PREDICTING CHANGES TO HYDRODYNAMICS, WATER QUALITY, SEDIMENT TRANSPORT AND WAVE RESONANCE CHARACTERISTICS IN SALDANHA BAY RESULTING FROM ALTERNATIVE PORT EXPANSION LAYOUTS

S.A. Luger, P.M.S Monteiro and R. van Ballegooyen

CSIR, Environmentek, P O Box 320, Stellenbosch, 7599

The possible medium term expansion of the port of Saldanha into the north-eastern sector of small Bay will have a potential impact on the water circulation in Small Bay that could in turn have impacts on water quality, sediment transport and wave resonance. These aspects have been investigated using a suite of coupled numerical models. A hydrodynamic model was used to determine the modification to the current regime due to a number of proposed Harbour layouts. A three-dimensional numerical model was used to simulate the current regime due to tides, winds and water temperature gradients for a range of representative environmental conditions. These results were then used in a water quality model to investigate the potential deposition of organic matter and fine particles of both natural and industrial origin in the Harbour and the fate of other pollutants arising from shipping operations (ore dust and hydrocarbons). In addition, the potential interactions between internal and external sources of pollutants, the potential interactions with mariculture activities and the potential impact on Langebaan lagoon were assessed.

A sediment transport model was then used to determine the likelihood of any potential negative impacts by the proposed Harbour layouts as regards sediment transport dynamics, e.g. the likelihood of sedimentation in the proposed new navigation channels. A resonance model was used to determine the natural periods of oscillation of the various basin layouts in order to assess mooring conditions inside the proposed basins. These model results provided a quantitative assessment of the impacts of the various proposed Harbour layouts as departures from the existing status quo, which allowed the optimum layout to be determined. It was found that all the layouts assessed caused a discernable change to the hydrodynamics of Small Bay, but did not significantly impact the hydrodynamics in Big Bay and Langebaan Lagoon. It was found that the more open layouts outperformed the more enclosed layouts since these layouts minimize stagnant areas which can potentially cause water quality problems due to low bottom shear stresses, which should exceed 0,05 Pa in order to minimize the likelihood of deposition of organic particles.

Sedimentation of the entrance channel could be prevented by suitably designed spur breakwaters could prevent sedimentation of the entrance channel. Regarding wave resonance, rectangular-shaped basins having dimensions, which are multiples of one another, were found to cause potential resonance problems, which could be avoided by minor changes to the basin geometry.
INTER-BASIN EXCHANGES SOUTH OF AFRICA: RECENT DISCOVERIES AND FUTURE PLANS

Johann R. E. Lutjeharms¹, Olaf Boebel¹, Will P. M. de Ruijter², Walter Zenk³ and Tom Rossby⁴

1. Dept. of Oceanography, University of Cape Town, Rondebosch, South Africa
2. Institut voor Marien en Atmospherisch Onderzoek, Universiteit Utrecht, Utrecht, The Netherlands
3. Institut fuer Meereskunde, Carl-Albrechts-Universitaet, Kiel Germany
4. Dept. of Oceanography, University of Rhode Island, Narrangansett, USA

One of the most perennially beguiling problems in physical oceanography has been the nature of the exchanges of water between the South Indian and the South Atlantic oceans south of Africa. Hypothesizing on this process started in the early 1800s and have continued to this day.

Satellite remote sensing has now contributed enormously to a good conceptual understanding of the Agulhas retroflexion, the occlusion of Agulhas rings and their subsequent movement into the South Atlantic. A substantial number of cruises in the region have shown the vertical dimensions of these features, how they react to contact with the atmosphere and how they are affected by shallow features in the bottom topography. A rough consensus on the quantities of heat and salt that are being transported is being reached. Current international research is concentrating on the influence this troughflow has on the Atlantic overturning cell and on the processes of ring splitting. A series of Dutch cruises under the rubric of MARE [Mixing of Agulhas Rings Experiment] are being planned to investigate the manner in which Agulhas rings decay in the southeastern Atlantic.

Flow behaviour in the South West Indian Ocean that may influence the exchange process south of Africa is receiving increased attention. It has recently been demonstrated that the Natal Pulse, an irregularly occurring meander on the trajectory of the current may be largely responsible for the timing of ring spawning events. It has recently been demonstrated that this Natal Pulse extends to great depths. A number of Dutch cruises as part of the ACSEX [Agulhas Current Sources Experiment] are planned to investigate the sources of the Agulhas Current, their variability and how this influences the inter-basin exchange processes. Most of what is known about the inter-basin exchange processes is based on measurements in the layer above the thermocline. One of the most difficult processes to investigate is what happens at intermediate depths. To this end an international programme KAPEX [Cape of Good Hope Experiment] has been put together to cover a large ocean region around southern Africa with sound sources and subsurface floats. This, the largest oceanographic experiment to have been carried out in oceans adjacent southern Africa is now coming to a close and some of the results are presented to illustrate new information on the movements at these depths.

