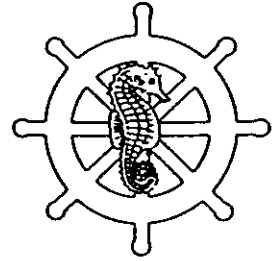


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South African National Scientific
Programmes Unit. Report
123





SANCOR: Summary report on marine research 1985

SANCOR

Summary report prepared for SANCOR by
the chairmen of the Programme Committees

SOUTH AFRICAN NATIONAL SCIENTIFIC PROGRAMMES REPORT NO

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COVER: Sand dunes - De Hoop Nature Reserve.

By courtesy of the Cape Department of Nature and Environmental
Conservation (Photographer: Zelda Wahl).

PREFACE

The South African National Committee for Oceanographic Research (SANCOR) Programme is one of a number of cooperative research programmes which are managed by the Foundation for Research Development (FRD) of the Council for Scientific and Industrial Research (CSIR). These programmes depend upon cooperation between scientists and engineers from various organizations and disciplines for the solution of diverse questions, including many with important management applications.

The SANCOR programme is administered under seven sub-programmes. These are: Benguela Ecology, Coastal Processes, Estuaries, Marine Linefish, Oil Pollution, Marine Pollution and Marine Sedimentology. The chairman of each of these programme committees annually prepares a report on the activities and progress in the relevant sub-programme. These reports form the basis of this summary report.

The summary report is supplementary to a volume, of which a limited number is printed, which is prepared annually and contains progress reports and final reports on all projects funded by SANCOR as well as many others which are voluntarily submitted to SANCOR.

The financial support of the CSIR, the Department of Environment Affairs (DEA) and the Department of Transport (DOT) is gratefully acknowledged. Without their contribution and encouragement the important marine research undertaken in the SANCOR programme would not be possible.

The marine community at large is indebted to all committee members, but particularly to the chairmen, for their considerable efforts and personal contributions in guiding the development and activities of SANCOR and its constituent programmes. I would like to express my personal appreciation to all participants.

J P de Wit
Chairman: SANCOR

ABSTRACT

The South African National Committee for Oceanographic Research coordinates and administers a significant portion of the marine research conducted in South Africa under seven sub-programmes. These are; Benguela Ecology, Coastal Processes, Estuaries, Marine Linefish, Oil Pollution, Marine Pollution and Marine Sedimentology. This report includes brief statements on the activities of each of these programmes for 1985 and emphasizes important findings and conclusions.

The total budget for SANCOR for 1985 was approximately R 2 229 000.

OPSOMMING

'n Belangrike deel van mariene navorsing in Suid-Afrika word deur die Suid-Afrikaanse Nasionale Komitee vir Oseanografiese Navorsing in sewe sub-programme gekoördineer en geadministreer. Die programme is: Benguela-ekologie, Kusprosesse, Getyrieviere, Mariene Lynvis, Oliebesoedeling, Seebesoedeling en Mariene Sedimentologie. Hierdie verslag bevat beknopte samevattinge van die aktiwiteite van elk van hierdie programme gedurende 1985 en beklemtoon belangrike bevindinge en gevolgtrekkings.

Die totale begroting vir SANKON vir 1985 was ongeveer R 2 229 000.

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EXECUTIVE SUMMARY

This summary contains selected highlights and important findings from the chairmen's reports.

Benguela Ecology Programme

- The investigation of the Virtual Population Analysis (VPA) stock assessment method using a maximum likelihood estimation technique has shown that the catch mass and age structure information alone do not have the necessary precision required for precise resource management. If additional information (eg Catch Per Unit Effort (CPUE)) is taken into account, precision is improved but age determination errors still result in a coefficient of variation of the most recent year's biomass estimate exceeding 50 %.
- An exciting development was the assessment by the Sea Fisheries Research Institute (SFRI) of the spawner biomass of anchovy in November 1984 using both the acoustic and egg production techniques. Spawning fish were found to be widely distributed across the Agulhas Bank. Based on these findings the anchovy quota was subsequently raised.
- Study of bird diets has shown that large anchovy occur close inshore throughout the year, even when unavailable to the fishery. The results from Dyer Island suggest that there is substantial anchovy recruitment on the south coast, and that the south coast stock may be self-sustaining.
- Good progress has been made with the study of nitrogen recycling in the Benguela. In both shelf and oceanic waters it has been shown that ammonium regeneration is largely confined to the region above the pycnocline, with very low rates in deeper water. Organisms smaller than 15 μm are mainly responsible for ammonium recycling: bacteria seem to be relatively more important in nutrient recycling at the base of the euphotic zone than at the surface.
- The 50 current meter moorings which have been deployed in the Benguela system show that there is a substantial (subsurface) poleward flow over the shelf in the southern Benguela. Wavelike reversals in flow occur with a period of 6-10 days. Further north there is strong intertidal motion over the shelf. A simple model which incorporates the current meter data shows convincingly how plankton can be confined in a coastal stretch between Cape Columbine and Lamberts Bay.
- Much needed research on the ecological role of squid in the Benguela has commenced.
- Good progress is being made with the synthesis of information on the Benguela ecosystem. Two major reviews "Evolution of the Benguela, Physical Features and Processes" and "Chemistry and Related Processes" have been published. Other reviews are in progress.

- Over 150 scientific papers pertaining to the Benguela Ecosystem have appeared during 1985. Approximately 55 of them result from work funded by SANCOR. The Monday Seminars continued to be the principal forum for interaction within this very dynamic programme. A total of 46 seminars were attended on average by 50 people. In addition three workshops took place: "Scaling Problems in Biological Oceanography", "Expert System Workshop on the Pelagic Fishery", and "Sediment - Water Interaction Workshop".

Coastal Processes

- Marcus Island, a seabird breeding island on the west coast, has a zone of enrichment of only about 500 m around it which is caused by leaching from guano. The nutrients stimulate algal growth and therefore herbivores, but both algae and limpets are also affected by predation by African black oystercatchers. This study clearly shows the importance of studying systems rather than individual organisms alone.
- Much over-exploitation of intertidal organisms along the Transkei coast has occurred, but protection of certain stretches of coast was followed by rapid recovery, indicating that a system of "rotational cropping" in intertidal areas might be a wise form of management.
- Further studies on the surf zone dynamics of Algoa Bay have confirmed that a single species of phytoplankton is the most important link in the flow of energy through the ecosystem, and is virtually restricted to the surf zone. From the phytoplankton, the most important energy pathway appears to be the microscopic food chain (bacteria and flagellates). The whole ecosystem has now been quantified to a large extent.
- In Natal, the detritus pathway has been shown to be the most important on a sandy substratum. The benthic (bottom-dwelling) organisms of this substratum are the basic food of about 25 % of the 52 tonnes of fish caught annually at the study site. At least 12 new species of benthic algae have been discovered along the Natal coast.

Estuaries

- At the end of its first five years of operation the SANCOR Estuaries Programme Committee reviewed the programme against the objectives set for the period 1982/1986 (South African National Scientific Programmes (SANSP) Report No 67) and found that the overall research direction was still highly relevant. However, there has been a pronounced and welcome shift in emphasis from essentially biological work to physical processes in estuarine environments.
- The multidisciplinary and multi-institutional Bot River Dynamics project was completed in 1985. The much improved understanding of the system led to a series of management recommendations, published together with the research papers.

- The foodweb involving predatory fish such as the white steenbras at Swartvlei and interaction with physical and hydrological processes have been elucidated, extending the already thorough understanding of the Swartvlei estuarine system.
- Research on the Swartkops River mouth is nearing completion, and a summary of research findings together with management recommendations is envisaged.
- Comparative research on the Kariega and Great Fish River mouths has yielded information on the biological effects of the relative volumes and movement of salt and fresh water, which will be of direct relevance in determining the freshwater requirements of estuaries.

Marine Linefish

- A National Marine Linefish Committee has been appointed to provide expert advice concerning the development of a national marine linefish management plan to the Minister of Environment Affairs. The SANCOR Marine Linefish Programme is well represented. South Africa's first National Marine Linefish Management Plan became law in January 1985. The SANCOR-coordinated linefish research programme had an important role to play in the provision of essential information, and will continue to provide information required for ongoing improvement of the linefish legislation.
- The second SANCOR Marine Linefish Workshop was held in Port Elizabeth during October 1985. The workshop reviewed existing knowledge of linefish species and critically examined whether current research is sufficiently goal-oriented in respect of resource management needs. Immediate and longer term research priorities were identified and personnel, equipment and funding needs discussed.
- An updated report will be published on the biology of priority species in South Africa. It will reflect some change in priority ranking on a species basis due to results already obtained. It will also reflect an ongoing need for life history research, with certain parameters such as growth and mortality requiring regional study due to differences between widely separated regions such as Natal and the south-western Cape.
- Recently initiated research includes top priority linefish such as galjoen, Hottentot, musselcracker, rock cods, kobs and bronze bream, and good progress is being made towards filling the gaps in knowledge of these.
- The national tag-and-release project is progressing well and is yielding valuable results on the migration of linefish around our coast. The project is being integrated with tagging studies at other institutions.
- Increased emphasis is being put on stock assessment of species such as the snoek, tuna spp, yellowtail, elf, leervis, king mackerel and slinger.

- An important aspect of the Marine Linefish Programme involves investigation of the effectiveness of marine reserves as a resource management option. Researchers from three institutes have cooperated in side-scan bottom topography mapping and in standardising underwater visual fish censusing by point and belt transects.
- The Marine Linefish Programme has concentrated its efforts on teleost (bony) fishes, but is aware of the large edible resource represented by cartilaginous fishes such as sharks, sand sharks, skates and rays. There is no doubt that research on these alternative resources will become a priority in the medium-term.
- The most serious impediment to improved marine linefish resource management is the fact that the fisheries inspectorate comprises too few posts to implement the new linefish legislation.

Oil Pollution

- The 1984/85 period constitutes the concluding phase of a programme which progressed naturally from the first phase of fundamental research through the interpretive phase which resulted in the information base necessary for the compilation of contingency plans, through the present stage where one of the series of coastal plans has been drafted and informally approved by the International Tanker Owners Pollution Federation (ITOPF). The Oil Pollution Programme was therefore concluded at the end of 1985.
- During the year, emphasis has been on actual involvement of the programme committee and members of the research community in the drafting of a model plan for the Agulhas area which would set guidelines for the suite of plans yet to be compiled.
- The Coastal Sensitivity Atlas was released early in 1985. This is an excellent baseline document of coastline types, utilization and sensitivity and will serve as part of the documentation for the oil pollution contingency plans.
- A project on the effects of oil on seabirds has led to a set of recommendations on the cleaning of oiled birds - also to be incorporated in the final set of contingency plans.
- A project on the use of water-in-oil emulsion-breakers and efficiency and toxicity of oil dispersants has led to valuable information to be included in the plans.

Marine Pollution

- Toxicological studies have continued along the Natal coast with investigations into the possible use of mussel larvae in bio-assays. This looks promising.
- Detection of very high concentrations of dieldrin near the mouth of the Reunion Canal is a matter which has received much attention. The source of the dieldrin is being investigated.

- Discharge has commenced through the recently constructed pipelines at Richards Bay - the effects of these discharges on the marine environment are being carefully monitored, both chemically and biologically, although it is still too early to assess the degree of impact, if any.
- The chemical pollution status of East London estuaries and coastal areas was investigated. Concentrations and distribution of organic carbon, major and minor ions and trace metals in sediments and water samples were found generally not to pose a serious threat, although the harbour was seriously polluted.
- Uptake of synthetic organic compounds in fish occurs at a much faster rate than depuration. This means that accumulation is likely to occur over long periods of exposure.
- The use of the steroid coprostanol as a chemical sewage indicator, shows promise.
- Health aspects of marine, particularly sewage pollution, are being looked at for the first time with investigations on viruses in seawater and shellfish.
- The synthesis of metal-binding proteins appears to be a universal defence mechanism by biota against stress arising from metal pollution.
- A very successful workshop was held at the University of Port Elizabeth (UPE) to look at problems with chemical analytical methods in marine studies. The problems of interlaboratory calibrations were brought out very clearly.
- A report summarizing all results from the Marine Pollution Programme since 1979 and a Programme Description for 1986 - 1990 have been published.
- SANSP Report No 94 "Water Quality Criteria for the South African coastal zone" has been published. The document is at present being applied to a test case in which a pipeline is being designed for the disposal of raw sewage to the sea.

