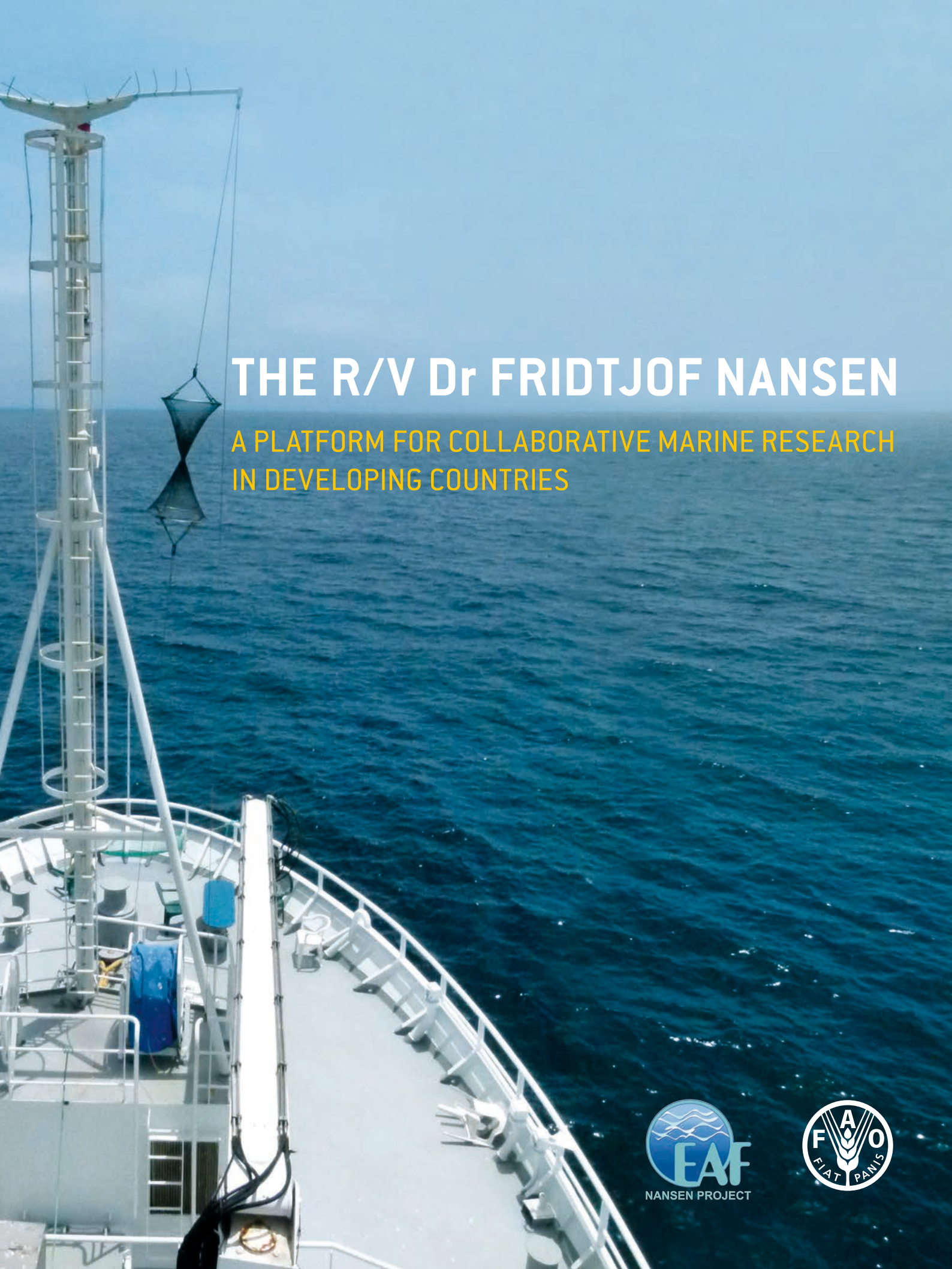


THE R/V Dr FRIDTJOF NANSEN

A PLATFORM FOR COLLABORATIVE MARINE RESEARCH IN DEVELOPING COUNTRIES

NANSEN PROJECT

The EAF-Nansen project offers an opportunity to coastal developing countries to receive technical assistance from the Food and Agriculture Organization of the United Nations (FAO) and the Institute of Marine Research, Bergen, Norway (IMR) for assessment and management of their fisheries within an ecosystem context, with the funding support of the Norwegian Agency for Development Cooperation (Norad).

FAO

The EAF-Nansen Project (and the forerunner Nansen Programme) is one that FAO is immensely proud of as it embodies many of the organization's core objectives.

The research vessel, that has always been an important component of the programme, has had a massive social and economic impact for fishing communities and fisheries management in countries where it has undertaken surveys and beyond.

Now is the time to build on consolidating the excellence of the Project and meet the next, and perhaps greatest, challenge of addressing the multiple impacts of human activities on fishery resources and the marine environment that include not only overfishing but also climate change and pollution, in order to keep the oceans as an immensely productive resource for future generations.

Norad

Support to fisheries development, and particularly to fisheries research and management, has been an important theme in Norwegian development cooperation during the last 60 years.

Norway is itself a coastal country with important fishery resources and a long-standing experience in marine research as a tool for fisheries management.

Naturally it followed that this experience could be shared with the developing world.

The Nansen Programme and Project have continuously adapted to internationally agreed policies and the needs and priorities of developing countries. The rationale behind the establishment of the programme to support developing countries in sustainable use of their marine resources is still valid and increasingly relevant.

IMR

Norwegian marine and fisheries research dates back to the early 1800s leading to the establishment of the IMR and the first custom built research vessel in 1900.

The IMR has a clear ambition of being a leading institution in marine science. Since it was founded, there have been great improvements in survey related methods, equipment and instruments. As these improvements have been implemented in northern waters, they have also been transferred to the R/V *Dr Fridtjof Nansen*.

IMR has been involved in development cooperation in fisheries research and management for over forty years, including with countries in Africa, Latin America and Asia.

FAO FIAT PANIS

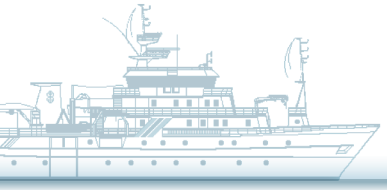
Norad

INSTITUTE OF MARINE RESEARCH
HAVFORSKNINGSINSTITUTTET

THE R/V Dr FRIDTJOF NANSEN

A PLATFORM FOR COLLABORATIVE MARINE RESEARCH IN DEVELOPING COUNTRIES

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 2014



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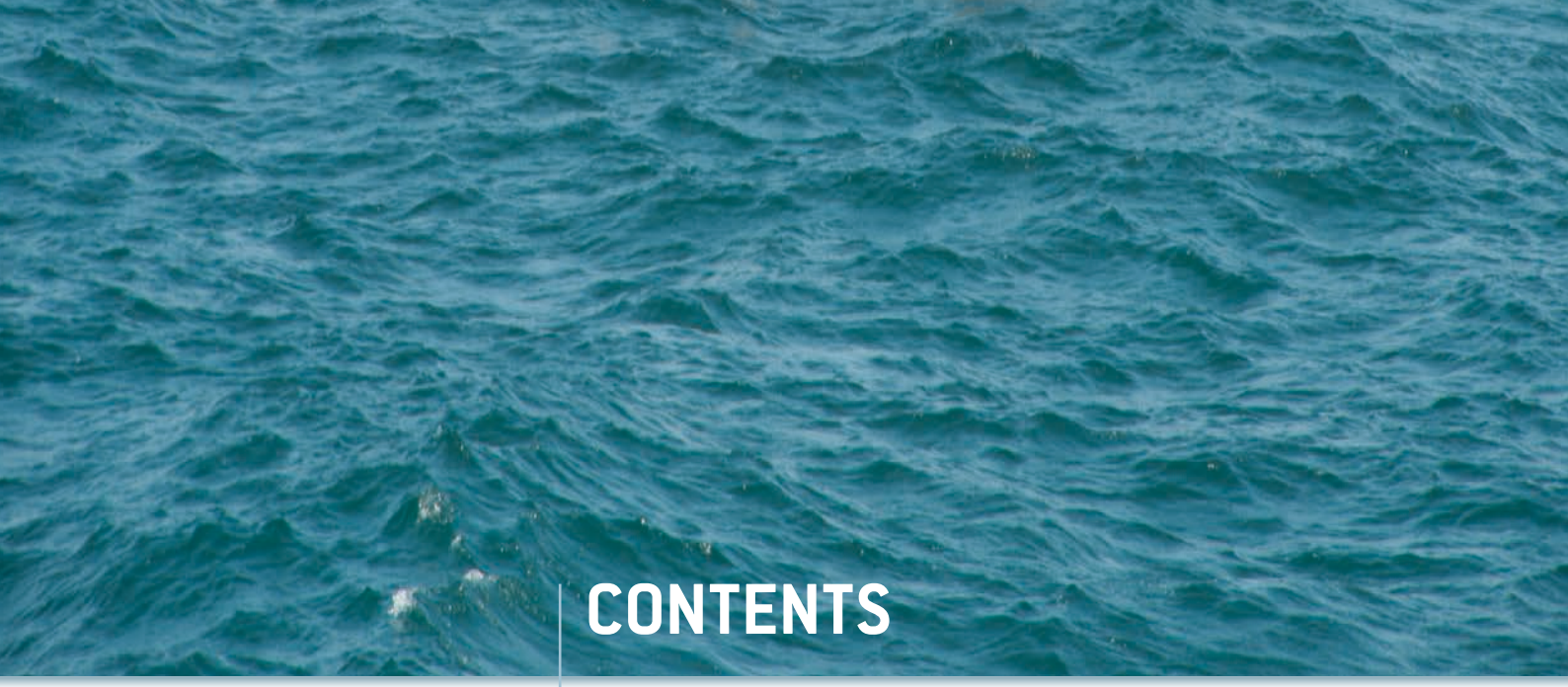

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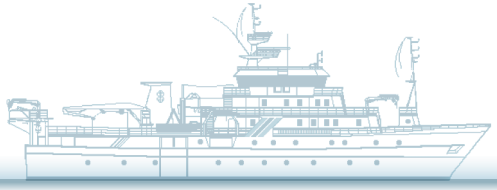
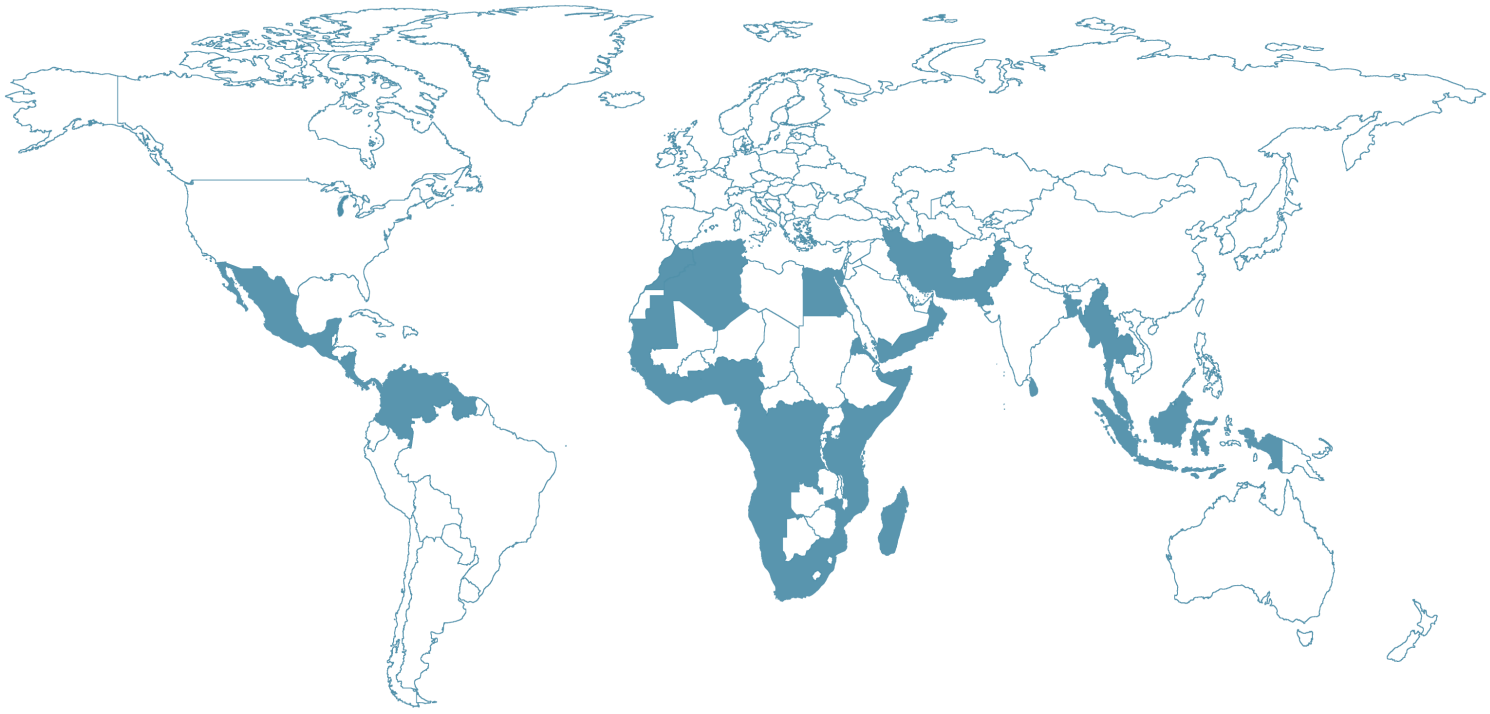


INTRODUCTION

Since 1975 the research vessel *Dr Fridtjof Nansen* has sailed the oceans assisting developing countries to understand and assess their fishery resources. In spite of its successes many people remain unfamiliar with its work and how it contributes to decisions on sustainable fisheries management. Aware of this, the EAF-Nansen project arranged for a communication team made up of a journalist and a photographer to join one of the research cruises off the North West African coast. Over two weeks they recorded the research taking place as well as the work of scientists, administrators, fishers and fish processors in this part of Africa for whom the survey results are of immense value.

