G.O. Sars

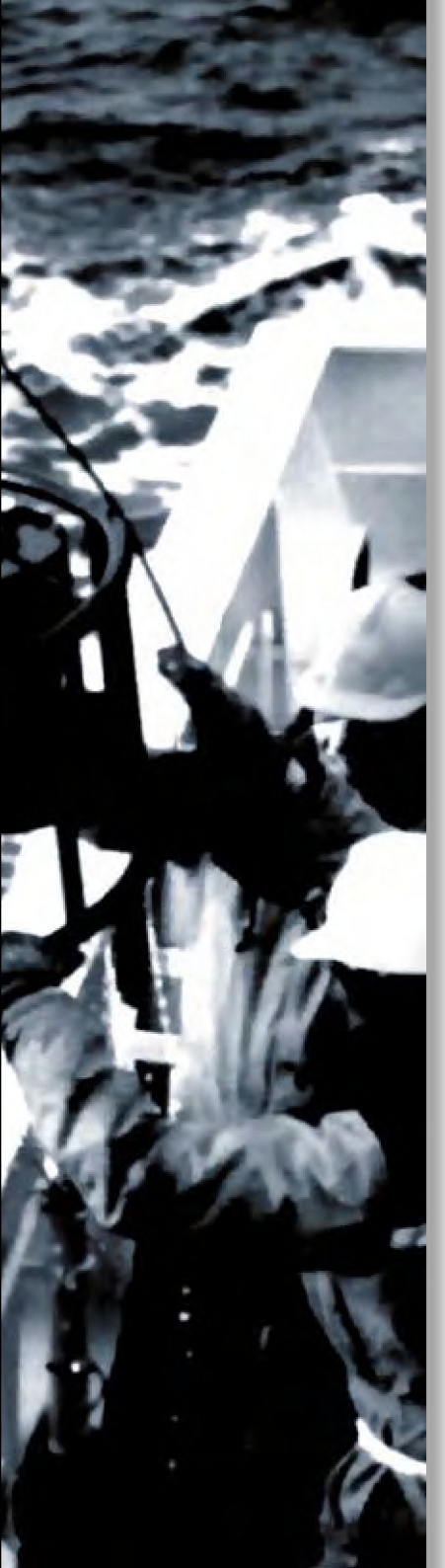
Our ships – and the men whose names they bear

INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET

Contents

The Institute of Marine Research today	3 - 9
The men who gave their names to our ships	10 - 30
The fleet today	30 - 39

This text is based on an earlier publication written by Per Solemdal and Sigmund Myklevoll. Revised 2009 by Erling Bakken and Ingunn E. Bakketeig.



The work of the Institute of Marine Research

The Institute's vision is "Knowledge and advice for rich and clean oceans and coastal areas". This means we will carry out scientific research to provide authorities, industry and the society in general with a broad and reliable basis for the management of our marine ecosystems. The aim of the management is to protect the marine environment and secure a high, but sustainable, yield of the fish stocks, other living marine resources and the aquaculture. The character of the ecosystems and the environmental conditions require that such management must be based on extensive international cooperation, both among scientists and authorities.

An important part of the research is directed towards fish stocks and other living resources which form the basis for the Norwegian fisheries. Monitoring stock fluctuations and continuously improve the knowledge will provide more reliable assessments of the marine production and hence better management.

The environmental research is also extensive, both by monitoring climatic changes and chemical pollution, and by investigating how such factors may influence the conditions for the living resources.

The Institute of Marine Research (IMR) contributes to the development of the marine aquaculture industry by providing new, basic biological knowledge related to salmonids, marine species, mussels and shellfish. This includes genetics, physiology, fish welfare and fish health.

Other research topics cover the ecosystem in the coastal zone, bottom fauna populations on the continental shelf and fishing gear technology.

The research carried out at IMR is initiated and financed through five research and advisory programmes and five special research programmes. The research activities are currently conducted by 19 specific research groups.

Large components of the Institute's research are based on biological and physical observations from the oceans and coastal areas, i.e. data collected on research cruises by the Institute's fleet of ships. The extensive use of field observations gives Norwegian marine research special research strength, today as well as historically. This will be illustrated in the following.

The Institute of Marine Research

The Institute's headquarters are at Nordnes Point in Bergen, Nordnesgaten 50. Here are the offices of the Managing Director, the Norwegian Marine Data Centre, the Public Relations and Communication Department, the Library and some technical support functions. The main building also houses research groups working on environmental quality, plankton, shellfish, fish health and genetics, and modern laboratories.

The Bergen Aquarium is the next-door-neighbour, and a shared system for water supply from the sea off Nordnes supplies the research laboratories of the Institute.

Our building in Nordnesgaten 33 accommodates scientists and technicians studying fish resources, sea mammals and climate. The Directorate of Fisheries is located in a connected building.

Just down the road, in C. Sundts gate 64, we find the research groups for fish capture, bottom habitats and observation methodology. Here is also the Centre for Development Cooperation in Fisheries organizing and implementing development projects by the use of skilled personnel from the Institute of Marine Research and the Directorate of Fisheries.

Further on, at Nykirkekaien, we find the Department of Administration and Services and the Research Vessels Department in premises rented from the Bergen Harbour Authority. This is also where the Institute's research vessels tie up on their occasional visits to Bergen, and where their research trawls and other equipment are stored.

The Research Vessels Department has the responsibility for the operations and maintenance of our research vessels, and also the procurement and service of scientific equipment. The Institute of Marine Research owns the vessels "G.O. Sars", "Johan Hjort", "Håkon Mosby" and "G.M. Dannevig". Both "Dr. Fridtjof Nansen" (owned by NORAD) and "Hans Brattström" (owned by UoB) are manned and operated by IMR. In addition "Jan Mayen" and "Fangst" are chartered by the Institute for special research surveys in parts of the year.

Our research stations

Flødevigen Research Station lies on Hisøy near Arendal. The station was established by Gunder Mathiesen Dannevig in 1882, when most of its work dealt with hatching and releasing of cod larvae. The main activities of the station today are related to research on environmental topics, biological production and carrying capacity, as well as providing management advice for the coastal zone.

Matre Research Station, on the shore of Masfjorden, north of Bergen, was established in 1971. The station was extended and modernized in 2005/2006. The research has mainly been on salmon and trout, but after the modernization, activities have in addition included studies on climate effects, fish welfare and reproduction of marine fish species.

Austevoll Research Station, which lies on the island of Huftarøy in Austevoll, was established in 1978. The activities of the station are concentrated on a wide range of marine aquaculture species, including halibut, cod, haddock, scallops, lobster and wrasse.

The Institute's Tromsø Department was established in 2003. The research activities cover bottom habitas, shellfish, sea mammals and fish, both as regards research and management advice. The department provides important links to other research institutions in Tromsø.

Where do we carry out our research cruises?

G.O. SARS • built: 2003 • 77,5 m • 4067 brt

JOHAN HJORT • built: 1990 • 64,4 m • 910 brt

HÅKON MOSBY • built: 1980 • 47,5 m • 493 brt

G.M. DANNEVIG • built: 1979 • 27,8 m • 171 brt

DR.FRIDTJOF NANSEN • built: 1993 • 56,7 m • 1444 brt

FANGST • built: 2000 • 15,0 m • 25 brt

Vessels and activities

A comprehensive programme for the research cruises is prepared annually, based on ongoing and planned research. This is challenging puzzle in which research requirements, efficient vessel operation and concerns of the ships' personnel must all be taken into account. The Institute programme forms part of a national research cruise programme prepared since 2006.

The Research Vessels Department is responsible for the implementation of the overall programme, while any particular cruise has a scientist in charge, working in close collaboration with the captain of the vessel.

The larger research vessels are operated 24 hours per day in a revolving watch system throughout the cruise that typically lasts for 3 to 4 weeks. This system gives a very high utilization of the investment in ships and equipment.

The need for vessels for monitoring and research is greater than what can be covered by the Institute's own vessels. It is therefore necessary to charter suitable fishing vessels for certain tasks.

The table below shows the number of cruise days in 2008 sailed by our own vessels and chartered boats.

Vessel	Cruise days
G.O. Sars	278
Johan Hjort	253
Håkon Mosby	255
G.M. Dannevig	180
Fangst	200
Dr. Fridtjof Nansen	319
Hans Brattström	216
Jan Mayen	75
Chartered vessels	947
Sum	**2 723**

Photo: Pål Buhl-Mortensen

How we gather information

Every year, our research vessels gather large quantities of environmental and fisheries data by direct measurements and by collecting samples of various kinds. The data and observations are to a large extent evaluated and processed on board, while further analyses are carried out on land. The data provide us with knowledge on the changes and status of our ocean areas.

The fish data form the basis for a comprehensive process of analyses that finish off by the scientists' advice to the authorities on fishing quotas and other management measures.

Acoustic instruments, echo-sounders and sonars, make continuous recordings of "echo data", and trawls are set and hauled at regular intervals to collect samples of the fish registered by these instruments. The fish taken by the trawls are sorted into species, weighed and the length is measured. The otoliths (tiny stones in the ear) let us determine their age, and the stomach contents are analysed in order to find out what they have eaten.