Marine Sedimentology Programme

- Two post-doctoral scientists have been recruited from overseas to work on micropalaeontological and geochemical problems.
- A large box-corer for use in multi-disciplinary sedimentological projects has been designed and successfully tested.
- A successful workshop to plan the second phase of the research on sedimentation in eastern Cape estuaries (ROSIE) project was held in Port Elizabeth.
- Research on fossil and modern calcareous marine plankton is providing information for palaeo-climatic and palaeo-oceanographic studies which will be used to test fisheries and climate predictions.

- A recently completed study of certain microfossils provides the basis for a biostratigraphic zonation that has potential use in exploration for oil.
- A revised bathymetric map of the Cape Canyon has been produced.
- Manganese nodules have been successfully photographed and sampled on the Mozambique Ridge and in the south-eastern Cape Basin.
- The stable isotope and analytical facility is now on stream.

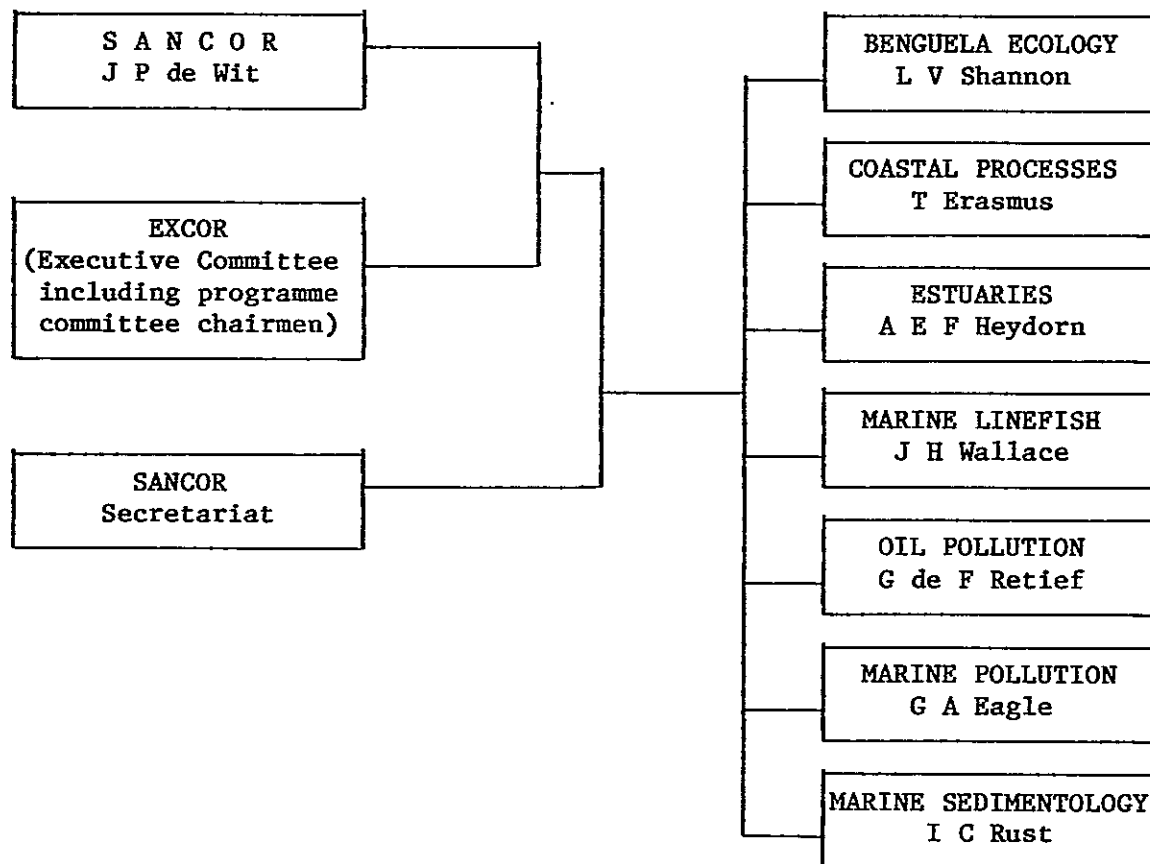
GENERAL**OBJECTIVE**

The objective of the SANCOR programme is to gain knowledge of the basic structures, processes and relationships in the marine environment around southern Africa in order to provide a fundamental scientific understanding and to facilitate:

- the efficient exploration, exploitation and conservation of living and non-living resources;
- the judicious management of the coastal zone;
- improved prediction of weather and climate;
- improved utilization of environmental information in maritime activities.

STRUCTURE

Overall policy and scientific guidance is provided by SANCOR itself. The committee structure for the management of the research activities within the seven sections of the SANCOR programme is set out below (Chairmen as in 1985):



FINANCES

A summary of the SANCOR budget for 1985/1986 is as follows:

Income

CSIR	1 180 000
Department of Environment Affairs	
- Environmental Conservation Branch	917 930
- Sea Fisheries Research Institute	50 000
Department of Transport	81 318
	<hr/>
	2 229 248

Allocations

Research Programmes:

Benguela Ecology	647 041
Coastal Processes	393 987
Estuaries	347 516
Marine Linefish	79 217
Oil Pollution	81 318
Marine Pollution	424 408
Marine Sedimentology	107 339
Other Projects	3 887
Salary Bonus Payments	70 000
Programme Management (including secretariat salaries, meetings, publication costs, etc)	219 395
	<hr/>
	2 374 108

The discrepancy between expenses and income is due to overbudgeting, which experience has shown allows for the optimum use of the available funds and can be made up from savings on project costs. It should further be noted that the above figures will differ from figures quoted in the status reports. These differences are due to savings and salary adjustments for 1985 which have already been included in the above amounts - information which was not available when the status reports were written.

LAY-OUT

The status reports on the seven programmes follow. Every report is followed by a list of the projects which have been funded by SANCOR in 1985 as well as some other projects of direct relevance to the programme. This is followed by short descriptions of the objectives of each programme and further general information. A list of acronyms which are used in this report appears on page 51.

BENGUELA ECOLOGY PROGRAMME

This report covers the period 1 January to 31 December 1985, the penultimate year in the first phase of the Benguela Ecology Programme (BEP). Last year the chairman documented adequately the progress of BEP since its inception. This year I shall review briefly the present status, mention some of the research highlights and I shall comment on the future direction of the programme.

STATUS

During the year under review, BEP embraced 22 separate research projects funded through SANCOR and approximately 70 projects funded directly by SFRI. Of the SANCOR funded projects, five were the primary responsibility of senior staff of SFRI while 15 were directed by senior staff of the University of Cape Town (UCT). Senior researchers at the University of Pretoria (UP) and the South African Museum (SAM) guided the remaining two projects. It is most encouraging that funding, albeit very limited, was available to enable a start to be made with four important new projects (squid ecology, lanternfish, cetacean predators, fish-zooplankton consultant). Apart from the research funded through SANCOR, UCT and SFRI, input into BEP of researchers from the National Research Institute for Oceanology (NRIO), the Electricity Supply Commission (ESCOM) and UPE is acknowledged with sincere appreciation.

The funds granted to BEP for the calendar year 1985 amounted to R 646 041. In view of the current unfavourable economic climate, potential applicants for 1986 funding were requested early in 1985 to adopt a conservative approach. The responsible attitude displayed by all participants was most noteworthy, and this, together with very careful pre-screening, resulted in applications from BEP for SANCOR funds for 1986 of R 789 202 plus R 39 470 for International Liaison. This represents an increase of 28 % over the amount of money granted by SANCOR to BEP during 1985. Total support via SANCOR of about R 750 000 is the minimum realistic amount necessary for the final year of the first phase of BEP.

Much of the research undertaken during 1985, as well as that proposed for 1986, is aimed at the proper rounding off of the first five-year phase of BEP. This attempt to consolidate the work of the past before embarking on the next phase is logical, and again highlights the responsible attitude of BEP participants towards SANCOR. The findings of the first phase will be reported at the International Symposium on Population and Community Ecology in the Benguela and Comparable Frontal Systems (Benguela-86) which is scheduled to be held in Cape Town during September 1986. Many of the BEP participants are channelling their efforts in this direction. Plans for Benguela-86 are well advanced. The symposium, which has received official recognition from the Scientific Committee on Oceanic Research (SCOR), has stimulated considerable international interest.

The well-attended BEP weekly seminars remained highly popular and have continued to facilitate communication between programme participants (and often also interested 'outsiders'). This series of seminars is the

principal forum for interaction within the programme, and, in my view, has contributed substantially to the success of BEP. In the first 10 months of this year 39 seminars were presented by BEP participants, non-BEP scientists and overseas visitors. During the second week in February 1985 BEP was fortunate to have Prof A Starfield (University of the Witwatersrand/University of Minnesota) and Mr A Bleloch (University of the Witwatersrand) participate in two workshops, viz Scaling Problems in Biological Oceanography and Expert System Workshop on the Pelagic Fishery, and in a report-back session of the Systems Analysis Group. BEP could benefit from the increased involvement of consultants such as Prof Starfield. The Sediment-Water Interaction Workshop which was scheduled for the end of June 1985 had to be postponed to October at the last minute on account of the indisposition of a key participant, Dr Scott Nixon (University of Rhode Island). The Symposium on Nutrients and Detritus: Pathways and Problems in Aquatic Ecosystems, which was organized by the Limnological Society of South Africa, was well attended by BEP members who contributed eight papers. In an effort to give more exposure to some of our many excellent younger members a mini-symposium entitled Promising Young Scientists was held on 29 August 1985. On the international front, Prof G B Brundrit and Dr L Hutchings attended the Seventeenth International Liège Colloquium on Ocean Hydrodynamics in Belgium in May and participated in the Liège Workshop on the Cooperative Oceanographic Project on Ergoclines (COPE), where two papers were delivered in support of BEP's proposal for inclusion of the southern Benguela frontal experiment in COPE. In August Drs L V Shannon and J R E Lutjeharms attended the International Association of Meteorological and Atmospheric Physics/International Association for the Physical Sciences of the Ocean (IAMAP/IAPSO) Joint Assembly in Honolulu where they presented four papers by BEP members. Much of the Assembly was devoted to the El Niño - Southern Oscillation (ENSO) phenomena and useful feedback was gained on the question of interannual variability in the Atlantic Ocean. During July and August Dr R Crawford undertook a study visit to the Bedford Institute (Halifax), SW Fisheries Centre (La Jolla) and NW and Alaskan Fisheries Centre (Seattle). Mr P Shelton departed on an extended visit to the Institute of Animal Resource Ecology at the University of British Columbia (Vancouver) in August. Profs G M Branch and F T Robb were overseas on sabbatical leave.

Staff-wise BEP is fortunate in having a corps of competent and enthusiastic scientists guided by a small group of hard-working project leaders. During 1985 BEP successfully recruited a scientist from overseas to work on squid ecology. We cannot afford to remain complacent on the subject of staffing, however, in view of developments within FRD, financial cutbacks and international political developments (refer to Short-comings).

On the organizational side, the Lobster/Abalone and Inshore Communities Coordinating Groups were combined.

FINDINGS AND HIGHLIGHTS

The investigation of the VPA assessment method using a maximum likelihood estimation technique has shown that the catch mass and age structure information alone do not have the necessary precision required for precise resource management. If additional information (eg CPUE) is

taken into account, precision is improved but age determination errors result in a coefficient of variation of the most recent year's biomass estimate exceeding 50 %.

Following research which established the scales of variability (and their spatial structure) of sea level along the west coast of southern Africa, the emphasis has been placed on the synoptic scale. It has been found that sea level changes of as much as one half a metre propagate down the west coast and along the south coast on a time scale of a few days. These disturbances are forced by the synoptic weather.

Investigations of community structure at Marcus and Malgas Islands in Saldanha Bay have shown interesting results. Marcus Island harbours a dense community of benthic invertebrates, but very few rock lobsters; whereas Malgas Island has a large rock lobster population that persists in the apparent absence of recognized food sources. It has recently been shown that the barnacle *Notomegabalanus algicola* is a major food organism of the lobsters, an unexpected finding.