This is their story.



FOUR DECADES OF **LEARNING**

THE ROOTS OF THE EAF-NANSEN PROJECT STRETCH RIGHT BACK TO THE EARLY 1960s. NORWAY'S IDEA WAS TO PROVIDE A RESEARCH VESSEL MAINTAINED BY A NORWEGIAN CREW THAT WOULD SPEND AS MUCH TIME AS POSSIBLE AT SEA PROVIDING INFORMATION TO DEVELOPING COUNTRIES. IT WOULD FLY THE UN FLAG FOR NEUTRALITY.

IN 1974 THE FIRST R/V *DR FRIDTJOF NANSEN* WAS LAUNCHED. IN THE SUBSEQUENT DECADES THE MISSION OF WHAT WAS THEN THE NANSEN PROGRAMME HAS EVOLVED, BUT THE CORE OBJECTIVES HAVE NOT.

The first phase was an exploratory one. It looked to help developing countries find new fishery resources. There were surveys in the Indian Ocean, Arabian Sea and Eastern Africa, Sri Lanka, Southeast Asia and through the Red Sea and the Mediterranean Sea.

These surveys found new fishery resources and also identified where stocks were depleted. For instance new pelagic resources were discovered off Oman while first estimates off the Horn of Africa showed much lower availability of fish as compared to what was expected based on primary productivity of the waters in that region. Where new resources were found, survey results were followed by feasibility studies on capture methods and processing. In contrast, where resources were found to be poor, large investments in new offshore fleets were cancelled as in the case of Somalia.

With developing countries declaring their Exclusive Economic Zones (EEZs) in the early 1980s, the vessel helped with providing detailed information on distribution and abundance of resources within countries' EEZs and thus entering a new phase of objectives. Studies were carried out off East and West Africa, in Central America's Pacific coast and off the North Coast of South America. Selection of areas to be surveyed was always the result of a close cooperation with FAO. Scientists from the countries involved actively participated in survey planning, data collection and processing aboard the ship.

The 1990s saw the vessel and the Nansen Programme concentrate efforts off West Africa and enter its third phase with monitoring and fisheries management (both at national and regional levels) as primary areas of work.

Meanwhile Namibia, Angola, South Africa, Senegal, The Gambia, Mauritania and Morocco all benefited from the information on biomass gathered by the vessel. This was used to inform national marine policies and fisheries management.

The unique database on fishery resources in developing coastal states which was developed in the early 1980s is probably the most comprehensive survey database available in many developing countries. Importantly, the data is owned by the respective countries, with the IMR, operators of the vessel, functioning as repository and FAO providing guidance on its use.

Above: First R/V Dr Fridtjof Nansen *(1974). Below: The Norwegian Crown Prince Haakon and the Crown Princess Mette-Marit visting the R/V* Dr Fridtjof Nansen *in Tema, Ghana, April 2011.*

In four decades the fisheries research vessels named after Dr Fridtjof Nansen have sailed the equivalent of 60 times around the globe. In that time they have found new fishery resources and species, helped developing countries manage their fisheries and protect threatened marine environments. They have also trained hundreds of scientists in Africa, South America and Asia.

The principles at the heart of what became the EAF-Nansen project remain, but new challenges require fresh objectives. The R/V *Dr Fridtjof Nansen* is uniquely placed as an independent scientific platform to monitor the impact of climate change upon marine environments.

Gabriella Bianchi, from the Fisheries and Aquaculture Department at FAO, said: "*The next decade could be the most challenging in the project's history. It will seek to expand its objectives to understand the combined effects of climate change, pollution, and fisheries, using the advanced scientific capabilities of the R/V* Dr Fridtjof Nansen*. Getting this right will be a major contribution to a sustainable future for the millions of people who depend on the oceans for their livelihoods.*"

The third phase of the Programme benefitted from the availability of a new R/V *Dr Fridtjof Nansen* that was launched in 1993. Institutional and capacity development as well as cooperation on monitoring and management of shared stocks became the focus of the programme in two regions, i.e. South West Africa (Namibia, Angola and South Africa) and North West Africa (Senegal, The Gambia, Mauritania and Morocco).

Given the transboundary nature of many resources in these regions, fishery research and management required a regional approach and cooperation between nations.

The fourth phase saw the Programme transformed into the EAF-Nansen project which ran from 2007 to 2011. Following the FAO Committee on Fisheries endorsement of the ecosystem approach to fisheries as an appropriate framework for fisheries management, the combined experience of FAO and the IMR was harnessed to build capacity of developing countries to adopt and implement the new management approach. The phase continued to provide a platform for training scientists. However the breadth of equipment used had increased enormously to gather data in a range of ways.

Tore Strømme first became involved with the project as a research scientist aboard the vessel in the late 1970s. In addition to leading the scientific work he also developed the NanSis database that allowed electronic storage and analysis of the data collected by the vessel and thanks to which most of the data collected are today readily available. Since the early 1990s he was given full responsibility of the "Nansen Programme", to lead all aspects of research and capacity development until 2007 when the headquarters of the project was moved to FAO. He is now based in FAO and holds the position of IMR coordinator.

"It has been a long and challenging journey" he said. *"The programme began by seeking out new marine resources for developing countries. It now seeks to understand and protect what is there. The impact of climate change makes this information gathering even more vital as the project moves towards its new phase."*

>>*FISHERIES assessments made by the Nansen are the only recent evaluations in Cameroon. They have provided information on the status of key resources and also an indication of deep water resources not currently exploited.*

Dr Ousman Baba Malloum,
Former Director of Fisheries, Cameroon

>>*THE PROJECT has helped us better understand the oceanographic processes in our region, identify new fisheries resources and build capacity in the conduct of fisheries surveys including data collection and survey methods.*

Mr Daroomalingum Mauree,
Director of Fisheries, Mauritius

Recalling his time on the R/V *Dr Fridtjof Nansen* Kwame Koranteng, Coordinator of the EAF-Nansen project, said:

>>*MY FIRST EXPOSURE to the Nansen programme and in particular the work of the vessel and the data analysis component was when I participated in a trawl and acoustic surveys training course in Morocco in 1980.*

>>*The knowledge that I acquired from the training helped me to reorganize the trawl survey programme of the Marine Fisheries Research Division of the Ghana Fisheries Department.*

THIS PAGE *R/V* Dr Fridtjof Nansen *(1994).*

FACING PAGE *The Scientific Team on the 2012 CCLME Survey.*

AWARD WINNING PROGRAMME

H.R.H. Crown Princess Victoria of Sweden presenting award to Norad DG Poul Engberg-Pedersen.

In July 2007, IMR and Norad were jointly awarded the coveted Swedish Seafood Award Kungsfenan. This was in recognition of the Nansen Programme's contribution over many years to sustainable fisheries.

The award was established to inspire the world in areas of research, innovation, technology and fishery-related entrepreneurship. Special recognition was given to two major players who contributed to this success, i.e. Kirsten Bjoru, Senior Fisheries Advisor in Norad, for her contribution from the development perspective and Tore Strømme who had lead the scientific activities of the programme.

KUNGSFENAN
THE SWEDISH SEAFOOD AWARD

THE **BENGUELA** STORY

THE BENGUELA CURRENT LARGE MARINE ECOSYSTEM (BCLME) SPANS SOME 30 DEGREES OF LATITUDE, EXTENDING FROM ANGOLA'S CABINDA PROVINCE IN THE NORTH, TO JUST EAST OF PORT ELIZABETH IN SOUTH AFRICA. IT IS ONE OF THE RICHEST MARINE ECOSYSTEMS ON EARTH, SUPPORTING AN ABUNDANCE OF LIFE.

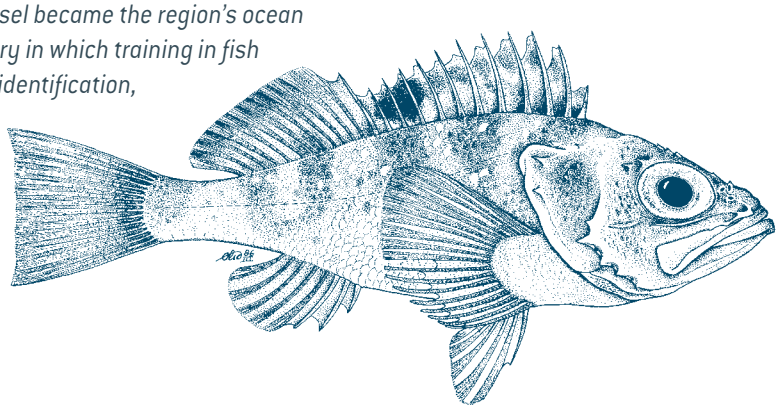
For the three countries bordering the Current, Namibia, Angola and South Africa, it makes a vital contribution both economically and socially. Fishing is the second biggest sector in Namibia's economy and Angola's third biggest. South Africa is less reliant but it is still a hugely important component.

The intervention of the R/V *Dr Fridtjof Nansen* in better understanding the Benguela Current came at a crucial time in the history of these three countries. All were going through periods of political upheaval which eventually saw Namibia achieve independence; Angola end a decades-long civil war and South Africa consign apartheid to history.

Michael O'Toole, then the Chief Technical Advisor of the BCLME project, said: *"The vessel became the region's ocean laboratory in which training in fish species identification, quantitative acoustic assessment, mapping and environmental monitoring was undertaken throughout the Benguela Current ecosystem under the direction of the IMR."*

In 1985, the Nansen carried out 18 months of surveys off Angola's coast. These provided important information on the marine environment and its resources. This was later complemented by specific studies on the effects of oil exploration and exploitation activities on the seas.

Five years later, the ship was the first research vessel to carry out surveys of fisheries resources off independent Namibia. Its findings proved crucial in allowing the fledgling government to set sustainable catch allowances both for its own fleet and foreign ships.



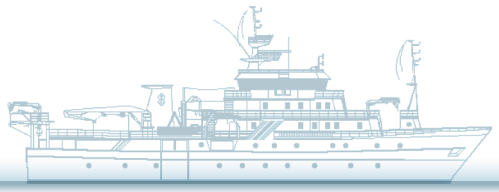
In 1994, the new Nansen vessel offered an even better platform to help local scientists develop their skills. They were trained in fish identification, the use of acoustic measurements, mapping and environmental monitoring. It helped build up a picture of the Current's variations in temperature, salinity, oxygen and chlorophyll.

Understanding the Benguela Current and managing its resources required a regional collaborative approach. Therefore in 1997 the Benguela Environment Fisheries Interaction and Training Programme (BENEFIT) was launched. With support from a number of international partners, including FAO, BENEFIT aimed to better understand the fluctuating marine resources, develop the capacity of local scientists and provide system-wide data and information.

This success in capacity building was demonstrated in 2000 when Namibia took over the research in its waters. Using the skills nurtured aboard the Nansen, it was able to carry out its own surveys on its own vessel.

Broadly, the pressures faced by the world's oceans are exploitation, climate change and pollution. The seas are often over-exploited both by long-distance as well as local fishing fleets often competing unfairly with small scale fishing operators.

In an effort to better understand and manage the marine areas, these have been organized into Large Marine Ecosystems (LMEs). These are highly productive areas which produce 95 percent of the global marine fishery catch. However, research indicates that a high percentage of fish stocks within LMEs are overexploited. The management and monitoring of these is carried out through a variety of collaborative projects which involve representatives from governments and other stakeholders.



BENEFIT was followed by the BCLME Programme which began in 2002. Its objective was to improve the capacities of Namibia, Angola and South Africa to deal with the environmental problems that occur across national boundaries and manage them in a coordinated way.

By funding and supporting dozens of projects, this programme was able to construct a comprehensive picture of the Benguela ecosystem. The Nansen has continued to provide data that scientists could use for policy advice. For instance, a reliable time series of stock distribution and status has been built and maintained.

Subsequently, Angola, Namibia and South Africa have implemented legislation and improvements in management practices to guarantee the future sustainability of fisheries and the associated environment of the Benguela ecosystem.

Increasingly that work has involved looking more closely at the possible impacts of climate change, that could, for example result in the changing frequency of events such as the so-called Benguela Nino.

The Nansen continues to provide a proven platform for research and support. The fruits of its work can be seen in the way these countries share expertise and resources to better manage the incredible resources of the Benguela Current.

>> *THE VESSEL has become a symbol for the sustainable development of fisheries in almost all coastal countries along the African continent,*

said Dr Hashali Hamukuaya, Executive Secretary of the Benguela Current Commission and chair of the African LME Caucus.

