Chapter 2

Historical overview of the Nansen Programme

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"The Nansen Programme needed to evolve continuously to remain a relevant means of providing development aid in marine fisheries research and management."

Abstract

The past 40 years witnessed a rapid expansion of the technological age, resulting in increased opportunities for exploitation of the oceans and their resources, but also in disturbing prospects of their over-exploitation and depletion. Against this background, the Nansen Programme needed to evolve continuously, to remain a relevant means of providing development aid in marine fisheries research and management. The activities of the programme covered the continental shelf waters of more than 60 countries in Africa, Central America and Southeast Asia, and its scope and objectives evolved through four phases. During Phase 1 (1975–1980), the RV *Dr Fridtjof Nansen*, a prominent feature of the programme and key to the achievement of its development objectives, undertook exploratory surveys, to find fish resources in the waters of newly independent states. The 1982 United Nations Law of the Sea Convention allowed for the establishment of Exclusive Economic Zones (EEZ), thus extending maritime jurisdictions of coastal states to 200 nautical miles from the shore. Phase 2 (1980–1990) provided detailed maps and inventories of fish resources within the EEZs of beneficiary countries. Phase 3 (1990–2006) focussed on capacity development and support for fisheries research and management institutions. This phase, which also saw the building of a new research vessel, was limited to Southwest Africa (Benguela Current area) and Northwest Africa, with no activities in the Western Indian Ocean. In Phase 4 (2006–2016), the Nansen Programme was transformed to become the EAF-Nansen Project, managed directly by FAO, and with the vessel operating costs co-funded by Norad and beneficiaries. In the Western Indian Ocean, the project supported the Agulhas and Somali Currents Large Marine Ecosystem project, and the Southwest Indian Ocean Fisheries Project. The scope of the surveys expanded to cover issues that are set to become central in future phases – such as ecosystem assessment, marine pollution, and impacts of climate variability and change on fish resources and biodiversity. Strong partnerships with the FAO, national institutions, GEF-funded large marine ecosystems projects and regional fisheries bodies have been key to achieving the objectives set by the Nansen Programme.

Previous page: Fishers mending their nets after a fishing outing off Zanzibar, Tanzania. © Bernadine Everett

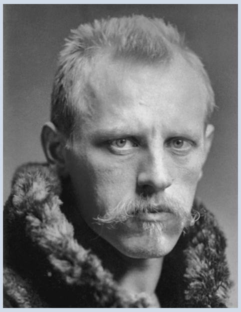
2.1 Introduction

The idea of supporting developing countries with a research vessel originated in Norway in 1963, and came from experiences gained during the earlier Indo-Norwegian fisheries development project in the 1960s (Sætersdal *et al.*, 1999). At that time, sparse information on fisheries resources and ecosystems hindered the expansion of fisheries in developing countries, where there was a keen interest in developing commercial fisheries for local marine resources. The importance of reliable information describing fish resources available for exploitation was clear, as this would guide the level of investment required, relative to the stock size and value. Human and financial resources for fisheries research were, however, limited in most developing countries, and required support from the international community. Norway's position as a leading fishing nation gave rise to an expectation that its government would support the development of sustainable fisheries in countries without the capacity to do so.

A research vessel to survey the waters of developing countries was proposed as a meaningful form of aid. The vessel would be operated by the Norwegian Institute of Marine Research (IMR), able to survey multiple countries in more than one ocean region, and co-operate with the FAO and regional fisheries organizations. This project was put into effect during the early 1970s. The operational costs of the vessel would be shared between FAO and Norway, the former with financial contributions from UNDP. In 1974, the research vessel named after *Dr Fridtjof Nansen*, the Norwegian explorer, scientist and humanitarian (Box 2.1), was completed, and what became known as the "Nansen Programme" was established.

BOX 2.1

The life of Dr Fridtjof Nansen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Dr Fridtjof Nansen (1861–1930)

Dr Nansen was a Norwegian explorer, scientist, diplomat and humanitarian. He made the first crossing of Greenland on cross-country skis but became most famous for reaching the record northern latitude of 86°14' N, while aiming for the North Pole. Nansen developed techniques for polar exploration that influenced subsequent polar expeditions for many years.