Good progress has been made with the study of nitrogen recycling in the Benguela. In both shelf and oceanic waters it has been shown that ammonium regeneration is largely confined to the region above the pycnocline, with very low rates in deeper water. Size fractionation experiments in surface waters and at the 1 % light level indicate that organisms smaller than 15 μm are mainly responsible for ammonium recycling, and it appears that bacteria (<1 μm) or a bacterivorous fraction (<3 μm) are relatively more important in nutrient recycling at the base of the euphotic zone than at the surface.

Sea bird diets have been studied to investigate the spatial distribution of anchovy and other prey species along the west and south coasts. Results show that large anchovy occur close inshore throughout the year, even when unavailable to the fishery. The results from Dyer Island suggest that there is substantial anchovy recruitment on the south coast, suggesting that the south coast stock may be self-sustaining.

Genetic studies on various species have yielded interesting results, eg preliminary results suggest that there are no significant genetic differences between the west coast and south coast monkfish; the South African mussel *Mytilus* has been shown to be the Mediterranean mussel *M. galloprovincialis*; field collections show that this mussel together with the black mussel *Choromytilus meridionalis* occurs from Cape Point to Lüderitz and that the brown mussel *Perma perma* does not occur on the west coast as previously thought.

Good progress is being made with the synthesis of information on the Benguela ecosystem. Two major reviews "Evolution of the Benguela, Physical Features and Processes" and "Chemistry and Related Processes" have been published in *Oceanographic Marine Biology, Annual Review*, one on plankton has been completed (to be published in 1986), while others on fisheries, sea birds and mammals and predation, decomposition and the carbon budget are in preparation (to be submitted mid-1986). Two further reviews on the inshore communities and the sedimentology of the Benguela are planned for completion by mid-1987.

Perhaps the most exciting development since the inception of BEP was the assessment by SFRI of the spawner biomass of anchovy in November 1984 using both the acoustic and egg production techniques. Spawning fish (1,0 - 1,6 million tonnes) were found to be widely distributed across the Agulhas Bank. Based on these findings the anchovy quota was subsequently raised.

An exploratory interdisciplinary cruise in the frontal zone of the southern Benguela during December 1984 provided valuable data for the proper planning of BEP's contribution to the international COPE.

Valuable information is starting to emerge from the 50 current meter moorings which have been deployed in the Benguela system during the past few years. The results show that there is substantial (subsurface) poleward flow over the shelf in the southern Benguela. Wavelike reversals in flow occur with a period of 6-10 days. Substantial southward transport of Antarctic Intermediate Water was indicated by a single deep mooring off the shelf west of Cape Columbine. Further north there is strong intertidal motion over the shelf. A simple model which incorporates the current meter data shows convincingly how plankton can be confined in a coastal stretch between Cape Columbine and Lamberts Bay.

Work on squid progressed well. Random stratified surveys indicated low and fluctuating biomasses for the three west coast species, the biomass of the most abundant one, *Loligo reynaudii* evidently being less than 25 % of its south coast biomass (estimated previously). The appointment of a top squid ecologist during the year has given this important project added impetus.

A book "South Africa Ocean Colour and Upwelling Experiment" was published during October 1985. The book, which is a contribution to two FRD programmes (SANCOR/BEP and National Programme for Remote Sensing), includes a number of chapters on the physical, chemical and biological oceanography of the southern Benguela region. The utility of remote sensing techniques in the study of the Benguela is clearly demonstrated.

SHORTCOMINGS

In a programme such as BEP, which counts among its members several eminent and individualistic experts, it must be expected that consensus cannot always be reached on all matters. The resulting discussion and sharing of diverse opinions is healthy and far from being a problem is, in fact, what keeps the programme active and makes it interesting. We do have two potentially serious problems, however, which are closely related to each other. One concerns funding, the other staff.

Funding

The present level of funding of BEP is barely enough to meet salary costs plus very limited running expenses for existing projects. It provides no scope for programme growth. New projects cannot really be contemplated until existing ones are terminated. The current level of funding for running expenses is totally inadequate and several project leaders are having to try to subvent the running of their BEP projects out of other sources. Moreover there are various pieces of specialized instrumenta-

tion which are desperately required for which funds are not available. This is leading to frustration among project leaders and researchers and is particularly worrying to the Management Committee of BEP in view of "competition" from the Main Research Support Programme of FRD coupled with the impact of the unfavourable international political climate. All BEP participants have worked very hard to ensure the success of the programme in the past, but it will be difficult to maintain morale unless the funding situation improves. We are at present preparing for the second five year phase, but if it is to be at all viable then a guarantee of a substantially higher budget than the 1985 amount is required.

Staff

BEP has established a good reputation internationally and we are in a fortunate position to be able to recruit experts locally and overseas (funds permitting). However, it would seem that greater permanence of position is needed if we are to continue to attract and retain key staff in SANCOR funded posts. The creation of a limited number of five year posts/appointments in SANCOR is an urgent priority. What is also of concern is that some of the SANCOR funded staff are occupying key supervisory positions. Some of these individuals head coordinating groups or otherwise have a heavy administrative workload yet have no security of tenure. I do not have a simple solution to this problem, but if these few individuals had more security of tenure, then the situation would be more acceptable.

PROSPECTS

Discussions took place during the year on the future direction of BEP - whether there should be a second phase and, if so, what the objectives and priorities should be. A preliminary "think tank" or working group under the able chairmanship of Dr C L Griffiths and comprising mainly "new blood" was established and it reported to the Scientific Planning Committee in April 1985. A second committee chaired by Dr D C Duffy was then established to provide a more specific set of goals, using the working group's report as a point of departure. The report of Dr Duffy's committee was then circulated among members of the Scientific Planning Committee.

It is proposed that there should be a second phase of BEP and that the original broad objective should be retained. A community approach to the Benguela ecosystem is proposed for the next five years, having as its more specific objective;

To improve knowledge of the dynamic processes controlling the distribution and abundance of standing stocks of key species in the Benguela system.

Implicit in this objective is the necessity for the determination of the standing stocks of key species.

Various specific steps have been identified which will need to be followed to understand the structure and functioning of Benguela communities.

The second phase of BEP, like the first phase, is in line with the organizational policy of SANCOR. It is designed to provide information which is important for the wise management of South Africa's marine environment, and project proposals for the next five years will be evaluated in terms of their relevance against these criteria.

OBITUARY

On 11 June 1985 our friend and colleague Dr E Horgan passed away after a long illness, which she bravely endured. She will be sorely missed by all the participants in BEP.

L V SHANNON

CHAIRMAN: SANCOR BENGUELA ECOLOGY COMMITTEE

BENGUELA ECOLOGY PROGRAMME: PROJECTS 1985

PROJECTS AND PROJECT LEADERS	DURATION
Community structure and energy flow in inshore ecosystems (G M Branch, UCT)	1981 - 1986
The role of detritus in Benguela ecosystems (J G Field, UCT)	1981 - 1986
Trophic transfers and systems analysis of Benguela ecosystems (J G Field, UCT)	1982 - 1986
Benguela pelagic fish eggs and larvae (J G Field, UCT)	1981 - 1986
Visit of consultant: Prof R C Newell (J G Field, UCT)	1980 - 1986
Benguela phytoplankton studies: Nutrient cycling consultant (L Hutchings, SFRI and J G Field, UCT)	1983 - 1985
Benguela pilchard and anchovy growth (R Thomas, SFRI and J G Field, UCT)	1984 - 1986
Microbial decomposition of detritus and nutrient cycling (F T Robb, UCT)	1981 - 1986
Fatty acids/lipids as tracers in marine food webs (F T Robb, UCT)	1981 - 1985
Resource partitioning and digestive physiology of pelagic zooplankton and fish (F T Robb, UCT)	1984 - 1986
Benguela theoretical studies (G B Brundrit, UCT)	1982 - 1986

BENGUELA ECOLOGY PROGRAMME: PROJECTS 1985 (Continued)

PROJECTS AND PROJECT LEADERS	DURATION
West coast physical field studies (G Nelson, SFRI and G B Brundrit, UCT)	1982 - 1986
Benguela anchovy populations (D S Butterworth, UCT)	1982 - 1986
Ecology of predatory fish (D S Butterworth, UCT)	1985 - 1986
Benguela anchovy acoustics (I Hampton, SFRI, and D S Butterworth, UCT)	1982 - 1986
Ecological relationships between seabird predators and anchovy populations. Seabirds as monitors (W R Siegfried, UCT)	1982 - 1986
Ecological relationships between seabird predators and anchovy populations. Seabirds as consumers (W R Siegfried, UCT)	1982 - 1986
A history of climate and marine productivity from sediments off the west coast of southern Africa (R F Johnson, UCT)	1984 - 1986
Benguela cetacean predators (J D Skinner, UP)	1985 - 1987
Oceanic lanternfishes (family Myctophidae) of the southern Benguela upwelling region (P A Hulley, SAM)	1985 - 1986
Ecology of pelagic squid (J G Field, UCT)	1985 - 1986
Pelagic fish - plankton interactions consultant (J G Field, UCT)	1985

COASTAL PROCESSES PROGRAMME

The Coastal Processes Programme (CPP) is responsible for the coordination of research and allocation of SANCOR funds in the coastal zone. The programme is in its fourth year and was planned to continue in its present form until 1988. The aims and priorities of the programme have been published in Report No 68 of the South African National Scientific Programmes Report Series.

STATUS

The CPP supported ten projects during 1985 at an average cost of R 39 900 each. This, however, is not a full reflection of the total research activity in the coastal zone. The project on inshore biology of the Benguela region under the auspices of BEP, the projects of the linefish programme, projects in the marine pollution programme, some projects in the estuarine programme as well as other research outputs by NRIO, the Institute for Coastal Research (UPE) and the Oceanographic Research Institute (ORI) all contributed to the research thrust in this very important zone.

Of the ten projects funded in 1985 two will end this year, one of these being the project on the Surf Zones of Natal. This leaves the programme with only one integrated interdisciplinary project namely the Surf Zone project of Profs A McLachlan and G C Bate. The other projects, all valuable on their own, look at the coastal zone from a restricted perspective eg birds, algae, taxonomy, exploited intertidal organisms, etc. This means that one of the aims of CPP as originally formulated namely the study of ecosystems as a whole, has not materialized.

Fortunately the other projects did address themselves to specific issues with management implications and our knowledge in this area is therefore slowly but surely improving. The balance between the various components in the programme has improved somewhat. For instance in 1985, 42 % of the funds went to organism orientated work (16 % botany and 26 % zoology), with 51 % towards ecological studies (physical/chemical/biological) and 7 % towards purely physical studies. A comparison of the utilization of the CPP funds by the three main centres of marine research shows that the western Cape used 21 % of the funds, the eastern Cape 42 % and Natal 37 %.

FINDINGS AND HIGHLIGHTS

It is not possible to do justice to all the findings of the various projects in a report of this nature, but attention is drawn to the following selected aspects:

A seabird breeding island on the west coast (Marcus Island) has only a narrow (500 m radius) zone of enrichment in the waters around it and shows an enhanced benthic algal growth in the intertidal zone in response to generally elevated nutrient levels. Herbivores benefit from this prolific algal growth.

African black oystercatchers, which prey on intertidal limpets have a major impact on densities and size structures of limpet populations on island shores.

A project in the Transkei compared the ways in which shorebirds and humans exploit the intertidal ecosystem. Sites protected from predation by man were compared with exploited sites, in terms of species richness, ground cover and the density and size structure of exploited and unexploited species. It was found that exploited species were less common and had smaller mean sizes at unprotected sites. In addition, irrespective of the initial community structure, communities at unprotected sites converged towards a common state characterized by high density and ground cover of algae and inedible sessile invertebrate species.

The implications of this are that whereas a sustained yield of prey is achieved by oystercatchers, which cannot remove very large limpets, and by shorebirds which migrate, allowing time for their prey stocks to recover, people disturb the intertidal system to the extent that it becomes degraded as a foraging habitat. Historically human intertidal foragers were nomadic, but today population pressure has precluded this strategy as a means of allowing recovery of the intertidal system. However, the recovery of recently protected stretches of coast was shown to be rapid, and intertidal food resources could be managed on a "rotational cropping" basis.

The project on *Bullia* sp (the plough shell) not only highlighted the unique interaction between temperature and metabolic control in these animals, but it has also been demonstrated that the direct absorption of dissolved organic matter from seawater can account for 15 % of its metabolic requirements. Some of the whelks also have algal "gardens" growing on their shells which they crop with their long probosci. The ingested algae provide nutrients via symbiotic bacteria living in the gut.