Tore Strømme, one of R/V *Dr Fridtjof Nansen*'s chief scientists throughout the history of the Nansen Programme and one of the initiators of the BENEFIT programme, said:

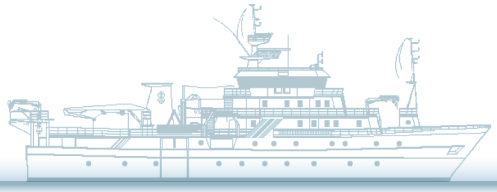
>> *FISH do not respect national borders, hence it is necessary to conduct research and sustainable management to the scale of the region to account for the highly migratory stocks, especially off West Africa. Regional collaboration is essential to understand the dynamics of marine ecosystems and for improved resources management. The Nansen Programme, utilizing the R/V* Dr Fridtjof Nansen *as a research platform, contributed to laying the ground for regional collaboration in the Benguela region. The data collected as a result of the BENEFIT collaboration constitute a data mine for future studies on ecosystem dynamics and climate change.*

THIS PAGE *Senegalese scientist Fambaye Ngom sorting catch.*

FACING PAGE *Above: Norwegian crew member Charles Voldsund attending to the net. Below: Helicolenus dactylopterus.*

The EAF-Nansen project works mainly in partnership with LME projects, particularly in the ecosystem surveys carried out by the R/V *Dr Fridtjof Nansen*.

Within each LME are huge range of local conditions that sees variations in temperature, salinity, primary production and other factors. These in turn affect the type and abundance of marine life which can change dramatically in short distances. The frontal zones, where these different environments meet, are often the most fertile as they involve an exchange of nutrients, that in turn are essential for marine life. The biological and oceanographic properties of the Canary Current make it one of the most productive globally.



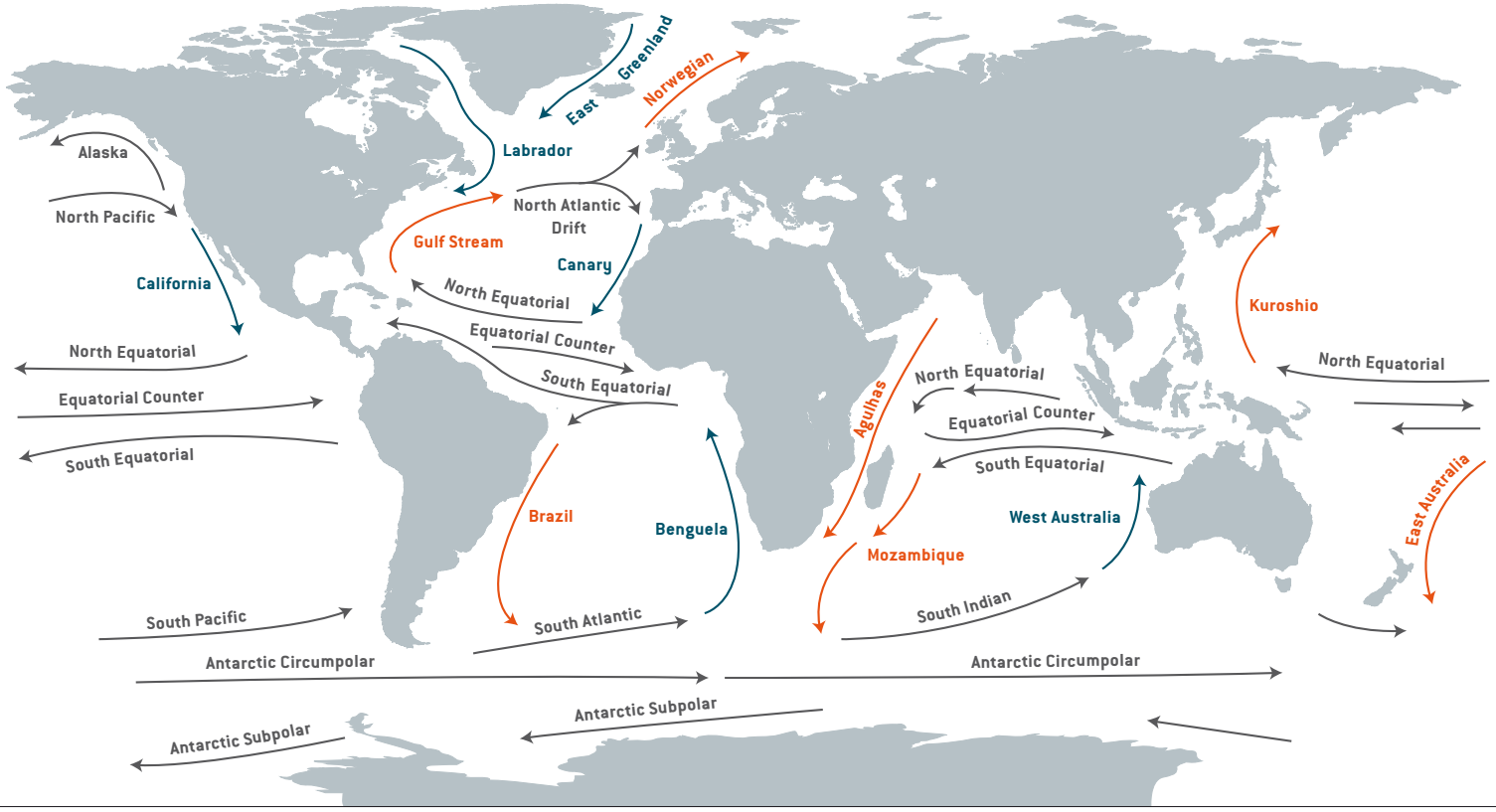
THE GREAT **PARTNERS**

THE LARGE MARINE ECOSYSTEMS (LMEs) IN SUB-SAHARAN AFRICA ARE THE CANARY CURRENT, THE GUINEA CURRENT, THE BENGUELA CURRENT, THE AGULHAS CURRENT AND THE SOMALI CURRENT.

The Canary Current area includes the maritime waters of Morocco, Mauritania, Cabo Verde, Senegal, The Gambia, Guinea and Guinea-Bissau.

The Guinea Current LME covers the waters of the 16 coastal countries between Guinea Bissau and Angola. Parts of the maritime waters of Guinea Bissau and Angola are also under the influence of the Canary current and Benguela current respectively. Angola, Namibia and South Africa (Atlantic side) are the three countries washed by the Benguela current.

The Agulhas and Somali Current Large Marine Ecosystems (ASCLME) include the maritime waters of all the countries in the eastern and the Horn of Africa as well as the island States located in the South West Indian Ocean.



OCEAN CURRENTS

WHAT MAKES THESE SEAS SO **FERTILE**?

THE WORLD'S OCEANS ARE CHARACTERIZED BY THE MOVEMENT OF LARGE AMOUNTS OF WATER. THESE CURRENTS ARE IMPORTANT IN THE DISPERSAL OF MANY LIFE FORMS, INCLUDING PLANKTON AND FISH AND ALSO CHEMICALS, OXYGEN AND CARBON DIOXIDE. CURRENTS CAN FLOW GREAT DISTANCES WHICH MEANS THE FISHERY RESOURCES ASSOCIATED WITH THEM MAY BE SHARED BY ALL THE COUNTRIES WHICH BORDER THEM.

Over the years, the R/V *Dr Fridtjof Nansen* has carried out surveys along much of the African coast and in particular has focused on the Canary and Benguela currents. These are two of the world's four most productive ecosystems. For instance the Canary Current Large Marine Ecosystem ranks third in the world in terms of primary productivity with two to three million tonnes of fish caught annually.

These currents are subject to intense upwelling, which is an oceanographic phenomenon through which dense, cooler, and usually nutrient-rich water is brought towards the surface, replacing the warmer, usually nutrient-depleted surface water. This results in high levels of primary productivity and thus fishery production.

Dr Ken Sherman of the United States' National Oceanic and Atmospheric Administration, who is the principal architect of the LME concept, has the following to say about the Nansen:

>> *THE R/V* DR FRIDTJOF NANSEN *assessment operations in Western Africa are critically important to the 26 countries engaged in moving toward recovery and sustainable development of LME fisheries.*

>> *The Nansen also provides crucial training opportunities for young scientists and technicians from developing nations engaged in carrying forward the LME fisheries and oceanographic assessments during a dynamic period of climate change.*

Above: Senegalese artisanal fishers hauling in their nets.

Organisms in the ocean are linked through predator-prey relationships that together form the so-called food web. A well-functioning marine ecosystem needs to maintain these relationships. Altering any of the components affects all the others and changes the way the ecosystem functions as a whole.

In the R/V *Dr Fridtjof Nansen* ecosystem surveys, observations take place above and below the water. The subject of investigations ranges from seabirds to fish and from whales to minute plants (phytoplankton) and animals (zooplankton). The data gathered allows a better knowledge of the marine organisms, helps monitor their relative abundance and contributes to a better understanding of their complex interactions. There may also be geographic specific concerns. For example off the coast of Angola and Ghana that has involved separate analysis of the impact of oil exploration.

THE **OCEAN FOOD WEB**

AN ECOSYSTEM IS A FUNCTIONAL UNIT CONSISTING OF A COLLECTION OF PLANTS, ANIMALS, MICRO-ORGANISMS AND NON-LIVING COMPONENTS OF THE ENVIRONMENT, AND THE INTERACTION BETWEEN THEM. THESE INDIVIDUAL PARTS INTERACT WITH ONE ANOTHER AND FORM A FUNCTIONAL WHOLE TO MAINTAIN ITSELF AND ITS INDIVIDUAL COMPONENTS IN WHAT IS CALLED A "TROPHIC PYRAMID".

In nature, these groups of organisms are interrelated in a predator-prey relationship. The interaction between the species forms the food web where large organisms eat smaller ones – each consuming organisms at a lower trophic level in order to gain energy. Sharks, whales and sea birds are apex predators while human beings are often at the top of the chain as super-predators.

A well-functioning marine ecosystem needs to maintain its structure, including the biomass of its component species at all levels. Altering any of the components of the functional unit (increasing, reducing, eliminating or introducing new parts) affects all the other components and changes the way the ecosystem functions as a whole. Understanding these interactions is extremely important because of the cascading effects of human activities such as fishing. These can be for example top down effects such as those that reduce the number and biomass of high trophic level species (birds, mammals and fish), or bottom up such as those generated by the exploitation of species that are low in the trophic pyramid such as krill or anchovies and sardines.

All components of the ecosystem and their role in maintaining the dynamic equilibrium of the system deserve to be better known. The surveys carried out by the R/V *Dr Fridtjof Nansen* are intended to contribute to this knowledge of the marine ecosystems.

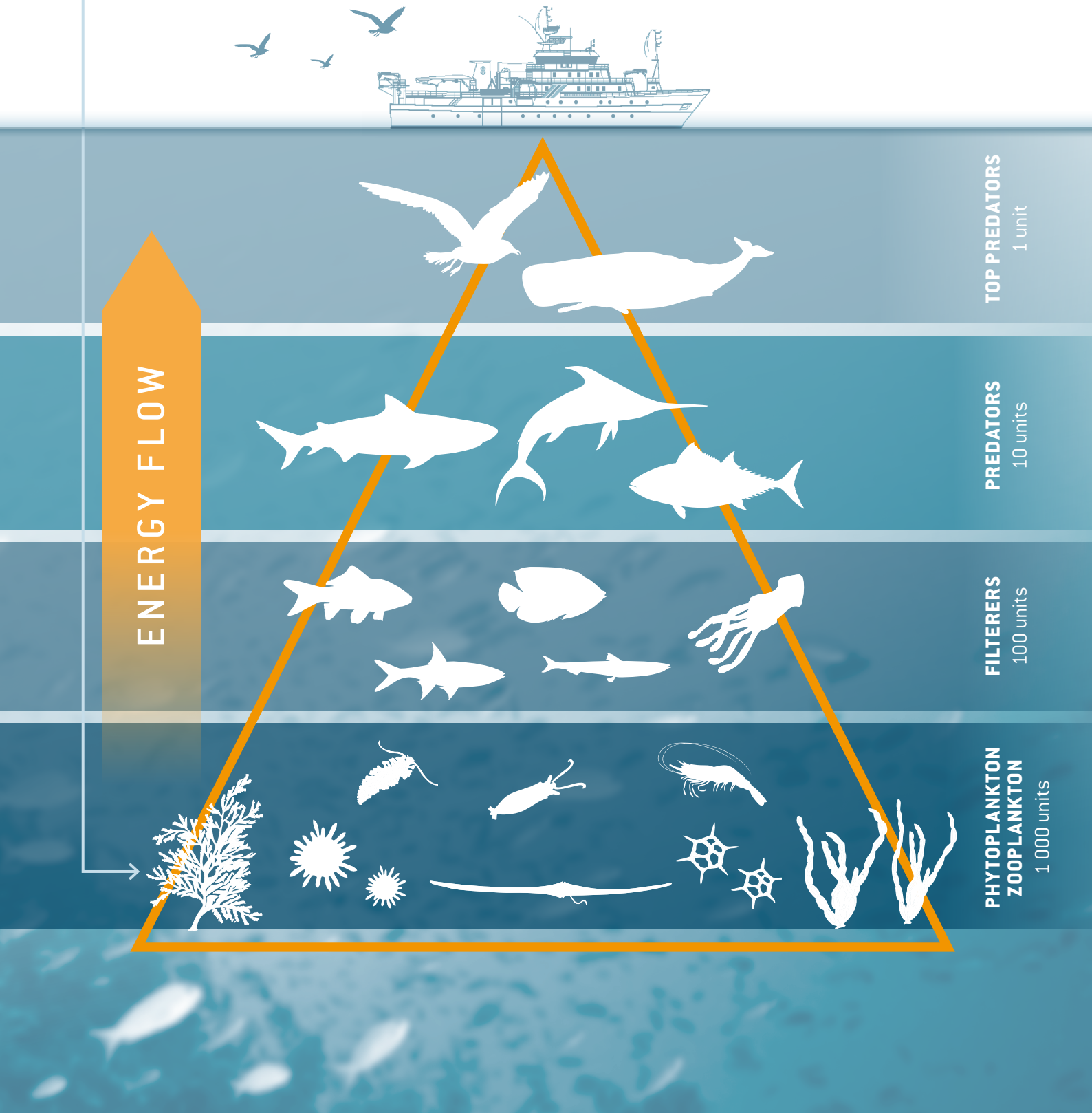
THIS PAGE *American scientist Tomio Iwamoto (left) and Norwegian scientist Oddgeir Alvheim (right) checking reference books to identify a catch.*

FACING PAGE *The ocean food web.*

Phytoplankton is the foundation of the food web (Trophic level 1) on which all other species rely. These microscopically small plants transform the energy of sunlight into organic matter through a process called photosynthesis. Zooplankton (microscopically small animals), small crustaceans, fish larvae and other marine organisms eat the plankton and algae and incorporate them in their own body mass as well as using the energy for movement and other life functions. Naturally, the relationships have positive impacts on most species and the groups have negative impacts on themselves because of the competition for food.