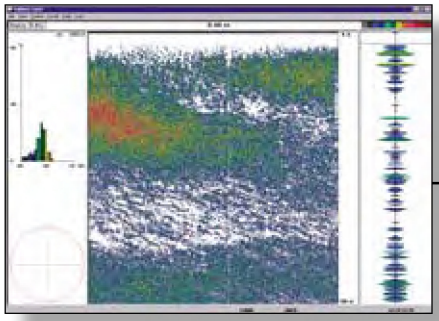
Fish data from the trawl hauls provide the basic information that we use to interpret the acoustic data. The total echo density is mathematically transformed into numbers of fish. In conjunction with reliable catch data from the commercial fishing fleet, these data provide essential input for our calculations of the total number of fish of each species found in our waters.

Managing the ecosystem

Good resources management means that we must look at stocks in an overall context, for example in terms of how the stocks of each species influence each other. Cod, for example, prey on capelin, and capelin eat herring larvae when they are present. Such interconnections must be considered in a management scheme, known as "multi-species management".

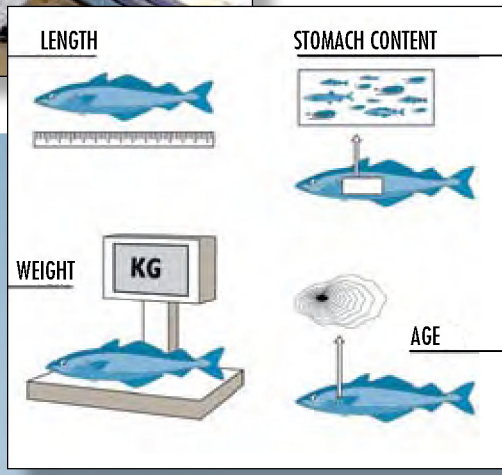
Climatic changes affecting the ocean environment is also an important factor in a management strategy that looks to the future. This sort of integrated management of all life-forms and of the marine environment itself is what we can call ecosystem management, one of the most important long term aims of marine research. The Institute of Marine Research will contribute to expand the knowledge about the marine ecosystems, not least by continued use of the research vessels in our wide-ranging ocean areas. Working towards ecosystem management will require international research cooperation, both in the laboratories and in the field. This is why cooperation with research institutions in our neighbouring countries, particularly in the north, is important, for example to coordinate the use of the research vessels in order to give the vast ocean areas complete coverage. Larger research programmes will as now be coordinated via the International Council for the Exploration of the Sea (ICES).

The collection of fisheries data

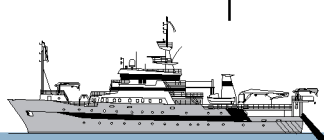


Acoustic recordings (echo-sounder)

Acoustic data are compared with trawl catches



Analysis of the trawl catch



Michael Sars (1805–1869) – one of the founding fathers of modern zoology

Trained as both a priest and a zoologist, Michael Sars was the son of a German-born ship's captain of the same name. His mother, Diwert H. Heilman, had come to Norway from Narva, a town on the Russian-Estonian boundary. Even as a young boy, Michael displayed a burning interest in natural history, especially palaeontology. He started to study natural history at the University of Christiania (now Oslo), but abandoned the course after only three terms, changing to theology, although without giving up his interest in natural history. In 1830, he was called to the poverty-stricken parish of Kinn, moving to Manger parish, just north of Bergen, in 1839. Financial difficulties plagued him for much of his life. His wife Maren, sister of the poet J.S. Welhaven, bore him 14 children, eight of whom survived to adulthood.

After 24 years as a priest, Sars became Professor of Zoology at the University of Christiania. His scientific production covers his periods both as priest and professor. Most of his work was on marine animals; their reproduction, development and their horizontal and vertical distribution in the ocean. At the time, it was widely believed that animal life did not exist at great depths. Together with his son Georg Ossian, and the story-teller and zoologist Peter Christen Asbjørnsen, Sars exploded this belief. In 1853 Asbjørnsen caught a primitive and free-swimming starfish from the bottom of the Hardangerfjord. This was given the name Brisinga, after the goddess Frøya's brooch. In 1864, Georg Ossian was responsible for the greatest sensation when he brought up an ancient sea-lily, a living fossil, from the bottom of Vestfjorden. This was described by Michael Sars and given the name *Rhizocrinus lofotensis*.

These finds, and many other like them, told us much about the animal life and the geology of previous eras. It was just at this time, in 1859, that Darwin published his epochal work "On the Origin of Species". At first, Michael Sars was unwilling to accept the evidence in favour of the theory of evolution, but towards the end of his life he defended Darwin. His own work supported evolutionary theory, but it was his son who would become the most serious missionary for the new learning in Norway.

Peter Christen Asbjørnsen offered an amusing personal description of Michael Sars as a "good comrade and excellent man. He also smokes tobacco like a maniac and curses as though he had never mounted a pulpit".

Michael Sars was probably the only Norwegian zoologist with an international reputation in the 19th century; only his son Georg Ossian enjoys the same scientific stature.

"Michael Sars" (1) – the research vessel of the "golden age"

The miserable cod fisheries at the end of the 19th century caused real distress, especially in northern Norway, and the authorities demanded that marine scientists should find out why catches varied so much. Johan Hjort accepted the challenge, but demanded an ocean-going research vessel. "Michael Sars" was built as an English steam trawler, and equipped with the latest scientific sampling equipment and every type of fishing gear. For 14 years, "Michael Sars" made a long series of cruises off the coast of Norway and in more remote waters, pursuing both purely scientific and more practical objectives, sometimes in combination. "Michael Sars" led Norwegian marine research into the international scientific community.

In 1910, "Michael Sars" criss-crossed the Atlantic and spent four months collecting an enormous amount of research material. In collaboration with Sir John Murray, who financed the expedition, Johan Hjort published the classic "The Depths of the Ocean". This was followed by a series of articles which continued to appear until 1962, the last of them written by Einar Koefoed, a Dane who was headhunted by Hjort and became one of his closest associates. A little-known detail of interest is found in a note on eel larvae which was published in the well-known journal "Nature" in 1910 by the highly regarded Norwegian scientist Einar Lea. On the basis of their size and distribution, he came to the conclusion that the spawning area of the eel must be somewhere between the Azores and the West Indies, and in fact it was in the Sargasso Sea that the Danish scientist Schmidt demonstrated several years later that spawning takes place.

In 1914, the Norwegian authorities and the international research community were given the answer to their question why fishing catches showed such enormous variations: the size of year-classes varies widely from one year to the next. This realisation marked a historical change of direction in modern marine research. In the course of the First World War, however, both "Michael Sars" and Johan Hjort, who by then was director both of fisheries and of marine research, left the Norwegian marine research arena. The "Golden Age" was over.

Read about "Michael Sars" (2) on page 31.

Shipyard:	AS Fredrikstad Mekaniske Verksted
Built:	1900
Length:	125 ft
Beam:	23 ft
Draught:	12 ft
Tonnage:	226 grt
Main engine:	Coal-fired steam engine, 300 Hp (Also sail-rigged)

Georg Ossian Sars (1837–1927) – our first marine scientist

Georg Ossian Sars was the son of Michael Sars, and was named after the (mythical) Celtic poet Ossian. While he was still a student he was also collaborating with his father and accompanying him on research trips. After his father's death in 1869, he completed the studies they had been doing together, producing a series of basic works on various groups of marine invertebrates: starfish, molluscs, etc. He followed up his father's methods in that he studied living material.

G.O. Sars' principal work, "An Account of the Crustacea of Norway", described most of the Norwegian crustaceans, and is still an international standard work. Its nine volumes and 4000 pages were published between 1895 and 1928. The drawings in these volumes bear witness to his artistic abilities; he engraved his crustaceans directly on copper plates. In 1864, G.O. Sars and the herring scientist Axel Boeck (1833–1873) became Norway's first full-time marine scientists. Sars gradually took over responsibility for the practical scientific studies of Norway's ocean fisheries, which he led until 1893, when Johan Hjort took over. He also became a fellow of the University in 1870 and professor in 1874.

Sars' made his most important findings in fisheries science in the Lofoten area during the annual cod fisheries, between 1864 and 1869. As he was rowed around the fjord he could observe with his own eyes the millimetre-sized eggs and recently hatched cod larvae floating in the surface. The finding that cod eggs float in the sea or in the surface was new to science, which until then had firmly believed that all fish laid their eggs on the seabed, as salmon do. However, Sars' discovery was not news to the Lofoten fishermen! Sars' methods of direct observation depended on the following conditions: 1) a small boat; 2) good eyesight (Sars was 27 when he discovered the pelagic eggs) and 3) good weather! As far as the weather was concerned he was rather restricted, not like today with our modern ocean-going research ships, and his reports to the Ministry of the Interior usually begin: "On a fine, calm day…".

Georg Ossian Sars' studies of the life-history of the spawning cod were models of their kind, even though he did not get to the bottom of all the mysteries involved. His research vessel was simply too small. His research methods showed the unmistakeable influence of his father, with their use of living material and their thorough planning. But his reports also reveal a brilliant independent scientist with a highly developed ability to concentrate and a great deal of imagination.

The Lofoten studies convinced Sars that an understanding of the animal life and the fisheries off the coast of Norway could not be isolated from each other. It was essential to study the "whole of the Northern Seas". Together with the geophysicist Henrik Mohn, Sars managed to finance three expeditions to the Norwegian Sea with SS "Vøringen" in 1876–1878. Norway had joined the competition to explore the ocean depths.