The programme on Surf Zone Dynamics at UPE was in its penultimate year. Most work on distribution and abundance of organisms has been completed as well as studies on basic energetics. The beach/surf zone ecosystem is driven by intense phytoplankton production in the surf zone caused by a single diatom species. This fuels three food chains, a macroscopic food chain, a microscopic food chain and an interstitial food chain in the sediments.

Most basic work on the phytoplankton has been completed and the emphasis has shifted now towards ecophysiology. The macroscopic food chain including zooplankton, benthos, fishes and birds has largely been quantified and the remaining projects are nearing completion. The microscopic food chain, or microbial loop in the water column, consists of bacteria and flagellates and appears to be the most important pathway for energy in the system. It is still incompletely understood and work is now concentrating on carbon and nitrogen flow through this. The interstitial fauna includes bacteria and small metazoans in the sediments. Research on this is complete except for a study of oxygen consumption and nutrient exchange using bell jars.

Helicopters have been successfully used in a series of field exercises for sampling in high energy surf and have contributed significantly to the success of the project. This project has been very productive and a large number of papers have been prepared for publication in international journals.

The Natal Nearshore Sand Substratum project carried out in the Durban area is nearing completion. Special sampling gear had to be developed to permit proper sampling in the heart of the breaker zone. The major primary consumers are detritivores contributing 81 % of the macro-invertebrate biomass. Detritus over the sand appears to be transitory while reefs act as detritus accumulators.

Eighty-six species of macro-invertebrates have been found with polychaetes, molluscs and crustaceans being the best represented groups. The most protected beach yielded the most species, the highest biomass and the highest density while the most exposed beach yielded the lowest biomass and the intermediate beach had the lowest density. The swash zone had by far the greatest biomass (45 %) mainly due to the presence of the hippid *Emerita austroafricana* and the bivalve *Tivela polita*, together contributing 91 %. The biology of these two important species has been studied in detail and their production determined.

In the vicinity of the study area it has been calculated that about 98 000 fishermen outings take place every year making a total catch of about 52 tonnes. Of this 13 tonnes (or 25 %) are composed of species relying, to a large degree, on sand dwelling benthic organisms for their food.

By subjecting the physical and biological parameters to multivariate analyses it appears that three distinct faunistic zones exist corresponding to the swash, breaker and nearshore zones. However, at Addington, although all three physical zones exist, the faunistic breaker zone is absent. Gradient analysis showed a close relationship between faunistic zonation, water velocity and sediment transport rate but not between zonation and sediment characteristics.

Studies of the benthic algae of Natal have revealed at least three genera and 12 species new to science besides the four genera and 50 species new to South Africa.

All of these projects have over the last four years given rise to at least 130 publications in refereed journals. Moreover, the combined wisdom of the project participants gained through their research was made available in several instances to assist with management decisions. Although this is a less tangible product than an actual publication, it is of no lesser importance and is further justification for the research effort in this important zone.

SHORTCOMINGS

The programme is still being developed into a well coordinated and balanced approach towards studying the coastal zone as a series of ecosystems. Although integrated and successful programmes examining sandy beach and rocky-shore ecosystems have already been established, there are still a number of essentially isolated projects where participants study aspects of the coastal zone without coordinating their work in time and space with others. This state of affairs, as unsatisfactory as it may be when evaluated against the aims of CPP, is understandable because it takes energy and time to weld projects into programmes. Moreover, the fact that the project leaders are spread all around the coast

militates against these projects developing on their own into larger programmes.

The programme still needs to develop a mechanism whereby the various ecosystems comprising the inshore zone can be studied in a systematic, integrated manner. This would require a reorganization of the programme as outlined below.

PROSPECTS

There appears to be general agreement that CPP should be able to achieve its goals sooner and better if we change the present concept of the programme where the entire coastline is regarded as the study area with all good projects acceptable, to a concept where the bulk of the work should be concentrated on study areas/sites. The various disciplines/institutes are therefore encouraged to concentrate their efforts at the three nominated sites, Natal (Durban area), eastern Cape (Algoa Bay area) and western Cape (Walker Bay area).

These will be the core study sites where participants from the various disciplines can integrate their work at least in time and space, thereby improving our understanding and ability to predict. These sites have been selected not only because of the management problems inherent in each, but also because there is a natural aggregation of researchers in CPP as well as in other programmes. This offers the opportunity for participants in other programmes to partake in interprogramme exercises. The data and ideas from the Marine Linefish Programme and the Marine Pollution Programme will also find a natural home in the wider context of the interprogramme site orientated studies.

For each of the study areas, an informal science coordinator must be nominated to facilitate the organizing of seminars and workshops as well as the planning of coordinated projects.

Each site will have its own research lines reflecting the interests and capabilities of participants but still within the programme framework. In Algoa Bay and Walker Bay, it will be possible to have interdisciplinary as well as interprogramme research projects while in the Durban area the work in CPP will be centred around research towards the management of exploited intertidal organisms.

The CPP feels that the nomination of three core study sites, is a natural development of the programme and will overcome some of the problems inherent in trying to integrate the results from studies in widely scattered areas. We trust that the SANCOR research community at large will accept this development and not only support us but also hopefully join us.

T ERASMUS
CHAIRMAN: COASTAL PROCESSES COMMITTEE

PROGRAMME FOR COASTAL PROCESSES: PROJECTS 1985

PROJECTS AND PROJECT LEADERS	DURATION
The ecological role of birds in the rocky intertidal zone (W R Siegfried, UCT)	1983 - 1986
Metabolic control mechanisms in sandy-beach Mollusca (A C Brown, UCT)	1984 - 1986
Population dynamics of south coast gannets (G J B Ross, PEM)	1982 - 1985
Population estimate of bottlenosed dolphins <i>Tursiops aduncus</i> off Natal (G J B Ross, PEM)	1984 - 1985
Surf zone dynamics (A McLachlan, UPE)	1982 - 1986
Reproductive ecology of <i>Gelidium pristoides</i> (B L Robertson, UPE)	1983 - 1985
The Natal nearshore sand substratum (A J de Freitas, ORI)	1981 - 1986
A study of the exploited intertidal organisms of Natal (A J de Freitas, ORI)	1984 - 1986
The benthic marine algae of the Natal and Zululand coasts (R N Pienaar, UN)	1982 - 1987
Synoptic littoral measurements (D H Swart, NRIO)	1985 - 1988

ESTUARIES PROGRAMME**STATUS**

As in previous years, the objective of the SANCOR Estuaries Programme has remained unchanged, namely:

to provide a scientific understanding of estuaries - in particular of the interactive physical, chemical and biological processes within them, of their interactions with their fringe areas and with their adjacent marine and terrestrial environments and finally of human impact upon them - thereby contributing information required for their wise management. (South African National Scientific Programmes Report No 67: 'The SANCOR Estuaries Programme 1982 - 1986')

The SANCOR Estuaries Programme is now nearing the end of its first five years of operation and it is therefore appropriate to consider whether it is still on the correct course according to the above objective, or whether changes in direction or emphasis are required. It is interesting to note therefore that a shift in emphasis in fact appears to be developing in this programme towards the study of physical processes in relation to biological processes. A similar tendency can be observed in the estuarine/coastal work of NRIO. In both cases, initial work was predominantly biological in nature but an increasing need for work of physical, sedimentological, hydrological and hydraulic nature is becoming evident. An analysis of the applications received for SANCOR support in estuarine work for 1986/87, reveals the following tendency:

TABLE 1: Analysis of Applications for 1986/87

	Nature of application				
	Biological	Biological/ Physical	NRIO I/D computer model	Sedimento- logical	Sedimento- logical/ Physical
Value (R)	19 937	30 694	20 000	65 766	13 350
	24 467	24 888		32 285	48 065
	24 566	32 894			18 840
	51 464	18 634			30 100
	40 502	69 580			
	20 411 31 022	9 833			
Overall total: R627 298	R212 369	R186 523	R20 000	R98 051	R110 355
	R398 892		R20 000	R208 406	

Table 1 indicates that 33 % of the applications received, are of sedimentological or sedimentological/physical nature. (The single R20 000 application relates to NRIO's one-dimensional estuarine computer model to which Water Quality Criteria (WQC) have now also been added.

This model is used extensively in both biological and in physical/sedimentological fields.) Reasons for increasing emphasis in physical work can be found in two major problems the country is facing:

- (a) A shortage of water and the priorities which must be given in the allocation of the available water resources, including releases required for ecological and associated economic reasons downstream of impoundments (particularly in estuaries and in river-mouth regions).
- (b) The effects of soil erosion (caused by a variety of human practices) which result in an acceleration of silting-up processes in the coastal reaches of many rivers. These effects are frequently severe and require rigorous management action if the usefulness of the coastal reaches of the rivers is to be maintained.

Associated with (a) and (b) are various facets of pollution of both urban and agricultural origin.

At the meeting of the SANCOR Estuaries Programme Committee on 2/3 September 1985 these problems and the research needs which emanate from them were recognized. This has a pronounced bearing on the direction which the programme is likely to take during its next five-year phase from 1987 to 1991. Action which the committee has taken in this regard will be discussed further under Prospects later in this report.

FINDINGS AND HIGHLIGHTS

It is not possible to present a representative list of findings within the space available nor to do justice to all the scientists who contributed to them. However, the main contributions to knowledge of South African estuaries in various coastal sectors emanating from both SANCOR-sponsored and other research can be summarized as follows:

Southwest Coast

The completion of the Bot River Dynamics project in 1985 which was both multi-disciplinary and multi-institutional, is regarded as a highlight because of the vast amount of knowledge which has been gathered by scientists from various disciplines in this semi-closed estuarine system. The results have just been published in a special edition of the Transactions of the Royal Society of South Africa, with a final chapter containing recommendations for the future management of the system. Major contributions to this collaborative study came from UCT, NRIO, the Cape Department of Nature and Environmental Conservation and the Geological Survey.

South Coast

Similarly, the substantial amount of knowledge about the processes governing the Swartvlei System which has resulted mainly from the work of Rhodes University (RU), has been expanded even further through completion of their SANCOR-funded project on the trophic relationships of fish in

this system. The project has elucidated the relationships between predatory fish such as the white steenbras, the benthos (mainly molluscs within and without the macrophyte beds), the role of amphipods in the diet of fishes and the role of zoobenthos. An energy flow diagram has been produced which illustrates the understanding of the interaction of physical and hydrological processes gained through the research at Swartvlei.

Southeast Coast

In similar vein the multi-disciplinary research by UPE, the Port Elizabeth Museum (PEM), NRIO and others in the Swartkops estuary is progressing well. It is hoped that it will be possible to produce a report similar to the one on the Bot system in one to two years time and UPE is encouraged to do this before diverting too much energy to other systems.

The comparative research by Rhodes University in the Kariega estuary (marine dominated) and the Great Fish estuary (freshwater dominated) has cast considerable light on the effects of various types of water circulation on the distribution of dissolved and suspended materials and the effects of variability in salinity and temperature on the distribution and biomass of zooplankton. The results will add to the ability of estuarine scientists to predict the effects of artificial manipulation of the freshwater flow through estuaries, for example, as a result of large-scale water extraction in catchments.

Natal

Work by Dr G Begg (ORI) is being followed up with more emphasis on the all-important sedimentological processes in the estuaries of this province. Modern sedimentary processes in the Mgeni, Mhlanga and Mvoti estuaries are to be investigated by the University of Natal in close collaboration with the ROSIE programme of UPE and the Sediment Dynamics Division of NRIO. A most interesting event was the total reshaping of the St Lucia/Mfolozi mouth regions by cyclone Domoina and NRIO is advising the Natal Provincial Administration on a more effective management strategy for the mouth in future years.

Finally mention is also made of two documents prepared by a working group of the SANCOR Estuaries Committee on the "Agreed State of Estuaries" in the Cape and in Natal. These documents are to be published in the SANSP Report series. They represent an important step forward and will be enormously useful in the setting of future research requirements.

SHORTCOMINGS

An obvious shortcoming is the lack of attention being devoted to the estuaries of the west coast. These systems are of particular interest in terms of their history and the role of sea-level fluctuations in their formation. A research proposal by NRIO, which will address this topic in the Verlorevlei system and Elandsbaai during a one-year study, therefore received strong support from the Programme Committee.

