News and Views

Anchovy Distribution and Migration

D. C. Duffy and A. J. Boyd

The Benguela Ecology Programme, a cooperative scientific programme under the auspices of the South African National Committee on Oceanographic Research, held its third symposium on 9 June at the University of Cape Town, to examine the theme: Anchovy distribution and migration. Presented at the meeting were the latest results of the year-and-a-half-old programme, which is designed to provide the scientific understanding necessary for the management of renewable marine resources in the Benguela ecosystem. The two major findings were that there are large numbers of anchovy, Engraulis capensis, inshore along the south coast of South Africa, and that there appear to be two rather than one or three stocks of anchovy: one north of Walvis Bay and the other extending from Algoa Bay in the southeast to the Orange river in the northwest. The symposium did not consider the young anchovy found south of Walvis Bay to be a separate stock, but could not agree to which stock they might belong.

The symposium was organized with the idea of synthesizing data, from as wide a variety of sources as possible, on anchovy distribution and migration. These included the anchovy fishery, predators of anchovy, spawning studies, and physical and biological oceanography. Most participants were from the Sea Fisheries Research Institute and the University of Cape Town, with other speakers from the Port Elizabeth Museum and the University of Port Elizabeth.

R. Crawford opened the talks with a description of anchovy distribution and migration, based on South African fishery landings. Anchovy spawn off the south coast but recruit off the west coast, being transported between the two by a jet current at the edge of the continental shelf. Anchovy are short-lived (less than four years), so maintenance of the population requires a strong recruitment of young fish at least once every two or three years. R. Thomas reported on fisheries-related work in Namibia. Most anchovy are caught off Walvis Bay. They are less than one year old, are present mainly in winter and show a circular migratory pattern to the south and back. In contrast, large anchovy tend to be found north of Walvis Bay and they exhibit little seasonal movement. S. Grant reviewed his work on anchovy genetics. Only a small exchange of individuals would be necessary to account for the similarity of genetic composition of anchovy off Namibia and South Africa.

Turning to surveys of anchovy eggs and larvae, L. Beckley found that egg and larval densities were as high in the inshore waters along the south coast as those reported at the generally recognized spawning grounds off Cape Agulhas. P. Shelton summarized the results of the Cape Egg and Larval Programme of the Sea Fisheries Research Institute, which has monitored the seasonal and regional distribution of anchovy eggs and larvae. These results, combined with those from other studies, showed that eggs are most abundant in Algoa Bay and off Cape Agulhas, but larvae are most numerous along the shelf edge between Cape Columbine and Cape Point. A. Boyd found that small larvae become much less abundant as he surveyed north between the Oliphants river and Lüderitz, but that there seemed to be no such trend for larger larvae. F. LeChus found a gap in egg and larval distribution from Lüderitz north to Conception Bay in Namibia. Most spawning north of this was inshore, within 20 miles of the coast. There was no evidence of a transport mechanism such as the jet current off the southwestern Cape.

Looking at anchovy predators, A. Berruti reviewed the diets of breeding seabirds off the west coast. Anchovy are most available to the birds of Saldanha Bay between July and December and to birds at Lamberts Bay between February and June. At the islands off Namibia, anchovy are apparently more available at Possession Island, the southernmost sampling site, than at islands north of Lüderitz. R. Randall reported that anchovy make up a substantial proportion of the diets of Cape Gannets, Morus capensis, and Jackass Penguins, Spheniscus demersus, in Algoa Bay, but this can fluctuate annually for the gannet and seasonally for the penguin. J. David discussed the Cape fur seal, Arctocephalus pusillus, and anchovy distribution. The main concentration of fur seals occurs in the Lüderitz area, where they primarily take gobies, Sufflogobius bibarbatius. Further south, along the west coast of South Africa, anchovy constitute 15% of the diet and hake, Merluccius spp., 32%. Food samples were not available from the south and east coasts.

P. Best reported on the diets and distributions of cetaceans in relation to anchovy distribution. Only the common and dusky dolphins, Delphinus delphis and Lagenorycthus obscurus, appear to forage in the right areas for anchovy but the existing data on diet indicate that only the common dolphin is a major consumer of pelagic fish. Bryde's whale, Balaeonoptera edeni, appears to concentrate on pelagic fish, on the evidence of samples taken during whaling operations in the 1960s. In a recent survey, most whales were observed off the south coast but this was during the summer in an oceanographically-anomalous year. The west coast whaling industry was most active in winter. M. Smale summarized an understanding of anchovy gained from a survey of ski-boat fishermen from the south coast. Juvenile anchovy occur inshore but adults are found both inshore and offshore. Anchovy may move offshore and into deeper water during the winter but do not appear to move westward to the Agulhas spawning grounds.

The third group of papers was the most diverse. I. Hampton presented preliminary results from the first comprehensive acoustic survey of anchovy undertaken off South Africa. He found three areas of abundance, each with differing fish-size compositions. Most fish occurred in the region delineated by 13°–14°C surface isotherms. R. Crikshank summarized the results of the acoustic sampling undertaken off Namibia, again reporting a discontinuous distribution of anchovy along the coast between the Orange river and Walvis Bay. M. Stuttaford presented the fishing industry's view on anchovy distribution and migration. Most fish spawn off the Cape south coast and recruit to the north along the west coast. However, there is a separate stock to the north of Walvis Bay and these fish do not appear to migrate. Anchovy off Walvis Bay migrate southwards, with shoals never being encountered moving northwards. Fishing mortality is believed to be only about 10% as the shoals move through the fishing grounds.