"Ossian Sars"

The cod hatchery station at Flødevigen near Arendal had a small boat named "Flødevig". For long-distance transport of large quantities of fish and fry, motorised fishing boats were chartered. The need for a larger, more suitable boat became more and more obvious as tasks of this sort increased in number.

In 1923 the station was able to take over a German motor cutter that had been impounded by the Customs Service (this was during Prohibition in Norway). This vessel was 40 ft in length and had been built in 1914. The question arose of what to call the new acquisition, and an obvious choice was the name of the man who had laid the foundations for the work of Flødevigen – G.O. Sars. With the permission of the professor, the boat was called "Ossian Sars". It was suitable for transporting spawning fish and fry; and it also made it possible to carry out field studies throughout the year, both in the fjords and off the coast.

However, old age gradually began to leave its traces on the boat, and in 1946 it was condemned.

Length: 40 ft
Built: 1914, in Germany
In 1929 new 24 Hp Rap-motor

Finn Devold (1902–1977)

– the herring shepherd

Finn Devold was the son of Harald Ophus Devold and Alida Elise Marie Lampe. He was born in Bergen but grew up in Tromsø. He studied in Paris, and had many different jobs before joining IMR in 1935.

Devold was an assistant at the Department of Geophysics in Tromsø and to Fridtjof Nansen in 1922–1923. He soon acquired a taste for the exciting life of the Arctic, and ran a meteorological station on Svalbard and on Jan Mayen. At the request of the Norwegian Government he led the occupation of an area in Southeast Greenland in 1931, while his brother Hallvard occupied what was known as Eirik Raudes Land in Northeast Greenland. Norway, however, lost its claim to Greenland land in a case at the International Court in The Hague.

Finn Devold became a fisheries biologist, and was awarded his masters degree for a piece of work on the biology of the plaice. He is best known for his study of the migration pattern of the Atlanto-Scandinavian herring. He also suggested an explanation for the long-term fluctuations in the occurrence and size of the herring stock off the coast of Norway and in Bohuslän on the Swedish west coast, an explanation which created a wide scientific debate.

Helge Ingstad wrote in a memorial article about Finn Devold: "Finn Devold was one of the finest and most fearless men I have ever known. Now he is gone from us – a giant tree has fallen in the forest".

"G.O. Sars" (1)

- Devold's "herring shepherd"

The fact that Devold's name is so closely coupled with the vessel "G.O. Sars" (1) is due to the great efforts he made in support of the coastal communities during the rich herring years of the 50s. These efforts were made with the aid of a device which had been developed by the British during the Second World War to locate German submarines. This was called ASDIC (Anti-Submarine Detection Investigation Committee). As with the echo-sounder, it was Norwegians who modified this horizontal-searching device to enable it to locate shoals of fish. It was Einar Lea, one of Hjort's closest associates, who took up the idea in 1947, and 1949 saw the delivery of the first herring asdic. The instrument was later re-named SONAR (SOund NAvigation and Ranging), which sounded rather more peaceful.

The 1950 herring year-class was extremely large. "G.O. Sars" set sail in July and made an important discovery with its new sonar set: large quantities of that year's herring fry were observed as far as 200 nautical miles from the coast. At that time, most people believed that all herring fry stayed close to the coast. Drift nets do not catch these tiny fish, but the sonar could see them!

Before the end of the year, "G.O. Sars" had set out on yet another pioneering cruise with Devold and the sonar on board. This was the first attempt to follow herring shoals in the Norwegian Sea on their migration to the spawning grounds off the coast of Western Norway, and they succeeded in

great style! A couple of the most curious purse-seine boats came out to meet "G.O. Sars" and realised that the herring were under observation. A large fleet of fishing boats had soon gathered, and Devold had to ask them to stay out of the way in order not to hinder his work. The "parade" of boats must have looked rather strange. When one of the skippers asked what was going on, the skipper of the purse-seiner "Reform" from Sunnmøre answered, "Well, we're all marching in a 17th of May (Constitution Day) procession, and the "Sars"t is setting the tune!"

When the herring arrived off the coast at Runde on 21 January 1951, "G.O. Sars" had demonstrated its good qualities and sea-worthiness, the sonar its fantastic ability to find herring, and Devold and the Institute of Marine Research had won the trust of the people of the coast. This was a fine start for the Institute's first sea-going research vessel since "Michael Sars".

In the early 1960s, the echo integrator was developed at the Institute of Marine Research. This instrument made it possible to "collect" echoes from a large number of fish and use these to estimate their biomass. The prototype was tested on board "G.O. Sars", and later became the most important instrument for the Institute of Marine Research's fish stock assessments.

Although "G.O. Sars" is closely linked to herring studies in the popular consciousness, the vessel was also the Institute's workhorse in several other fields. During the post-war years, the aim of Norwegian fisheries policy was to build up a diversified fishing fleet, including ocean-going vessels. This required a particularly high level of research activity in the Barents Sea, a region that makes very high demands of both crews and ships, especially in the winter months. The need to expand research activities and the success of "G.O. Sars" resulted in a third "Johan Hjort" to be built in 1958.

What was later to become "G.O. Sars" was originally a whaling-boat that during the Second World War was being built in Arendal for a German ship company. The construction was sabotaged and delayed, but the hull was completed by the end of the war in 1945. The hull was then confiscated by Norwegian authorities, and thanks to a special grant provided by the Parliament, the vessel was reconstructed and completed as a research vessel at Moss Verft & Dokk. The vessel was commissioned in 1950 and initiated a new, active phase of the IMR.

Designed as a whaling-boat, the hull of "G.O. Sars" had a relatively narrow beam and was deep in draught. The superstructure, the deck arrangement and the interior were influenced by British trawler design. The engine power was quite low, but in the post-war years one had to use what was available. "G.O. Sars" was, however, a very effective research vessel, behaving well in rough seas thanks to the draught and the low superstructure.

"G.O. Sars" was decommissioned in 1970 and given the name "Harengus" to make the original name available for a new "G.O. Sars". It was then sold and ended its days some years later being wrecked at Tusenøyene south of Edge Island, Svalbard.

Read about "G.O. Sars" (2) on page 30, and "G.O. Sars" (3) on page 37.

Shipyard:	AS Pusnes Mekaniske Verksted, Arendal AS Moss Værft & Dokk
Built:	1945/1950
Length:	52.0 m
Beam:	8.7 m
Draught:	5.2 m
Tonnage:	595 grt
Main engine:	2 x Crossley HRL6, each of 600 Hp

Gunder Mathiesen Dannevig (1841–1911)

– sea captain and pioneer in the aquaculture of marine fish

Gunder M. Dannevig was the son of skipper Mathias Wilhelm Dannevig and Kirsten Gundersdatter Guldsmedengen. He went to sea at an early age and became a skipper when he was only 24 years old, when Arendal was the richest and most important shipping centre in Norway. In 1878 he became a fisherman. There was a critical shortage of fish on the coast of Southern Norway at the time, and fishermen wanted to have certain types of fishing gear banned. Dannevig, who had a good understanding of how the fisheries were developing in other countries, had heard that the Americans had begun to experiment with hatching marine species of fish. The idea of improving cod stocks by releasing newly hatched larvae into the sea won the support of everyone in the fishing industry, and community spirit in Arendal provided the necessary financial support for a cod hatchery. Dannevig received scientific backing from G.O. Sars who, in his first report from Lofoten in 1864, had already proposed artificial hatching in order to even out annual variations in the cod fisheries. Dannevig's hatchery in Flødevigen was the first largescale hatchery for marine fish in the world. Hundreds of millions of cod eggs were hatched every year, and the yolk-sac larvae were released into specially selected locations. Dannevig attempted to demonstrate the results of the releases by local questionnaire studies.

The fishermen who had a positive attitude to these measures, also tended to respond positively to questions about trends in cod stocks. When the launch of the venture obtained financial support, the practical scientific studies also began. Dannevig then proposed to investigate the effects of the releases by means of beach hauls of nets in selected fjords where fish had been released, and in others without releases. This was in 1904–06. Johan Hjort was not convinced of the usefulness of this sort of activity, and he insisted that his assistant Knut Dahl should be on the spot to check the catches. The spirit of cooperation between the old seacaptain and the young academic must have been poor. The front page of the first mimeographed report from the beach-net studies is "decorated" with the following remark: "Damned lies. Knut Dahl". But it was precisely this report that provided the first signals about a new explanation of the wide annual fluctuations in fish catches, the central finding of the golden age. The report showed quite clearly that the number of fry was much greater in 1904 than in 1905 and 1906, no matter whether yolk-sac larvae had been

released or not. The fact that differences in fish catches were largely due to variations in year-class strength was later demonstrated in herring, which also had a successful year-class in 1904.

The verdict of history on the economic importance of Dannevig's releases of cod fry has been negative. On the other hand, the scientific activity which his initiative triggered in the infant Norwegian marine research sector has given him a major place in the history of marine research in Norway. The biologist O. Nordgaard described Dannevig in the following words: "Dannevig was characterised by his unusually practical bent, his almost violent energy, and his sharp understanding. Whether he was speaking Norwegian, English or French, he resembled a post that was difficult to shift. He could be unpleasant to have as an opponent".