Nansen had a background in zoology and marine biology, and having participated in many oceanographic surveys in the North Atlantic, he developed the "Nansen reversing bottle", a device for obtaining samples of seawater at specific depths. As director of the Christiania-based International Laboratory for North Sea Research, Nansen helped found the International Council for the Exploration of the Sea (ICES) in 1900.

As diplomat, Nansen was instrumental in ending Norway's union with Sweden, and between 1906 and 1908, he helped to negotiate the Integrity Treaty that guaranteed Norway's independent status.

As humanitarian, Nansen served as the High Commissioner for Refugees for the League of Nations. He introduced a passport for stateless persons, aptly known as a "Nansen passport", which was recognised by more than 50 countries. For his work on behalf of displaced victims of the First World War and related conflicts, Nansen received the Nobel Peace Prize.

Because of his achievements, Fridtjof Nansen became a national hero, and naming the research vessel after him was a natural choice, considering that the vessel would be dedicated to international development projects.

2.2 General objectives and phases of the Nansen Programme

The original goal of the Nansen Programme was to assess and map the living resources available for fisheries development in the Indian Ocean, at that time one of the least known of the world's oceans. The goals and objectives of the programme evolved over time, responding to new global challenges and the needs of recipient countries.

Overall, the Nansen Programme can be subdivided into four main phases (Figure 2.1), based on their scope and character. For the earliest phases of the programme, this chapter is largely based on Sætersdal *et al.* (1999).

PHASE 1: 1975–1980
Exploratory surveying

Phase 1 surveys aimed at finding fish resources in the waters of newly independent states of the Indian Ocean, bordering on the Arabian Sea and adjacent Gulfs, Eastern Indian Ocean and South China Sea, and the Southwest Indian Ocean (Figure 2.2). Following on the International Indian Ocean Expedition (IIOE; 1959–1965), when 40 research vessels and 20 countries surveyed the region, the Nansen Programme identified the Indian Ocean as a priority area. The IIOE had systematically covered the ocean basin, resulting in information on physical, chemical and biological oceanography (Behrmen, 1981), but it did not provide data of direct interest to fisheries, such as the abundance and distribution of fish resources.

Based on the outcome of the IIOE, the FAO commissioned a special analysis of oceanographic data, to infer fishery potential, starting with the Arabian Sea (Marr *et al.*, 1971). The analysis showed a mean productivity of several times higher than the mean of the world oceans, and with estimates comparable to the productivity of major eastern boundary current systems off Peru and West Africa. By the early 1970s, fisheries production in Peru had risen to 8–9 million tonnes per annum (Csirke, 1995; Csirke and Gumy, 1996; IMARPE, 1972), creating expectations of similar yields in the Arabian Sea.

For this reason, the Nansen Programme initially surveyed the Arabian Sea (1975–1977), to test whether high primary productivity would support a high abundance of small (coastal) pelagic fish, such as anchovy, herrings or sardines, similar to other upwelling regions. Survey objectives were to assess pelagic and mesopelagic resources using acoustic methods. The area from Somalia to the Pakistan-India border was covered five times in 1975–1976, while the Pakistan shelf was covered five times in January–June 1977.

