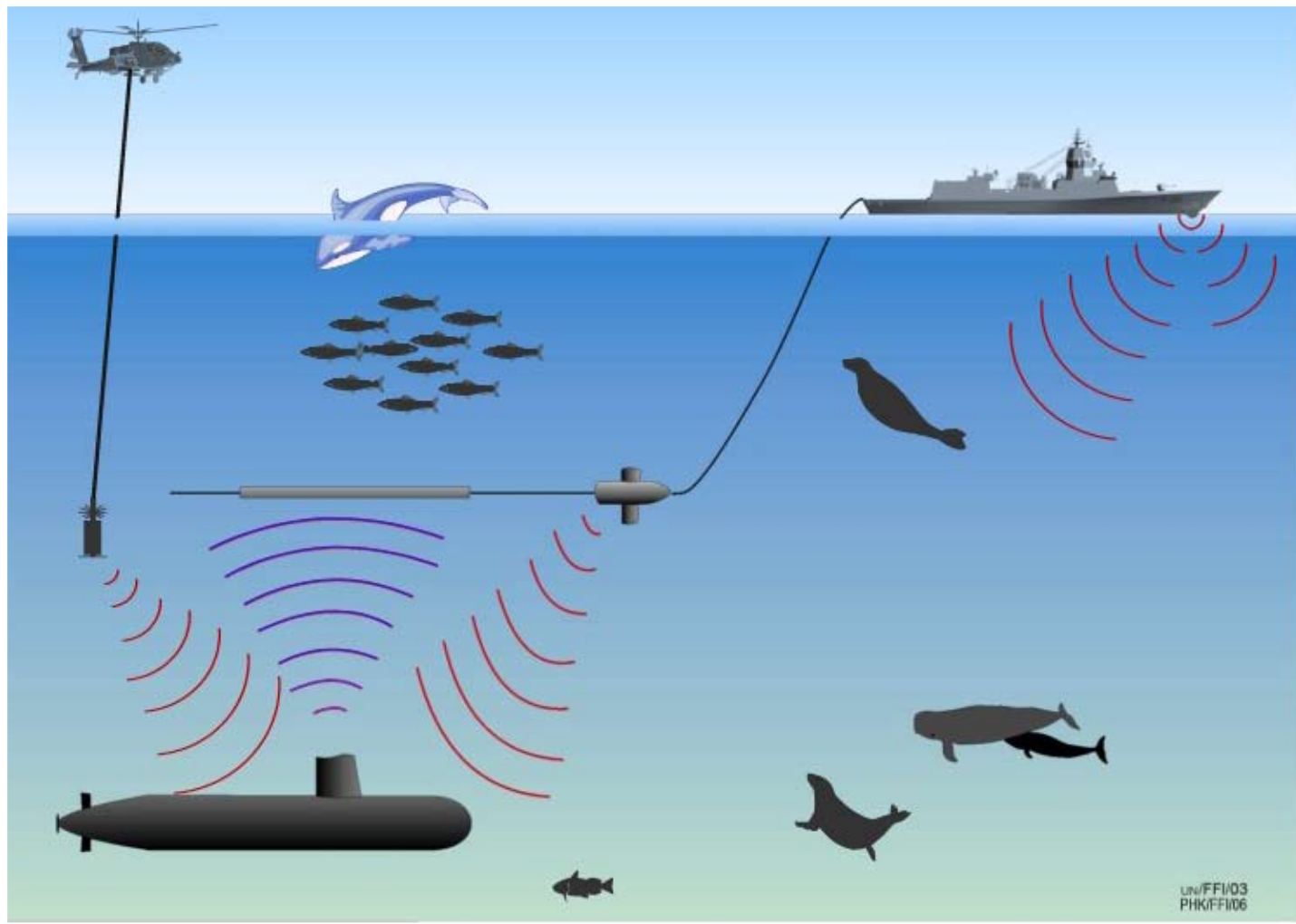
the frequency range 1–8 kHz. While this is very audible to both seals and whales, most fish species will not be able to hear these signals.

In other parts of the world, a number of whale strandings have coincided with the use of military sonar. This has given rise to the suspicion that sonar signals may physically harm marine mammals, or scare them to altered behavior that may in turn have caused the strandings. In connection with naval exercises in Norwegian waters, the Navy has also been met with charges that the use of sonar can harm fish or affect their behavior

whereby they become less accessible to the fishing fleet. Obviously, the Navy wishes to avoid harming the marine resources, its mission is to protect. FFI has therefore been asked to study the effects of the new sonars on marine life. The objective of the research is to arrive at sensible regulations governing the use of sonar in Norwegian waters – rules that are scientifically based while simultaneously adapted to the day to day operations of the Nansen class frigates.

Scientific cooperation

In order to access the national expertise, FFI appointed the “National Panel of Experts



Nansen class. The frigates will be equipped with both hull mounted sonar, towed array sonar and helicopter operated dipping sonar. These transmit powerful sound pulses in the 1-8 kHz frequency range, which may be potentially harmful to both fish, seals and whales. (Figure courtesy of FFI)

on Sonar Effects on Marine Life". This team of specialists comes from the University of Tromsø, the University of Oslo, the Norwegian Institute of Marine Research, the Norwegian Polar Institute the oil industry, the Norwegian Veterinary School, the Royal Norwegian Navy, and FFI. The group possesses civilian expertise in underwater acoustics and different areas within the field of marine biology (fish, marine mammals, behavior and physiology) and military expertise on the operational use of sonars. The group has identified the most important knowledge gaps and recommended effect studies to fill in these gaps. The panel has also been involved in recommending guidelines for the use of sonars in Norwegian waters.