FISHING EFFORT IN THE SOUTH AFRICAN CHOKKA SQUID JIG FISHERY

Genevieve Maharaj¹ and Beatriz A. Roel²

1. Institute of Fisheries and Marine Biology, University of Bergen, Norway
2. Marine and Coastal Management, Private Bag X2, Roggebaai, 8012 Cape Town, South Africa

The South African chokka squid Loligo vulgaris reynaudii is caught by a jig fishery, which targets primarily spawning aggregations off the south coast. The most important management tool currently in place for the squid jig fishery is effort control. However, in spite of attempts to control effort, there are indications that overall effort has in fact escalated over the years. An almost continuous process of upgrading has taken place in the chokka fleet and new, more efficient vessels have replaced older ones over the years. A generalized Linear Model (GLM) has been used to fit catch per unit effort data as a function of resource abundance, catch position and vessel characteristics. The results are used to obtain an estimate of annual standard fleet capacity and of changes in this measure over time. Recent management regulations to reduce fishing effort in the chokka squid fishery were evaluated by looking at their impact on standard capacity.
THE IMPACT OF HUMAN EXPLOITATION ON ROCKY SHORE MACROFAUNAL COMMUNITIES IN CENTRAL TRANSKEI

Nonttsikelelo V. Majiza

Zoology Dept., University of Transkei, P/Bag X1, Umtata 5117 South Africa

The impact of human exploitation on the structure of rocky intertidal macrofaunal communities in Central Transkei, an area thought to experience considerable exploitation pressure, is examined. To determine the effect of such disturbance on community structure, the biota from the mid- and low-shore areas at three sites with different exploitation levels was compared with that of a non-exploited site. Community attributes such as species richness, diversity, evenness and macrofaunal abundance were compared across sites using ANOVA. Graphical techniques such as ABC curves and multivariate analyses such as ordinations were also used to compare the biota of the exploited and non-exploited sites. Finally, an attempt was made to correlate the differences in community structure with the differences in the intensity of exploitation.

Significant across-site differences were found in the mean estimates of all the parameters examined but these could not be directly related to the exploitation gradient. The trends evident in the ABC curves, dendrograms and ordinations also did not appear to be linked to the intensity of exploitation. The tendency was for the samples to group into southern and northern-most sites, which suggests that alongshore trends may have a greater effect on community structure than exploitation in this region.

SEAWEED TAXONOMY: A SOLUTION TO ECOLOGICAL STUDIES ON CORAL REEFS

Gavin W. Maneveldt, and Derek W. Keats

Botany Dept., University of the Western Cape, P. Bag X17, Bellville 7535, South Africa

Coralline algae are widespread in shallow water in all of the world’s oceans, where they often cover close to 100% of rocky substrates. Nowhere are coralline algae more important than in the ecology of the complex biological structures that we know as coral reefs. Not only do coralline algae help cement the reef together, but they comprise a considerable portion of the mass of the reef itself, and are important sources of primary production, food for certain herbivores, and of sediments.

Of particular significance in the ecology of coral reefs on a worldwide basis are various species of non-geniculate coralline algae that have been ascribed to the now defunct genus Porolithon Foslie (1909). In 1998 Penrose and Woelkerling subsumed this genus along with the genus Hydrolithon Foslie (1909) in Spongites Kutzing (1841). Later in 1992, they restored Hydrolithon to genetic status and moved the type of the genus Porolithon to Hydrolithon; Porolithon is now regarded as a heterotypic synonym for Hydrolithon. 22 Species have however been ascribed to Porolithon and along with P. onkodes, only 7 others had subsequently been placed into Hydrolithon; 1 of these finding its way into Pneophyllum. The remaining 14 species previously ascribed to Porolithon have not been examined in light of these changes.