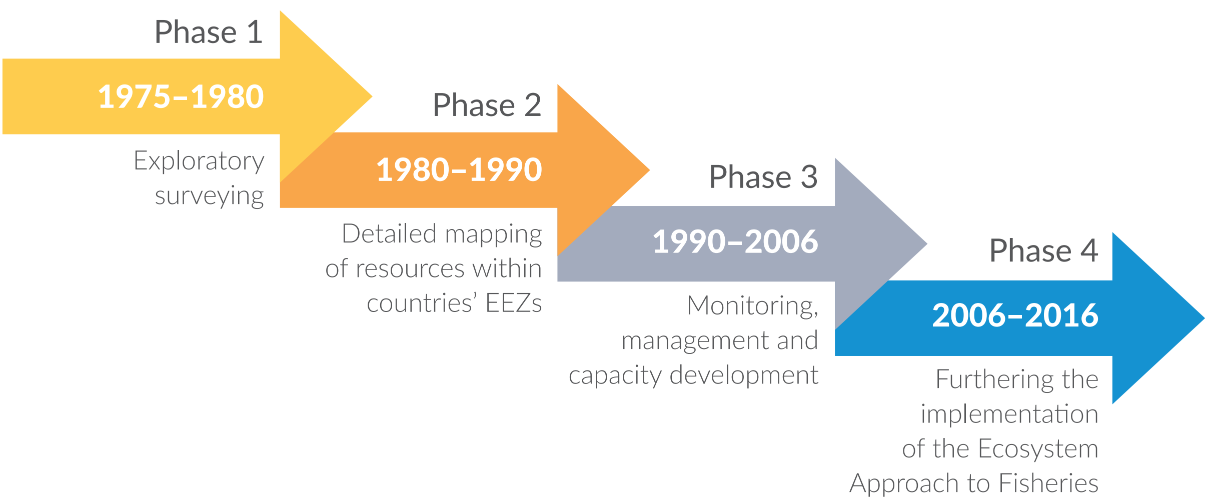

Figure 2.1 Main phases of the Nansen Programme.

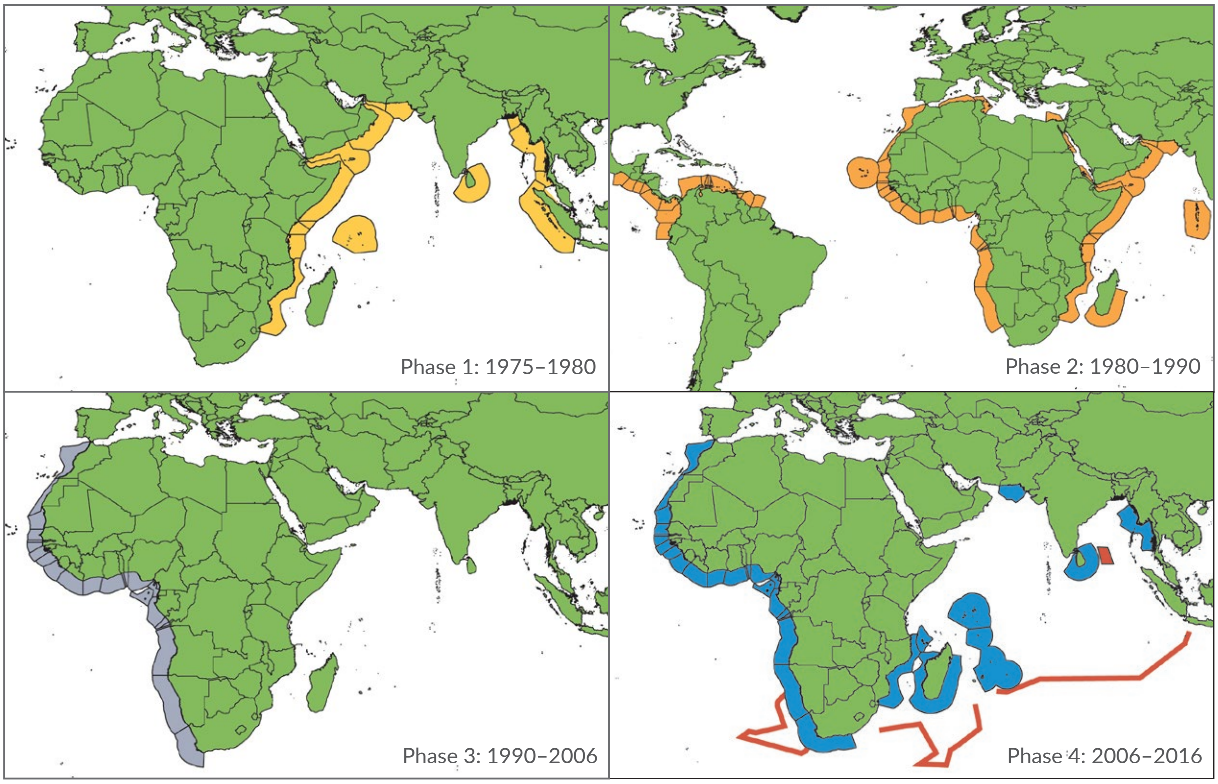

Figure 2.2 Areas covered during the four phases of the Nansen Programme (1975–2016).