Another system which warrants intensive attention is the Breede River estuary and the adjacent marine environment. Unfortunately a shortage of funds precluded support of an application for research in this system during the coming financial year but it is hoped that this work will come under way in 1987.

It would be of great value if the estuaries of the Transkei could receive more attention.

Other shortcomings as perceived by the committee will be addressed under Prospects, below.

PROSPECTS

Financially, the prospects do not seem good. Funds granted for the SANCOR Estuaries Programme for the financial year April 1985 to March 1986 amounted to R 342 802. Funds requested for 1986/87 amounted to R 627 298, that is, an increase of 83 %. Whatever the merits of estuarine research in South Africa, it is not possible to grant increases of such magnitude within the constraints of the overall funds available to SANCOR. The Programme Committee therefore gave careful consideration to SANCOR's terms of reference and in particular to the acknowledged need for information which is vital for the wise management of South Africa's coastal/marine environments and resources. The Committee therefore decided that the planning of the second phase of the SANCOR Estuaries Programme would have to take place along the following lines:

- (i) To draft precise goals in accordance with:
 - the overall objectives of the existing programme description, and
 - the known and predicted needs of the authorities responsible for
 - . freshwater resources
 - . coastal zone management
 - . living marine resources
 - . land-use patterns in the catchments.
- (ii) To consider the merit/need of using a statistically based classification system for the determination of future management and research needs, with due cognizance for present/previous research.
- (iii) To define a limited number of systems for collaborative study, which are representative of the east coast, south coast, south-west coast and west coast.
- (iv) To investigate ways of soliciting participation in the Estuaries Programme.

The Committee came to the conclusion that the overall objectives of the programme as set out in the Programme Description of 1983 are still valid and it was therefore not necessary to amend the programme framework. However, a number of points which could have a profound bearing on the direction of the research programme over the next five years were high-

lighted, with special emphasis on the information needs of authorities responsible for the management of the country's freshwater resources, of catchments and of the coastal environment. A working document was set up asking for a systematic response by all members of the Programme Committee (and other estuarine researchers) to questions set in accordance with the above terms of reference.

At the time of writing this report, the response of the members of the SANCOR Estuaries Committee to the working document had not yet been analysed. However, I am optimistic that the approach adopted will lead to an estuarine research programme for 1987-1991, finely tuned to the needs of the country and the financial support which can be made available for the purpose.

A E F HEYDORN
CHAIRMAN: SANCOR ESTUARIES COMMITTEE

ESTUARIES PROGRAMME: PROJECTS 1985

PROJECTS AND PROJECT LEADERS	DURATION
Dynamics of the Bot River estuary (G M Branch, UCT)	1982 - 1985
An experimental analysis of the role of key organisms in Langebaan Lagoon (G M Branch, UCT)	1983 - 1985
Geochemistry and physical characteristics of sediments from Bot River estuary (J P Willis, UCT)	1982 - 1985
Freshwater requirements for the Knysna estuary (J R Grindley, UCT)	1984 - 1986
Research on sedimentation in estuaries: ROSIE Phase II (I C Rust, UPE)	1984 - 1986
Exchange of nutrients, organic particulates, phytoplankton, zoo- and ichthyoplankton between Swartkops estuary and the sea (D Baird, UPE)	1983 - 1986
The role of birds in the Swartkops estuary ecosystem (D Baird, UPE)	1984 - 1987
The influence of oil and water soluble fractions on phytoplankton productivity (G C Bate, UPE)	1983 - 1986
Trophic relationships and resource utilization by the dominant fish species associated with the seagrass beds of the Swartvlei estuary (A K Whitfield, RU)	1983 - 1985
The fate of allochthonous materials in estuaries (G H L Read, RU)	1983 - 1985
Primary productivity in some estuaries of the eastern Cape (B R Allanson, RU)	1984 - 1985
A study of the mangrove crab <i>Scylla serrata</i> Forskal (A J de Freitas, ORI)	1984 - 1986
Estuarine chemistry (G A Eagle, NRIO)	1985
Modern sedimentary environments of the Natal coast (R Tavener-Smith, UN)	1985 - 1988
Aeolian processes Bot River and Klein River estuaries (I L van Heerden, NRIO)	1985 - 1986

MARINE LINEFISH PROGRAMME

STATUS

This programme's objectives are to identify priorities and to coordinate research needed to provide a scientific basis for the rational exploitation of South Africa's marine linefish resources. Emphasis is placed on studies of the biology of exploited species to determine effective methods of resource management, as well as on the collection of catch and effort statistics as a basis for detecting trends in the fishery.

The programme traces its origins back to 1978. Its first descriptive document appeared in 1979 as No 37 of the SANSP Report series. In 1982 the first National Marine Linefish Workshop was held in Durban to review progress and to identify shortcomings and future needs. This led to the publication of No 70 in the SANSP Report series which provides an overview of the existing knowledge of the biology of 83 linefish species; it also identified the species most urgently requiring research, gaps in knowledge and parameters most in need of investigation.

Only four research projects are currently financed through SANCOR, but the programme fulfils a very valuable national function through coordinating marine linefish research conducted by other institutes. These include SFRI, ORI, UCT, RU, UPE and PEM.

FINDINGS AND HIGHLIGHTS

Mention was made in last year's report of the appointment of a National Marine Linefish Committee to provide expert advice to the Minister of Environment Affairs, the Hon Mr J W E Wiley MP, concerning the development of a national marine linefish management plan. The SANCOR Marine Linefish Programme is represented on the National Committee by its Chairman, while four members of the SANCOR Committee are either appointees to the National Committee or serve it in their capacity as staff members of SFRI.

New legislation was enacted late in 1984 and South Africa's first National Marine Linefish Management Plan became law in January 1985. This was particularly gratifying for linefish researchers, for the SANCOR Marine Linefish Programme and for the research institutes that had over many years provided the data on which the new legislation is founded.

In essence the plan:

- makes provision for the legitimate interests of both the commercial and recreational sectors of the fishery;
- standardizes legislation between the Cape and Natal;
- licenses sea-going linefishing craft according to whether they are used for full-time commercial, part-time commercial or sport fishing;

- obliges full-time and part-time commercial licensees to submit catch and effort returns;
- protects immature fish through minimum size regulations based on the length at which 50 % attain maturity;
- limits fishing effort, particularly on the most threatened endemic reef fishes, through restricting the number of licences issued for full-time commercial fishing, and through limiting the daily catch of reef fish by part-time commercial and sport anglers; and
- provides for closed seasons and for the decommercialization of particularly threatened species.

Senior representatives of both the commercial and recreational fishery acknowledge the need for resource management and are willing to accept the advice of scientists provided this is based on adequate research. The SANCOR coordinated Marine Linefish Research Programme is therefore under considerable pressure to provide the information required for ongoing improvement of marine linefish legislation.

In view of this challenge, it is appropriate that the second National Marine Linefish Workshop was held in Port Elizabeth during October 1985. The workshop reviewed existing knowledge of marine linefish species and critically examined whether current research is sufficiently goal-oriented in respect of resource management needs. Additional marine linefish conservation options, such as marine reserves, were considered. Immediate and longer term research priorities were identified, and personnel, equipment and funding needs discussed.

Comparison of information available in 1985 with a summary of data published on the biology of 83 marine linefish species in SANSP Report No 70 (1983), revealed encouraging progress over this period: life history information of 48 % of the 83 species has been substantially improved, while on a priority basis this amounted to a 63 % improvement for top priority species, 48 % for medium and 22 % for low priority species. In view of the contribution Report No 70 has made to focusing research effort on priority species and parameters, the workshop agreed that an updated report should be published. This would reflect some change in priority ranking on a species basis due to results already obtained. It would also reflect an ongoing need for life history research, with certain parameters, such as growth and mortality requiring regional study due to differences between widely separated regions, such as Natal and the south-western Cape. An increasing emphasis would also have to be placed on stock assessment through mortality studies and estimates of trends in fishing intensity based on time series of catch per unit effort and mean length/mass of catches. In view of these needs and the fact that expertise tends to be localized at different institutes, it was agreed that specialized workshops should be held on marine linefish stock assessment and ageing techniques.

Recently initiated research projects are making good progress towards filling gaps in knowledge of top priority marine linefish. These are the UCT project on the galjoen (*Coracinus capensis*) and the Hottentot

(*Pachymetopon blochii*), the PEM project on the mussel-cracker (*Sparodon durbanensis*) and bronze bream (*Pachymetopon grande*), the ORI project on east coast kobs (Sciaenidae) and rock cods (Serranidae), as well as the national tag-and-release project of ORI which is being integrated with tagging studies at other institutions. A National Linefish Tagging Register is under consideration by a working group representing ORI, SFRI and PEM.

Well established, ongoing research projects are also making good progress. SFRI and ORI are placing increased emphasis on stock assessment of species such as the snoek (*Thyrsites atun*), tuna (various species), yellow-tail (*Seriola lalandi*), elf (*Pomatomus saltatrix*), leervis (*Lichia amia*), king mackerel (*Scomberomorus commerson*) and slinger (*Chrysoblephus puniceus*). The SFRI commercial/recreational catch and effort monitoring project is well established, an important step forward being the transfer of a technician and computer system to ORI. In the eastern Cape the main projects are a study of the marine linefishery at Port Alfred (RU), with particular reference to the sea catfish (*Galeichthys* spp) and geelbek (*Atractoscion aequidens*), and the PEM projects on the red steenbras (*Petrus rupestris*), kob (*Argyrosomus hololepidotus*), Roman (*Chrysoblephus laticeps*) and dageraad (*Chrysoblephus cristiceps*).

A final report was submitted by PEM on a five-year project on the general biology and ski-boat fishery of south coast reef fishes. Evaluation of a typical ski-boat club in the Port Elizabeth area showed that fishing effort had increased by a factor of 1,6 between 1975 and 1982. Although the overall value of the recreational catch in the eastern Cape was relatively low (R 270 000 per annum), there is a significant investment in boats (R 13,5 million) and fishing tackle (R 3,5 million), while running costs amount to R 1,83 million per annum. Results on the biology of some of the target species showed that many were endemic, some exhibited sex reversal and all were long lived and consequently late maturers. These findings, together with the fact that all suffer from barotrauma (over-inflated swim bladders when raised to the surface), have important consequences for management of the deep reef fish resource.

An important aspect of the Marine Linefish Programme involves investigation of the effectiveness of marine reserves as a resource management option. It was apparent from the Marine Linefish Workshop that useful progress has been made by ORI in the St Lucia Reserve, by PEM in the Tsitsikamma National Park and by SFRI in the proposed reserve off De Hoop. Researchers from these institutions and NRIO have cooperated in side-scan bottom topography mapping and in standardizing underwater visual fish censusing by point and belt transects.

During the past two years, two of the four SANCOR financed research projects have produced six published papers, with an additional four in press.

SHORTCOMINGS

The urgent need for stock assessment, and hence for long-term monitoring of the species and length composition of catches, cannot be met by the present system of research conducted by university graduates funded on short-term projects. Typically, such researchers monitor catch and

effort for one to two years while actively involved in life history studies, but are thereafter unable to maintain the monitoring function. This disrupts development of the time series of CPUE, mean length/mass necessary for detecting trends in the fishery and for determining management responses. Ways and means of financing the technical assistant posts required to undertake ongoing monitoring, need to be investigated.

More effective use could also be made of existing experienced linefish researchers if funds were available for employment of technical assistants. This shortage of funds also adversely affects acquisition of capital equipment, while it tends to circumscribe research by restricting it to easily accessible areas and to projects that are relatively cheap to operate. Another manifestation of the funding problem is the tendency for marine linefish research to be shore-based, with relatively little access to ship's time. This problem is particularly acute on the south-east coast due to its distance from Natal and the RV *Meiring Naudé* used by ORI, as well as from the south-western Cape and the ships of SFRI. There is little doubt that the Marine Linefish Programme, together with other SANCOR programmes active in the region, would benefit greatly if a sea-going vessel was based in Port Elizabeth. Alternatively, if a SFRI vessel was available for a multi-programme use in the region.

Efforts have been made to stimulate a comprehensive assessment of the direct and indirect value of the marine linefishery to the South African economy, but success has not yet been achieved. This is unfortunate because greater priority can be expected to be given to research and to enforcement of the new legislation once the overall value of the catch and allied activities have been estimated.

