

Fig. 2. Track chart and station positions of FRS *Africana* during Cruise 2 (Legs 1 and 2) (southwest Cape coast of South Africa) in May/June 1999.

and the Angola-Benguela frontal system. This included direct measurements of currents, the collection of data on water column chemistry and nutrient concentration, and on the distribution of phytoplankton and zooplankton. The cruise grid in Fig. 1 provides a quasi-synoptic view of the Equatorial Current system with its southward extension along the coasts of Angola and Namibia.

Most of the training was conducted aboard the *Africana* from May to July 1999 on two separate cruises (Cruises 2 and 3). Cruise 2 comprised South Africa's annual routine pelagic fish stock assessment survey, which provides scientific data towards the setting of total allowable catches of anchovy and sardine. In 1999, this two-legged survey (Leg 1: Orange River to Cape Point, 7–19 May; Leg 2: Cape Point to Port Alfred, 19 May–2 June; Fig. 2) was expanded to accommodate trainees from the SADC region and provide training in marine electronics and acoustic survey techniques for fishes. Its specific objectives were to

- estimate the biomass and size structure of anchovy and sardine recruits, and examine their distribution and behaviour;
- collect biological data on pelagic fish species;
- collect data on the distribution and abundance of anchovy and sardine eggs;
- examine the distribution and abundance of plankton in relation to the environment and to the distribution and condition of recruits; and
- collect hydrographic data on water column properties and water flows to study their influence on the above.

Cruise 3 started on 21 June 1999, when the *Africana* left Cape Town for Walvis Bay, the first of four legs that was to see her conducting research northward past the Angola-Benguela Front to Luanda, before returning to Cape Town in early

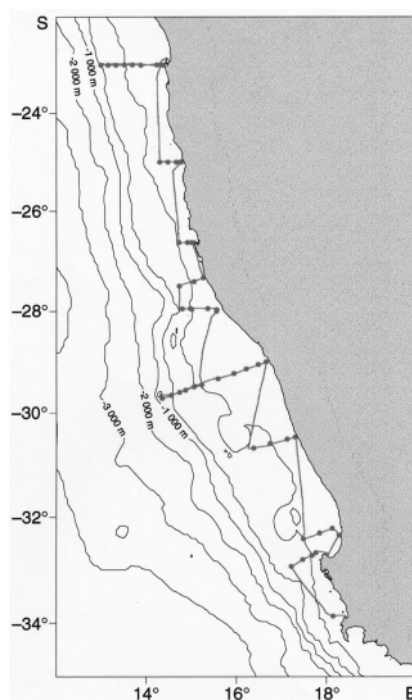


Fig. 3. Track chart and station positions of FRS *Africana* during Leg 1 (Cape Town–Walvis Bay) of Cruise 3 in June/July 1999.

August. The primary scientific objective of Cruise 3, Leg 1 (21 June–1 July 1999; Fig. 3) was based on various project proposals received to examine the fisheries environment of the region, and thus to provide support to resource-orientated work. This cruise leg was therefore planned to investigate differences in the oceanography between the southern Benguela off South Africa and the central Benguela off Namibia, south of Walvis Bay, as well as the exchange of water between these two sub-systems due to ocean currents. Specific scientific objectives were to study the physical, chemical and biological oceanography in the southern and central Benguela, in support of improving our knowledge of the fisheries environment; provide ground-truthing for satellite remote sensing of ocean colour (SeaWiFS); support regional monitoring work; and investigate oceanographic linkages between South Africa and Namibia.

The *Africana* left Walvis Bay on 1 July 1999 to conduct Leg 2 of Cruise 3 on the Namibian shelf up to the Cunene River (Fig. 4). The main scientific objectives were to (a) investigate the coastal current and undercurrent systems and the hydrography along the Namibian coast; (b) investigate the distribution and transport of the plankton community, and their relationship to the prevailing currents and hydrography; and (c) study the development, short-term variability and