The surveys confirmed high fish production in the Arabian Sea, but most (about 80 percent, or a biomass of 46 million tonnes; Gjøsæter, 1977, 1981) comprised of mesopelagic fish – of which a large proportion were lanternfishes. These are small filter- feeding fish, occurring in the mesopelagic zone (200 to 1 000 m depth) during the day, but ascend during the night to feed at shallower depths. Despite the high estimates, subsequent fisheries for mesopelagics have been unsuccessful, because fish aggregations are not dense enough to support economically viable fishing operations. A main finding of Phase 1 was therefore that high primary productivity in the Arabian Sea and adjacent areas do not support major stocks of coastal pelagic fish species, at the level of other upwelling regions with comparable primary productivity. This provided a more realistic indication of the actual level of exploitable resources. One explanation of the lower potential yields is the dissipative character of the region's physical oceanographic system (see Chapter 4), with strong offshore current flows and wind-driven surface transport disrupting retention processes (Bakun *et al.*, 1998). Another finding was that mesopelagic fish biomass exceeded that of coastal pelagic fish, suggesting energy flow along different paths than in upwelling systems where coastal pelagic fishes dominate. Surveys in the Southwest Indian Ocean, which started from mid-1977, showed far lower productivity than in the north (Sætersdal *et al.*, 1999), and fish biomass along the East African coast was estimated to be an order of magnitude lower than in the Arabian Sea. Unexploited pelagic fishes were identified in Mozambique, but they were too dispersed to exploit at industrial scale. Similar conclusions were drawn from surveys carried out in the other East African countries. Even though few new fish resources were found, the initial phase of the Nansen Programme informed beneficiary countries of the level of investment required to further develop the fisheries sector.

PHASE 2: 1980–1990
Detailed mapping of resources within EEZs of countries

Following on the 1982 United Nations Law of the Sea Convention, countries around the world extended their maritime jurisdiction through establishing Exclusive Economic Zones (EEZs; from the coast to 200 nautical miles offshore). The second phase of the Nansen Programme focussed on detailed mapping and taking inventory of fish resources within the EEZs of beneficiary countries. During this phase, the *Nansen* surveyed the coastal waters of the Western Indian Ocean, Eastern and Western tropical Atlantic, and the Eastern Central Pacific.

In the Western Indian Ocean, the *Nansen* surveyed the waters of most coastal countries as well as the Gulf of Aden, the southern Red Sea and the island States of Maldives, Madagascar and Seychelles. In its first ten years at sea, the *Nansen* spent nine years surveying the Indian Ocean.

Bottom trawling to provide swept-area biomass estimates became an important tool in the programme, because coastal states required more information on demersal fish resources. The trawl sampling augmented the acoustic methods, which do not accurately detect fish in the "dead zone", close to the seafloor. More intensive sampling with bottom trawling generated important information on the abundance, distribution and diversity of demersal species throughout the Western Indian Ocean (Sætersdal *et al.*, 1999). The surveys accumulated large amounts of data, making efficient data storage and retrieval crucial. The availability

BOX 2.2

The NAN-SIS database and software

NAN-SIS is a Survey Information System for logging, editing and analysis of scientific trawl survey data, including information on the trawl station, catch by species and biological information such as length frequency, gender and maturity stages. Data can be retrieved according to user-selected criteria. Species densities and swept-area calculations can be made for data grouped by user-defined limits. Storage of information by species is handled through a mnemonic species code system to which scientific and common names are also linked.

Information from electronic measurements are automatically logged onto Nansis.

While NAN-SIS was originally developed for the *Nansen* surveys in the early 1980s (Strømme, 1992), over time it has been made available to counterpart cooperating institutions. The software can be used on other research vessels, or to store and analyse data from other sources for biomass estimates. The first NAN-SIS version was designed for the DOS environment and has been used by many fisheries scientists in developing countries for well over 30 years.

Additional modules were developed later on including:

- **Bridge Log:** An electronic diary of all the ships movements and events (e.g. trawling, hydrographic stations, cruise-track lines).
- **Track Log:** Underway logging system to record weather and surface water conditions.
- **QD Log:** To store acoustic data from the QD integrator and allocate integrator values to species groups, later replaced by the Bergen Echo Integrator System (BEI).
- **Map make:** A system to produce digital maps of fish distribution, based on acoustic or trawl density.

A Windows-based version (called Nansis) with the additional features has been in use since 2007 and can be downloaded at: www.fao.org/in-action/eaf-nansen/topic/18010/en of portable computers in the 1980s provided a conducive environment for the development of a purpose-made database for *Nansen* surveys, called NAN-SIS (Box 2.2).