The Marine Linefish Programme has concentrated its efforts on teleost (bony) fishes but is aware of the large edible resource represented by elasmobranch (cartilaginous) fishes, such as sharks, sand sharks, skates and rays. SFRI has recently initiated research in the little understood south-western Cape shark fishery, while ORI is investigating the alleged proliferation of dusky sharks in Natal. There is little doubt that research on these alternative resources will become a priority in the medium-term. Every effort should be made to study the interrelationships between shark predators and marine linefish, especially in Natal where there is already an extensive gill-net shark fishery.

PROSPECTS

Prospects for marine linefish research and scientific management of resources have improved in recent years. However, further progress in research is subject to numerous shortcomings (some already mentioned) while effective management of resources is difficult.

A multi-species fishery is inordinately difficult to manage, especially when it is impossible to determine precisely what species will be caught during any particular fishing operation. In practice this means that some species, even if known to be exploited beyond their maximum sustainable yield, will continue to be caught during fishing for other species fished at or below their maximum sustainable levels. Furthermore, perceptions of what represents an acceptable level of exploitation

in the above situation will vary between sport and commercial fishermen. The former may wish to protect an over-fished quality angling species and accept the penalty of under-fishing of associated commercial species; a strategy unlikely to find favour with commercial operators. Another complication is that fishing effort and catch composition differ along the coast with the result that management by area is ideally required. All this presupposes that resource managers have access to adequate factual information upon which to base enlightened decisions, a situation unlikely to be achieved in the foreseeable future with the present inadequate investment in research.

For the first time, South Africa has a National Linefish Management Plan. If implemented in the form recommended by scientists, it will afford some relief to our hard-pressed endemic reef fish stocks. However, resource management is a mix of scientific, socio-economic and political considerations. If the emphasis is allowed to swing too far from the scientific, due to pressure from special interest groups or for other reasons, the management plan's effectiveness will be endangered.

In conclusion, it can be stated that the most serious impediment to improved linefish resource management is not the inadequacy of research, or of the database, but the fact that the fisheries inspectorate comprises too few posts (of which many are vacant) to implement the new marine linefish legislation.

J H WALLACE

CHAIRMAN: SANCOR MARINE LINEFISH COMMITTEE

MARINE LINEFISH PROGRAMME: PROJECTS 1985

PROJECTS AND PROJECT LEADERS	DURATION
South coast reef fish project (C D Buxton, PEM)	1985 - 1987
South coast game fish project (M J Smale, PEM)	1983 - 1987
Catch-statistics sampling strategy evaluation (D S Butterworth, UCT)	1983 - 1986
The Port Alfred ski-boat fishery with emphasis on the ecology and biology of the sea catfish (<i>Galeichthys feliceps</i>) (T Hecht, Rhodes University)	1984 - 1986

OIL POLLUTION PROGRAMME

STATUS

Research aimed at reducing the deleterious effects of oil pollution along the South African coast was financed by DOT and until 1984 was managed as a subsection of the SANCOR Marine Pollution Programme. During 1985 it was managed as an independent SANCOR programme directing almost all its efforts towards the compilation of contingency plans and close interaction with DOT. The programme was terminated at the end of 1985. This work was aimed at meeting the objectives set out in the 1981 programme documents, viz:

- to provide DOT with the relevant scientific information to combat oil pollution;
- to assist in the interpretation of this information:
 - for the purpose of establishing procedures and standards required for contingency planning;
 - for decision-making during an oil spill event.

Whereas during the previous four years of the programme all effort had been concentrated on the generation of information needed for the compilation of contingency plans, the emphasis during the past year was on actual involvement of the programme committee and members of the research community in the drafting of a model plan which would set guidelines for the suite of plans yet to be compiled.

The 1984/85 period thus constituted the concluding phases of a programme which progressed naturally from the first phase of fundamental research (1974 - 1980) on the effects of oil on coastal flora, fauna and specific ecosystems through the interpretive phase (1980 - 1984) which resulted in the information base necessary for plan compilation through to the present stage where one of the series of coastal plans has been drafted and informally approved by ITOPF. This progression was not without its problems, but important lessons on communication have been learnt.

Most of the work on the model plan was carried out during 1985 by a specially appointed working group consisting of representatives of DOT, SFRI, and the Oil Industries, and it is expected that such a group will continue to act in an advisory/monitoring role until final completion of the Contingency Plan Series.

FINDINGS AND HIGHLIGHTS

Publication of the Coastal Sensitivity Atlas towards the end of 1984 and its official release early in 1985 was one of several important and useful contributions by the programme, not only to DOT's effort to combat oil pollution, but to the greater scientific community as well. This excellent baseline document of coastline types, utilization and sensitivity has already proved its worth to researchers in the field and has been distributed by DOT to all coastal local authorities as part of the

documentation for the oil pollution contingency plans. Enquiries regarding the atlas have also been received from overseas and ITOFF has recognized the atlas as an excellent example of this type of mapping and has recommended similar action to other member countries of the Federation.

Work at UPE on the effects of oil on seabirds has led to a set of recommendations on the cleaning of oiled birds which will be incorporated in the final suite of contingency plans. Similar studies on the feasibility of aerial application of dispersants, emergency barriers from materials of opportunity and the recovery of oil at sea have been completed and will form part of the Codes of Practice and Guidelines section of this plan series.

Work done by SFRI led to two valuable reports on the use of water-in-oil emulsion-breakers and efficiency and toxicity of oil dispersants. The information will be included in the Contingency Plans.

By far the most significant development in the programme last year was the drafting of the Model Coastal Plan for the Agulhas area by the specially appointed working group. This plan was submitted to DOT for finalization and publication and will also be formally submitted to ITOFF for their comment. The working group has also addressed the format required for the remaining suite of plans which include a master plan, plans for combating of oil at sea, the control and salvage of shipping casualties, and plans for specific installations such as single buoy moorings (SBM).

Important lessons that have been learnt from this programme revolved around the difficulties to be encountered in managing a research programme which sets out to address simultaneously fundamental research, interpretation and communication of results, investigational studies and the implementation of recommendations and guidelines. These various components of the programme involve different levels and types of technology and very often totally different time bases. However, the nature of the oil pollution problem demanded at least an attempt at a multi-faceted approach with due regard to the problems of communication between the different groups involved in the project. The result was a natural dominance of the more fundamental research projects in the earlier stages (associated with signs of impatience from the client body), moving through to the latter stages where the fruits of the research became more obvious but the freedom of the research community became severely curtailed and eventually replaced by specific prescribed tasks. It is thus opportune and probably overdue that research applications in the wider field of hydrocarbon research be again released to compete in the wider field of the Marine Pollution Programme.

PROSPECTS

The Oil Pollution Programme in SANCOR has thus been satisfactorily completed. New applications for research on the effects of hydrocarbon pollution on the coastal environment will in future be handled through the SANCOR Marine Pollution Programme.

The present working group under DEA will continue to act in an advisory/monitoring capacity to assist in the drafting of the remaining plans and be available to assist in the event of an oil spill. This working group will probably meet formally about twice per annum and on an *ad hoc* basis according to the needs of DOT and DEA. SANCOR has no formal role to play in this, but may act in an advisory capacity.

G de F RETIEF

CHAIRMAN: SANCOR OIL POLLUTION COMMITTEE

OIL POLLUTION PROGRAMME: PROJECTS 1985

PROJECTS AND PROJECT LEADERS	DURATION
An evaluation of the effects of experimental pollution of seabirds with crude oil and dispersants (T Erasmus, UPE)	1984 - 1985
Probable effectiveness of protection of South African estuaries by oil booms (PEPSAE)(G de F Retief, US)	1982 - 1985
Verification of oil boom model (VOM) (G de F Retief)	1984 - 1985

MARINE POLLUTION PROGRAMME

STATUS

The beginning of 1985 saw the appointment of a number of new members to the Marine Pollution Committee, including a new chairman. I would like to pay tribute to Dr J K Basson who served as the Committee Chairman since the inception of the programme in 1974. Dr Basson steered the programme through its formative years and his wise council has been felt by all participants of the programme. His guiding influence has led to many of the achievements of the programme and he will be sorely missed.

During the past year the programme has continued along much the same lines as in the previous year, although it appears as though it may be undergoing a slight shift in emphasis. The programme started with an initial period of assessment and monitoring, but towards the end of the 1970's there was a movement towards site-specific and pollutant-specific problems. For the coming year there seems to be a move back towards establishing carefully planned, long-term monitoring programmes. This is in line with a world-wide trend which became clear at a pollution conference in Plymouth in July 1985. The value of long-term sets of good data is beginning to be realised for the monitoring of environmental change, not only in pollution studies but in marine science in general.

At present the programme consists of 18 separate projects covering a wide range of subjects. As in the past, these projects are mostly concentrated in three institutions: National Institute for Water Research (NIWR), UPE and NRIO. Other institutions involved are UCT, ORI, National Research Institute for Mathematical Sciences (NRIMS) and UP. In addition, a large amount of pollution research work is carried out at SFRI in close cooperation with the Marine Pollution Programme but without its financial support.

FINDINGS AND HIGHLIGHTS

The toxicological studies have continued along the Natal coast with investigations into the possible use of mussel larvae in bio-assays. Results of preliminary interlaboratory calibration tests carried out between NIWR and SFRI indicate that the mussel larvae are approximately ten times more sensitive to pollutants than are the eggs of a coral reef fish and the sea urchins which have been used to date. The mussel bio-assays (NIWR) are carried out over a 24-hour period, while those with the sea urchin (SFRI) are even shorter than this. One problem with mussels is that the eggs are not always available since the animals spawn during a limited season, usually May to October. Attempts to overcome this will be made in the coming year either by freezing the mussel embryos or by inducing the mussels to spawn at other times in laboratory aquaria.

The detection of very high concentrations of dieldrin near the mouth of the Reunion Canal is a matter which has received much attention. The concentrations found are among the highest that have been reported anywhere in the world. This situation will need extremely careful monitoring in the future, and all analyses should be accompanied by

thorough verification of results. The source of the dieldrin is being investigated.

Discharge has commenced through the recently constructed pipelines at Richards Bay. The effects of these discharges are being carefully monitored, both chemically and biologically, although it is still too early to assess the degree of impact, if any. The monitoring programme has been carefully planned in collaboration with a statistician to ensure that the results obtained will be statistically valid. A large amount of background information has been accumulated over the past few years, particularly by NIWR and ORI, and this will provide an excellent opportunity to observe whether actual effects agree with predictions. Three executive summaries of the pre-discharge background information will soon be published by NIWR, ORI and DEA and much more detailed scientific reports are also far advanced. The Richards Bay discharge will be a very large one but it is hoped that the care which has gone into the design of the pipeline and the planning of the monitoring programme will ensure that environmental damage will be kept to a minimum.

In addition to this, all other pipeline discharges along the Natal coast are being ranked according to the toxicity of the effluent and the volume discharged. In this way it has been possible to identify those discharges which are potentially the most harmful, and work can be concentrated on these.

The chemical pollution status of East London estuaries and coastal areas was investigated by UPE. Concentrations and distribution of organic carbon, major and minor ions and trace metals in sediments and water samples were studied. Water samples were also analyzed for nutrients and *E. coli*. The investigations found that there was considerable contamination of the Buffalo River by sewage in the aqueous phase and by anthropogenic inputs of copper, lead, zinc, cobalt, nickel and chromium in both aqueous and sedimentary phases. However, the contamination levels decreased rapidly beyond the harbour mouth and within one kilometre there was no evidence of contamination. Along the coast, trace metal and nutrient levels were variable and sometimes were much higher than background with the worst pollution found near Bats Cave. The Nahoon River also showed signs of low contamination.

Experiments on accumulation rates of synthetic organic compounds in fish carried out at UPE, have shown that uptake occurs at a much faster rate than depuration. This means that accumulation is likely to occur over long periods of exposure. This has been confirmed in dolphins, where results have shown that there is an increase in organic loading with length (or age). Female dolphins lose the bulk of their loading during lactation, suggesting that the calves may be exposed to high concentrations of pollutants.

The use of synthetic organic compounds as oceanographic tracers is a subject which is also receiving attention in the eastern Cape. This is an interesting development which may have general oceanographic application.

The study of the effects of sewage discharges on the coastal environment is a subject which has received attention by a number of different groups. The use of the steroid coprostanol as a chemical sewage indicator shows promise, and it is interesting to note that investigations of this compound as a sewage indicator are now being carried out in a number of institutions in Britain. Regular monitoring, both chemical and biological (including microbiological), of the Durban sewage outfalls has indicated that there is little environmental damage to be found along the shore and that there is no health hazard on the beaches.