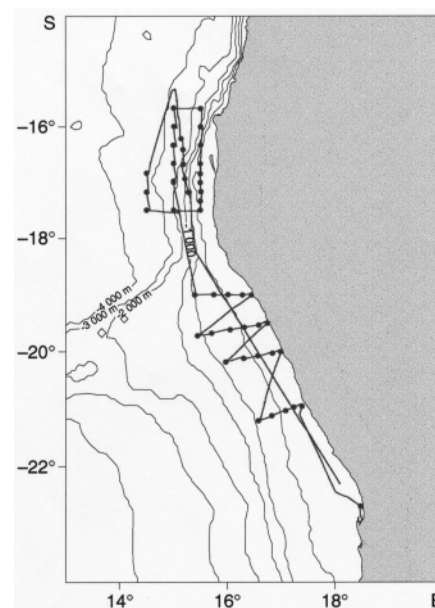


Fig. 4. Track chart and station positions of FRS *Africana* during Leg 2 (Walvis Bay–Angola-Benguela Front–Walvis Bay) of Cruise 3 in July 1999.

position of the Angola-Benguela Front. The *Africana* and her crew carried out their duties until propulsion problems were encountered on 10 July north of the Cunene River, forcing her back to Walvis Bay. Moving primarily on her bow thrusters, sometimes at speeds not greater than 2 knots, she reached Walvis Bay on Wednesday 14 July.

Within hours, in an exemplary model of regional cooperation, Marine and Coastal Management Coordination in Cape Town and the Namibian Ministry of Fisheries and Marine Resources began to make plans to continue the shipboard training programme; the *Algoa* and the *Welwitschia* took over the research/training duties of the *Africana*. The *Algoa* arrived in Walvis Bay on the evening of 20 July, and the *Welwitschia* had just returned to port following an orange roughy survey.

The *Welwitschia* sailed again on 23 July and provided oceanographic training during the northward Leg 3 of Cruise 3 to Luanda (Fig. 5). Originally, the overall scientific objective was to investigate the nearshore current systems on the Angolan shelf (between Luanda and the Cunene River) and their influence on the distribution and transport of plankton communities, and to study the development and position of the Angola-Benguela frontal system. Since the replacement vessel was much smaller, however, fewer scientists could be accommodated and less scientific equipment was available, hence it was no longer possible to fulfil all objectives. The scientific goals of the revised programme (23 July–3 August)

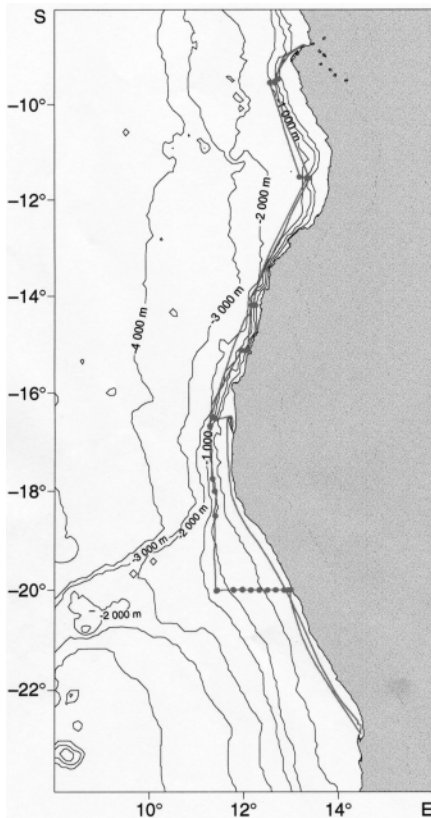


Fig. 5. Track chart and station positions of RV *Welwitchia* during Leg 3 (Walvis Bay–Luanda–Walvis Bay) of Cruise 3 in July/August 1999.

were therefore to (a) monitor environmental conditions such as temperature, salinity and dissolved oxygen; (b) deploy ARGOS satellite-tracked drifters off the Angolan coast; (c) collect water column samples for the analysis of nutrients and hydrogen sulphide; (d) sample populations of zooplankton and ichthyoplankton; and (e) map the distributions of nutrients and chlorophyll *a* from the underway scientific seawater supply.

For the completion of Leg 4 of Cruise 3, equipment from the *Africana* was transferred to the *Algoa* before both vessels sailed to Cape Town on 21 July, with the *Algoa* conducting training in fishery resources (Fig. 6). The main objectives of this leg were instruction in acoustic survey methods and monitoring interactions between the fish and their environment. The cruise included two 30-h experiments studying the diel migration behaviour of hake and covered an acoustic survey between Lüderitz and the Orange River mouth, an area seldom surveyed. In addition, plankton and hydrological sampling, and the recovery of a current meter deployed during an earlier leg of the BENEFIT cruises, were also included in the revised cruise programme.