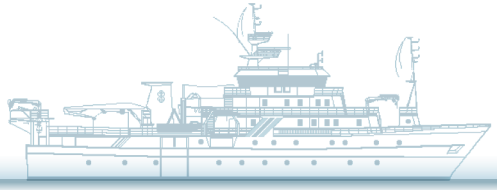
Only about 10 percent of the biomass (and therefore the energy) from one trophic level is 'transferred' to the next level because the metabolism of each organism requires a lot of energy. Much of the energy goes to sustain the body and its normal functions and only a small portion of the food intake gets transformed into growth in size and weight.

All other life functions, such as swimming, eating, or fleeing from predators require a lot of energy.



Every year, fishing nets accidentally kill some marine mammals as well as non-targeted fish species and some gears impact bottom habitats including corals and other sensitive ecosystems. Unregulated fishing leads to decline in resources and deprives the most vulnerable people of vital food and income.

Thus, the Nansen ecosystem surveys help scientists and policy-makers understand the different elements of the food web, chart the threats they face and suggest where action needs to be taken.



SOCIAL IMPACTS AND **SUSTAINABILITY** OF FISHERY RESOURCES

YOU ONLY HAVE TO LOOK AT A MAP TO SEE WHY FISHING IS SO CRUCIAL FOR MAURITANIA. MOST OF THE COUNTRY IS DESERT AND ITS FOOD SECURITY HAS BEEN THREATENED FURTHER BY AN ONGOING DROUGHT. THE FERTILE SEAS OFF ITS 700 KM-LONG COASTLINE OFFER AN IMPORTANT SOURCE OF PROTEIN AND INCOME. FISHING IS WORTH AROUND 7 PERCENT OF THE COUNTRY'S TOTAL GDP – TWICE THE PROPORTION OF THE EUROPEAN UNION (EU) OR SENEGAL, ITS LARGER FISHING NEIGHBOUR TO THE SOUTH. THIS VITAL MARITIME RESOURCE HAS LONG ATTRACTED TRAWLERS FROM ACROSS THE GLOBE LEADING TO OVER-EXPLOITATION. THE COMMUNICATIONS TEAM SPENT A DAY ASSESSING HOW THESE CHANGES MIGHT IMPACT ON PEOPLE IN MAURITANIA.

It has been more than an hour since they started and it will take the lines of young men several more to finish emptying the pirogues which have spent all day fishing.

We're on the edge of Mauritania's largest port of Nouadhibou and two pirogues lie at anchor. The men are wading out until they are waist deep. Each is clad in waterproof waders and carries a small flat cushion. From the vessel a carton of fish is handed to them. Balancing it on their heads, with the cushion to ease the weight, they head towards a metal fence which surrounds the city's most up to date fish factory. Waiting at the entrance to the factory's main hanger are large plastic bins into which the fish are tipped.

The factory is owned by Boughourbal Moulaye Abbasseand and has been operating for a decade. The factory was part funded through loans from the European Bank for Reconstruction and Development and the Organization of the Petroleum Exporting Countries (OPEC). The idea was to support an indigenous industry suffering because of foreign trawlers.

That industry is still in a delicate situation. The FAO's 2012 State of the World Fisheries and Aquaculture report says that in the Eastern Central Atlantic: *"43 percent of its assessed stocks [are] fully exploited, 53 percent overexploited and 4 percent non-fully exploited, a situation warranting attention for improvement in management."*

THIS PAGE *Artisanal landing beach in Mauritania.*

FACING PAGE *Above: Net maintenance. Below: Processing fish in Mauritania.*

It's not just over exploitation that affects the vital fishing economy. Environmental changes driven by global warming are altering the make-up of the seas leading to changes in species composition.

The evidence gathered by the R/V *Dr Fridtjof Nansen* helps Mauritania plan its fishing policies to ensure that factories such as this one in Nouadhibou can continue to operate sustainably and effectively.

Despite all the problems Mauritania has seen fish exports grow considerably with investment from China and Algeria in infrastructure as well as profitable licences sold to European fishing fleets. The price of fish oil, one of the products produced by Abbasse's company, Société d'élaboration des produits halieutiques, has increased by a third in the last year. He is now looking to expand and there are plans for a dozen factories like his.

Inside the warehouse the fish are deposited in a vat of water to clean them. From there they enter a conveyor belt system staffed by around 50 men and women. The fish drop down and are swiftly grabbed, inspected and placed into slots. A machine then chops the heads and tails off.

These discards are pumped outside to be turned into meal for agricultural use, particularly popular in Denmark, or exported as fish oil to Europe and North America. The latter will feed increasing consumer demand in developed countries, particularly for omega 3 tablets.

Back on the conveyor the fish continue to the packaging and freezing stages. These will be exported, mostly to Eastern Europe.

It is now gone 10pm and the fish factory is operating at full capacity. Aissa, 34, one of the factory workers started at 8pm and will work until 8am. For the past year she has worked this shift, six days a week.

"It is considered a good job," she said. *"I come from a village far from here so I live with others nearby and send my money back to the village. I have a young daughter who goes to school. She is looked after back home. I get to see her once a week."*

Aissa earns 50 000 ouguiyas (approximately 140 euros) a month. The factory provides medical care and sick pay. This is well above the country's minimum wage of 30 000 ouguiyas.

Overlooking the factory floor is a sign of the expansion of this indigenous fish processing plant. It's another hanger filled with new machinery. Once this new plant is ready, fish will be sucked straight from small trawlers berthed at a new jetty into an automated processor. It will mean more than half the people on the neighbouring conveyor along with men who wade out to the pirogues will be surplus to requirements. However other factories are planned and they'll need workers. Their success and the livelihoods of all who depend on the industry rest upon having fish to process – and for that the ecosystem surveys of the R/V *Dr Fridtjof Nansen* are fundamental to planning for the future.

The R/V *Dr Fridtjof Nansen* is one of the few vessels properly equipped and able to fully examine the interlocking currents within LMEs. Satellites offer a general picture at a large scale but can only see the thin top layer and it just takes a bit of cloud cover to render them unreliable.

The ship is equipped to provide a definitive picture of this complex and changing system. Since the vessel goes over certain areas time and again it is also one of the few ways scientists can build up a picture of how these zones are changing and thus give a health check on the maritime environment.

HOW THE NANSEN **MEASURES UP**

THE CURRENT R/V *DR FRIDTJOF NANSEN* IS THE SECOND SHIP OF THE INSTITUTE OF MARINE RESEARCH OF NORWAY TO BEAR THE NAME. THE FIRST WAS LAUNCHED IN 1974 AND SERVED FOR 19 YEARS.

At 47 meters long and with a crew of 26 it was around two-thirds the size of the current vessel. It was sold to a French diving firm hunting for sunken treasure before returning to Norway to carry out seismic surveys.

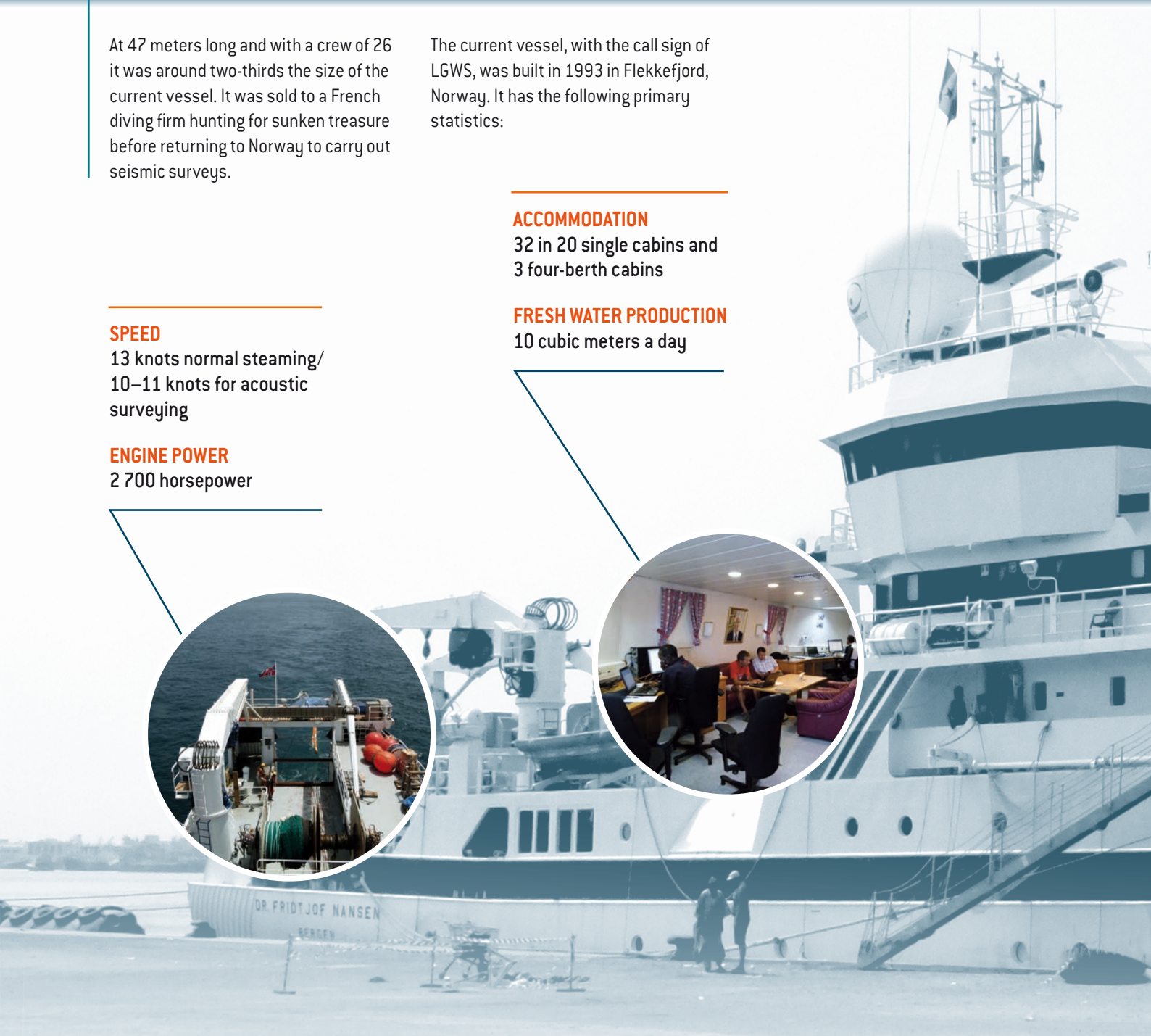
The current vessel, with the call sign of LGWS, was built in 1993 in Flekkefjord, Norway. It has the following primary statistics:

ACCOMMODATION
32 in 20 single cabins and 3 four-berth cabins

FRESH WATER PRODUCTION
10 cubic meters a day

SPEED
13 knots normal steaming/ 10–11 knots for acoustic surveying

ENGINE POWER
2 700 horsepower



Spanish scientist Susana Soto entering data in the NanSis Database.

Between 1993 and 2010 the Nansen sailed **603 986** nautical miles.

By 2012, the two vessels had sailed the equivalent of **60 times around the globe**, and worked **more than 10 000 transects in 60 countries** (Africa – 36, Central and South America – 13 and Asia – 11).

The CTD has been used nearly **22 000 times** on the present vessel.

LABORATORIES
fish wet, biological, environmental, and hydrographic

LENGTH 56.75 m

BREADTH 12.50 m

GROSS TONNAGE 1 440 tonnes

MAXIMUM DRAUGHT 6.9 m

FROM **HIGH-TECH** TO **TRIED** AND **TESTED METHODS**

EACH DAY AROUND 5GB OF DATA FROM A BATTERY OF EQUIPMENT FLOWS THROUGH A BANK OF SCREENS IN THE NANSEN'S INSTRUMENT CENTRE PROVIDING A SNAPSHOT OF THE STATE OF THE OCEAN.

- The ADCP consists of four acoustic beams that reflect off particles in the water. A computer triangulates on them and then compensates for the pitch and roll of the ship to provide a picture of the speed and direction of currents.
- An echo sounder with its transducer at the bottom of the boat provides a picture of the sea floor.
- The large trawl nets are released from a drum on the back of the boat to scoop up creatures at different depths.
- Orange boxes (SCANMAR trawl monitoring sensors) are attached to trawl nets, which transmit data on their geometry and sea conditions.
- The sledge is a steel rectangular box about 3 m long. It is dropped out the back of the boat and dragged along the sea bed to gather large quantities of sediment.
- A small metal tube swinging from the trawl chain scrapes a sample from the ocean floor.
- The sediment grab is a large metal scissor with buckets on either end to scoop up mud samples. One of the uses for these samples is to map the bottom fauna to document future changes caused by for instance pollution, global warming, industrial activity like mining or bottom trawling; another is to identify new species.