"G.M. Dannevig" (1)

- transport vessel for fish fry

"G.M. Dannevig" (1) was brought into service in 1950 and was intended for use as a transport vessel for fish fry (releases of cod larvae) and research cruises off the Norwegian coast and in the Skagerrak.

The building of "G.M. Dannevig" signalled the start of a new epoch in the history of the Flødevigen Research Station, in that the new vessel greatly extended the range of tasks that could be carried out at sea. The ship gradually became too small to perform the functions it was intended for, and was sold in 1987.

Read about "G.M. Dannevig" (2) on page 32.

Shipyard:	Lunde Bätbyggeri, Tysnes in Sunnhordland
Built:	1949
Length:	19.8 m
Beam:	5.5 m
Draught:	2.7 m
Tonnage:	55 grt
Main engine:	Alpha, 200 Hp
Accommodation:	3 double cabins

Johan Hjort (1869–1948) – still a current name in Norwegian marine research

Johan Hjort's father was a professor and eye specialist, who came from a prominent Danish family of civil servants. His mother was from the Falsen family. Johan Hjort inherited his interest in science from his father; his rather volcanic temper came from his mother. He studied biology in Munich and was G.O. Sars' successor as leader of the fisheries studies in Christiania in 1893, at the age of 24.

In 1900, these studies were moved to Bergen, and after a few years, Hjort became both director of marine research and director of fisheries. He had a will of iron, an enormous capacity for work, and a well developed interest in scientific collaboration. He was also one of the founders of the International Council for the Exploration of the Sea (ICES), and was its president during the last few years of his life.

Hjort resigned during the First World War in protest against the behaviour of the authorities in connection with the sale of fish to Britain, believing that Norway was not observing the conditions of neutrality. After the War, Hjort studied biology in Cambridge, and he also spent some time in Denmark before becoming a professor at the University of Oslo. His scientific production covered a wide range of subjects, from larval development in Ascidians to studies of population dynamics in whales. His more polemical writings in connection with Captain Dannevig's cod-hatching experiments in Flødevigen are also well known.

Johan Hjort as a person was shrewdly described by Francis Bull in the following terms: "As a superior, he was without peer; helpful, kind, patient – as an equal, rather difficult, because he always believed that he was right – and as a subordinate, sure of himself and full of the need to oppose". His ability as a leader to "fire up" his colleagues is illustrated by what was once said by two of his favourites, Hjalmar Broch and Einar Koefoed: "Not the least of the factors that stimulated our work in the old laboratories was Hjort's great gift of making each of us feel that we were working freely and independently on our allotted tasks. At the same time, he always kept us in contact with practical life, which was an unusual attitude for those times".

Johan Hjort's achievement has acquired renewed relevance during the past few years. His underlying ecological attitude is in line with the ecological management model for marine resources which we can glimpse in the distance. Hjort's observations came to the aid of the Institute of Marine Research in the 1980s in particular, when

one "stock earthquake" after another was discovered in the Barents Sea. Hjort's descriptions of similar situations in 1903 showed that nature itself occasionally "goes mad", without human beings necessarily being the worst culprits.

"Johan Hjort" (1)

– fragile, but still useful

After the First World War there was little money available for research cruises, and "Michael Sars" was laid up, while the most important field-work was carried out with the aid of chartered boats. In 1922 the Institute acquired a small wooden vessel which was specially designed for research purposes. This was the first "Johan Hjort", and it is said that Dr. Hjort was not particularly satisfied by the honour of having such a "pathetic" vessel named after him. Nevertheless, the new boat performed well in Lofoten (cod), off the coast (winter and spring-spawning herring) and in the fjords (sprat and yearling herring). Plankton and hydrographic studies also provided valuable new knowledge.

Since it turned out to be impossible to get "Michael Sars" into operation again (except for a whaling trip to the Davis Strait in 1924), "Johan Hjort" was refitted for large-scale studies in the Norwegian Sea. However, it was felt that such operations were beginning to verge on the irresponsible.

The Institute's scientists Sund, Lea and Bjerkan led most of the fieldwork during that period. During a shipyard refit in 1931, rot was discovered in the hull of the boat. The attack was so serious that it was regarded essential to invest in a completely new boat, but everything that could be used of the existing equipment and fitments was transferred to a new "Johan Hjort" (2). Meanwhile, the shipyard took over and rebuilt the old boat, which sailed in cargo traffic under the names of "Kola" and "Ruth Vagle", until it ended its days on the beach rocks in Morfjorden, Nordland.

Shipyard:	Gravdal Skipsbyggeri, Opsanger, Sunde in Sunnhordland
Built:	1922 (rebuilt: 1928)
Length:	68 ft
Beam:	16 ft
Draught:	10 ft
Tonnage:	49 grt
Main engine:	Bolinder B20M21, 70 Hp
Accommodation:	9 bunks; certificated for 11 persons

Oscar Sophus Sund (1884–1943) – marine scientist from the North

Oscar Sund was born on the Sund property in Gildeskål in the County of Nordland. His father, Haagen Olsen, was a country policeman married to Annette Katharina Neumann. He grew up among the northern fisherfolk, virtually at the gateway to the sea. His great ambition was to study fish and their migrations, in order to help the fishermen. While he was still a student, he published a number of studies on central topics in zoology, demonstrating that he was an excellent basic scientist.

In 1908, he was engaged as an assistant to Hjort, and he carried out most of the age determinations of cod that formed much of the data in Johan Hjort's important publication of 1914. Like most of Hjort's close associates, Sund was keen to keep the fishermen always up to date about his research results, and he had a gift for doing so. His schematic method of showing the variations in catches of spawning cod is particularly well known. Gunnar Rollefsen has characterised Oscar Sund's presentations as "masterly analyses and diagrams of the changes in cod stocks". Oscar Sund also played an important role in processing the material from the major "Michael Sars" expedition in 1910. In 1916, he took over as leader of the fisheries studies when Johan Hjort resigned.

Perhaps Oscar Sund's gifts of popularisation were most evident in "Skårungen" ("The Youngster"); his last and best known work, published in 1942. The sub-title of the book offers a fine characterisation of Sund: "A book about the sea and its fauna, ships and travel, for the young people of the coast."

In 1947, the people of Northern Norway erected a monument to Oscar Sund at the new church in Gildeskål, bearing the following inscription: "He was a tireless servant of science, and a friend and helper of the fishing community. A faithful, warm-hearted northerner who brought honour to his community".

"Johan Hjort" (2)

"Oscar Sund" – small but revolutionary

The second "Johan Hjort" was also a small wooden vessel with a length of 79 feet, designed for use in coastal water. Financial conditions were difficult at this time, and the fishing industry was struggling with overproduction and market problems. Hjort's expansive ocean fishery model was de-emphasised, and the scientists' wishes for new boats were modest.

"Johan Hjort" (2) had the honour of testing out the echo-sounder to locate fish. This extremely important tool for practical fishing had originally been developed by the British Admiralty in the 1930s as a depth sounder. In 1934, Oscar Sund heard that the sprat seine netter "Signal" had recorded echograms of fish shoals. Sund managed to obtain money for an echo-sounder, and on 11 March 1935, "Johan Hjort" arrived at Hølla in Lofoten. Now, for the first time, it was possible to "see" the concentrations of spawning cod in a thin horizontal layer in thermocline water at 4–6 °C. The results of the investigations were published in the prestgious journal "Nature" on 8 June that very same year. A new era in world fishing had arrived.

When the third "Johan Hjort" was commissioned in 1958, the existing "Johan Hjort" was renamed "Oscar Sund"; a well deserved honour. The vessel was, however, sold the same year.

Shipyard:	Gravdal Skipsbyggeri, Opsanger, Sunde in Sunnhordland
Built:	1932
Length:	79 ft
Tonnage:	67 grt
Main engine:	Wichmann 90–120 Hp

"Johan Hjort" (3)

– modelled on the "G.O. Sars"

The success of "G.O. Sars" (1), particularly as regards the herring investigations, opened people's eyes to the possibility of carrying out important new tasks in fisheries research. The northern waters and cod were now down for work. When the new "Johan Hjort" (the third vessel of that name) arrived in 1958, it was designed with "G.O. Sars" (1) as its model and ideal, as an ocean-going vessel. Even then, some people believed that a stern-trawler design would have been more useful, but the side-trawler tradition was still powerful.

With two ocean-going vessels available, the geographic range of the Institute's investigations could be increased, and new fish stocks were added to the study programme. Fish-finding and hydrographic instruments were renewed in step with developments in technology. In 1975, the vessel was fitted with stern-trawling gear, which was not particularly practical for that type of vessel, and the scientists began to dream of a new boat.

The hull of "Johan Hjort" was reinforced for operations in waters with drift ice, but could not work in permanent ice and therefore be used for the Institute's studies of the seal populations in the eastern Barents Sea and in the Jan Mayen area. For this reason, collection of biological samples and tagging of seals were carried out by scientists and technicians accommodated on board commercial seal-hunting vessels. The Institute was otherwise involved in organizing government assistance service for the seal hunting fleet which was in operation from 1953 to 1979. "Salvator" from Norsk Bjergningskompani was often used, and at times the helicoper on this vessel was utilized for surveys of the seal breeding areas and also to carry out counts of the seal populations.