Following the cruises, 30 of the trainees were invited to Cape Town in November

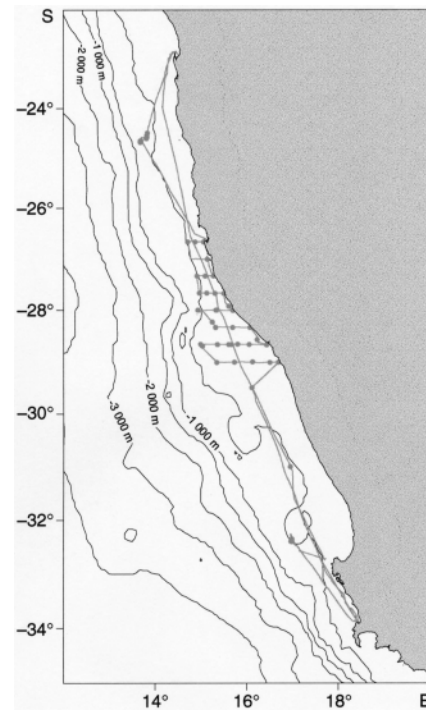


Fig. 6. Track chart and station positions of FRS *Algoa* during Leg 4 (Walvis Bay–Cape Town) of cruise 3 in July/August 1999.

1999 to participate in a workshop devoted to analysing the database that had been assembled at sea. The scientific and technical staff of the Branch: Marine and Coastal Management Coordination are to be complemented for organizing this workshop as a crucial antecedent to the 10th Southern African Marine Science Symposium (SAMSS) held at the Wilderness, South Africa, during 22–26 November 1999. SAMSS provided the BENEFIT trainees and trainers an opportunity to present the scientific results of the combined cruises to the broader marine science community of southern Africa. The abstracts of talks and posters presented at SAMSS were subsequently extended to include earlier cruise data, and these were collated in a compendium,¹² which was distributed at the annual BENEFIT Forum held in Swakopmund, Namibia, during 3–7 April 2000.

The compendium¹² in effect served as the precursor to the more expanded articles contained in this issue. Contributions include research results from winter observations on the hydrography,¹³ nutrient regeneration,¹⁴ distribution patterns of ichthyoplankton in the Angola-Benguela Front region,¹⁵ currents and hydrology of the southern¹⁶ and northern¹⁷ Benguela and off southern Angola¹⁸ and large-scale surface flow patterns in the Benguela Current;¹⁹ pigment bio-optical properties^{20,21} and vertical and horizontal variability²² of phytoplankton in the

southern Benguela; secondary production in the Benguela and Angola currents;²³ and the stock identity of small pelagic fish in the Orange River region.²⁴

The shipboard research training programme for the SADC region is a significant milestone for BENEFIT. This single programme was a hallmark in that it was identified, planned and conducted by the southern African marine science community (represented by BENEFIT) using predominately African resources. The programme encompassed over 100 days of sea-time, covered over 10 000 km longitudinally, and provided training for 59 individuals from nine African nations aboard three regional research vessels, plus the German RV *Poseidon*. By any standards, the programme was a substantial success.

BENEFIT is indebted to all those persons who had the vision to promote the regional partnership; the respective ministries of Angola, Namibia and South Africa, who have been unwavering in their support to BENEFIT; and especially the original donors, Germany and Norway, who believed in the regional vision. The African Development Bank in particular is singled out for its contribution to BENEFIT that served as the primary funding base for conducting the programme.