There has been much historical inconsistency in the taxonomic treatment of the Spongites, Hydrolithon, Porolithon group and subsequently there is a need for a complete revision at the generic level of all these taxa. The possibility that these and other species once ascribed to Porolithon may be conspecific has not been examined in a modern context. It is therefore the purpose of this paper to revisit those taxa originally ascribed to the now defunct genus Porolithon and examine them in light of those changes brought about since 1988.
THE EFFECT OF Zostera capensis ON INVERTEBRATE ABUNDANCE AND WADER FORAGING ECOLOGY IN THE SWARTKOPS ESTUARY, EASTERN CAPE

Caryn Manicom\textsuperscript{1}, Joanne M. Boule\textsuperscript{1}, and Jane K. Turpie

1. Zoology Dept., University of Cape Town, Rondebosch, 7701
2. The Percy FitzPatrick Institute of African Ornithology, University of Cape Town, Rondebosch, 7701

The Swartkops estuary near Port Elizabeth has a high invertebrate abundance and is therefore an important feeding ground for migrant waders. The eelgrass \textit{Zostera capensis}, growing within this estuary, undergoes natural fluctuations in density over varying time-scales. This study aimed to investigate the abundance and distribution of invertebrates in relation to \textit{Z. capensis} density. Furthermore, the distribution, foraging efficiency and prey biomass captured by waders in relation to the density of \textit{Z. capensis} were observed.

Six sites, each containing a range of \textit{Z. capensis} densities, were selected at low tide in the estuary. Samples of 0.2 m\textsuperscript{2} to a depth of 0.1 m were dug in dense, moderate and non \textit{Z. capensis} habitats and sieved through a 1.0 mm mesh. Invertebrates were identified, and invertebrate and \textit{Z. capensis} biomass for each sample obtained. During wader observations, scan samples were carried out at half-hour intervals at low tide and species, foraging status and habitat were recorded. Five-minute focal observations of Wimbrels \textit{Numenius phaeopus} and Grey Plovers \textit{Pluvialis squatarola} were made record foraging behaviour and number and type of prey captured.

Preliminary analysis appears to indicate greater invertebrate abundance and a preference and high rate of capture by waders foraging in \textit{Z. capensis} beds. However, detailed analysis still needs to be completed.

THE PONDOLAND MARINE PROTECTED AREA - TO BE OR NOT TO BE?

Bruce Mann\textsuperscript{1}, Rob Broker\textsuperscript{2}, and Div de Villiers\textsuperscript{3}

1. Oceanographic Research Institute
2. KwaZulu-Natal Nature Conservation Service
3. Eastern Cape Dept. of Nature Conservation

Establishment of a large marine protected area (MPA) on the Pondoland coast is urgently needed to fulfill the functions of biodiversity protection, fisheries management and sustainable utilization of marine resources. In terms of biodiversity protection, the Marine Reserves Task Group has identified this area as an important gap in the current distribution of large MPAs along the South African coast. In terms of fisheries management, establishment of a MPA in this region has been identified as one of the best management options to rebuild depleted line fish stocks and to ensure the seeding of adjacent exploited areas. This would also apply to exploited invertebrate resources found in the area. Furthermore, the development of an integrated MPA management plan for this region will greatly enhance tourism potential of the Pondoland region as a whole and provide much needed employment for coastal communities. Evaluation of this area using the recently developed COMPARE methodology (Criteria and Objectives for Marine Protected Area Evaluation) is presented and a draft procedure to establish this important MPA is discussed.
Marine education in South Africa has advanced considerably in the last 10 years. In the early years, marine education was seen primarily as an activity for scholars and was given more 'lip service' than real support. However, changes in the political climate of the country, in attitudes to resource management and in the role of the public in ensuring the sustainable future of our coast, have seen increasing emphasis being placed on the role of education in marine and coastal management. The need for focused marine education and training has also been recognized by a number of new policies and Acts in South Africa. The Marine Living Resources Act (1998) and the new coastal Management White Paper (1999) have both stressed the need for greater public awareness and specialized training in order to build capacity amongst the general public, resource users and managers.

In this paper we will look at the broad range of marine education initiatives currently underway in South Africa. The paper will primarily examine activities in the coastal provinces, although the importance of marine education in the landlocked provinces should not be forgotten. The paper will draw on the expertise of some of the participants at the first South African Network for coastal and Oceanic Research (SANCOR): Marine and coastal Educators Network workshop held in Glenmore in January 1999. Programmes with conservation staff and local resource users, teacher education programmes and scholar workshops in Kwazulu-Natal, initiatives with scholars and divers in the Eastern Cape and community outreach programmes, mass media campaigns and resource material production in the Western Cape will all be examined. The impact, effectiveness, cost and sustainability of these initiatives will be discussed. The paper will also look at future needs for marine education and will give some suggestions as to how these needs can be addressed.