The government's economic idea at the time was "rent rather than buy". This resulted in a multi-year contract with the fishing boat company of Tor Østervold to charter the fishing vessel "Eldjarn". The vessel was fitted up with the necessary equipment for research and was used by the Institute from 1980 to 1990 in cooperation with the owner.

"Johan Hjort" was sold in 1983 and moved to the North Sea offshore sector under the name of "Skandi Ocean". The vessel was bought in 1996 by the environmental protection organization "Sea Shepherds" and has been observed in Australia under various names, lately "Farley Mowat".

Read about the current "Johan Hjort" on page 34.

Shipyard:	Mjellem & Karlsen AS, Bergen
Built:	1958 (rebuilt 1975)
Length:	52.3 m
Beam:	9.3 m
Draught:	5.3 m
Tonnage:	697 grt
Main engine:	MAN G7V 40/60 MA, 1300 Hp
Class:	DNV +1A1 ice
Accommodation:	25 cabins (crew 32; scientists 7)

Peder A. Rønnestad (1879–1949)

Peder A. Rønnestad joined "Michael Sars" in 1902 as a fisherman under Captain Thor Iversen. Following several years of education and commercial fishing, he returned to the ship as its captain in 1912. In 1916, he became an expert consultant in fisheries to the Directorate of Fisheries.

Rønnestad has been praised for his wide-range of contributions to fisheries research, and in particular for his work on the Load-line Act and registration of Norwegian fishing vessels, as well as his efforts to improve sanitary conditions in the fishing villages and in building fishermen's lodging for use in the seasonal fisheries.

"Peder Rønnestad"

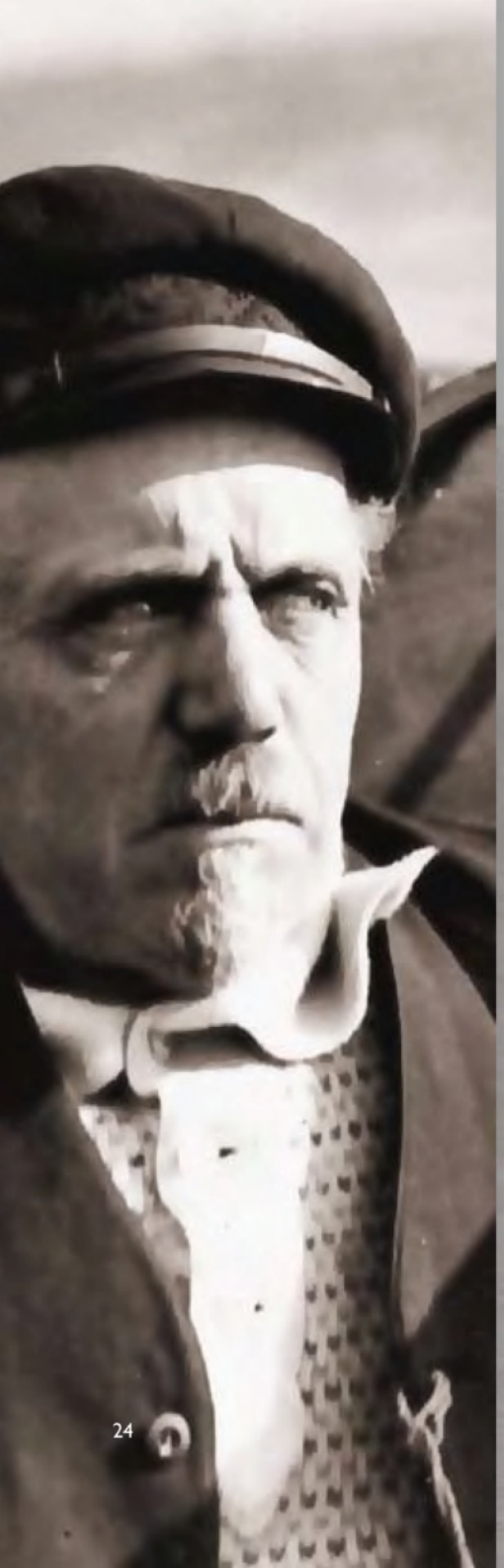
– trawler and fishing trials vessel

The boat was built in Germany as the trawler "Spitzbergen" and was purchased by the Directorate of Fisheries in 1951. During its first few years with the Directorate, it was primarily used as a fishing trials vessel together with "Thor Iversen" (see p 25) by the Directorate's practical fishery consultants.

When "Oscar Sund" (ex. "Johan Hjort" (2)) was taken out of service in 1958, "Peder Rønnestad" was rebuilt and handed over to the Institute of Marine Research. The vessel lost its "good looks" as a result of the rebuilding operation, while it acquired a laboratory and cabin facilities needed for research cruises. It was employed on the coast and in the fjords, and occasionally over large areas of the North Sea and on the banks west of the Shetlands. The boat was equipped with side trawls, drift-netting and long-lining gear and a hydrography/plankton winch.

"Peder Rønnestad" was sold in 1979 and acquired the name "Rønner".

Built:	1948
Length:	26.3 m
Beam:	6.4 m
Draught:	3.2 m
Tonnage:	126 grt
Main engine:	Bergen Diesel 250 Hp
Accommodation:	8 single and 2 double cabins
Class:	Deutsche Lloyd 100A4 fishing vessel/North Sea



Thor Iversen (1873–1953)

Thor Carl Iversen was a well-known personality in the world of Norwegian fisheries and marine research. Already in possession of experience from merchant shipping, fishing, sealing and whaling, he joined "Michael Sars" as a seaman in 1900. He was later captain of the vessel, and skippered it on its famous Atlantic research cruise in 1910.

In 1912, Thor Iversen became a consultant to the Directorate of Fisheries, and in addition to a number of administrative tasks, he carried out several research cruises, particularly in northern waters. His list of publications bears witness to a wide range of interests, which included the history of fishing, geographical measurements and descriptions, charting fishing banks, etc. His artistic bent found expression in film and photography, a hobby that he cultivated with such keenness and talent that he must be given a place among the "greats" of Norwegian photography.

"Thor Iversen"

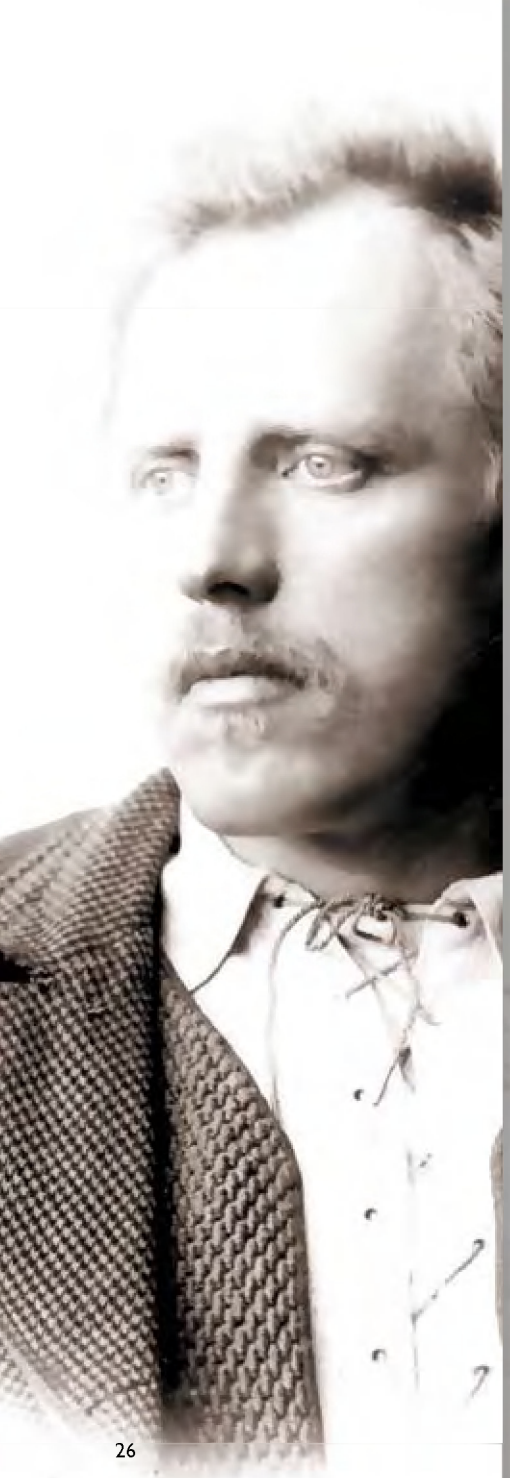
– practical fishing trials and research

This vessel was originally built in the Netherlands as the trawler "Gerdy Mia", but was purchased as a relatively new vessel by the Directorate of Fisheries for test fishing, and especially for training Norwegian fishermen in trawling techniques. The boat was named after Thor Iversen, and was used first and foremost by the Directorate's consultants for practical fishing trials. "Thor Iversen" was also used by the Institute of Marine Research.

The vessel was sold in 1968, and as fishing vessel, "Thor Iver" sank west of Kvannhovden lighthouse in 1976.

