Namibia's Marine Environment

BY MICK O’TOOLE

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The waters off the Namibian coast are unusually cold for the latitude but support some of the greatest concentrations of marine life found anywhere in the world. This high level of biological productivity is the result of seasonal south to southeast winds which induce upwelling at the coast, making available an abundant supply of nutrients in the upper layers. These nutrients together with sunlight promote extensive blooms of phytoplankton, rich resources of zooplankton and an abundance of pelagic fish such as pilchard, anchovy and juvenile horse mackerel. These fish shoals in turn provide food for large populations of higher predators such as seals, dolphins and seabirds. Further offshore over the continental shelf, large stocks of hake inhabit the

While most of Namibia's 1400 km long coastline consists of sandy beaches, rocky areas such as the Bogenfels arch are a feature of the south. Bogenfels is a typical sea arch formed by strong wave action over millions of years.
Fishing boats anchored off Lüderitz form part of the Namibian fleet. Fish stocks were plundered by foreign vessels during the 1960s and 1970s, but recent conservation measures and the declaration of a 200 mile exclusive economic zone are allowing for the gradual recovery of most species.

Deeper waters near the seabed and the adult horse mackerel form large shoals in the midwater layers.

THE BENGUELA CURRENT

The Benguela Current forms the eastern boundary of the south Atlantic intercontinental gyre. It sweeps northwards within 150 km of the west coast, bringing cold Antarctic water into warmer subtropical regions. It flows in a northwesterly direction along the west coast of southern Africa and roughly follows the isobaths or contours of the seabed. North of Walvis Bay the current flow moves offshore away from the coast. A southward undercurrent reportedly flows at deeper levels on the continental slope and also nearer the coast at depths greater than 30 metres. The speed of the Benguela Current varies between 10 and 30 cm per second depending on the location off the coast, wind velocity and direction, and the time of year.

During the upwelling process, surface water is transported in an offshore direction by a combination of the effects of the prevailing equatorward winds and the rotation of the earth (Coriolis Force). This is compensated for by the movement of deeper cooler bottom water into the upper layers at the coast. The rate and intensity of upwelling fluctuates with seasonal variations in wind patterns. Bottom topography and the seaward extent of the continental shelf also influences the upwelling process with high energy areas being found where the shelf is narrowest and the wind strongest. The most intense and important upwelling region off the Namibian coast is located in the south near Lüderitz. There are smaller less intense upwelling cells at Cape Fria, Pelgrave Point and Conception Bay. Typical surface temperatures and salinity values in coastal upwelling areas such as off Lüderitz range from 11° to 14°C and 34.8 to 35.2 parts per thousand respectively. The marine environment off Namibia and the dynamics of the Benguela Current are controlled by seasonal changes in the south Atlantic high-pressure system. Southerly winds which blow off Namibia throughout the year are strongest in winter and spring. In the Lüderitz area, these winds are strongest in spring and summer, whereas at Cape Fria, they tend to be most intense in spring and autumn. Hot, dry “berg winds” (mountain winds from the east or the north in autumn and winter) also influence the marine environment by suppressing local upwelling and occasionally transporting large quantities of dust and sand far out to sea.

In summer and autumn, the southerly winds relax off central and northern Namibia and upwelling becomes weak. The warm and more saline Angolan Current moves south and mixes with the cooler water of the Benguela Current leading to stable stratified
conditions over the continental shelf. The surface water temperatures rise to between 17°C and 22°C and salinities are usually within the range of 35.5 to 35.9 parts per thousand. These frontal areas where the two currents mix have high plankton production and are important spawning and nursery grounds for pelagic fish.

SULPHUR ERUPTIONS AND LOW OXYGEN CONDITIONS

During the summer and winter months frequent sulphur eruptions occur in inshore waters, especially in the region between Cape Cross and Conception Bay. Many visitors to the coast during such eruptions return with tales of rock lobster and other animals literally walking out of the sea. Fish mortalities often result and the sea takes on a lime green colour. Such eruptions are accompanied by a characteristic pungent smell along the coast. The release of hydrogen sulphide gases are caused when high levels of plankton production decay leading to a depletion of oxygen in the seabed sediment and in the near bottom water. This process results in the accumulation of mud with little or no marine life but rich in organic and sulphur content.