Field studies on the feeding habits of Cape horse mackerel *Trachurus trachurus capensis* in Namibian South African waters have provided useful baseline information on the types and relative quantities of prey consumed by this species. Crustacean zooplankton, primarily copepods and euphausiids, are the most common prey items found in horse mackerel stomachs, and these prey seem to be ingested selectively. Laboratory studies have demonstrated that both prey size and prey type affect selection. Because they are size selective feeders, horse mackerel ingestion rates are likely to vary with prey size. Laboratory experiments will be conducted to examine the feeding behaviour, selectivity and rates of ingestion of juvenile horse mackerel offered prey of different sizes. Preliminary results permit an assessment of the relationship between prey size and ingestion rate. Large preys are generally ingested at a higher rate than small prey. However, preferential feeding by horse mackerel on prey types that may not be the largest available complicates this relationship.
The prioritization of South African estuaries for conservation and management purposes is currently receiving increasing national attention. A multidisciplinary approach has been initiated in which various estuarine biota are to contribute to a national prioritization analysis. As a contribution to this initiative, a 'Fish Importance Rating' (FIR) project has been initiated, resulting in a ranking of South African estuaries in which their importance to estuary-associated fish is prioritized.

Constituting the basis of the FIR project, the distribution (presence/absence) and abundance records of selected estuarine-associated fish species in 251 South African estuaries were reviewed from various sources, and compiled to create a comprehensive, national 'estuarine-ichthyofaunal' database. The FIR for South African estuaries incorporates seven major criteria that will reflect the importance of estuaries to fish:

- The potential number of species in each estuary;
- The potential number of endemic species in each estuary;
- The potential number of recreational and economically important species in each estuary;
- Estuarine size;
- Estuarine type;
- Estuarine condition;
- Estuarine isolation.

Within each criterion, data are subjected to a scoring system that ultimately results in the production of a fish-based estuarine ranking protocol. Species accounts in South African estuarine systems are considered and related to the criteria above in order to highlight trends, potential conservation hotspots and to investigate patterns that may aid in the improved understanding of the 'potential' distribution of fish species in South African estuaries.

Oral

ENVIRONMENTAL INFLUNCES ON THE VERTICAL DISTRIBUTION OF CAPE HAKES OFF THE WEST COAST OF SOUTH AFRICA

Ralton Maree\textsuperscript{1,2}, Manuel Barange\textsuperscript{2} and Greville Nelson\textsuperscript{2}

1. Dept. of Ichthology and Fisheries Science, Rhodes University, Grahamston, South Africa, 6140
2. Marine and Coastal Management, Private Bag X2, Roggebaai, 8012

The demersal fishery off the West Coast of South Africa experiences decreased catches per unit effort of hake, \textit{Merluccius capensis} and \textit{M. paradoxus}, following the onset of strong south easterly winds. Research has demonstrated that, during daylight hours, Cape hakes migrate vertically in the water column in response to strong south easterly winds, decreasing their availability to the bottom trawl. Hydroacoustic, trawl and environmental data were collected off the West Coast during both calm and wind-swept periods in an attempt to understand the forces that initiate this behaviour and its spatial variability. Near-bottom currents appear to be the primary factor influencing the vertical distribution of the demersal fish community, of which hake constitutes a large proportion, during daylight hours. Correlation between wind and near-bottom currents suggest that the poleward component of the currents increase in velocity within eight hours following the onset of south easterly winds. The fish avoid boundary layers where currents change direction and speed dramatically, and seem to concentrate in waters with relatively stable current regimes. This result questions the assumption of CPUE-based assessment models that hake availability to the bottom trawl is constant or varies randomly.
Redistribution, Sustainable Usage and Stability
in the South African Squid Fishery

D. Mather, W Sauer and P Britz

Dept. of Economics, Rhodes University, P O Box 94, Grahamstown 6140, South Africa

The new Living Marine Resources Act (1998) embodies three underlying and fundamental tenants: equity, sustainable usage and stability. Stability and sustainable exploitation, along with economic efficiency, are well documented and can be more or less achieved. However, with redistribution -- or equity -- constraint, added uncertainty is introduced which affects the established incentive structures of existing fishers. These incentives lead to industrial instability and overexploitation, which places the resource under strain. Although Government intervention is needed due to the open access nature of the squid fishery, from an economic and organizational efficiency point of view, a smooth and rapid transition period could be achieved using, as far as possible, a market driven or organic process. The paper argues that rather than redistributing short term 'men licenses', long term nontransferable boat licenses be used as an equity incentive for the squid industry to rapidly and lastingly transform itself.