In Table Bay the discharge of sewage from the Green Point outfall has been related to all other known sources of pollution into the bay, including the harbour, rivers, industrial and natural inputs. Estimations of stormwater and atmospheric inputs have also been included in an attempt to get a mass balance for the whole bay. Just to the north, the effects of thermal pollution from the Koeberg Power Station are being investigated by means of growth studies on mussels.

Health aspects of marine, particularly sewage pollution, are being looked at for the first time with investigations into the monitoring of viruses in shellfish. Methods for the detection of enteric viruses have been tested at NIWR in Pretoria.

The synthesis of metal-binding proteins appears to be a universal defence mechanism by biota against stress arising from metal pollution. These proteins are synthesized only when the metal is available to the organism concerned and their presence may be a more sensitive indicator of metal pollution than some of the more conventional methods. Their presence has been detected in a number of different types of marine organisms. At present, efforts are being made to develop a quick, relatively simple test for the presence/absence of these proteins, which may be used as a field test.

Some simple speciation studies have been carried out on False Bay sediments and metals have been chemically separated into different phases, associated with different fractions of the sediments. These analyses give a good indication of the source of the metals and it is hoped that in future they may be used to distinguish between pollution from, say, a sewage outfall and a stormwater drain.

A very successful workshop was held at the Department of Oceanography of UPE to look at problems with chemical analytical methods in marine studies. Although the Chemical Methods Working Group is a subgroup of the Marine Pollution Programme, the subjects covered by the working group are applicable to the whole spectrum of SANCOR programmes. The workshop addressed three main problems: analysis of organic pollutants, trace metals, and ammonia. Emphasis was on a hands-on approach and all participants were chemists who are active laboratory workers. The problems of interlaboratory calibrations were brought out very clearly.

A report summarising all results from the Marine Pollution Programme since 1979 has been published. This report follows earlier ones and completes 10 years of such work.

Up to now, the Marine Pollution Programme has not had a programme description document, but this document has now been published. It

contains a number of key questions which should be addressed and identifies priority areas where attention is most urgently required. It should be of considerable assistance to both those already involved in the programme and anyone else who wishes to undertake pollution-related research for the first time.

"Water quality criteria for the South African coastal zone", edited by Dr J A Lusher, was published as SANSP Report No 94. The close cooperation between the various participants in the Marine Pollution Programme with Government departments in drawing up this document, emphasizes the importance of this programme to the Government agencies. The document is based on many others of a similar nature from various countries but particularly the approach adopted in Western Australia was followed. In this approach, various 'beneficial uses' of any water body are identified and for each use water quality criteria are set for a variety of potential contaminants. These water quality criteria are defined as limits which must not be exceeded in order to maintain the chemical, physical and biological characteristics of the water body. In this document the concept of mixing zones, the area immediately surrounding an outfall in which the water quality criteria do not apply, is also discussed. The document is at present being applied to a test case in which a pipeline is being designed for the disposal of raw sewage to the sea.

A literature review on the Effects of Crude Oil Pollution on Marine Organisms was published by Prof A C Brown. This was done under the auspices of the Oil Pollution Programme and published as SANSP Report No 99, but is also of direct interest to the Marine Pollution Programme.

SHORTCOMINGS

There is now much information available on the levels and distribution of many pollutants around the coast. However, the dynamics of these pollutants are not known and efforts should be made to determine the rates and routes of pollutant movements within the ecosystem. Some studies of this nature are already being carried out but these should be expanded wherever possible. In this way it should eventually be possible to draw up 'discharge guide plans' for all areas of importance around the coast.

There is some information available on the pollution load of stormwater from some cities, but this is a subject which has been neglected in the past. Published literature indicates that in certain instances inputs of some pollutants to the coastal environment via stormwater may be at least as great as those from many industrial sources.

During the past years there has been much emphasis in the programme on trace metals but less work on trace organic pollutants. Although there are projects dealing with trace organics in the environment, this is an aspect which should be expanded, particularly in the western Cape, where no work of this nature is being carried out.

All data from the programme are being entered into the South African Data Centre for Oceanology (SADCO) database on a regular basis. This is essential for the building up of long-term data sets for the country as a whole.

PROSPECTS

It is hoped that the programme description document will provide a basis for much more cohesion in the programme in future. All prospective participants should take note of the priorities set out before submitting new project proposals. Because of the shortage of funds which applies to all programmes within SANCOR, all new proposals will be scrutinized carefully with a view to answering specific questions which have been raised in this description document.

Closer cooperation between chemists and biologists could lead to some major advances being made. Biochemical and physiological features of animals and plants are those which are the most intimately responsive to contaminants in the environment and it is at this level that the most immediate and quantifiable link between chemical stimulus and biological response is to be found. Defence mechanisms against trace metals are related to metal-binding proteins and some work of this nature is being continued in the programme. However, at present the programme contains no similar work related to organic pollutants although this is receiving attention in other countries. Metabolism of toxic organic compounds is controlled by cytochrome P-450 mono-oxygenase or mixed function oxidase systems, and measurement of the activity of these enzyme systems can be related to organic pollution stress. Research should continue along applied lines in order to characterize observed responses and along fundamental lines in order to understand them.

During the Estuarine and Coastal Pollution Conference in July this year at Plymouth, attended by delegates from 28 countries, my overall impression was that, while pollution researchers in South Africa are thin on the ground in terms of numbers, many of the ideas which are coming out of the programme are at the forefront of pollution research worldwide. This bodes well for the future of the programme.

G A EAGLE

CHAIRMAN: SANCOR MARINE POLLUTION COMMITTEE

MARINE POLLUTION PROGRAMME: PROJECTS 1985

PROJECTS AND PROGRAMME LEADERS	DURATION
Effects of temperature variations and chlorination on marine organisms on the west coast of South Africa especially near the Koeberg Nuclear Power Station (P A Cook, UCT)	1984 - 1986
Interlaboratory analytical calibration studies (D A Lord, UPE)	1980 - 1986
A study of the partitioning and uptake of selected organic xenobiotics in an aquatic ecosystem (D A Lord, UPE)	1984 - 1985
The distribution and effect of selected pollutants in the East London area (D A Lord, UPE)	1982 - 1986
Marine pollution surveys: Metal-binding proteins (H F-K O Hennig, NRIO)	1983 - 1985
Sewage indicators (P D Bartlett, NRIO)	1984 - 1985
Toxicity testing of specific effluents with selected marine organisms (A D Connell, NIWR)	1981 - 1985
Post-discharge monitoring of the Richards Bay pipeline (A D Connell, NIWR)	1985 - 1988
Marine viral pollution (W O K Grabow, NIWR)	1984 - 1986
Juvenile ichthyofauna and sessile marine organisms as indicators of water quality (R P van der Elst, ORI)	1981 - 1986
Statistical principles for coastal biological monitoring (T C Gilfillan, NRIMS)	1984 - 1986
Organics and organotins, eastern Cape (D A Lord, UPE)	1985 - 1987
Transportation of hazardous chemicals around the South African coast (D A Lord, UPE)	1985
Ecology of selected vibrios and faecal bacteria in the Swartkops estuary (D J Livingstone, NIWR)	1985 - 1986
Studies on specific toxic metals in polluted areas on the Natal coast (T P McClurg, NIWR)	1985 - 1988

MARINE SEDIMENTOLOGY PROGRAMME

STATUS

As the Marine Sedimentology Programme completes its fourth year, its pattern of directed research in the open ocean around southern Africa continues systematically to build up a coordinated picture of the marine sedimentology of the region. Hitherto five projects have been completed. At present six SANCOR-funded projects (including one funded through the Benguela Ecology Programme) and six projects funded through the Main Research Support Programme are underway. All of these projects are the responsibility of UCT Marine Geology Unit headed by Prof R V Dingle and one is also a collaborative project with SFRI. Of the 14 researchers and specialized technicians involved in these projects, four are funded by SANCOR. In addition, the Marine Sedimentology Programme acts as adviser and consultant to four other sedimentological projects in other SANCOR programmes.

In 1985, SANCOR awarded an amount of R 107 339 to this programme, representing 66 % of the funds requested. Ship's time continues to absorb a large proportion of the budget (more than 18 %) and this energetic group is to be congratulated on their achievements despite so limited a budget. During 1985 the Marine Sedimentology Programme received only 5 % of the total funds awarded by SANCOR.

Whilst contributing in an advisory capacity to nearshore work the programme has continued to remain essentially 'deep-water'-orientated. In line with the oceanographic efforts of scientific communities overseas, it is considered important that offshore marine sedimentology not be neglected and that a healthy balance of expertise be maintained in South Africa between researchers working in the coastal zone and further offshore. Results obtained by the 'deep-water' marine sedimentologists continue to elucidate or form baseline information for sedimentologists, biologists and physical oceanographers working in other SANCOR programmes.

FINDINGS AND HIGHLIGHTS

Some of the principal findings of the SANCOR-funded and related work include:

Deep currents/sediments project

The bathymetry and geology of large areas of the outer continental margin and ocean basins adjacent to southern Africa have been mapped. This work included the discovery of huge slumped masses (equivalent to land-slides) along the whole margin. Combined with detailed knowledge of the seafloor morphology, such information could have future significance for military, engineering, and mineral prospecting purposes. It has helped us understand the mechanisms of continental margin construction and local sediment flux relating to basin infill, which should be of great interest to the Southern Oil Exploration Corporation (SOEKOR), and has brought into perspective modern continental erosion rates caused by bad agricultural practice. The monitoring of deep-sea currents has assisted

local and overseas physical oceanographers understand the large-scale deep-ocean circulating patterns around the subcontinent. During the course of this work, new instrumentation and techniques were developed that have and will continue to be of use in other projects and programmes.

Micropalaeontology

SANCOR-funding has helped establish the only viable research group in South Africa on fossil and modern calcareous marine plankton, and will soon develop a similar facility for diatoms. The work provides the basis for palaeo-climatic and palaeo-oceanographic studies that will be the only way of testing the predictions made by environmental scientists working on modern situations: eg, fisheries and climatic sciences. A facility for analysis of stable isotopes has been developed, which has potential users in a variety of geological, chemical and environmental areas (eg, estuarine, fisheries, land-form studies). A recently completed study of certain microfossils provides the basis for a biostratigraphic zonation that has potential use in SOEKOR's exploration for oil.

Cape Canyon and Agulhas Bank projects

Both projects will provide detailed bathymetric maps that are of potential use to physical oceanographic, fisheries, SOEKOR, military and engineering programmes. The geological and structural results will be of value to mineral and engineering interests. In particular, the Agulhas Bank work will provide surface geological maps that will be crucial for pipe and seafloor structures should hydrocarbons be produced from the area. The configuration of the shallower parts of the Cape Canyon is possibly relevant to offshore diamond prospecting.

South-eastern Cape Basin project

Mapping and understanding the distribution of manganese nodules off the south-western Cape is an obvious exercise in establishing the extent and potential for deep-water mineral exploitation. Seafloor photography and current monitoring will provide detailed information relevant to physical oceanographic studies in the World Ocean Circulation Experiment (WOCE), as well as helping local workers understand the relationship between deep and shallow circulation patterns. This project will also provide the opportunities to develop and test instrumentation under severe conditions. This could have relevance to military and engineering programmes.

Training

The importance of the training received during the development of instrumentation and new techniques for these projects must not be underestimated. In conjunction with the Geological Survey, and the NRIO team, the SANCOR-funded programmes in the Marine Geoscience Unit at UCT have trained numerous marine geoscientific and technical personnel in geological and geophysical techniques at sea, and in the laboratory - over 30 during the last 19 years.

The highlights of the programme cannot be separated from those of UCT's Marine Geoscience Unit. The move to new self-contained quarters with more laboratory and office space formed the background to a successful year in which seven papers were accepted by international scientific

journals, three PhD's were awarded and one MSc. Other highlights include:

- Recognition for comprehensive award status by FRD;
- Recruiting two post-doctoral scientists from overseas to work on micropalaeontological and geochemical problems;
- Construction of large box corer for use in multi-disciplinary sedimentological projects;
- Production of revised bathymetric map of the Cape Canyon;
- Successful sampling and photography of manganese nodules on the Mozambique Ridge and in the south-eastern Cape Basin;
- Coming-on stream of the stable isotope and analytical facility; and
- The acquisition of programmable seismic recorder.