The R/V *Dr Fridtjof Nansen* collects its data through a series of carefully plotted line transects which run from the coastline to the edge of the continental shelf and beyond. It uses a mixture of advanced equipment and proven and appropriate standard methods.

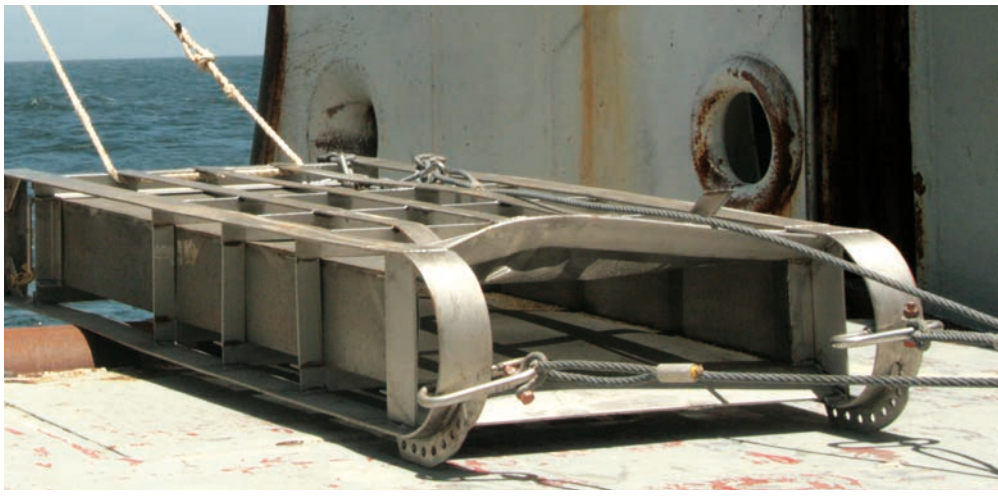
At the labour-intensive end of its work are the regular trawls and samples of marine life taken from the ocean floor. Scientists count and identify what they find. They are confronted with everything from plankton, visible only through a microscope, right up to sharks and whales and sometimes completely new species. A substantial amount of the work is done with pen and paper, good reference books and years of experience.

At the more advanced level probes are sent into the sea to get readings on its temperature, salinity and other aspects.

- The multi net is a plankton collector with five nets ending in flasks. It can sample at selected depths and provide information on zooplankton, fish eggs and larvae. This is crucial to identify spawning and nursery areas.
- The CTD is 1.5 m high and looks like a cotton reel with five cylinders to collect water. It has an electronic brain that continuously gathers information on water properties, including temperature, oxygen, salinity and fluorescence. It is crucial for assessing the state of the environment that fish live in.

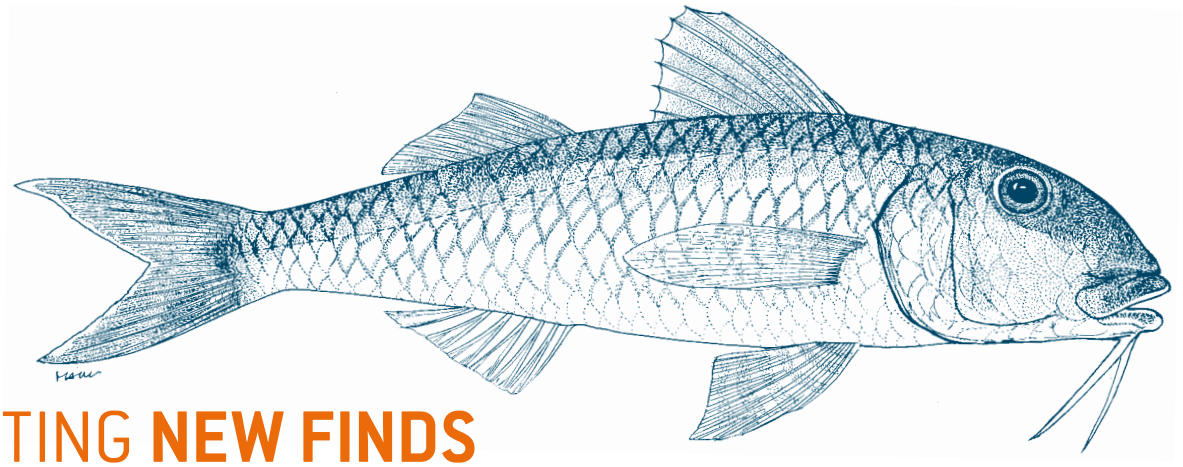
NOT FORGETTING...

Despite the impressive computing power on the boat, traditional pen and paper still have their place. A lot of records are made initially by hand before being entered into electronic databases. It is common to see the scientists flicking through reference books trying to identify particularly difficult species. A huge number of photographs are taken of individual finds.



THIS PAGE *Above: Angolan scientist Stianete Fernanda Arcanjo da Cunha Antonio working with the CTD. Below: Sledge on deck.*

FACING PAGE *Above: Spanish scientist Susana Soto (left) and Norwegian scientist Bjørn Krafft (right) entering data. Below: Trawl nets (left) – scanmar sensors (centre) – survey samples (right).*



NETTING **NEW FINDS**

IT IS NOT UNCOMMON FOR THE R/V *DR FRIDTJOF NANSEN* TO ENCOUNTER NEW SPECIES – ALBEIT OFTEN WITH LITTLE POTENTIAL FOR FISHERIES DEVELOPMENT.

The comprehensive nature of the surveys conducted in areas which have not previously been fully charted have inevitably led to new discoveries. These have included new fish species and benthic organisms off South America, Africa and in the Indian Ocean.

Parupeneus nansen (of the family Mullidae– Goatfishes) is a newly discovered species named after the famous Norwegian explorer, scientist and statesman Dr Fridtjof Nansen whose name the research vessel bears. It was found off the coast of Mozambique in 2007. At barely 20 cm, and bearing the traditional 'goatee', experts aboard quickly realised it was an original find from the Mullidae family. Another find off Mozambique, a species of the family Labridae is yet to be described and named.

As part of an investigation into the benthic fauna of the Gulf of Guinea, six new marine snails of the genus *Turbonilla* were seen from material collected during a cruise in July 2005. The species were later named as *Turbonilla krakstadi*, *T. anselmopenasi*, *T. iseborae*, *T. korantengi* and *T. alvheimi* and also *Kongsrudia rolani* under the new genus *Kongsrudia* (Zootaxa 2657:1 – 17).

Further analysis of mud samples from the same region has recently revealed a number of new species of worms (Polychaeta). It is believed that many more invertebrate species may be described once experts have identified all the animals extracted from the sediments samples collected from North West Africa and the Gulf of Guinea.

The experts using this equipment come from across the world. Working alongside them are scientists from the countries being surveyed. While some are experienced, for others it will be their first time. They can be on board for anything from ten days to six weeks. During that time they will develop skills to conduct surveys and use equipment. These are all skills which can then be transferred back to their home country.

GULF OF GUINEA EXPERIENCE

IN 1981 THE R/V *DR FRIDTJOF NANSEN* CARRIED OUT ITS FIRST SURVEY IN THE GULF OF GUINEA – AN AREA ENCOMPASSING THE MARITIME WATERS OF CÔTE D'IVOIRE, GHANA, TOGO AND BENIN ON THE ATLANTIC COAST OF AFRICA. IT WAS AT THE PEAK OF THE TRIGGERFISH (***Balistes capriscus***) BOOM IN THE AREA WITH TREMENDOUS CATCH RATES. WHEN THE VESSEL RETURNED TO THE REGION EIGHT YEARS LATER, A VERY DIFFERENT SITUATION PREVAILED.

The triggerfish biomass had declined and only few specimens were caught. The fishery developed for the species had collapsed with enormous socio-economic consequences, especially in Ghana.

The situation called for investigation and a scientific explanation. In subsequent years, the vessel carried out several surveys in the region and contributed data and information to help unravel the mystery.

Acknowledging the contribution of the R/V *Dr Fridtjof Nansen* to knowledge of the Gulf of Guinea resources, Kwame Koranteng, Coordinator of the EAF-Nansen project, said: *"When I started working on my PhD after the apparent disappearance of the triggerfish, the Nansen database became the primary source of data and knowledge.*

"This comprehensive study became a major input into the management of fisheries at a time that Ghana was implementing the World Bank-assisted Fisheries Sub-sector Capacity Building project. Decisions on fishing licence allocation were also based on the results of this work and other factors."

From its inception, the Gulf of Guinea Large Marine Ecosystem project benefitted from data and information emanating from the Nansen surveys in the sub-region. The expanded project (the Guinea Current Large Marine Ecosystem Project) was the first to benefit from the ecosystem demonstration surveys carried out by the Nansen and co-financed by the EAF-Nansen project.

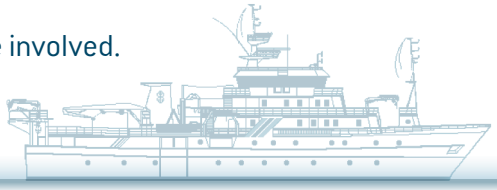
THIS PAGE *Norwegian crew member Thor Egil Johansson processing a CTD cast in the Instrument room.*

FACING PAGE *Above: Parupeneus nansen. Below: American scientist Tomio Iwamoto sorting fish.*

An idea of the range of people who work on the Nansen can be gauged by looking at just one survey trip off North West Africa.

Vito Melo from Cabo Verde was documenting plankton which is vital because they are at the base of the food chain and a good health indicator for the sea. Guinean scientist Raymond Koivogui was gathering samples scraped from the ocean floor to extract tiny sea creatures. In the laboratory Ana Martos and Susanna Soto from Spain are cataloguing molluscs. These will be shipped ashore for further analysis. Taxonomist Tomio Iwamoto will take back what he has learned to the Californian Academy of Sciences in San Francisco. Peruvian-based Koen van Waerabeck was carrying out ground-breaking research on the movement of humpback whales. Englishman Paul Robinson was charting the migratory patterns of birds.

Over the next pages read about some of the people involved.



BRINGING **EXPERTISE** TO CABO VERDE

AS WITH OTHER COUNTRIES BORDERING THE CANARY CURRENT LARGE MARINE ECOSYSTEM (CCLME), CABO VERDE HAS BOTH A TREMENDOUS RESOURCE ON ITS DOORSTEP BUT ONE THAT IS ALSO UNDER THREAT FROM EXPLOITATION AND CLIMATE CHANGE. FOR THIS SMALL ARCHIPELAGO, FISHING FORMS AN EVEN MORE VITAL PART OF ITS ECONOMY THAN FOR SOME OF ITS NEIGHBOURS.

Vito Melo is a scientist from Cabo Verde's National Institute for Fishery Development. On his latest assignment aboard the R/V *Dr Fridtjof Nansen* one of his responsibilities was the multi net plankton collector. Vito puts the water samples through filtration processes to extract even more minute living material. All are carefully labelled, treated and then sent away for further analysis. The plankton is important because it is at the base of the food chain.

Vito said: *"Within the fishery system in Cabo Verde there are the research, management and audit branches and we are the research branch. We are responsible for all the scientific information given to the management personnel to allow them an overview of the fisheries.*

"I work in biological oceanography, that is everything related to hydrology, the physical and biological factors, zooplankton and phytoplankton, chemical factors, nutrients, etc. Studying these factors gives us an understanding of the state of our ecosystem.

"The work of the CCLME project and the R/V Dr Fridtjof Nansen *are very important because of the ecosystem approach. On this survey the information collected is not only about fish but all the elements which make up the marine ecosystem. We need this to better understand the system as a whole.*

"Through collaboration with local scientists and with those on board the Nansen we are able to fill the gaps in our knowledge. That's the reason why there are people from each of the CCLME countries on board. We can help each other. It is one of the most important objectives of this initiative."

THE OPPORTUNITY TO **BUILD STRONG WORKING RELATIONSHIPS**

RAYMOND KOIVOGUI FROM GUINEA, WORKED AT THE NATIONAL CENTRE OF SUPERVISION AND FISHERIES PROTECTION BEFORE TRANSFERRING TO THE NATIONAL CENTRE FOR FISHERIES SCIENCES IN BOUSSOURA AS A RESEARCHER.

He has experience working on board the Centre's R/V *General Lansana Conte*. His job on the Nansen involved collecting invertebrate samples.

"Invertebrates are bio-indicators that help to measure the state of sea life," he explained. *"When collecting them, we need to make sure that our samples are kept in a very good condition."*

"It was very interesting working with the other researchers and I was pleased to get the opportunity to build strong working relationships with some experts and hopefully we could remain in touch."

"I am sure that when the researchers abroad analyze what I have sent to their laboratories they will find many new organisms not discovered until now. For example, there were earth-worms found only in Mauritania and not seen anywhere else."

"When I go back to Guinea after the survey, I will be able to use the procedures that I have learned on the Nansen aboard the General Lansana Conte. Hopefully I could carry on similar fundamental research into the state of fisheries of the Republic of Guinea."