Built:	1951
Length:	83 ft
Beam:	20 ft
Draught:	9 ft
Tonnage:	84 grt
Main engine:	200 Hp diesel engine
Crew:	8

From Per Alsaker's collection



Fridtjof Nansen (1861–1930)

Fridtjof Nansen was a man of many talents. He began to study zoology at the University of Christiania (Oslo) in 1880, and after only two years of study was appointed curator at Bergen Museum. In the same year, he sailed with the sealing boat "Viking" of Arendal to the Western Ice off Greenland, where he studied seals and made hydrographic observations of the waters of Eastern Greenland. Here, in the drift ice, Nansen found driftwood and mud which probably came from Siberia. As a result of these observations he led the 1893–1896 "Fram" expedition, on which he collected oceanographic data as the vessel drifted across the Polar Sea. Among other things, Nansen noted that the polar ice drifted at an angle of about 45 degrees to the right of the direction of the wind – and he was the first to realise that this must be due to the rotation of the Earth. Nansen believed that the ice dragged the water beneath along with it. In the same way, each layer of water would drag the next layer along. Friction would mean that the current velocity would fall off with depth at the same time as the direction of the current gradually turned more to the right. Nansen did not have the mathematical knowhow that would have enabled him to demonstrate that this was the case, but at his request, Professor V.W. Ekman succeeded in proving Nansen's theories. The phenomenon has since been known as the "Ekman Spiral". Nansen constructed an instrument for collection of water samples and measuring of water temperature. This became a standard oceanographic instrument, named and known internationally as a "Nansen bottle", and in use up to recent times.

Fridtjof Nansen made major, pioneering discoveries in several aspects of the development of modern marine research, particularly in physical oceanography. He was also a keen exponent of international cooperation in marine research, and played a key role in the establishment of the International Council for the Exploration of the Sea (ICES).

Nansen's doctorate (1888) was a study of the central nervous system of the hagfish (an invertebrate), with a thesis whose quality and range was probably not fully appreciated by his contemporaries. Today, however, Fridtjof Nansen is internationally recognised as one of the pioneers of brain research. In 1897, Nansen became Professor of Zoology at the University of Christiania, and planned the physical-oceanographic studies for the Board of Fisheries carried out by the "Michael Sars", which was named after his father-in-law. In 1922, Fridtjof Nansen was awarded the Nobel Peace Prize for his important humanitarian efforts in the wake of the First World War. It was Nansen who negotiated and organised

the transport home of about 400,000 German and Russian prisoners of war. He was also the underlying force and the organiser of efforts to feed millions of people threatened by famine in Russia.

"Dr. Fridtjof Nansen" (I)

– the international helper

The first marine research vessel with the name "Dr. Fridtjof Nansen" was a Norwegian contribution to international development efforts, the appropriate choice of a nation that can point to a rich tradition of research in fisheries and marine science. The vessel was operated in cooperation with developing countries in mapping fisheries resources, strengthen marine research capabilities and improve fisheries management. . The programmes were drawn up in close collaboration with the countries, and with scientific support provided by the UN's Food and Agriculture Organisation (FAO).

The vessel was operated continuously from 1975 to 1993, from Indonesia in the east, via countries bordering the Indian Ocean to the west coast of Africa and further to the Caribbean and the coast of the Pacific Ocean in Central America. The investigations revealed that the fish resources in some areas could sustain expanding fisheries while restrictions in fisheries of other areas were needed. Training and education were provided on board, at institutions in cooperating countries and in Norway.

The vessel was financed by NORAD (Norwegian Agency for Development Cooperation) which also covered the running costs, while the Institute of Marine Research was responsible for the technical and scientific operation.

In 1993, following 19 years of service in many oceans, "Dr. Fridtjof Nansen" was sold to a French diving company to be used in hunts for sunken treasury ships in the Mozambique Canal. Later, the vessel came to Marseille where it was used for accommodation, before it returned to Norway in the mid 1990s. Here, it was employed to assist in offshore seismic surveys.

Read about the current "Dr. Fridtjof Nansen" on page 35.

Shipyard:	Mjellem & Karlsen AS, Bergen
Built:	1974
Length:	47.5 m
Beam:	10.3 m
Draught:	4.3 m
Tonnage:	495 grt
Main engine:	Normo LDMCB9, 1500 HP
Accommodation:	14 single, 2 double and 2 four-berth cabins

"Fjordfangst"

This vessel originally belonged to the Fish Capture Division of the Institute of Fisheries Technology Research (FTFI), and it was built in order to carry out tests and trials of fishing gear. The vessel came to the Institute of Marine Research when the Fish Capture Division was incorporated into the Institute in 1991. "Fjordfangst" was sold to Iceland in 1999.

Shipyard:	Sandøy Plast AS (hull) and Storebø Slipp & Mekaniske Verksted AS
Built:	1983
Lengthened by:	Lunde Båtbyggeri AS
Length:	14.2 m
Beam:	4.3 m
Draught:	2.3 m
Tonnage:	25 grt
Main engine:	Yanmar 82, 188 Bhk
Accommodation:	2 two-berth cabins

"Virgo" and "Krill"

– modest servants of marine research

Between the wars, the Institute of Marine Research had a 40 ft motor boat, "Virgo", but this was confiscated during the Second World War. After the War, a new boat was purchased and given the name of "Krill". It had a cabin forward, with room for two persons. The boat was equipped with a hand-powered winch for plankton sampling and hydrography, and it was employed in studies in these fields in Hardanger and Sunnhordland, but it was also used more and more often for studies of sprat, crabs, lobsters and eels in the same area.

In spring 1985, the boat was transferred to the Matre Research Station, but was condemned after a couple of year.

"Virgo"
Length: 40 ft
No further technical details available.

"Krill"
Built in Nordtveitgrend during the late 1940s
Length: 25.5 ft
Beam: 6.6 ft
Motor: Sleipner petrol engine, 10–14 Hp
Marna diesel, 18 Hp (about 1965)
Sabb 22 HP (1979)

"G.O. Sars" (2) – into the computer era

The 1960s saw a series of rapid developments in fisheries technology and instrumentation. The second "G.O. Sars" was built as a stern-trawler and rigged to be able to alternate easily between the use of bottom and pelagic trawls. The vessel's hull was designed to disturb the echo-sounders as little as possible, since these had become essential instruments for fisheries research. A new generation of echo-sounder was being developed in collaboration with Simrad. Used in combination with the echo-integrator, the new sounders made it possible to perform quantitative measurements. While it had previously been possible to register where the fish were and to only roughly estimate their biomass, scientists now had more accurate measures of the amount of fish that they were recording.

Electronics was also entering the field of oceanographic instrumentation. Water samplers and turning thermometers were being replaced by sondes which recorded temperature, salinity, etc. while lowered through the water column. Signals from these sondes were registered and processed on board while the sondes were still being lowered, a process that required computer power. Echo integration was later also carried out by the computer system.

The various types of fishing gear were the best kind, and the operations were facilitated by the stern-trawler rigging and the powerful hydraulic winches with double drums, all controlled from the ship's bridge. This made it easy for the scientists to obtain samples of fish and other organisms as recorded on the echo-sounders.

The vessel itself and the instrumentation were continuously renewed, but in February 2003, after 33 years of service, the "G.O. Sars" was taken out of operation. It was then given the name "Sarsen" to make the "G.O. Sars"-name available for a new vessel. "Sarsen" was owned by the Institute for a short period and was then sold. "G.O. Sars" (2) from 1970, however, is in good shape in Australia where it is used as a cruise and expedition ship to the Pacific islands and to Antarctic. What is interesting is that the ship still carries the name "Sarsen"!

Shipyard:	Mjellem & Karlsen AS, Bergen
Built:	1970
Length:	70.0 m
Beam:	13.3 m
Tonnage:	1.447 grt
Main engine:	Bergen Diesel 2500 Hp (1838 kW)
Class:	Det Norske Veritas, Class +1A1
Accommodation:	Crew + 16 scientists

"Michael Sars" (2)

- fish finding and research

The vessel was designed according to the "Dr. Fridtjof Nansen" (1) model, but with a slightly modified interior design. It was equipped to perform more or less the same range of tasks as "G.O. Sars" (2), though with certain limitations due to its smaller size. The vessel was well equipped with acoustic instrumentation and trawls. Improvements made in later years included a dropkeel with echo-sounder and sonar heads, which enabled it to carry out acoustic studies of herring and other fish species even in fairly bad weather. The vessel was particularly suitable for coastal water operations.

The vessel was originally used by both the Directorate of Fisheries and the Institute of Marine Research, but the Institute gradually took it over on a full-time basis.

"Michael Sars" was sold in the end of 2003 and is now a training vessel for a maritime school in Åland, Finland.

Shipyard:	Mjellem & Karlsen AS, Bergen
Built:	1979
Length:	47.5 m
Beam:	10.3 m
Draught:	4.3 m
Tonnage:	495 grt
Main engine:	Normo diesel LDMCB-9, 1500 Hp
Accommodation:	20 persons

"G.M. Dannevig" (2)

– the environmental monitor

In 1985, FTFI's vessel "Kystfangst" was transferred to the Institute of Marine Research and stationed in Flødevigen, where it was given the new name of "G.M. Dannevig". In order to meet modern standards, the vessel was lengthened to 27.8 mt and refurbished in 1986–87.