Poster

The Effect of Environmental Factors on the Distribution of the Cape Hake Merluccius capensis in the Benguela Region

Justus Matshile¹, Rob Tilney², Coleen L Moloney², John G. Field³ and Rod Bally¹

1. Marine and Coastal Management, Private Bag X2, Roggebaai 8012
2. Zoology Dept., UCT,

The Cape hakes species form the basis of the most valuable fishery in South African and Namibian waters. M. capensis is dominant in Namibian waters and preys on anchovy, mesopelagic fish, myctopids, cephalopods and euphausiids. The waters of the Benguela region encompass the coastal upwelling regime, frontal jets as well as the eastern part of the South Atlantic gyre. The shelf waters of the Benguela region frequently have oxygen levels even becoming anoxic at times, with variable bottom temperatures ranging from 7-16 C. Cape Hakes tend to undertake diurnal vertical migrations as well as some horizontal movement. This research aims at using GIS (Geographical Information System) to assess the environmental factors responsible for the distribution of the M. capensis by relating patterns of such environmental parameters to the distribution patterns and movement of this species. GIS is well suited to analyzing the patterns of temporal and spatial variability of both hake and the environmental parameters likely to influence them, in relation to upwelling and longer-term movements of water masses.
RESERVES FOR ROCK LOBSTERS: ARE THEY JUST A BUREAUCRATIC BLUNDER?

Stephen Mayfield, Lara J. Atkinson and George M Branch

Zoology Dept., University of Cape Town, Private Bag, Rondebosch 7701

Marine reserves around the world are important to numerous exploited species because they play pivotal roles in the recovery of overexploited stocks and maintaining stability of harvested species. There are three sanctuary areas for the West Coast rock lobster along the cape peninsula of South Africa. They were not considered vital for stock enhancement through either migration of adults (adults are thought to be largely territorial) or enhanced egg production from reserves (reserve areas probably too small).

Over the last 18 months an intensive ongoing survey involving the use of commercial rock-lobster traps, ring nets and SCUBA-divers has estimated rock-lobster abundance, size-frequency distributions, sex ratios, catch and egg production from both sanctuary and non-sanctuary areas while a contemporary project is examining large and small-scale movements of the species. No rock lobsters were caught or observed during dives in either the St Helena Bay sanctuary or adjacent area. For the other three sanctuaries, preliminary data show that rock lobsters were not more abundant in sanctuary areas compared to exploited areas although sanctuary areas tended to house generally larger individuals.

Female rock lobsters collected from sanctuaries were not carrying more eggs per unit body length, compared to rock lobsters outside of sanctuaries; reserve areas do not generate more eggs per unit area when compared to non-sanctuary areas. We estimated the proportion of the total annual rock lobster egg production emanating from sanctuary areas to be about 7%. This is approximately equal to the proportion of the coast over which rock lobsters are protected (6.6%).

Rock lobsters do not show substantial long-shore movements and a reasonably high level of whole fidelity. This would explain the absence of a local increase in CPUE in the commercial fishery on the fishing grounds immediately adjacent to sanctuary boundaries. Consequently, reserves for rock lobsters are probably not useful as spillover sources to fished out areas.

The reserves do not seem to be fulfilling the roles for which they were designed. The St Helena sanctuary is a classic example of a misplaced sanctuary -- not only is it situated in an area subject to periodic black-tide catastrophes, but it was placed there principally to prevent trap lines fouling shipping lanes. The others were likely to have been selected on inadequate information and contain large areas unsuitable as rock-lobster habitat. There is a real danger that they misrepresent any conservation image they may hope to project.

Poster

ABUNDANCE AND DISTRIBUTION OF Dotilla fenestrata AT TWO ESTUARIES IN SOUTH AFRICA

Victricia McArthur, Denver Goliath, Olivia de Wit1, Ndumisa Bokveldt1,2, and Mark J. Gibbons1

1. Zoology Dept., University of the Western Cape, Private Bag X17, Bellville
2. Zoology Dept., University of Fort Hare

The soldier crab, Dotilla fenestrata is an abundant ocypodid crab found on sandy shores of subtropical Africa. It burrows intertidally and the crab remains buried whilst its habitat is covered with water. As the tide recedes it emerges to feed, using its mouthparts to sort the organic fraction from the surface layer of sand. Field observations suggest that the distribution of these crabs is stratified down the shore, and furthermore, that they are limited to certain areas of the intertidal zone. To investigate this variation two populations of this crab were examined; one found at the mouth of the Breede estuary (the southern most limit of this species) and a second population from Durban Bay. To compare abundance and distribution transects were done perpendicular and parallel with the shore. All the crabs in a 0.25 m² area were measured and counted at 5 m intervals down (to low tide level), and at 10m intervals along the shore (extending beyond the boundaries of the populations). At each sampling station sediment was collected and analyzed for grain size, pore water, and organic content. The distribution of the crabs was found to be similar at both sites. Small crabs were found closest to the waters edge and larger crabs higher up the shore. This was correlated to the greater concentration of organic matter found in upper shore sediments (making it a preferred habitat) and the firmer sand on the higher shore, allowing deeper burrows to be built and access to the water table to moisten gills. The distribution of the population along the sandy shore is limited at the boundaries by the pore water concentration of the sand; poor drainage produces a sand consistency that is unsuitable for burrow building. It is concluded that physical characteristics of the shore had a direct effect on the soldier crab distribution.
THE USE OF VIDEO IMAGING AND MULTIMEDIA DATA STORAGE TO FACILITATE MARINE BENTHIC ECOLOGICAL IMPACT ASSESSMENTS