PHASE 3: 1990–2006
Monitoring, management and capacity development

In January 1994, a new RV *Dr Fridtjof Nansen* started operations, replacing its older namesake. The Nansen Programme focussed mainly on the southwest African subregion, (Namibia, Angola and western South Africa), in line with Norwegian development policy, and to support Namibia as a newly independent state. Activities included resource and ecosystem monitoring, follow-up research through regional collaboration, and capacity development in fishery research and management. The strengthened regional collaboration between the three countries resulted in the establishment of the BENEFIT (Benguela Environment, Fisheries, Interaction and Training) programme.

BENEFIT significantly increased knowledge of the dynamics of key resources and the processes that support them in the Benguela Current Large Marine Ecosystem (BCLME). Capacity and awareness of environmental monitoring was strengthened (Hampton and Sweijd, 2008) during BENEFIT, which was followed by other regional marine research and management projects, such as the BCLME Programme, which in turn led to the creation of the Benguela Current Commission. During Phase 3, the *Nansen* also surveyed Northwest Africa (Senegal, the Gambia, Mauritania and Morocco) and West Africa (Côte d'Ivoire, Ghana, Togo and Benin), but there were no activities in the Western Indian Ocean.

During this phase, the scope of capacity development, research focus and support to institutional development in fishery research and management at the national and regional levels were significantly expanded. The programme's commitment to development reached an apex in Phase 3, compared to other phases which were more research-orientated and spanned a broader geographic scope.

PHASE 4: 2006–2016
The Ecosystem Approach to Fisheries

In Phase 4, the Nansen Programme was transformed to become the EAF-Nansen Project, managed directly by FAO. This followed the FAO Committee on Fisheries endorsement of an ecosystem approach to fisheries (EAF) as the practical implementation of the 1995 FAO Code of Conduct for Responsible Fisheries (Fletcher *et al.*, 2012). The aims of the EAF-Nansen Project were to (i) develop and implement fisheries policy and legislation, (ii) improve fisheries research and management skills, and (iii) strengthen cooperation across regions, among others.

Phase 4 coincided with implementation of the large marine ecosystem (LME) projects supported by the Global Environment Facility (GEF) in Africa. In the Western Indian Ocean, *Nansen* surveys supported the Agulhas and Somali Currents LME (ASCLME) project and the Southwest Indian Ocean Fisheries Project (SWIOFP). Surveys were also carried out in the Eastern Indian Ocean, mainly off Myanmar (Figure 2.2). Surveys were expanded to cover issues that are set to become central in future phases – such as marine pollution, climate variability and its potential impact on fish resources and biodiversity. The first five years of Phase 4 (2006–2011) was followed by a transition period (2012–2016), during which preparations for a follow-up project and construction of a new research vessel were made. The project continued to support ongoing activities, with a focus on fisheries management and EAF implementation. The project assisted several countries to prepare management plans for specific fisheries.

A survey of seamounts in the southern Indian Ocean in 2009 was carried out in collaboration with the Zoological Society of London, the World Conservation Union (IUCN) and the ASCLME project. Five seamounts of the Southwest Indian Ocean Ridge, and one further north at Walters Shoals, were surveyed for physical oceanography, phytoplankton, zooplankton, fish and seabirds (Rogers *et al.*, 2009). Seamounts are known hotpots of biodiversity and attract a range of oceanic predators, including seabirds, whales and sharks.

A demonstration survey across the southern part of the Indian Ocean was undertaken in 2015, in preparation for the 2nd International Indian Ocean Expedition. Scientists and technicians from six Western Indian Ocean countries participated in the survey.

The first leg of the survey started in Jakarta, Indonesia and ended in Port Louis, Mauritius, and the second leg continued from Port Louis to Durban, in South Africa. The survey investigated ecological features of the southern Indian Ocean, and habitat studies were carried out on the Mascarene Plateau and Madagascar Ridge, using a Video-Assisted Multi Sampler (VAMS – see Box 2.3) (Serigstad *et al.*, 2016a). Preliminary survey results show that the southern Indian Ocean gyre consists of a number of smaller eddies with specific features. The biological production in the gyre is low but relatively higher away from the centre and at the edges. Mesopelagic fish densities are low in the gyre, but tend to follow biological production. Plastic particles were present in almost all water samples, with higher densities along the gyre edges, especially on the eastern edge.