COASTAL HABITATS

For most of its length the Namib coast is exposed and open to buffeting from waves by the Atlantic ocean. The few rocky outcrops and intertidal reefs that characterise the coast are covered by seaweeds and marine animals such as limpets, black mussels and sea anemones. Areas of sheltered coast formed by rocky promontories and sandspits occur only at Lüderitz, Sandwich Harbour and Walvis Bay. The relatively tranquil waters provide a rich haven for microscopic flora and many small aquatic animals, especially snails and worms. Although these bays cover less than 30 square kilometres of coast, they serve as important feeding areas for thousands of wading birds, mostly migrants.

One of the rarest seabirds along the Namib coast is the Damara Tern. These birds breed in colonies which are sometimes located up to eight kilometres inland so as to avoid beach patrolling predators such as brown hyaena and black-backed jackal. Once thought to number less than 4 000 birds, recent surveys conducted by the Ministry of Environment and Tourism indicate that more than 10 000 birds inhabit the coastline. During the breeding season, these birds are easily seen on the gravel plains and salt pans where they nest well apart from each other in small, scattered colonies. Only one chick is raised each year. Parents carry food from the sea to the nests far inland. Indiscriminate off-road driving has crushed many eggs and chicks. In some cases, disturbance has resulted in entire colonies being abandoned. Other wildlife species seen most often along the coast are Cape fur seals, with the biggest breeding colony at Cape Cross, Jackass Penguins, Cape Cormorants, gannets and a variety of terns.

COMMERCIAL FISHERIES

At present, fishing is one of the cornerstones of the Namibian economy. The industry was expected to have earned nearly N$1.5 billion in 1994. With the development of local companies and the processing of fish onshore, some optimists predict that the fishing industry could contribute N$2 billion to the economy by the year 2000 and provide up to 15 000 jobs.

Besides pelagic fish, the coastal and continental shelf waters off Namibia are also rich in demersal species such as hake, monkfish, and kingklip. Rock lobster are exploited in the inshore waters around Lüderitz and red crab are
fished in deep water along the northern part of the continental shelf. Since Independence there have been important developments in line fishing for large hake and long-fin tuna off the northern coast. A small seasonal ski-boat fishery for snoek, cob, steenbras, dassie and barbel is based at Swakopmund.

At one time, Namibia had one of the richest pelagic fish resources in the world but over-exploitation by the South African inshore pelagic fleet in the late 1960s and early 1970s led to a decline in the pilchard resources. At the same time, the abundant deep sea resource of hake was almost depleted by intense fishing activities by foreign fleets, mainly from Spain, the former Soviet Union and the eastern block countries.

After Independence in 1990, a 200 mile exclusive economic zone was declared within which fishing by foreign trawlers is prohibited except under licence to Namibian companies. A new Ministry of Fisheries and Marine Resources was created in 1991 to take over resource management and regulatory responsibilities. The status of fish stocks are now routinely assessed and monitored by research vessels, with much assistance being provided by NORAD through the “Dr Fridtjof Nansen Programme”.

ANOMALIES IN THE MARINE ENVIRONMENT

The marine environment undergoes constant change through regional and local variations in wind patterns, upwelling intensity and water circulation. These changes directly affect temperatures, nutrient availability and plankton production, which in turn markedly influence fish distribution, spawning and future growth.

The effects of the warm water events known as the Pacific El-Nino on the anchovy fishery off Peru and Chile during 1972/73 and 1983/84 have been well documented. These warm water intrusions led to a depletion of nutrients and phytoplankton in the upper layers and a collapse of the anchovy stocks. Similar, but less intense occurrences have been recorded in the past in the northern Benguela off Namibia during 1934, 1963, 1973/74 and 1984, when warm tropical water from Angola pushed further southward than usual to reach Walvis Bay. These extreme events, the most recent of which occurred in summer/autumn 1995, are characterised by a relaxation of equator wind stress, higher sea level rises, suppression of effects of upwelling and strong thermal gradients in the water column. As a result, marked reductions in phytoplankton production usually occur, followed by a decreased spawning intensity of pelagic fish with less food available for developing larvae.