Its instrumentation and equipment was supplemented in the next few years, so that after 1988, the Institute had a fully operational modern vessel suitable for marine research in coastal areas, the Skagerrak and the North Sea.

"G.M. Dannevig" has an unconventional shape of the bow designed by FTFI's fishing vessel section for trials in projects in the late 1970s related to energy savings in the fishing fleet.

Shipyard:	Kystvågen Verft, Frei in Møre og Romsdal
Built:	1979
Rebuilt:	1987
Length:	27.8 m
Beam:	6.7 m
Tonnage:	171 grt
Main engine:	2 x Volvo 330 Hp
Accommodation:	1 single, 7 two-berth cabins

Håkon Mosby (1903–1989)

Mosby was awarded his Master of Science degree in 1930 and his doctorate in 1934. As a student in Oslo he acted as assistant to Professor Fridtjof Nansen at the Department of Oceanography, participating in several cruises with the research vessel "Armauer Hansen". In 1927, before he took his final degree exams, he was engaged as a lecturer at the Department of Geophysics, Section for Theoretical Meteorology, at Bergen Museum. In 1927-28 Mosby was a member of L. Christensen's first "Norvegia" expedition to the Antarctic Ocean, on the basis of which he wrote his doctoral thesis "The Waters of the Antarctic Ocean".

Håkon Mosby subsequently led several expeditions to our northern ocean regions. In 1939 he became associate professor at the hydroraphic section of the Department of Geophysics, and in 1947 he succeeded Bjørn Helland-Hansen as professor at Bergen Museum which in 1948 became the University of Bergen.

Håkon Mosby played a central role in the development and organisation of oceanographic research at national and international level. He was director of the Department of Geophysics for two periods, and from 1966 to 1971 he was rector of the University of Bergen (UoB).

"Håkon Mosby"

RV "Håkon Mosby" is the sister ship of "Michael Sars" (2). A drop-keel with acoustic instrumentation was installed in 2002 and the laboratories were restructured. The vessel was until 2008 owned by the UoB.

The vessel is equipped to carry out oceanographic, geological and biological research. It is particularly suitable for studies of sea bottom structures and sediments, studies which are also of relevance to research on organisms and diversity on the sea bed.

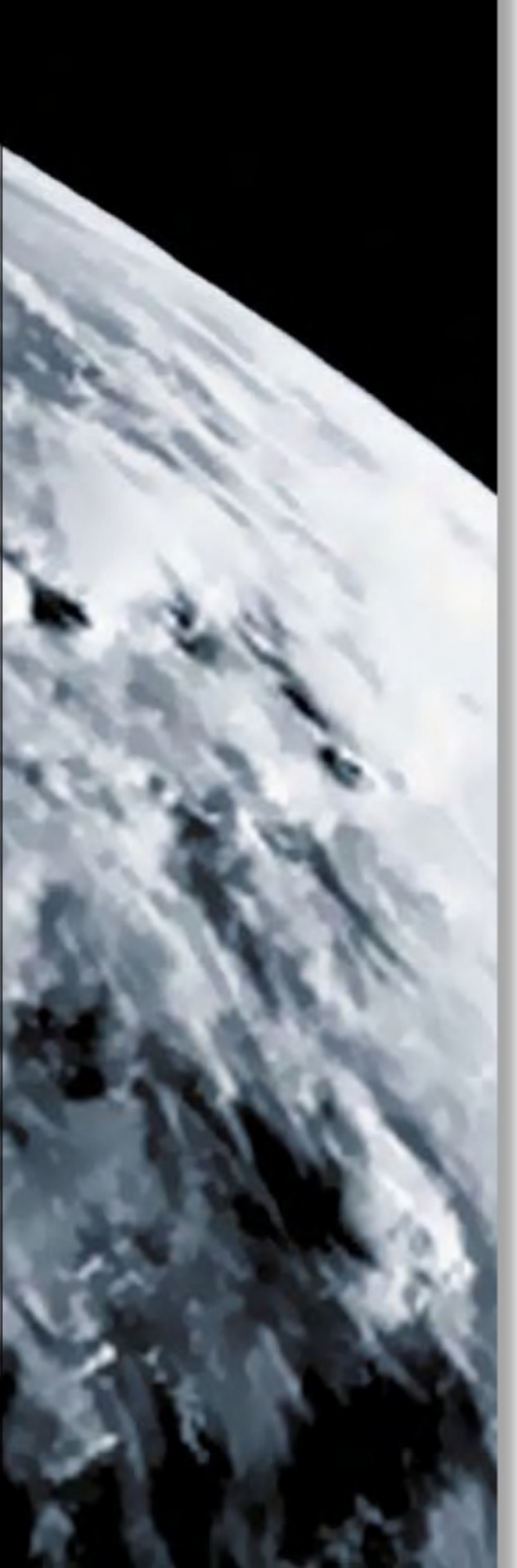
Shipyard:	Mjellem & Karlsen AS, Bergen
Built:	1980
Length:	47.2 m
Beam:	10.3 m
Tonnage:	701 grt
Main engine:	Normo LDMB-9, 1500 Hp
Class:	Veritas 1A1 Ice
Accommodation:	17 cabins (15 single, 2 four-berth)

Johan Hjort" (4)

The newest "Johan Hjort", which is the fourth in a row of research vessels with this name, was designed on the basis of the Institute's good experience with "G.O. Sars" (2) from 1970. A vessel of that size had proven its working efficiency in the rough weather-conditions of the Norwegian and Barents Seas. The new "Johan Hjort" was therefore constructed with a good length and a modern hull design which made it so sea-kindly that work on board is not held back to any extent even in the Barents Sea in mid-winter. An important advance in this respect was the fitting of de-icing gear on the foredeck, as was the fact that winches and other items of deck equipment were largely built in under protective housings. It was hoped that "Johan Hjort" could be brought into service without a long period of trials, and the Institute managed to do so. A very solid, good research vessel, was the verdict of the scientists after its first season of operation.

In order to reduce surface noise (bubble formation by the hull in bad weather) during acoustic measurements, "Johan Hjort" was designed in such a way that towed echo-sounder heads could be deployed from the bottom of the hull. This system did not function well, but in 1995, "Johan Hjort" was fitted with a dropkeel containing the echo-sounder and sonar transducers. This set-up works so well that good acoustic measurements can be made even in heavy gales. Nowadays, all new ocean-going research vessels have such retractable dropkeel.

Shipyard:	Flekkefjord Slipp & Maskinfabrikk AS Kvina Verft AS
Built:	1990
Length:	64.4 m
Beam:	13.0 m
Tonnage:	1950 grt
Main engine:	Wärtsilä Wichmann diesel, 8V28B, 3264 Hp (2400 kW)
Class:	Det Norske Veritas +1A1, Ice 1B (hull), Ice 1C (propeller)
Accommodation:	24 single, 5 two-berth cabins



”Dr. Fridtjof Nansen" (2)

When it was decided that it was time to replace the old "Dr. Fridtjof Nansen" with a new vessel, the Institute of Marine Research had only recently taken delivery of the new "Johan Hjort", which was one of the most advanced marine research vessels in the world. It was therefore only natural that the team responsible for planning the new "Dr. Fridtjof Nansen" should incorporate both drawings and experience from "Johan Hjort".

The new international helper was not to be inferior to our domestic flagship, and in fact the two vessels almost look like sister ships in terms of design, internal layout and scientific equipment. This is also rational in purely research terms, given that both research and technical personnel alternate between cruises in domestic waters with the Institute's vessels and cruises on board "Dr. Fridtjof Nansen". Acoustic equipment, marine environment instrumentation and trawl set-ups are identical. This also makes it easier to utilise the same or similar methods, compare and exchange experiences, and to use the results and experiences gained for example in West African waters in our own Scandinavian waters, and vice versa.

An important purpose of today's development cooperation is to build and support competence in fisheries science in our partner countries. "Dr. Fridtjof Nansen" is in this connection an effective instrument.

"Dr. Fridtjof Nansen" gives students and scientific personnel from our development partner countries an ideal opportunity to learn modern marine research which can create a basis for rational fisheries management.

Shipyard:	Flekkefjord Slipp & Maskinfabrikk AS
Built:	1993
Length:	56.8 m
Beam:	12.5 m
Tonnage:	1444 grt
Main engine:	Wärtsilä Wichmann diesel 6L28B, MCR 1980 kW (2700 Hp)
Class:	Det Norske Veritas +1A Ice 1C, MV, EO, Stern Trawler
Accommodation:	23 cabins (33 berths)

"Fangst"

"Fangst" replaced the old "Fjordfangst", which was the boat the Institute used for research studies on the coast and in the fjords. The Institute does not own "Fangst", but has chartered the vessel on a long-term basis.

"Fangst" is only about half a metre longer than "Fjordfangst", but has a greater beam and is more roomy. The boat has three double cabins and provides good living and working conditions for its crew and scientific personnel. There is ample deck-space and a small wet laboratory. The vessel is ideal for many tasks of the research group fish capture such as behavioural studies and trials of new types of fishing gear. The Institute's aquaculture scientists also use "Fangst" frequently.

A small vessel such as "Fangst" has low running costs in comparison with the Institute's ocean-going research vessels, and it is a good, cost-effective facility for many types of coastal studies and research projects.