T.P. McClurg and S.V. Gumede

Division of Water, Environmental and Forestry Technology, CSIR Box 17001, Congella, South Africa

Changes in benthic community structure are widely used in monitoring the impact of marine pollution. This often entails painstaking microscopic analysis and reference to many keys and preserved specimens. The procedure is usually time-consuming and may delay decision-making. Recent advances in information technology, and particularly in image processing, have provided potential for streamlining the process. This can be achieved by storing images of specimens, with appropriate keys and text, in an interactive read/write multimedia framework. Aside from saving time, this approach enables greater consistency between sequential surveys and facilitates consultation with specialist taxonomists (by allowing image transfer via internet). It has particular relevance in remote situations where there is little taxonomic expertise but a need for regular and consistent monitoring. It is anticipated that tailored packages could be produced to suit specific needs at remote locations. This paper describes a system, which is being devised for use along the southern Africa coast.

ENVIRONMENTAL INDICATORS IN ESTUARIES: CRITERIA AND SELECTION

L.E. McGwynne and J.B. Adams

1. SAB Institute for Coastal Resource Management, University of Port Elizabeth
2. Botany Dept., University of Port Elizabeth

The Marine Integrated Development Support System (MIDeSS) aims to provide all role players in the coastal zone with clear, accessible, up-to-date information, data and advice to facilitate sustainable development and sound management. The system will be web-based and will incorporate and integrate biophysical, economic, social and legal considerations and guidelines. The development of appropriate indicators to describe and evaluate the ecological status of estuaries along the South African coastline will provide managers with simple measures that can accurately summarize and communicate key aspects of these systems. Furthermore, the use of indicators can broaden the understanding of ecosystems, highlight research priorities, predict emerging problems, and address national and international monitoring priorities, regulatory and policy needs. This paper describes the criteria used to identify indicators for South African estuaries and presents an appropriate selection.

FISHING FOR INFORMATION ON CD-ROM AND THE INTERNET: SO WHAT GEAR IS AVAILABLE AND HOW GOOD IS IT?

A.S. McPhail and M. Crampton

The innovative move of publishing bibliographic data bases on CD-ROM, and more recently the Internet, has greatly enhanced the electronic storage and retrieval of vast amounts of information. This information is readily available to aquatic scientists and covers a wide variety of topics from ichthyology and ecology, to fisheries management and aquaculture. This paper considers the relevant terminology used in this area of information technology, and evaluates the tools available to researchers for accessing such data. Comparisons are drawn between these tools in terms of subject coverage, and in terms of cost effectiveness. CD-ROM publications discussed include Fish and Fisheries Worldwide (FFW), Aquatic Biology, Aquaculture and Fisheries Resources (ABAFR), Aquatic Sciences and Fisheries Abstracts (ASFA), Marine, Oceanographic and Freshwater Resources (MOFR), as well as various other titles. The numerous advantages of publishing on CD-ROM and the Internet are discussed and a brief look is taken at the respective software retrieval systems.
THE CHEMICAL ECOLOGY OF THE NUDIBRANCH, Hypselodoris capensis, IN THE TSITSIKAMMA NATIONAL PARK

Kerry McPhail, and Michael T. Davies-Coleman

Dept. of Chemistry, Rhodes University, Grahamstown, South Africa

The endemic South African nudibranch Hypselodoris capensis is a colorful member of the family chromodorididae, a group of soft-bodied opisthobranch molluscs whose striking coloration implies a chemical defense strategy. Dorid nudibranchs are specialist feeders that have evolved the ability to selectively take up and store bioactive metabolites from marine invertebrates, such as sponges, soft corals and bryozoans, which are rarely fed upon by other organisms. These metabolites are known as marine natural products and are generated as part of the invertebrate's secondary metabolism. They are used by the soft-bodied nudibranchs to defend themselves against fish and other molluscan predators. Ecologists use these marine natural products to reveal complex food webs comprising predator-prey relationships, which may not be evident through underwater observation or biological approaches such as analysis of gut contents for evidence of the prey species.