BOX 2.3 VAMS – a tool for habitat mapping and monitoring

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Launching the VAMS from the RV Dr Fridtjof Nansen (not in view).

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Images from the Madagascar Ridge at depths of 1 485 m.

The Video-Assisted Multi Sampler (VAMS) is an integrated bottom sampling unit especially designed for monitoring areas where oil and gas exploration and exploitation are taking place, but also useful for mapping bottom habitats, particularly in deep waters.

The VAMS consists of multiple samplers, a remotely operated vehicle (ROV) with a 30 m umbilical carrying a high resolution video camera and a set of sensors to monitor the surrounding ocean environment. The sampling platform has five hydraulic grabs (four double chamber grabs) that can be opened and closed from the ship, a current meter, a CTD with oxygen, fluorescence and turbidity sensors, and a sonar. The ROV is equipped with a HD camera for documentation, guidance and visual inspection of the sampling. The VAMS can also be towed along transects for habitat studies. In this case, it follows the ship, with the ROV flying in front of the VAMS without drag on the cable. The current version of the VAMS can operate down to 2 500 m depth and collect nine parallel sediment samples in one dive, in addition to obtaining various sensor outputs, high resolution video and pictures from the seabed.

The VAMS protocols have been adjusted for tropical and deep-water assessments for use on the *Nansen*. It has been used successfully for environmental monitoring in Angola, Ghana, the Nigeria-Sao Tome & Principe Joint Development Zone (JDZ), Myanmar and the Western Indian Ocean area.

Contributed by: Bjorn Serigstad
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2.3 Development of survey types and methods

The Nansen Programme continued to evolve over the past four decades, to keep up with the needs of its partners. The RV *Dr Fridtjof Nansen* itself, and its sampling equipment, were continually adapted, or replaced, to keep up with rapid advances in available technology (Table 2.1).

Although these improvements led to more accurate information, and the ability to broaden the scope of surveys, it also brought new challenges, such as the compatibility of information collected during earlier and later surveys, using different sampling equipment (see Axelsen and Johnsen, 2015).

Table 2.1 Survey types, objectives and methods used in the Nansen Programme.

SURVEY TYPE	OBJECTIVE	METHODS
Acoustic survey	Abundance and distribution of pelagic and mesopelagic fish resources. Biomass estimation of demersal fish in Phase 1.	Acoustic sampling and echo-integration. Analog echo-sounders and echo-integrators used until 1983 – replaced with digital equipment.
	Oceanographic conditions.	Nansen bottles used for oceanographic sampling (oxygen, salinity and temperature). Replaced by CTD with Niskin bottles in 1994.
Bottom trawl (swept-area) survey	Abundance and distribution of demersal fish resources (also oceanographic conditions).	Estimation of demersal fish biomass using average catch rates, area swept and total distribution area. Introduction of sensors on bottom trawl nets (1994) improved accuracy of estimates by monitoring gear geometry and bottom contact. Introduction of GPS in late 1980s improved trawl distance measurements.
Combined acoustic and bottom trawl surveys	Abundance and distribution of pelagic and demersal fish resources (also oceanographic conditions).	In areas with moderate productivity, the two methods were used simultaneously to cover all resources. Methods as explained above.
Ecosystem surveys	Provide synoptic information on main ecosystem components/features including: – abundance estimation and distribution of pelagic and demersal fish – oceanography – phytoplankton and chlorophyll – zooplankton – benthos – sediment – sea mammals – sea birds	Acoustic and bottom trawl sampling. Oceanographic sampling. Bongo and Juday nets in the early phases for plankton sampling, replaced by multinet since 1994. Van Veen grab and VAMS. Visual observations of mammals and sea birds.
"Environmental" surveys	Set baselines and develop monitoring systems for bottom habitats in areas of oil/gas exploration and exploitation: – bathymetry – oceanography – sediment – benthos	Bathymetry with multi-beam sampling. Oceanographic sampling: as above. Sediment sampling and visual observations with VAMS.

2.4 Funding

Through the Norwegian Agency for Development Cooperation (Norad), the government of Norway funded most of the Nansen Programme. During Phase 1 and up to 1983, the UNDP, through various FAO/UNDP projects, covered about 40 percent of vessel operation costs, but this was reduced to about 20 percent in 1987 (Sætersdal *et al*., 1999). In the following years, and up to the start of Phase 4 in 2006, the programme became fully funded by Norway.