Shipyard:	Båt & Motorservice AS, Rørvik
Built:	2000
Length:	15.0 m
Beam:	5.5 m
Draught:	3.2 m
Tonnage:	25 grt
Main engine:	Fiat IVECO, 8210 SRM-36, 400 Hp
Accommodation:	3 two-berth cabins

"G.O. Sars" (3)

- a technological innovation

The third "G.O. Sars" represents a new generation of marine research vessels. With its vibration- and noise-damped diesel generators and its propellers driven by direct-current motors, "G.O. Sars" is an extremely quiet vessel under way. It emits only 1 % of the noise under water emitted by comparable conventional research vessels. This means that the fish that are to be registered by the vessel's acoustic instruments are not scared off, giving the scientists better biomass measurements of the fish in the sea.

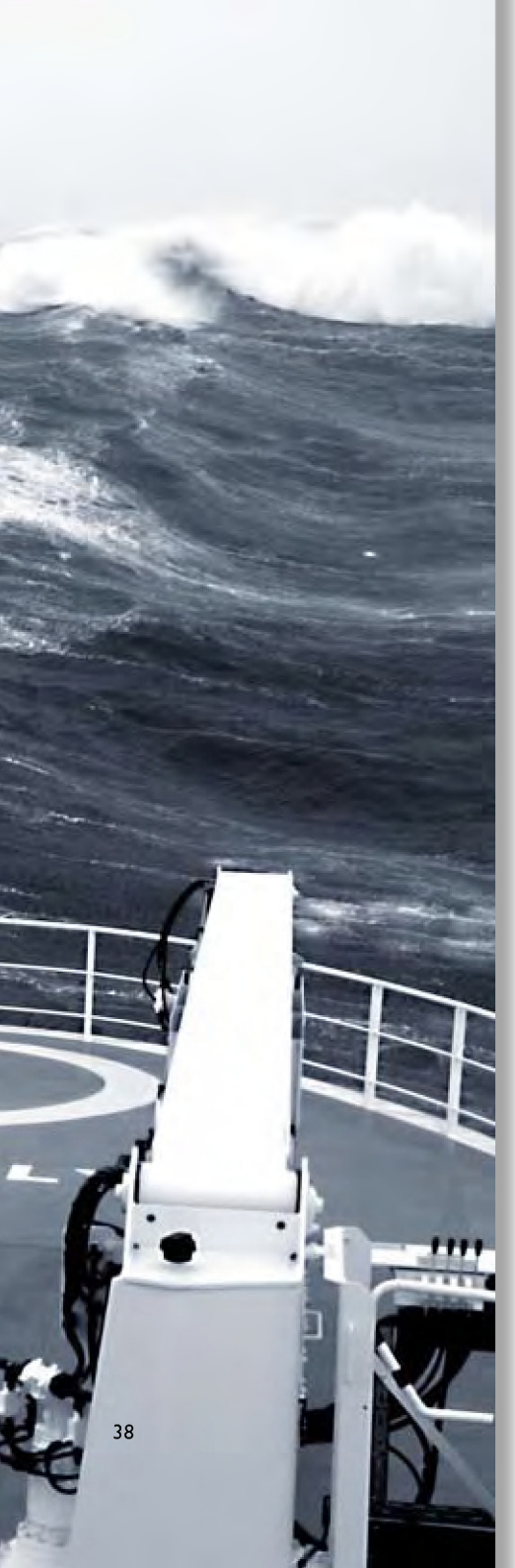
"G.O. Sars" has a roomy and well equipped trawl-deck, 18 m broad, is equipped with two sets of trawl winches, and has room for two complete sets of trawl-doors. This means that a pelagic trawl can be deployed as soon as the bottom trawl has been hauled. The scientists can thus combine cod and capelin studies, for example, on the same cruise.

The efficiency of research cruises has also been improved by the fact that "G.O. Sars" has sufficient engine power to tow a large pelagic trawl at speeds as high as 5–6 knots, which is important when representative samples of fast-swimming fish such as mackerel are being taken.

Amidships there is a large "environmental hangar" which contains six winches, each of which carries up to 6000 metres of cable for lowering instruments to the deepest parts of the sea. One of the winches is loaded with fibre optic cable, which is capable of transferring large quantities of data. At the after end of the trawl-deck are two winches for towing plankton sampling equipment and remotely operated underwater vehicles (ROVs). "G.O. Sars" contains several special laboratories for performing environmental, plankton and fish analyses, and the aim is that most of the analysis of data will be carried out on board before the vessel returns to port.

The vessel is also equipped to collect core samples 25 metres into seabed sediments. A special echo-sounder will be capable of studying sediments as much as 150 m below the seabed. "G.O. Sars" is able to carry out seismic studies using towed air-guns and hydrophones.

Advanced acoustic instruments, as echo-sounders and sonars, makes us capable of detecting and recording fish throughout the water column, from the surface down to the seabed.



"G.O. Sars" has an echo-sounder that operates at six different frequencies simultaneously. Three multi-beam sonars are also installed to identify and measure shoals of fish. A special echo-sounder can chart the seabed topography, while yet another measures ocean currents.

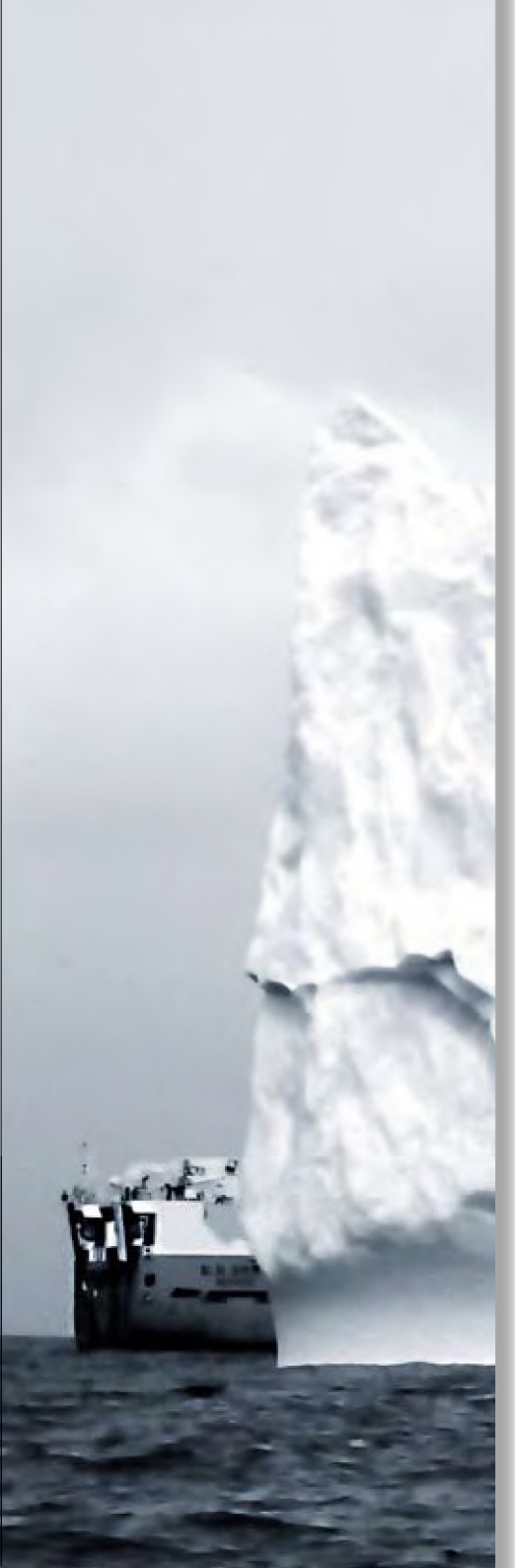
In 2003, "G.O. Sars" was voted by the Norwegian maritime industry to be "The ship of the year".

In accordance with the ship pool arrangement, 25 % of the available research time of "G.O. Sars" is currently used by the University of Bergen.

"G.O. Sars" has completed two large expeditions, MAR-ECO in 2004 and AKES in 2007–2008. MAR-ECO was part of the international research programme Census of Marine Life, which involved scientists from 16 nations. The purpose of the cruise was to improve the knowledge of animal life along the Mid-Atlantic Ridge between Iceland and the Azores. "G.O. Sars" turned out to be a very suitable research platform. Trawl hauls were made at depths down to 3,600 meters, and more than 80,000 individual organisms were collected for further analyses.

Amongst the aims of AKES, Antarctic Krill Ecosystem Studies, was to study the Antarctic ecosystem, in which krill is very important. Again, "G.O. Sars" proved to be an excellent technological research platform. The vessel spent 12 weeks in the Atlantic portion of the Southern Ocean, in addition to 4 weeks off the coast of Brazil and 4 weeks off Namibia.

Shipyard:	Flekkefjord Slipp & Maskinfabrikk AS
Built:	2003
Length:	77.5 m
Beam:	16.4 m
Depth to 1st deck:	6.2 m
Depth to 2nd deck:	9.1 m
Tonnage:	4 067 grt
Main engine:	Diesel-electric, three generators totalling 8,100 kw
Class:	DNV +1A1 Ice C, Eo, Dynpos AUT, Clean
Top speed:	17 knots; cruising speed 11–13 knots
Accommodation:	45 persons (19 single and 13 double-berth cabins)



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