THIS PAGE *Guinean scientist Raymond Koivogui sorting micro-organisms in sediment.*

FACING PAGE *Norwegian scientist Oddgeir Alvheim (left) and Cabo Verdean scientist Vito Melo (right) exchanging ideas.*

KEEPING AN **EYE ON THE SKIES**

ENGLISHMAN PAUL ROBINSON HAS BEEN BASED IN DAKAR, SENEGAL, FOR 18 MONTHS, AND TAKEN TWO TRIPS ON THE R/V *DR FRIDTJOF NANSEN* AS THE GUEST ORNITHOLOGIST.

"We are adding small pieces of knowledge simply because there are not many ornithologists able to spend this much time on the West African coast," he said.

Paul spends from 9am to 5pm sharing a viewing platform high above the boat with a whale watcher. Both slowly scan different sectors and make regular notes. The information is inputted into a database and then made available as part of the general research trip report.

Among the regular visitors to the ship are Wilson's Storm Petrels, known locally as Sea Swallows. Various terns dive into the sea while Sabine Gulls and Pomeranian Skuas circle.

Paul points out Cabo Verde Shearwaters which are specific to those islands some 500 miles north of our current position. Supposedly they shouldn't be seen this far out.

Paul said: *"Until last year the presence of Cabo Verde Shearwaters so far south was thought unusual. But sightings from this boat as well as tagging by ornithologists at Cabo Verde show the birds range far more widely than thought. This thousand-mile round trip now seems a regular pattern. At around 400–500 birds this probably represents 1 percent of the total population – which makes it a statistically significant figure."*

It is possible that the birds are attracted by the trawlers, feeding off discards. Although their long flight might also be evidence of the impact of human activity.

Another sign of birds interacting with humans is clear from the immature Gannet gliding above us. It has a piece of net stuck in its bill. Gannets are long-winged seabirds that range widely. While sightings of birds with netting are increasingly common off Africa it is not so much the case in Scotland or Brittany in France where they live. It is possible that the netting causes more of the young to die because they can't feed properly and therefore fewer make it back to their home territories.

TRACKING THE **GIANTS OF THE DEEP**

IT WAS ONLY THE SECOND DAY OF KOEN VAN WAERABECK'S WORK ON BOARD THE R/V *DR FRIDTJOF NANSEN* WHEN HE SPOTTED THE HUMPBACK WHALES. IT WAS A SIGHTING WHOSE RIPPLES ARE STILL BEING FELT.

Koen, a Belgium-born expert in cetaceans, had asked the Canary Current LME project if he could join a survey to carry out research.

The seas off West Africa have not been thoroughly surveyed for whales and dolphins, though there was anecdotal evidence from fishermen of lots of activity in the area.

Koen, who is based in Chile, spotted the whales off the coast of Senegal. It wasn't just once, but 21 separate sightings of different groups. This was clearly no accidental encounter.

Humpback whales generally feed in cold waters, building up valuable layers of blubber and then moving to warmer climates to breed. The whales Koen spotted included young ones which, from their size, must have been born close to where they were sighted.

It was thought that whales in the south don't travel as far north as Senegal. However the timing of Koen's sighting, as well as the presence of young, meant that this must have been whales that winter in the Antarctic. All the scientific literature said that there should not be whales in this area. Yet, here they were.

Koen has now written a paper on his findings that is being discussed widely within the scientific community.

For Koen it demonstrates the value of incorporating different elements into the Nansen surveys. It leads to a more rounded picture of the marine ecosystem. He has also trained West African scientists to carry on the work. Abdoulaye Djiba from Senegal is one such scientist and has done several cruises on his own on the R/V *Dr Fridtjof Nansen*.

Sampling along a line-transect allows a rigorous and comprehensive examination of cetacean activity in a certain area. It requires careful use of a GPS, visual sightings and regular notation. It has to be perfected at sea and can't be taught effectively in the classroom. The ship is an excellent platform to introduce and perfect these methods.

And it is one that Djiba is putting into practice and is already providing new data for marine scientists.

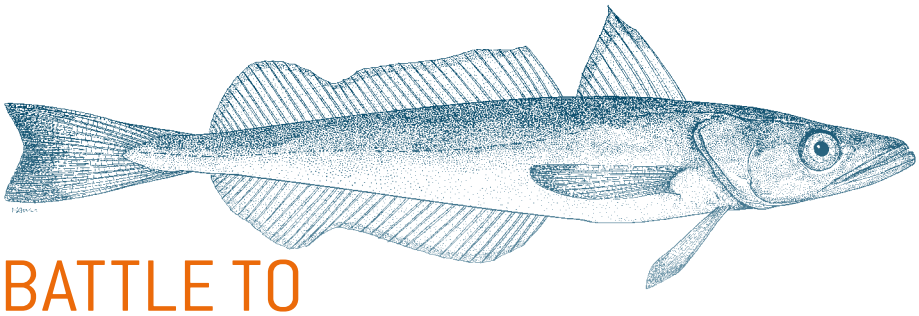
WHALE SPOTTING

Looking for whales and dolphins requires patience and a good pair of binoculars. On board the R/V *Dr Fridtjof Nansen*, Djiba sits 35 metres up on a viewing platform above the wheelhouse. It offers a 360 degree view, though with little respite from the sun and wind during his dawn to dusk shift. Djiba uses a 7 x 50 pair of binoculars because that gives him the widest possible angle to view. The 7 is the magnification produced, while the 50 is the width of the lens in millimetres.

He also has a GPS, so he knows exactly where the sighting takes place, and the old-fashioned pencil and clipboard to make regular notes on conditions and activity.

THIS PAGE *Senegalese observer Abdoulaye Djiba whale watching.*

FACING PAGE *Above: Gannet.*
Below: British observer Paul Robinson (left) and Senegalese observer Abdoulaye Djiba (right).



WINNING THE BATTLE TO **SAVE THE HAKE** IN NAMIBIAN WATERS

WHEN NAMIBIA ACHIEVED INDEPENDENCE IN 1990 THE EYES OF THE WORLD WERE ON THE POLITICAL PROCESS. HOWEVER A VALUABLE TASK WAS QUIETLY UNDERWAY WITH THE CONSENT OF THE FIRST GOVERNMENT OF AN INDEPENDENT NAMIBIA. THE R/V *DR FRIDTJOF NANSEN* WAS SURVEYING NAMIBIA'S FISHERIES RESOURCES TO PROVIDE THE DATA FOR A THOROUGH AND URGENTLY NEEDED STOCK ASSESSMENT.

Namibia's highly productive marine waters had for many years attracted the fishing fleets of many nations as there was no internationally recognized exclusive economic zone. In effect, the fishery was a free-for-all. 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 and the deep-water hake.

Between 1965, when the hake fishery began, and 1989, the last year before independence, the declared total cumulative hake catch according to the International Commission for the Southeast Atlantic Fisheries (ICSEAF) was 10 664 600 tonnes, valued at 1996 prices as approximately US$15 084 million. Of this Namibia got virtually nothing.

Realizing the importance of Namibia's marine resources for the country's future economic development, the Norwegian Government offered to have the R/V *Dr Fridtjof Nansen* undertake an extensive resource survey of Namibia's waters to establish the state of its fish stocks.

The total declared hake catch had grown rapidly from the 47 600 tonnes in 1964, to the 815 000 tonnes in 1972, the highest hake catch ever declared in Namibian waters. ICSEAF collected data, but there was no monitoring of catches and they largely failed to regulate the fisheries. 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 ICSEAF. Based on the R/V *Dr Fridtjof Nansen* survey data, in 1990 the fishable hake biomass was estimated at 130 000 tonnes 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.

The Namibian Government announced a hake TAC of 60 000 tonnes for 1991, 85 percent of which was to be reserved for existing concessionaires and leaving 9 000 tonnes. The affected foreign fishing nations disputed

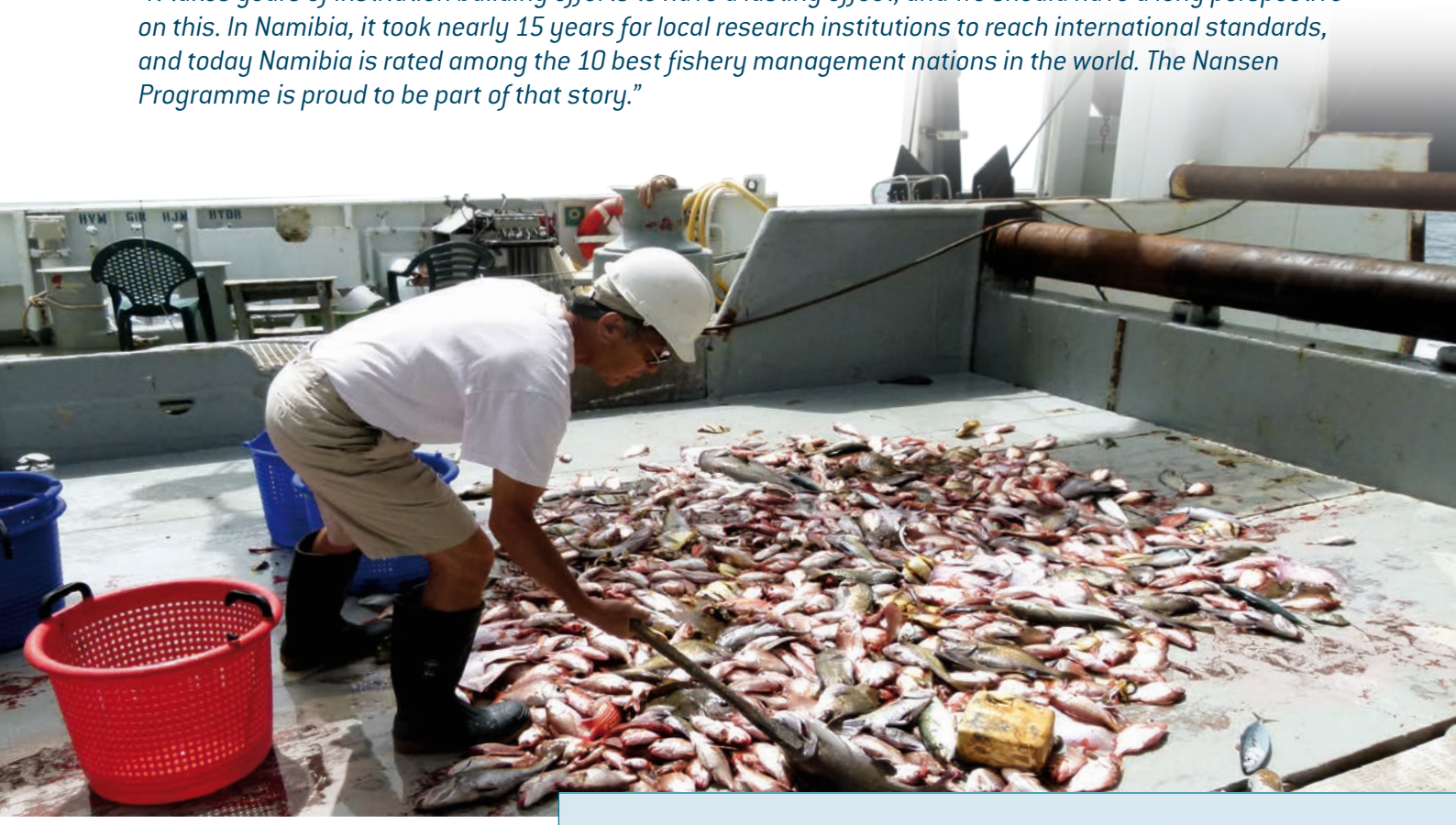
THIS PAGE *Above: Merluccius paradoxus. Below: Namibian sea cadet Lukas Shikongo operating the CTD.*

FACING PAGE *Above: American scientist Tomio Iwamoto sorting fish. Below: Namibian sea cadet Lukas Shikongo.*

Tore Strømme, who has decades of experience working with the Nansen programme, explains: *"A typical survey with R/V* Dr Fridtjof Nansen *will last from two to six weeks and then the report is finalized in the following three months. It is a fundamental part of the project that all data collected belong to the partner countries and that the report shall serve the countries' management needs."*

"Governments then take independent management action on the survey results. This can be a long process in itself and the swifter the science team is able to complete its work the better placed governments are to utilize the findings."

"It takes years of institution building efforts to have a lasting effect, and we should have a long perspective on this. In Namibia, it took nearly 15 years for local research institutions to reach international standards, and today Namibia is rated among the 10 best fishery management nations in the world. The Nansen Programme is proud to be part of that story."



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 valuable stock surveys conducted by the R/V *Dr Fridtjof Nansen*.

Without this intervention at such a critical point, Namibia might well have faced a complete collapse of its hake stocks.

LIVING THE **DREAM**

The partnership between the Nansen Programme and Namibia continues with Namibian Sea Cadets serving aboard the research vessel for up to 18 months to gain valuable experience.

Lukas Shikongo is one such cadet. He serves with the crew working in a small team of three carrying out the same duties. Cadets are chosen for their aptitude and are closely monitored through their training.

When Lukas leaves the ship he'll do another six months at a maritime school in Namibia learning navigation.