- Parrish R.H., Bakun A., Husby D.M. and Nelson C.S. (1983). Comparative climatology of selected environmental processes in relation to eastern boundary current pelagic fish production. In *Proceedings of the Expert Consultation to Examine Changes in Abundance and Species Composition of Neritic Fish Resources, San José, Costa Rica, April 1983*, (eds) G.D. Sharp and J. Giske. *F.A.O. Fish. Rep.* 291(3), 731–777.
- Bakun A. 1990. Global climate change and intensification of coastal ocean upwelling. *Science* 247, 198–201.
- Hutchings L. (1992). Fish harvesting in a variable, productive environment: Searching for rules or searching for exceptions? In *Benguela Trophic Functioning*, eds A.I.L. Payne, K.H. Brink, K.H., Mann and R. Hilborn. *S. Afr. J. mar. Sci.* 12, 297–318.
- BENEFIT Science Plan (1997). BENEFIT Secretariat, Windhoek, Namibia.
- Payne A.I.L. and Lutjeharms J.R.E. (eds) (1997). *A Century of Marine Science in South Africa. Trans. Roy. Soc. S. Afr.* 52(1).
- Payne A.I.L., Gulland J.A. and Brink K.H. (eds) (1987). *The Benguela and Comparable Ecosystems. S. Afr. J. mar. Sci.* 5.
- Payne A.I.L., Brink K.H., Mann K.H. and Hilborn R. (eds) (1992). *Benguela Trophic Functioning. S. Afr. J. mar. Sci.* 12.
- Pillar S.C., Moloney C.L., Payne A.I.L. and Shillington F.A. (eds) (1998). *Benguela Dynamics: Impacts of Variability on Shelf-Sea Environments and their Living Resources. S. Afr. J. mar. Sci.* 19.
- Siegfried W.R. and Field J.G. (1981). A description of the Benguela Ecology Programme 1982–1986. *Rep. S. Afr. natn. scient. Progrms* 54. FRD, Pretoria.
- Field J.G. (1996). The Benguela Ecology Programme. In *Proceedings of the International Seminar on The Benguela Current and Comparable Eastern Boundary Upwelling Ecosystems, Swakopmund, Namibia, May/June 1995*, ed. M.J. O'Toole, pp. 27–35. Gesellschaft für Technische Zusammenarbeit, Eschborn.
- BENEFIT Training Plan (2000). BENEFIT Secretariat, Windhoek, Namibia.

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12. Verheye H.M. (ed.) (2000). BENEFIT Shipboard Research Training Programme for the SADC Region, 1999: Compendium of extended abstracts presented at the 'SAMSS 2000' symposium, The Wilderness, South Africa, 22–26 November 1999. BENEFIT Secretariat, Swakopmund.
13. Mohrholz V., Schmidt M. and Lutjeharms J.R.E. (2001). The hydrography and dynamics of the Angola-Benguela Frontal Zone and environment in April 1999. *S. Afr. J. Sci.* **97**, 199–208.
14. Dittmar T. and Birkicht M. (2001). Regeneration of nutrients in the northern Benguela upwelling and the Angola-Benguela Front areas. *S. Afr. J. Sci.* **97**, 239–246.
15. Ekau W., Hendricks A., Kadler S., Koch V. and Loick N. (2001). Winter ichthyoplankton in the northern Benguela upwelling and Angola-Benguela Front regions. *S. Afr. J. Sci.* **97**, 259–265.
16. Iita A., Boyd A.J. and Bartholomae C.H. (2001). A snapshot of the circulation and hydrology of the southern and central shelf regions of the Benguela Current in winter 1999. *S. Afr. J. Sci.* **97**, 213–217.
17. Mouton D.P., Boyd A.J. and Bartholomae C.H. (2001). Near-surface currents and hydrology off northern Namibia in July 1999. *S. Afr. J. Sci.* **97**, 209–212.
18. Boyd A.J., Filipe V.L.L. and Bartholomae C.H. (2001). Near-surface currents and hydrology off southern Angola in July 1999. *S. Afr. J. Sci.* **97**, 219–222.
19. Largier J. and Boyd A.J. (2001). Drifter observations of surface water transport in the Benguela Current during winter 1999. *S. Afr. J. Sci.* **97**, 223–229.
20. Barlow R.G., Aiken J., Sessions H.E., Lavender S. and Mantel J. (2001). Phytoplankton pigment, absorption and ocean colour characteristics in the southern Benguela ecosystem. *S. Afr. J. Sci.* **97**, 230–238.
21. Bernard S., Probyn T.A. and Barlow R.G. (in press). Measured and modelled optical properties of particulate matter in the southern Benguela. *S. Afr. J. Sci.* **97**.
22. Mitchell-Innes B.A., Silulwane N.F. and Lucas M.I. (2001). Variability of chlorophyll profiles on the west coast of southern Africa in June/July 1999. *S. Afr. J. Sci.* **97**, 246–250.
23. Richardson A.J., Verheye H.M., Herbert V., Rogers C. and Arendse L.M. (2001). Egg production, somatic growth and productivity of copepods in the Benguela Current system and the Angola-Benguela Front. *S. Afr. J. Sci.* **97**, 251–257.
24. Kanandjembo A., D'Almeida G. and Iita A. (2001). The distribution of pelagic fish in the Orange River region, July 1999: a separate marginal stock? *S. Afr. J. Sci.* **97**, 266–270.