Effect studies

In cooperation with its national and inter-

national collaborators, FFI is carrying out a series of experiments to study the physiological and behavioral effects of sonar signals on fish and marine mammals. These studies have been carried out, or are in the process of being carried out, on juvenile fish, adult fish, seals and whales.

Operational restrictions

From what we already know about the effects of sonar signals on fish and marine mammals, there is no basis for strict regulations on the use of sonar in Norwegian waters. Nevertheless, FFI recommends certain restrictions on the use of sonars in areas having high presence of herrings and marine mammals. As of today, we lack a complete understanding of how intense acoustic signals affect marine life, but the aim of the guidelines is to establish the best pos-



Herring. The pie chart shows the assumed mortality of herring spawn owing to a hypothetical sonar-intensive exercise in a spawning area (marked red) compared to the daily natural mortality (marked black). Thus, sonar exercises will have no significant effect on herring stocks.

sible balance between operational needs and environmental considerations. Operational regulations will be correspondingly updated as we acquire greater understanding.

Fish

Contrary to other species of fish, clupeid fish (herring and brisling) are able to hear signals in the frequency range of the sonars. Our studies also confirm that clupeid fish are more vulnerable than other fish species. Juvenile herring are particularly sensitive, even though the effect of sonar is not significant at the stock level. It does not appear that the use of sonar affects the accessibility of adult herring to the fisheries, but this is being examined more closely. The effects of sonars on other fish species appear to be minimal. Based on the effects that have been discovered, restrictions have been imposed on the use of sonar in areas with a high presence of juvenile herring. Furthermore, to be on the safe side, restrictions have been imposed on sonar exercises in areas having a large presence of important ecological and commercial fish species. This also applies to areas in which these species are intensively fished. A safety zone from fish farms has also been established.

Marine mammals

Our aim is to minimize the risk of harm to individual animals. As long as they are not in the immediate vicinity of the sonar source (closer than 100 m), it appears that marine mammals are not directly harmed by sonar. However, possible causal links between development of decompression sickness (the bends), a phenomenon that appears to occur in certain species, and the use of active sonar is still obscure. Further more, there are no studies that have looked at potential injury (e.g. hearing injury) to marine mammals that range very close to a sonar source. Of the species of seals and whales that have been studied, it appears that

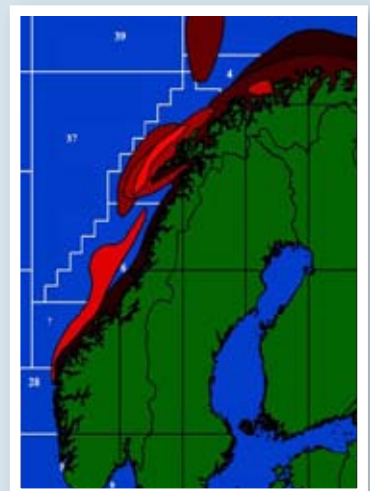


Seals. *The Department for Arctic Biology (University of Tromsø), National Hospital of Norway (Rikshospitalet) and FFI have been studying how seals react to sonar signals. (Photo: Erik Sevaldsen)*

though the sonar source does not cause any panic reaction, most animals will endeavor to get away from it. This reduces the risk of them coming too close to the sonar source, which could result in injury. In order to minimize the risk of harming marine mammals, sonar transmissions are not initialized until a safety zone around the sonar source is checked for the presence of marine mammals. Alternatively, transmissions might be initialized at reduced power to alert the animals and allow them to leave the danger zone. Sonar exercises are not carried out in areas where beaked whales are expected to be encountered or where there is a high density of other marine mammals. Special efforts should be made to avoid sonar transmissions at high speed or in constricted waters, as this hampers the ability of the animals to get away from the sonar source.

Decision aid tool

In order to ensure that information reaches operations planners, FFI is collaborating with the Institute of Marine Research to develop a decision aid tool to assist in the planning and execution of sonar exercises. This tool will be placed on board the new Nansen class frigates and integrates information about fishery activity and the presence of different species in time and space with information about the sensitivity of individual species to acoustic signals and the applicable operational regulations. With the decision aid tool, the Armed Forces can easily obtain an overview of the particular considerations that must be taken into account within a certain ocean area in any given period of time.



Decision aid tool. *Operators will have access to information advising of any considerations that must be taken into account. The map shows the distribution of fish.*

Sonar - an important tool for the Navy

The Nansen class frigates are the very backbone of the Royal Norwegian Navy constituting a flexible combat system that can both hunt submarines and combat surface vessels and aircrafts.

Captain Bjørn Egenberg is in charge of the frigate service.

- The new frigates will form the backbone of Norway's naval defense. They are tailor-made for us, and have the capability of executing a wider range of tasks than the old frigates, both in national and international waters, says Bjørn Egenberg.
- How important to Navy operations are the

new sonars? Do they have capabilities that the old equipment did not?

- Yes, they are far more advanced and they have a much greater range. Furthermore they make it easier for operators to classify what they are looking for, for example a submarine. It's always a challenge when hunting submarines to classify what is what under water.

Environmental consciousness

- Are naval officers concerned about marine life?
- Yes, absolutely. To the highest degree. Our task is to defend Norway's interests, of which marine life is certainly included. The Royal Norwegian Navy is always concerned

about health, the environment and security/safety. Environmental protection is obviously an important part of this.

- But what about allied naval vessels that are on exercise in Norwegian waters? How do we know that they too respect the life in the sea?
- We expect them to follow our rules
- unless of course their own guidelines are even stricter than ours. Restrictions on the use of active sonar is always addressed in our exercise orders. It is also a topic that we discuss before the exercise begins.

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Flexible. *The Nansen class frigates are the backbone of Norway's future naval defense. The frigates will have the capability of combating submarines, surface vessels and air targets. Each of the frigates will have a NH-90 helicopter on board. (Photo: FMS)*