"Then I will be ready to get a job on a Namibian vessel and hopefully be on the fast track to promotion," he said. *"I want to be able to make first mate as soon as possible."*

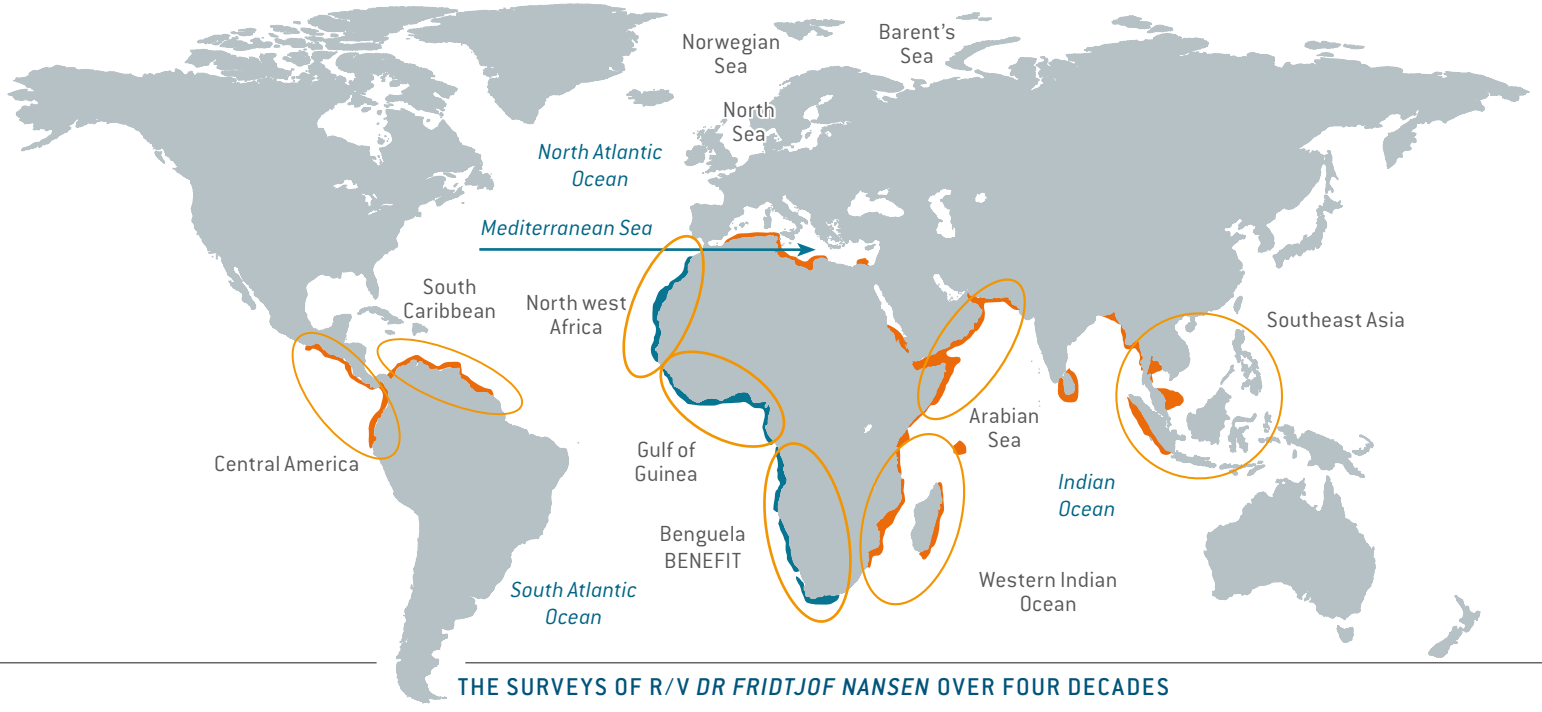
PIONEERING RESEARCH

THE FAO'S EAF-NANSEN PROJECT HAS HELPED NINE COUNTRIES IN THE WESTERN INDIAN OCEAN TO TAKE THEIR FIRST COMPREHENSIVE STEPS TOWARDS IMPLEMENTING ECOSYSTEM-BASED MANAGEMENT OF THEIR MARINE RESOURCES.

In partnership with three Global Environment Facility (GEF)-funded projects, the UNDP implemented Agulhas and Somali Current Large Marine Ecosystems (ASCLME) Project, the World Bank implemented South West Indian Ocean Fisheries Project (SWIOFP) and the IUCN implemented Seamounts Project, the R/V *Dr Fritdjof Nansen* has enabled comprehensive ecosystem-level surveys of much of the Western Indian Ocean (WIO).

The WIO region is considered to be poorly understood by researchers. Besides its importance to the well-being of the inhabitants of the region, the WIO's position as a key part of the global thermohaline circulation makes a full and detailed understanding of its oceanography vital. This will help gain an understanding on issues such as the extent and rate of climate change and associated ecosystem variability.

Surveys included measurements of currents, monitoring of sea surface temperature and salinity, multibeam bathymetry, multinet and bongo net tows for phytoplankton and zooplankton, bottom and mid-water trawls and acoustic surveys to establish fisheries potential and status of marine biodiversity.



THE SURVEYS OF R/V *DR FRIDTJOF NANSEN* OVER FOUR DECADES

Highlights of this work include:

- Documenting the oceanography of a Mozambique channel eddy, in concert with another vessel simultaneously examining the fisheries aspects and importance to seabirds. Increasing evidence points to these eddies not only being the dominant oceanographic features in terms of water movement, but also of extreme importance to the biological productivity and possibly genetic inter-connectedness throughout the channel.
- A pioneering survey of the Mascarene Plateau which indicates that terrain-induced upwelling may be responsible for increased fisheries productivity in the area and may lead to the discovery of new species.
- Surveys of most of the Madagascar coastline including pioneering studies of the poorly understood East Madagascar Current and eddies to the southwest.
- A comprehensive survey of the Comoros gyre to help understand the source region for the Mozambique Channel eddies.
- A comprehensive survey around Mauritius, which allows a greater understanding of the interactions of small islands with the surrounding ocean.
- Pioneering survey of five seamounts and the subtropical convergence zone of the South West Indian Ocean Ridge.

Countries in the region generally lack ocean-going research vessels, and most lack the equipment needed to undertake surveys, particularly with regard to more modern methods.

In addition to critical shortages in infrastructure to implement the ecosystem approach to fisheries, most nations lack the human capacity to undertake such surveys. The presence of the R/V *Dr Fridtjof Nansen*, along with its comprehensive capacity building and training programmes, allows the region to build a trained cadre of researchers with the knowledge and skills, and perhaps most importantly, practical experience, to undertake surveys.

Nearly 200 regional researchers and technicians eventually took part in the surveys.

One limitation on the comprehensive surveys in the region has been the incidence of piracy in the northern part which has made it impossible to conduct surveys in that area.

Despite this the R/V *Dr Fridtjof Nansen* surveys have revealed that this previously poorly studied region is scientifically intriguing and deserving of ongoing research efforts. They have also demonstrated the value of the ecosystem approach.

The legacy of this work will be an ecosystem-based approach to management of the region's marine and coastal resources through the adoption of a Strategic Action Programme by the countries of the region.

Above: Norwegian crew member Stein Johansen on bridge.

THIS PAGE *Mauritanian scientist Jemal Ould Abed (left) and Senegalese scientist Abdoulaye Sarre (right) sorting catch.*

Actions to protect and stabilise other resources like the sardine and sardinella off West Africa could take as long as Namibia needed to restore its hake population. At the same time there is evidence that other pressures such as pollution from land-based activities and oil exploitation, and global warming are already having an impact on the oceans.

The observations by scientists aboard the vessel are confirmed by the United Nations Development Programme in their 2012 publication *Frontline Observations on Climate Change and the Sustainability of Large Marine Ecosystem*. It says: "*In northwest Africa, stocks of sardines and mackerel in the Canary Current LME are moving from traditional fishing areas in Senegal northward towards cooler waters off the coast of Mauritania*."

The importance of the ship's work is emphasised by Mor Sylla, a senior technician with Senegal's Centre for Oceanographic Research. Sylla has more than 20 years experience studying the seas off West Africa and a long association with the R/V *Dr Fridtjof Nansen*.

ANCIENT TRADE **UNDER THREAT**

FOR THE ARTISANAL FISHERS OF SENEGAL THE TRADITIONAL FISHING CRAFT IS THE CANOE – ALSO REFERRED TO AS PIROGUE.

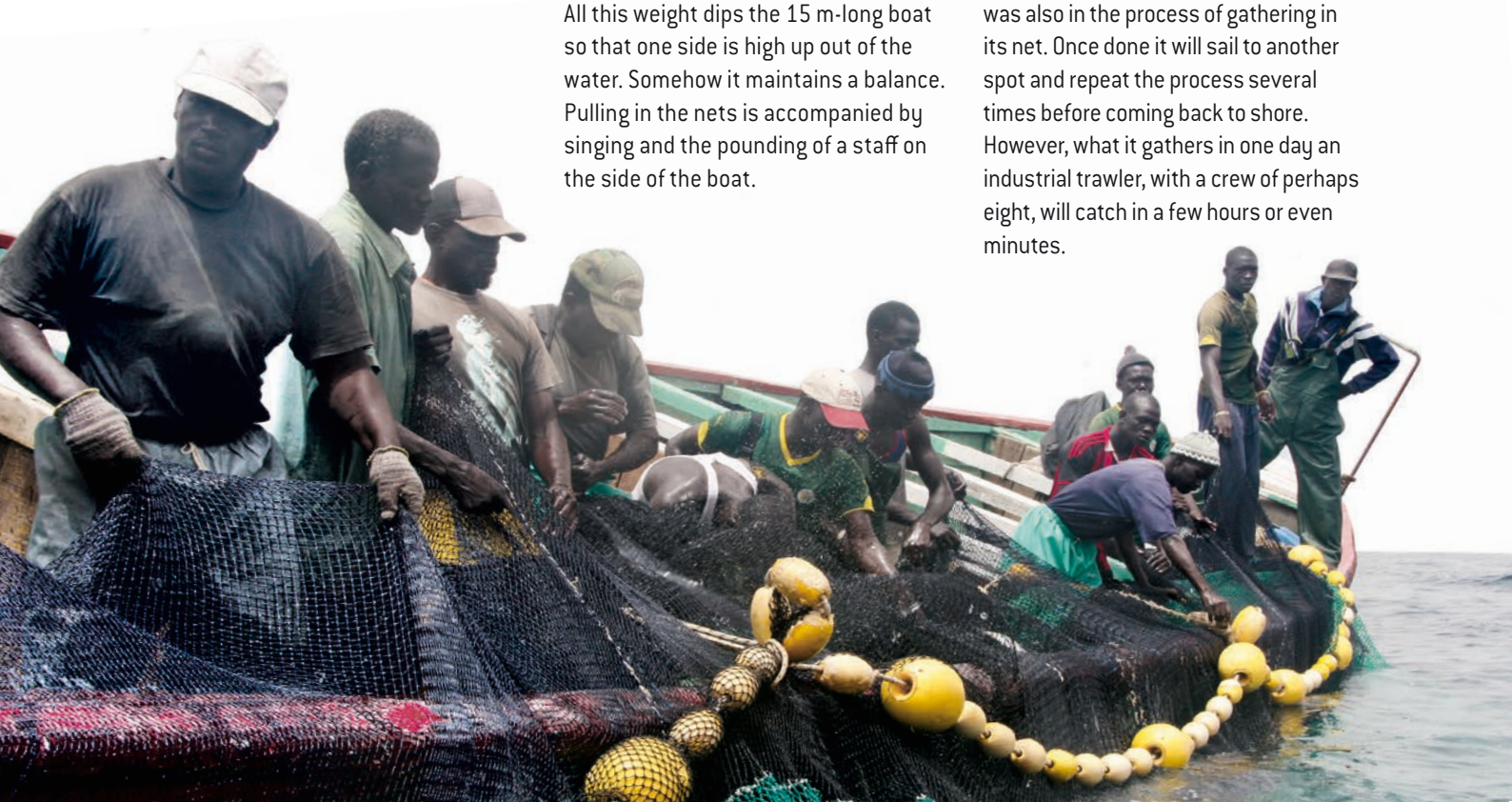
The vessels vary in size, and therefore crew numbers, but they're generally round-bottomed and some carry a basic two-stroke outboard engine on the back. They'll be piloted as far as is safe and necessary and that can be well out of sight of land. There are no GPS or distress flares on board. This is hard and sometimes dangerous work but also one vital to the local economy and to feeding people onshore.