Initially, as part of our ongoing marine natural product research in the Tsitsikamma National Park the nudibranch Hypselodoris capensis was collected together with the dark green Fasciospongia sponge on which it was found and presumed to be feeding. A known series of marine natural products together with a new derivative was isolated from the nudibranch. This chemistry matched that of the sponge, which contained a further compound, furanosinulosin, not found in the nudibranch. However, other chemical compounds, the nakafurans, were found only in the nudibranch and were recognised from the literature as being characteristic of another genus of sponge, Dysidea. On returning to the collection site in the Tsitsikamma National Park, H. capensis specimens were observed on a dirty white sponge. An examination of this sponge's chemistry revealed the presence of the nakafurans, confirming that this Dysidea sponge is another dietary source of defense chemicals for H. capensis.

C.D. McQuaid

Dept. of Zoology and Entomology, Rhodes University, Grahamstown 6140, South Africa

The intertidal mussel Perna perna is intensively exploited for food on the south and east coasts of South Africa. Rates of inshore primary production decrease from west to east along the coast, coinciding with increasing density of coastal human populations. As a result non-commercial, subsistence level exploitation is most intense where the ability of mussel productions to sustain exploitation is likely to be lowest. Several population parameters are influenced by degree of wave exposure, but the effects depend on height up the shore. Densities of plantigrade settlers decrease upshore. Settler densities are also higher on exposed sites, though only on the low shore. Growth is twice as fast on exposed shores as on sheltered shores. Although mortality rates are also higher on exposed shores, they support larger mussels. As with recruitment, differences between exposed and sheltered shores disappear farther upshore. These findings indicate that mussel populations on exposed shores are likely to be more resilient to exploitation than sheltered shores because recruitment and growth are more rapid. Ironically, just as the eastern coastline is both more vulnerable and more heavily exploited, so predation pressure by people is likely to be greater on the more accessible sheltered shores.
COMPARISON OF THE ICHTHYOFANA IN THE SEA>FARM DAM WITH THAT OF THE SURROUNDING SURF ZONE OF SALDAHNA BAY

Nicky McQueen and Pete Cook

Zoology Dept., University of Cape Town

Data from three separate studies were used to assess the fish communities inside the Seafarm dam, and in the surf zones immediately surrounding it, in Saldanha Bay. Fish were sampled using beach-seine and gill nets.

Thirty-four species of fish were caught in all three studies, with 14 being found exclusively in the dam and 8 being found only outside. The remaining 12 were present in both areas. Densities of juvenile fish were found to be much higher outside the dam, whereas the maximum sizes obtained by the fish were generally much larger inside the dam. Catch per hour rate was higher outside the dam for certain species, notably *Liza richardsonii*, *Mustelus mustelus*, *Myliobatis aquila* and *Callorhinchus capensis*. For the species *Pomatomus saltatrix*, *Trachurus trachurus*, *Rhabdosaurus globiceps* and *Spondyliosoma emarginatum*, catch per hour rates were much higher inside the dam. In the case of the trek net data, all densities outside the dam were larger, but most noticeable were those for *Rhabdosargus globiceps*, *Liza richrdsonii* and *Atherina breviceps*.

Size comparisons amongst species common to both the dam and the surf zones revealed that there are generally more large individuals of certain species inside the dam.

Species diversity was found to be much higher inside the dam than outside, probably due to a higher habitat diversity created by manmade structures, as well as a higher availability of food in the dam, than is present in the surf zone for certain species. The majority of species found only in the dam feed on benthic invertebrates, which are more plentiful within the dam due to the deposition of silt and mud caused by reduced water movement.

Although there were no strong trends, it would appear that the Seafarm dam provides a sheltered, protected environment for fish, similar to that of an estuarine system, with similar food resources, but without the fluctuations in salinity found in an estuary.

SPATIAL ANALYSIS OF THE CAPE HAKES (*Merluccius paradoxus* AND *Merluccius capensis*) IN RELATION TO ENVIRONMENTAL PARAMETERS OFF THE WEST COAST OF SOUTH AFRICA

Dinah Millar and John Field

Marine Biology Research Institute, University of Cape Town, Rondebosch, 7701 Cape Town

Generalized Additive Models (GAMS), nonparametric regressions without the assumptions of normality or linearity of traditional regression methods, were used to test the hypothesis that trends in hake abundance are related to ocean environmental conditions including bottom temperature, bottom oxygen concentration, sea surface temperature, sea surface temperature minus bottom temperature (as a measure of stratification or mixing) and location including longitude, latitude and bottom depth. In addition, GAMS were used to try to increase the precision of existing biomass estimates by including detected trends in the model. Trawl survey data collected from 1984 to 1997 off the west coast of South Africa were used to test these relationships. GAM provided reasonable fits to the spatial distribution of the Cape hakes, with bottom depth being observed as the primary determining factor for hake distribution and abundance. The biomass and biomass variability estimates produced by the GAM are lower then those previously predicted by traditional methods but follow a similar trend.
Oral

PATAGONIAN TOOTHFISH – MANAGEMENT OR MAYHEM?