Co-funding of vessel operations became a condition of use in Phase 4. At that time, the LME projects around Africa needed to collect updated information on the state of resources and ecosystems. They became natural partners of the EAF-Nansen Project and provided co-funding for several surveys. Co-funding has also been provided by some coastal countries for national surveys, through budgetary allocations or externally-funded national programmes; for instance, the Mozambican government provided co-funding for an ecosystem survey in 2014.

2.5 Partnerships

National, regional and international partnerships have been key to the broad dissemination of the project objectives, and reflective of its underlying principles of ownership, accountability and cooperation. Partnerships during the early phases were mainly between Norad, FAO and UNDP, with IMR as the scientific arm. Scientists from beneficiary countries were invited to participate in surveys, with training opportunities offered through the University of Bergen's international programme on fisheries biology and management.

During the early years of the Nansen Programme, the scanty literature on the marine biota of the Western Indian Ocean, and lack of experience of Norwegian scientists with tropical fish taxonomy, gave rise to a strong partnership with the FAO's Species Identification and Data Programme (SIDP). This collaboration was based on mutual interests: FAO provided a tropical fish expert for surveys, while at the same time collecting valuable field information. Records of new occurrences, or range extensions, were confirmed by sending specimens to specialist taxonomists. The JLB Smith Institute of Ichthyology in South Africa (now the South African Institute for Aquatic Biodiversity, or SAIAB) also assisted with fish taxonomy.

During Phases 1 and 2 of the Nansen Programme, its objectives, areas of deployment and survey plans were decided by the FAO, UNDP and Norway. National experts were invited to participate in surveys, and contribute to survey reports, but were not actively involved in survey design. In Phase 3, governments and regional projects, such as the BENEFIT and BCLME programmes, became formal partners of the Nansen Programme. Some countries entered the partnership through the Norad bilateral programmes, with access to the vessel through the Nansen Programme. At national level, fisheries research and management institutions contributed to project objectives by committing staff to surveys and training programmes.

By Phase 4, formal partnerships were established with all the LME programmes in Africa and also in Southeast Asia. In the Western Indian Ocean, partnerships with the World Bank-assisted SWIOFP and the UNDP-managed ASCLME projects facilitated the introduction of Ecosystems Approachs to Fisheries (EAF). The *Nansen* surveys were co-funded by the two projects, and the planning of surveys and their objectives were shared among partners. Partnerships with the Southwest Indian Ocean Fisheries Commission (SWIOFC) and the Fishery Committee for the Eastern Central Atlantic (CECAF) facilitated the implementation of EAF-aligned management plans.

The EAF-Nansen Project also partnered with the Norwegian Oil for Development Programme, to investigate the impact of oil and gas extraction at sea on ecosystems and fish stocks. Environment monitoring systems were set up in areas of future oil exploration.

2.6 Capacity development

Although not part of the initial objectives of the Nansen Programme, an increasing need for the capacity to manage fisheries in a sustainable way became apparent over time. Capacity development took place through ad-hoc training, including design of survey methods, analysis of survey data, and use of NAN-SIS. Together with the University of Bergen, the Nansen Programme provided an opportunity for students from developing countries to study fisheries science and management at diploma and masters levels. Practical training has been integral to the programme, mainly though visits to Norwegian institutions and conducting research on board the *Nansen* during surveys.

The most intensive capacity development period was perhaps during the BENEFIT programme, when a Training Working Group for ad-hoc and short courses in resource and environmental research was established. It also created opportunities for overseas training, mainly at master's degree level, through direct participation in research projects. BENEFIT was co-funded by the Nansen Programme.

In the Western Indian Ocean, at sea training was used to develop capacity during the first two phases of the Nansen Programme. Capacity development expanded during the EAF-Nansen Project phase, making use of partnerships with SWIOFP and the ASCLME surveys in 2008–2010. Fisheries scientists, technicians and managers from the region participated in training activities on land and at sea on the *Nansen*. Group training covered subjects such as survey methodology and data analysis, stock assessments, fisheries management based on EAF principles, and fish species identification. Courses were presented in Mauritius, Kenya, South Africa and Mozambique. The 2015 demonstration survey to the southern Indian Ocean seamounts introduced sampling for microplastics, and detailed habitat studies using the VAMS.