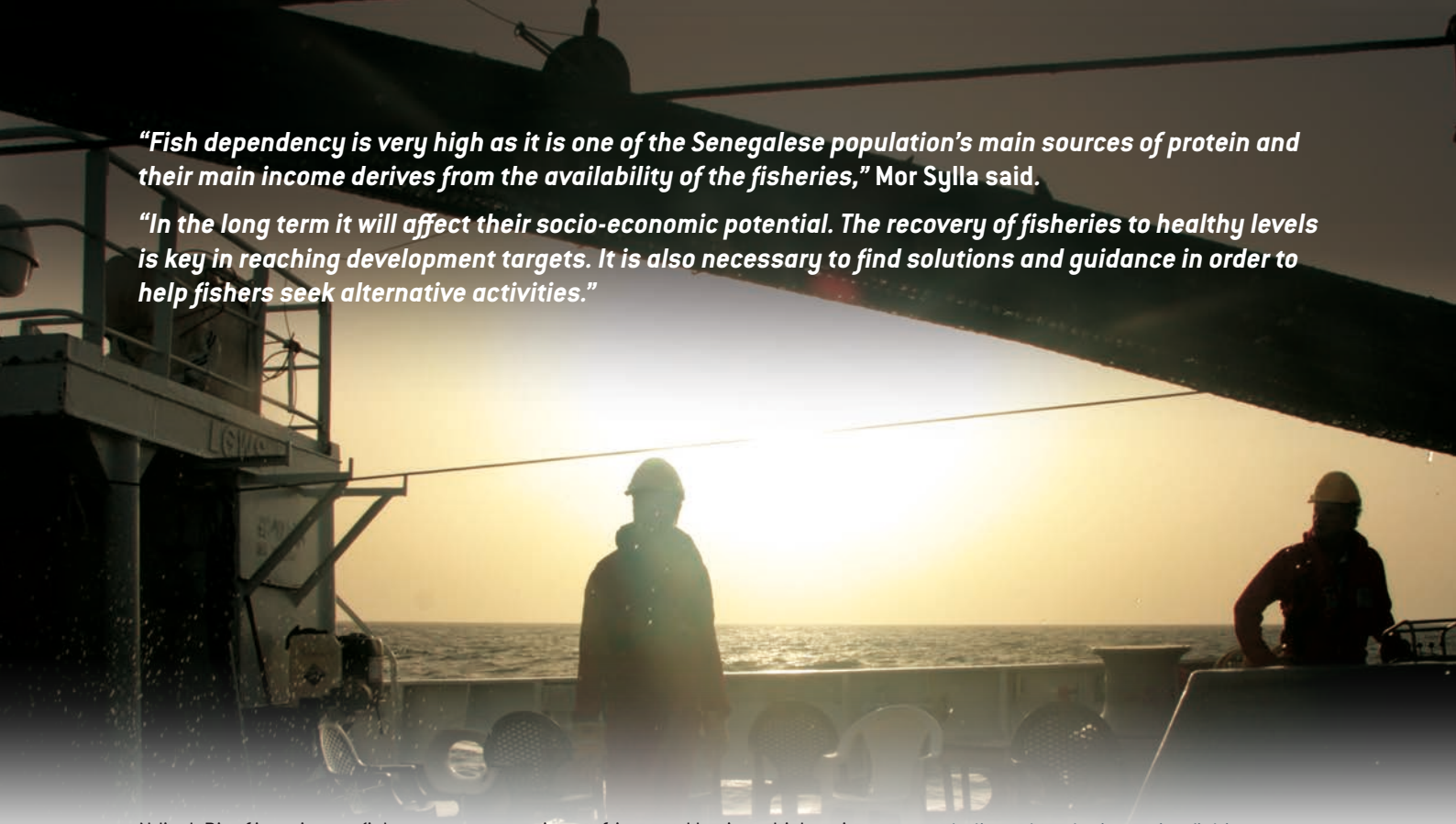
It took us two hours sailing after we left the beach at Mbour in Senegal to reach an area where pirogues had come to fish. Our mission was to follow their operation and assess the fruits of their labour.

The crew we observed cast an encircling net in a wide arc out from the pirogue and slowly hauled it in. It means most of the 30 people on board are at one side straining at the ropes. All this weight dips the 15 m-long boat so that one side is high up out of the water. Somehow it maintains a balance. Pulling in the nets is accompanied by singing and the pounding of a staff on the side of the boat.

The net is spread over about 100 square meters and it takes about an hour before you realize that all the effort has had any effect. Then the bottom of the net comes over the lip of the boat and the final stage is completed relatively quickly. The water boils with fish as the bulging net is pulled over the side. Most of the catch is sardines.

Less than a mile away another pirogue was also in the process of gathering in its net. Once done it will sail to another spot and repeat the process several times before coming back to shore. However, what it gathers in one day an industrial trawler, with a crew of perhaps eight, will catch in a few hours or even minutes.





***"Fish dependency is very high as it is one of the Senegalese population's main sources of protein and their main income derives from the availability of the fisheries,"* Mor Sylla said.**

"In the long term it will affect their socio-economic potential. The recovery of fisheries to healthy levels is key in reaching development targets. It is also necessary to find solutions and guidance in order to help fishers seek alternative activities."

Ndiack Diouf is a pirogue fisherman – a trade the 24-year-old has had all his life. He points out that it isn't just capacity which gives industrial trawlers an advantage.

"From June to August or during the rainy season months, the weather is very bad with too much rain and winds. The sea becomes so rough that it isn't always possible to go fishing as usual," he explains. Indeed he says there are some seasonal changes that now appear permanent with warming seas making traditional grounds less productive. *"We have to go elsewhere in search of fish,"* he says. *"There is a lot of competition."*

Ndiack is one of an estimated 120 000 people employed in the Senegalese fishing industry. His is one of more than 9 000 motorised canoes fishing in Senegalese marine waters.

Once the haul from Ndiack's boat is landed some will feed his family and his fellow crew members with the rest sold on. The catch needs to be preserved quickly. So as soon as it is landed it is sorted, crated up and put into refrigerated lorries which wait on the edge of the beach. Some fish will be sold locally while others may be exported. Around two-thirds of fish caught by the Senegalese serves the domestic market.

It's not the only way fish are preserved. A few miles along the coast Anta Diouf is standing in the middle of a large field where fish are being cured on fires. Closer to the beach, piles of sardines have been salted. Anta is in charge of this cooperative which is mostly made up of women. It's a cheaper way of preserving fish and offers another way for the community to profit from its marine resources.

But Anta fears this option may not last forever.

"We are concerned about the scarcity of fish, especially for processing locally," she said. *"Year by year we unfortunately see fish become increasingly rare and fishing difficult.*

"Initially, we thought that the situation was due to the growing demand by the local people. We now believe that the intensive fishing practices by the fishermen in deep sea and also the kind of agreements the Senegalese government authorities have made with some foreign fishing companies are the true causes.

"There has been a growth in the number of canoes and fishers. We have also learned that the change in climate also has an impact; but we believe that it is mainly due to intensive fishing."

The scientific data supplied by the R/V *Dr Fridtjof Nansen* has a direct impact on both Ndiack and Anta. The evidence on fish stocks allows catch quotas to be set and enforcement of these quotas on larger foreign fleets. The focus on identifying the impact of climate change offers opportunities to protect an industry upon which tens of thousands depend for their livelihood.

THIS PAGE *Crewmen on watch.*

FACING PAGE *Fisherman off the Senegalese coast.*

Birane Sambe, Coordinator of the CCLME Project, said: "*We are dealing with living resources that are renewable if we manage them properly. This could benefit the present and future generations. Consequently the scientific research and appropriate management of resources is crucial.*"

What is now urgently required are more efficient research platforms; more scientists sharing their knowledge and a closer interaction between science and LME management.

"*While the communications team looked in detail at the work in North West Africa, the Nansen programme has an impact at a global level. That impact is felt at an economic, environmental and political level. It is also clear the work of the EAF-Nansen Project is, and will continue to be, felt at a very personal level. Strong cross-cultural friendships and alliances have been forged,*" said Kwame Koranteng, Coordinator of the EAF-Nansen project.

Those alliances are not just for today, but will continue to flourish for tomorrow and into the future.

SENEGAL: THE *ITAF DEME*

MOORED IN A MILITARY HARBOUR IN DAKAR IS SENEGAL'S FISHERIES AND OCEANOGRAPHIC RESEARCH VESSEL – THE *ITAF DEME*. FROM ITS REAR MOUNTED DRUMS CONTAINING TRAWL NETS TO ITS WET LABS AND SONAR ROOM THE BOAT MIMICS THE DESIGN OF THE R/V *DR FRIDTJOF NANSEN*.

Senegalese scientists have been working on the Nansen since the 1990s and so, when Japan donated a research vessel in 2002, the Senegalese used the lessons learned to kit out their new ship. And they continue to draw upon it as a resource, from using the same software to getting guidance on improving its equipment.

Abdullaye Sarre is one of the longest-serving Senegalese scientists.

"The contribution of the Nansen programme is not limited to only training of staff for the acoustic surveys," he explained. *"There are other types of contribution for example; the Itaf Deme has had to confront a problem with the pelagic trawl. At that stage FAO sent some experts to work with the crew to improve the performance."*

The *Itaf Deme* is 36 meters long and has a crew of 14 personnel and eight scientists.

It was named after a Senegalese scientist who tragically died in a car crash.

In keeping with the regional cooperation which is a hallmark of the Nansen project, the Itaf Deme doesn't just serve Senegal but has conducted surveys for Sierra Leone, Guinea and The Gambia.

Sarre said: *"It is important to highlight that these are shared resources, in particular in the case of pelagic resources. This monitoring cannot be done individually at country level but should be done at a regional level.*

"Consequently this has been done in agreement with scientists of the subregion, particularly for acoustic assessments. In the subregion there is a planning group that organizes meetings for scientists from Morocco, Mauritania, The Gambia, Senegal and in recent years Guinea. The group is facilitated by FAO with support from the EAF-Nansen project."

WAITING WITH **BATED BREATH**

"THE EAF-NANSEN PROJECT IS ENTERING A NEW PHASE – AND THE STAKES COULD NOT BE HIGHER. IT IS INCREASINGLY CLEAR THAT WE ARE LIVING THROUGH A PERIOD IN WHICH ECOSYSTEMS ARE BEING DEGRADED AND BIODIVERSITY IS BEING LOST AT RATES NOT SEEN IN HUMAN HISTORY," SAYS EAF-NANSEN PROJECT COORDINATOR KWAME KORANTENG.

The FAO Committee on Fisheries has made mitigation of the effects of climate change a priority – and that means having proper data. Several developed countries have dedicated research programmes in place to monitor various oceanographic aspects, using satellites, research vessels, buoys and other means. However these programmes rarely fully cover ocean areas adjacent to developing countries.

Further, the specific impact that climate change will have on the production of tropical and sub-tropical upwelling systems, areas of regular field work by the R/V *Dr Fridtjof Nansen*, is particularly unclear. Some researchers have predicted that climate change will cause large-scale redistribution of fish catch potential, with a considerable reduction in the tropics, and several species may face extinction.

The decades of surveys the R/V *Dr Fridtjof Nansen* has undertaken have built up a unique and comprehensive body of evidence. Therefore it is ideally placed to set baselines and identify indicators to monitor climate change.

Tore Strømme, the Research Coordinator of the EAF-Nansen project, said: *"The new challenge is to continuously improve the link between fisheries research and environment research so that we can respond better and faster to climate change.*

"By documenting the present state of the marine ecosystem as a reference for later change the EAF-Nansen project can give important support to developing nations for the climate change challenges ahead. This next phase is a unique opportunity that will gather vital data for the next 20 years or more."

It is clear that a multidisciplinary and collaborative approach is required to understand the science and the R/V *Dr Fridtjof Nansen* is well placed as platform for cooperation among the UN and other agencies. The vessel could also serve the needs of developing countries and regional partners for monitoring the state of the marine ecosystem. This would ensure that climate change issues in developing countries are fully considered.

Getting this right so that scientists can confidently predict the impact of climate change and effectively advise policy-makers will affect the lives of millions of people. But action is required now.

Just in time, Norway has stepped in and allocated around US$ 80 million to procure a new research vessel to replace the current Nansen. Work has already started and the new ship should be in place by 2016.

>> *CÔTE D'IVOIRE needs urgent help on developing and adopting a National Programme of Action of Adaptation to Climate Change in marine fisheries.*

Mr Helguilè Shep,
Director of Fisheries and Aquaculture, Côte d'Ivoire

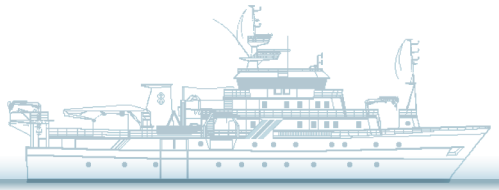
>> *TOGO is adopting policy instruments and institutional, technological and agricultural advice to adapt to climate change and reduce, or at least stabilize, the concentration of greenhouse gases in the atmosphere. Research is needed to fill gaps in current knowledge and reduce uncertainties in projections to improve the capacity of the state's decision making related to climate change.*

Dr Ali Domtani,
Director, Department of Fisheries and Aquaculture, Togo

THIS PAGE *Norwegian crew member Charles Voldsund.*

FACING PAGE *The Senegalese research vessel* Itaf Deme *moored in Dakar.*

PHOTO CREDITS



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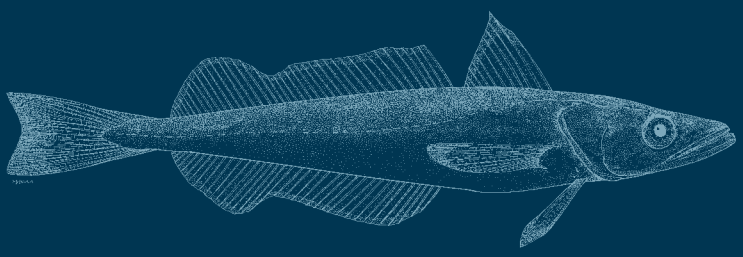
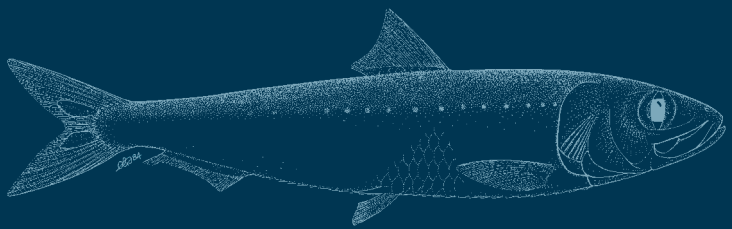
And with grateful thanks to everyone who has worked on board the R/V Dr Fridtjof Nansen.

Above: Spanish scientists Ana Ramos Martos (left) and Susana Soto (middle) with Mauritanian scientist Jemal Ould Abed (right) sorting catch.



Please take the time to watch this 19 minute film 'Sounding the Oceans' produced by Antonello Proto for the EAF-Nansen project after a two week expedition aboard the R/V *Dr Fridtjof Nansen*.

There is the option to watch in English or French – choose your preferred language from the initial menu.



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