SHORTCOMINGS

The Marine Sedimentology Programme comprises a close-knit group of scientists working at UCT. This is both a strength and a shortcoming. Within the programme, communication and cooperation are excellent, but inter-programme communication has had a low profile up till now. In the past, little need has been seen to emphasize the multi-faceted nature of this group's expertise and research and its bearings on not only other SANCOR programmes but also on other academic disciplines (eg, archaeology) and resource management (eg, fisheries, minerals). This low profile may have resulted in a poor comprehension of the direct relevance of the programme to the SANCOR community and consequently it appears as if the Marine Sedimentology Programme may have been receiving a disproportionately small slice of the SANCOR budget.

PROSPECTS

With the acquisition of two new scientists and two additional technicians, the basis of expertise of this small group has been substantially improved. Work has been completed on the east coast and is nearing completion off the south coast. Two exciting new areas are being looked at: the diatomaceous muds off Walvis Bay and the manganese nodules in the south-west Cape Basin. Both these projects are a natural consequence of the initial surveys carried out by the programme many years ago and both have exciting fundamental as well as economically applied research value. These projects indicate the trend that is apparent in the programme as a result of its tightly-directed approach, the move from baseline initial investigations to more sophisticated in-depth studies of processes.

I C RUST

CHAIRMAN: SANCOR MARINE SEDIMENTOLOGY COMMITTEE

MARINE SEDIMENTOLOGY PROGRAMME: PROJECTS 1985

PROJECT AND PROJECT LEADERS	DURATION
Cape Canyon: Structure, sedimentology and oceanography (R V Dingle, UCT)	1984 - 1988
The relationship between deep-ocean currents and sediment dispersion in the Agulhas Passage, Transkei Basin and Natal Valley (R V Dingle, UCT)	1977 - 1985
West Agulhas Basin (R V Dingle, UCT)	1985 - 1987
Mesozoic basins of the northern Agulhas Bank and southern Cape (R V Dingle, UCT)	1985 - 1988
Late quaternary palaeo-oceanographic and palaeo-climatic history of the south-west Indian Ocean adjacent to southern Africa (R V Dingle, UCT)	1985 - 1986

PROGRAMME OBJECTIVES

BENGUELA ECOLOGY PROGRAMME

The objective is to provide information on the structure and functioning of constituent ecosystems, to complement the scientific knowledge which is required for the management of the renewable natural resources of the Benguela system. The main geographical focus of this programme is roughly between Cape Agulhas and the mouth of the Orange River, and extending from the coast approximately 200 nautical miles into the ocean. This programme does not incorporate all research along this coast. Rather, it is a multidisciplinary and interdisciplinary programme which gives priority to ecological research in the subtidal and pelagic environments, and devotes a major part of its resources to obtaining ecological information on pelagic shoaling fish of commercial importance, particularly the anchovy.

The programme is undertaken jointly between SFRI, UCT, SAM, UP, PEM and NRIO under the aegis of SANCOR. It builds on a successful SANCOR programme on the communities which live in the kelp beds of the west coast - with the rock lobster as the major commercial resource - and on the research work over many years of SFRI. Through the integration of effort which it has now achieved, it is confidently expected that it will aid substantially those responsible for the management of our fisheries resources. In addition it should contribute state-of-the-art scientific information which will be useful in international efforts aimed at synthesizing, through the comparative approach, knowledge that will reveal universal principles necessary for our understanding of how natural systems are structured and function.

COASTAL PROCESSES PROGRAMME

This programme is limited to the study of those parameters which have a direct bearing on coastal systems. As such, this loose definition implies a system with open boundaries which may include estuaries, onshore areas and offshore areas whenever they form an integral part of the system under investigation; and the zone could vary in width and could extend from the coastal dunes out across the continental shelf.

The objectives of the programme are:

- to identify the key processes which operate in the coastal zone and to define the factors and understand the mechanisms that control them; and
- to contribute information required for the judicious development, management and conservation of the coastal zone and its resources.

An integrated systems approach is followed within which physical, chemical and biological aspects and their interactions are studied. Processes are identified in terms of input/output to and from the coastal zone, external driving forces (including human interference), basic features (including habitat features) and the responses and interactions within the zone.

Priorities on which research is concentrated in this programme are identified and emphasis is given to the study of those factors which are most needed for the understanding of the coastal zone as a whole, with particular reference to understanding the effect on the environment of human interference.

ESTUARIES PROGRAMME

The objective is to provide a scientific understanding of estuaries - in particular of the interactive physical, chemical and biological processes within them, of their interactions with their fringe areas and with their adjacent marine and terrestrial environments and finally of human impact upon them - thereby contributing information required for their wise management.

While it is easy to set such general objectives, a major consideration is that each estuary has its individual characteristics and problems. It has therefore been necessary to set priorities as to which estuaries should receive attention, bearing in mind both research and management needs and to identify specific research requirements.

The following considerations *inter alia* played a role in the identification of the priorities: research and management considerations, industrialization and urbanization, freshwater requirements, agricultural development and forestry, recreation and conservation.

The programme covers estuaries from the Orange River to Kosi, including Langebaan, the Wilderness system, St Lucia and the Kosi system.

MARINE LINEFISH PROGRAMME

In this programme an attempt is made to assess the state of knowledge about marine linefisheries. Certain common problem areas are recognized and the different components of the resource are considered with regard to available knowledge and current research. Important gaps in existing knowledge and research requirements, particularly in terms of fishery management needs, are identified according to type of fishery and geographic area.

The objective of SANCOR is to gain scientific knowledge required *inter alia* to facilitate the efficient exploration, exploitation and conservation of marine resources and the judicious development, management and conservation of the coastal zone. The objective of this programme which has been developed within this framework, is specifically to provide scientific information about this valuable component of the marine food web to aid the development of effective management strategies.

At present research is directed at angling fishes caught in estuaries, rock, surf and open sea environments along different parts of the coast. In addition it was realized early on in the programme that biological research on its own would not be adequate and that trends in the fishery for individual species could only be determined through the analysis of catch statistics, which are provided through the close cooperation of the organized angling community in the country.

OIL POLLUTION PROGRAMME

Oil pollution research in South Africa was financed by DOT and managed by FRD of the CSIR as part of the SANCOR programme. In addition, SFRI conducts appropriate research on effects of oil pollution, which was not directly funded by the programme but was coordinated with it, as relevant. Details of the SFRI work can be found in their annual report.

Much research has already been done on the effects of oil on coastal marine plants and animals, various seabirds and specific ecosystems. In addition, in-depth studies and reviews were done on the applicability of research results obtained in other parts of the world on the sensitivity of the South African coast to oil pollution and the most vulnerable areas in terms of water and wind movement. The highest priority is still to minimize the oil which could reach the coast as well as the effects of the oil which reaches the coast.

For this purpose, comprehensive contingency plans are necessary and the objective of the programme was thus:

- to supply DOT with the relevant scientific information to combat oil pollution;
- to assist in the interpretation of this information
 - . for the purpose of establishing procedures and standards, required for contingency planning,
 - . for decision making during an oil spill.

MARINE POLLUTION PROGRAMME

The programme sets out to advance our understanding of the occurrence and effects of marine pollution processes. The long-term objectives may be stated as follows:

To provide a scientific understanding of the effects of waste disposal on the marine environment, in particular the interactive physical, chemical and biological processes which occur. This understanding is directed towards providing sound scientific advice to the controlling authorities for dealing with waste disposal to the marine environment, implying that information should be presented to the controlling authorities in a suitable form.

These objectives are very general and have been broken down into closely defined short-term goals, aimed at answering specific questions of scientific and management importance. This has been done by identifying major types of pollution sources, as follows: pipelines and other point sources, non-point sources, petroleum hydrocarbons, stormwater discharge, dumping at sea, and seabed activities. This is followed by a list of key questions, which were not placed in order of priority, since priorities differ from one area to another. Instead priorities were set by identifying a number of priority areas, in which a whole range of key questions can be addressed. These areas are: Natal (Richards Bay, the South African Industrial Cellulose Corporation (SAICCOR) pipeline, Bluff), eastern Cape (south-western corner of Algoa Bay, East London),

southern Cape (Mossel Bay area) and western Cape (Table Bay, including the harbour and Camps Bay pipeline).

Emphasis will be placed on developing conceptual models for each of these areas, showing major inputs, pathways and sinks of potential pollutants. Trends in concentrations of contaminants will be evaluated against monitoring work which was undertaken in the programme during the first ten years. In addition, all harbours and dump sites will be studied and particular attention will be paid to the availability of pollutants from sediments. Techniques for measuring biological effects of pollution will continually be updated and toxicity bioassays will be developed.

Notwithstanding these priorities, any large scale pollution event which may take place in the marine environment will be investigated as a matter of highest priority.

MARINE SEDIMENTOLOGY PROGRAMME

This programme seeks to advance our understanding of marine sedimentary processes and products in the South African marine sedimentary environment.

In the broadest sense the programme's main objectives are:

- The establishment of geological models for marine sedimentary environments, in particular with respect to those typical of the South African marine environment.
- The recognition of the evolution and development of the South African continental margin and adjacent ocean basins, including the identification of those sedimentological, geological, physical, chemical and biological features which characterize and contrast the eastern and western continental margins and basins.
- The development of models relating to the physical, chemical and biological processes affecting the transportation, deposition, erosion and diagenesis of marine sediments.
- The production of palaeo-oceanographic and palaeo-geographic models which would be applied to the historic sedimentological and stratigraphic record.
- The prediction of expected changes in sedimentological, climatological and related trends in the marine environment around southern Africa.

Although mainly sedimentological in emphasis, the programme encompasses other scientific disciplines as well. Furthermore, some of the problems addressed require interaction with other FRD programmes. When this happens, it may be appropriate to carry out some of the work under the auspices of those programmes.

TERMS OF REFERENCE OF SANCOR

The terms of reference of SANCOR are to provide policy and scientific guidance in matters pertaining to oceanographic research in South Africa by designating priorities. Specifically it:

- takes cognizance of actions and developments affecting marine science and technology in southern Africa and promotes communication within the oceanographic community;
- reviews the objectives, priorities and progress of its constituent programmes;
- guides effort by deciding on the funding of its constituent programmes, keeping in mind also the need for balance both geographical and disciplinary;
- ensures that its research findings reach decision makers;
- keeps informed on international developments in marine science, *inter alia* by acting as national committee for SCOR and related international bodies.

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LIST OF ACRONYMS

BEP	Benguela Ecology Programme
COPE	Cooperative Oceanographic Project on Ergoclines
CPP	Coastal Processes Programme
CPUE	Catch per Unit Effort
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environment Affairs
DOT	Department of Transport
ENSO	El Nino - Southern Oscillation
ESCOM	Electricity Supply Commission
FRD	Foundation for Research Development
IAMAP	International Association of Meteorological and Atmospheric Physics
IAPSO	International Association for the Physical Sciences of the Ocean
ITOPF	International Tanker Owners Pollution Federation
NIWR	National Institute for Water Research
NRIMS	National Research Institute for Mathematical Sciences
NRIO	National Research Institute for Oceanology
ORI	Oceanographic Research Institute
PEM	Port Elizabeth Museum
PEPSAE	Probable effectiveness of protection of South African estuaries by oil booms
ROSIE	Research on Sedimentation in Estuaries
RU	Rhodes University
SADCO	South African Data Centre for Oceanology
SAICCOR	South African Industrial Cellulose Corporation
SAM	South African Museum
SANCOR	South African National Committee for Oceanographic Research

LIST OF ACRONYMS (Continued)

SANECOR	South African National Engineering Committee for Oceanic Research
SANSP	South African National Scientific Programmes
SASCAR	South African Scientific Committee for Antarctic Research
SBM	Single Buoy Mooring
SCOR	Scientific Commission on Oceanic Research
SFRI	Sea Fisheries Research Institute
SOEKOR	Southern Oil Exploration Corporation
UCT	University of Cape Town
UP	University of Pretoria
UPE	University of Port Elizabeth
US	University of Stellenbosch
VOM	Verification of oil boom model
VPA	Virtual Population Analysis
WITS	University of the Witwatersrand
WOCE	World Ocean Circulation Experiment
WQC	Water Quality Criteria

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