2.7 Use of the data

Initial surveys collected data on fisheries resources, which were used by Norwegian scientists to produce biomass estimates. Survey reports also provided abundance and length frequencies for main commercial species, and information on oceanographic conditions sampled along hydrographic transects. Bathymetric charts of the survey areas were substantially improved, to show the main bottom characteristics of the shelf and slope areas. The increased accuracy was made possible by improvements in satellite navigation and higher echo-sounder resolution.

The information provided realistic estimates of the level of resources, as basis for future fisheries development in newly established EEZs. For example, Norad sponsored national seminars in the early 1980s to review marine fish stocks in Mozambique (Sætersdal *et al.*, 1999), Tanzania and Kenya (Iversen and Myklevoll, 1984a, b). The outcome was a down-sizing of investment in offshore fishing fleets, because *Nansen* survey data showed low biomass and fisheries potential (NORAD, 1982), with some exceptions, such as prawn resources in Mozambique.

The Nansen Programme provided credible information on fish resources at national and regional levels, independent of information obtained from fishing companies. In some countries, including those outside the Western Indian Ocean, surveys conducted as far back as the early 1980s are still used as reference points when decisions must be made. In Namibia, for example, biomass estimates obtained after independence became the main source of information for the management of pelagic and demersal fish stocks, at least during the first years (see Box 2.4). Likewise, Angola uses *Nansen* survey results as the main source of information for fisheries management. In South Africa, the *Nansen* undertook surveys when the regular survey vessel was unavailable. The Nansen Programme also facilitated transboundary demersal surveys between Namibia and South Africa.

BOX 2.4 The *Nansen* survey results and the Namibia hake story

Namibia's highly productive marine waters had for many years attracted the fishing fleets of many nations, as there was no internationally recognised exclusive economic zone. Of particular interest was the foreign fleet of mostly freezer trawlers (about 178 of them at independence) targeting the two species of hake, the Cape hake (*Merluccius capensis*) and the deep-water hake (*Merluccius paradoxus*). Realising the importance of Namibia's marine resources for the country's future economic development, the Norwegian government assisted the new government with surveys carried out by the *Nansen*, to establish the actual state of fish stocks in Namibia's waters. The survey took place in early 1990. The total declared hake catch had grown rapidly from 47 600 tonnes in 1964, to 815 000 tonnes in 1972, the highest hake catch ever declared in Namibian waters. Subsequent years saw a general downward trend until 1980 when the declared catch was 156 300 tonnes. Declared catches were well below the total allowable catches (TACs) set by the International Commission for the Southeast Atlantic Fisheries (ICSEAF). Based on the *Nansen* survey data, the fishable hake biomass was estimated at 130 000 tonnes in 1990 and some 83 percent of the hake sampled were juveniles between two and three years old. It was clear that the hake stocks had been seriously over-fished and needed to be protected.

Hake (Merluccius spp.) caught by trawl nets off Namibia.

The Namibian government announced a hake TAC of 60 000 tonnes for 1991, 85 percent of which was to be reserved for existing concessionaires. The affected foreign fishing nations disputed the validity of that decision and the biomass survey on which the decision was based. They argued that, on the scientific evidence they had available (based solely on questionable catch data), Namibia could easily grant their fleet a hake quota of 200 000 tonnes for 1991. Considerable pressure was exerted on the new government to meet these demands. However the Namibian government was able to confidently take a firm stand because of the stock surveys conducted by the *Nansen*. Without this intervention at such a critical point, Namibia might well have faced a complete collapse of its hake stocks.

Contributed by: Peter Manning
Adapted from "*Winning the battle to save the hake*" in the EAF-Nansen brochure: "*The RV Dr Fridtjof Nansen – a platform for collaborative marine research in developing countries*".

At regional level, data from the *Nansen* surveys constitute a key input into regular assessments of the state of stocks in areas covered by regional fisheries bodies, such as the SWIOFC, and the BCC. Survey information has also been used for environmental impact assessments and monitoring of oil exploration activities in Angola and Ghana (Serigstad *et al.*, 2013, 2016b). Biological and environmental data, collected over a forty year period, have also been used for academic work, including PhD and master's theses (see Chapter 8). Nevertheless, existing restrictions on data use, *inter alia* approval from the country of origin, hinder its wider use, so that the survey data have not yet been used to their full potential.

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