Studies have suggested strong links between the Pacific El-Nino and regional climatology, oceanography, rainfall and crop yields around southern Africa. There is an apparent time lag of one year between the occurrence of
of the Pacific event and effects around southern Africa. Such connections, although poorly understood, may provide a useful mechanism for future forecasting of such environmental anomalies and predicting fish spawning success and recruitment.

**MONITORING MARINE ENVIRONMENT**

Basic monitoring of the marine environment involves the routine collection of information on the temperature, salinity, oxygen and nutrients such as phosphates, nitrates and silicates. The seasonal movements and interactions of cold and warm water off the coast of Namibia also need to be studied. Such oceanographic surveys are routinely carried out by research vessels of the Ministry of Fisheries and Marine Resources which are equipped with modern oceanographic instruments and recording devices. The speed and direction of surface currents are also measured by releasing buoys and tracking by the Argos satellite. This work is being sponsored by the Namibian National Petroleum Corporation (NAMCOR) and undertaken by the Council for Scientific and Industrial Research (CSIR) in South Africa with the assistance of the Ministry of Fisheries and Marine Resources. The results of these investigations have important applications in oil spill contingency planning, establishing migration patterns of fish, and mapping the dispersal of fish eggs and larvae from spawning to nursery grounds.

Satellite remote sensing has important implications for fisheries management and the understanding of ocean processes taking place off the coast. The fishing industry uses information from satellites to locate favourable temperature regimes along ocean frontal systems where tuna concentrate to feed. Areas of high plankton primary productivity can also be detected by satellite imagery through changes in ocean colour. Such regions are likely to be favourable grounds for pilchard and anchovy shoals to aggregate. A new satellite to be launched by NASA later this year (SeaWiFS) will measure phyttoplankton concentrations more accurately and provide higher sensitivity to detect chlorophyll pigments and scattering material in the surface layers.

Since the upwelling processes taking place off the Namibian coast are amongst the most intense in the world, the information collected by satellites is of great interest to both Namibian scientists and the international scientific community. A satellite receiving station and image processor was recently donated by the British Overseas Development Agency (ODA) to the National Marine Information and Research Centre (NAMIRC) at Swakopmund. This equipment has been very useful in monitoring recent anomalous changes taking place in the marine environment and in studying the interactions between oceanographic processes and fisheries.

The marine ecosystem, like any other, is sensitive to change. Industrial activities can detrimentally affect the environment through oil pollution, dumping of waste, release of toxic substances or disruption of the water chemistry. As the search for offshore diamonds, oil, gas and other substances increases, so does the risk of environmental degradation. To prevent this, Namibia has made provision in the Petroleum Exploration and Production Act of 1991, that registered license holders conduct environmental impact assessments. License holders have to prepare a detailed oil spill contingency plan. The national environmental assessment policy drawn up by the Ministry of Environment and Tourism also regulates aspects of environmental protection and planning. Although the companies fund the assessments, the Ministry can, at the cost of the licensees, appoint an independent reviewer to test or monitor the assessment. Comprehensive environmental assessments have already been done by some companies. The German Technical Cooperation Agency (GTZ) through the Marenpro programme is currently assisting the Ministry of Fisheries and Marine Resources with various aspects of environmental monitoring particularly in relation to the potential impacts of diamond mining on rock lobster stocks in the Lüderitz area. The results of such assistance will enable future changes in the coastal marine environment to be monitored more effectively and models to be tested as commercial developments of these resources proceed.

### Physical Volume of Catches (tonnes)

<table>
<thead>
<tr>
<th>Period</th>
<th>Purse-seine net fishing</th>
<th>Trawling and other coastal fishing</th>
<th>Line fishing</th>
<th>Ring-and-bow net fishing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horse Mackarel</td>
<td>Other</td>
<td>Total</td>
<td>Horse Mackarel</td>
</tr>
<tr>
<td>1986</td>
<td>53.067</td>
<td>15.511</td>
<td>82.951</td>
<td>1.241</td>
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<td>1992</td>
<td>80.784</td>
<td>38.821</td>
<td>115.874</td>
<td>3.161</td>
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</tbody>
</table>

Source: Ministry of Fisheries and Marine Resources