D. Butterworth discussed the implications of anchovy migration and distribution...
for fishery assessment. Accurate divisions of the stocks are essential for correctly assigning fishing quotas. The low correlations between stock size and recruitment may reflect incorrect divisions of stocks. The low proportion of older anchovy in fishery catches suggests either a high mortality or that anchovy become less vulnerable to fishing, perhaps by leaving the area normally exploited by the fishery or because of changes in shoaling behaviour associated with increasing age. V. Shannon and L. Hutching concluded the talks with a discussion of the environment in relation to anchovy distribution and migration. The only suitable areas for anchovy spawning off South Africa appear to be the Agulhas Bank and Algoa Bay. The upwellings off Luderitz and Namaqualand appear to be too intense and cold to sustain anchovy populations, thus forming a boundary between the South African and Namibian anchovy stocks. Exchange may, however, be facilitated by favourable conditions around the mouth of the Orange river. Finally, on the evidence of productivity at lower trophic levels, total pelagic fish production is not likely to be more than two million tonnes. with a spawning biomass of no more than half-a-million tonnes off the southwestern Cape.

A panel discussion addressed the question of how many anchovy stocks there were in Southern Africa. The distribution of anchovy off the south coast appears to extend continuously from Algoa Bay to the spawning areas off Cape Agulhas, suggesting that the west and south coast anchovy belong to a common stock. In contrast, the Walvis Bay and west coast stocks are separated by a considerable area of low anchovy density and unfavourable oceanographic conditions for spawning and larval survival. Observations of southward migration between the two stocks presented by the fishing industry were inconclusive and did not agree with inferences based on scientific evidence.

R. Bailey, of the Department of Agriculture and Fisheries for Scotland, summarized the proceedings by placing the symposium in the context of international fisheries work, especially that done in the North Sea. He concluded that hard evidence for differentiating the stocks was not available. Directed research to resolve this problem might be profitable. Meristic analysis of taxonomic characters, tag parasites, or use of artificial tags might provide the necessary data. Drift nets might also be used to determine the extent and direction of anchovy migration. Finally, he suggested that, while we know a great deal about the distribution and movement of anchovy larvae, we know little of how they actually recruit into the population. Much more work on this, especially in relation to environmental variability, is needed before effective stock management based on recruitment can be provided.

**Obituary**

**Professor E. S. W. Simpson**

With the sudden death of Professor Eric S W Simpson in Cape Town on 28 June, South Africa lost one of its most enthusiastic and well-known scientists. His name will be remembered for his contributions to marine geology and oceanography in South Africa and indeed the world over. It is appropriate to review his career and his achievements in international science.

After school and active service in the Navy, Eric Simpson went as a student to the University of Cape Town. Thus began his long association with UCT, as lecturer and from 1957-74 as Phillipson-Sow Professor of Mineralogy and Geology, and from 1977-1983 as Professor of Oceanography and Director of the Institute of Oceanography. During this time Eric Simpson laid the foundation for much development in the geological sciences, particularly marine geology. Many of his plans blossomed and bore fruit — the Department of Geochemistry, the Chamber of Mines Pre-cambrian Research Unit, the Marine Geophysical Unit, and the Marine Geology Research Group. He was greatly influenced by the profound changes in geology brought about by plate tectonics and the key role that the sea floor and ocean crust would play in future advances in geology. This led to his active involvement in marine geology and the mapping of the ocean floor, and his close association with various oceanographic vessels, both foreign and South African.

Eric Simpson served as a member of the South African National Committee for Oceanic Research from the early sixties and was thus actively involved in the development of oceanography in South Africa. His great contribution to South African science was his vigorous involvement in international marine science. He recognised the need for scientists to share their aspirations, knowledge and skills within the international scientific community. He symbolised the outward look, the international connection in South African marine science. Eric Simpson became a member of the IUGS Commission for Marine Geology in 1965, its secretary from 1968-76, and its chairman from 1976-80. He was a member of the executive committee of the International Association for the Physical Sciences of the Ocean from 1970-79. In 1970 he became a member of the ICSU Scientific Committee on Oceanic Research, being a representative of the CMG and a nominated member from South Africa. From 1976-80 he was a member of the SCOR executive committee, ex-officio as chairman of CMG, and in 1980 was elected to a four-year term as president of SCOR. This was the culmination of his international work, a task which entailed much overseas travel and great diplomacy which he executed with distinction.

At this same time he was associated with the international effort on sea-floor mapping. From 1971 he was a member of the Inter-Union Commission on Geodynamics Work Group 8 on Passive Continental Margins, as chairman for the initial period of three years. From 1972, he was a member of the International Cartographic Association on Oceanic Cartography. From 1974-82 he was chairman of the Joint Intergovernmental Oceanographic Commission/International Hydrographic Organisation Guiding Committee for the General Bathymetric Chart of the Ocean. The Fifth Edition of GEBCO was published in full in 1982 by the Canadian Hydrographic Service. From 1977-83 he was chairman of the editorial board of the IUGS Commission for the Geological Map of the World Peri-African Geologic Map, and in 1978 he was a member of the IOC central editorial board for International Geological/Geophysical Atlases; from 1982 he was deputy editor.

This list of his responsibilities and activities can provide only an indication of his achievements. Some measure of the great contribution Eric made in fostering international marine scientific research can be gained from the messages of sympathy which have come from all over the world. All have stressed the deep sense of loss felt by their colleagues at his sudden death. Here in South Africa, this can be echoed; he will be sorely missed. **Professor Geoff Brundrit**