Denzil G.M. Miller

Marine and Coastal Management P/Bag X2, Rogge Bay, 8012

The history of the South African fishery for Patagonian Toothfish (Dissostichus eleginoides) in the Prince Edward Island EEZ is described. Uncertainty concerning stock yield and potential catch limits is highlighted. The impact of illegal fishing on the resource is identified as a key factor affecting future management of the stock. The development of fishery is discussed in light of the implementation of the ‘new’ South African fisheries policy and in respect of possible lessons to be learned.

Oral

SIMULATION OF EUTROPHICATION AND PARTICLE DYNAMICS IN A BAY SYSTEM IN ORDER TO PREDICT THE TRANSPORT AND FATE OF TRACE METALS USING THE DEFT3D-FLOW AND -WAQ MODELS

P.M.S. Monteiro, S. Luger, P.J. Pretorius, and R. van Ballegooyen

Marine Water Quality and Hydrodynamics Group, CSIR PO Box 320, Stellenbosch, 7599 South Africa

Saldanha Bay, located 100km north of Cape Town, South Africa, in the southern Benguela upwelling system, is a rapidly expanding industrial, shipping, tourist and mariculture centre. This study integrates the work of three components of a research programme to predictively model the transport and fate of trace metals and other water quality concerns by model simulations of hydrodynamics, particle and eutrophication dynamics and trace metal partitioning. The main objective of this study is to investigate the hypothesis that copper accumulating in the western margin of Saldanha Bay originates from a discharge of ore dust into a far-field sedimentation area. The trace metals are then released into the overlying oxic water through dissolution and, through the interaction of hydrodynamics and biogeochemical forcing they are transported and re-concentrated in a remote depositional area. This study demonstrated the synergy linked to the interaction of eutrophication processes, which lead to the formation of organic rich anoxic sediments, and discharges of effluents containing trace metals. The modeling results show that whereas lithogenic particles govern the transport of Cu, it is the deposition and accumulation of organic matter that governs the long-term fate of these potentially toxic trace metals. Overall, the study shows how non-steady state approach to the complex biogeochemical interactions in marine systems helps improve both understanding and predictive capacity in a quantitative way.

Poster

PHENOLOGY AND GROWTH IN CULTURE OF TWO CARRAGEENOPHYTES, Sarcothalia scutellata AND Grateloupia filicina

T. Morley¹, J.J. Bolton¹ and R.J. Anderson²

¹ Botany Dept., University of Cape Town, Private Bag, Rondebosch, 7701 South Africa
² Seaweed Unit, Sea Fisheries Research Institute, Private Bag X2, Roggebaai 8012, South Africa

An intertidal population of two carrageenophytic species was investigated over the course of a year. Factors investigated included carrageenan content, phase composition, frond mass and fecundity. Only gametophytic fronds of Sarcothalia scutellata were found to be a potential source of carrageenan in terms of yield. This species was gametophyte dominated whereas Grateloupia filicina was sporophyte dominated. The tetrasporic fronds tended to have larger average frond masses than carposporic fronds in both species. Fronds also tended to have larger average masses in summer. Both species remained fertile throughout the study period. Fewer fertile structures were produced in June by S. scutellata and by the tetrasporic fronds of G. filicina. The female gametophytes of the later species showed little variation in the number of carpospores produced on the few gametophytic fronds that were found. Greater numbers of carpospores were released than tetraspores in both species. More spores had germinated by the third day in spores that were clumped compared to those that were isolated. The two species showed similar responses to temperature and light with highest growth occurring from 15 to 21°C and light saturation occurring around 30 to 60 µE.
Benefit Oral

NEAR-SURFACE CURRENTS AND HYDROLOGY IN THE NORTHERN BENGIUELA IN JULY 1999


National Marine Information and Research Center, Ministry of Fisheries and Marine Reseources, P.O. Box 912, Swakopmund, Namibia

In July 1999 the near-surface currents and hydrology of the northern Namibian shelf (21ºS and 19ºS) were studied on board FRS Africana as part of the 'BENEFIT' program. Work included the measurement of currents by means of a shipboard ADCP with differential GPS input as well as the analysis of temperature and salinity values obtained with a CTD to study both horizontal and vertical patterns of these parameters. In addition, infrared satellite imagery for the time of the cruise was interpreted for the horizontal distribution of sea surface temperatures and the possible indication of fronts suggesting current flow and surface water mass distribution. Four latitudinal transects was made, mainly to study the current flow in the area whilst the vessel was underway.

Consistent northward current flow on the inner shelf with virtually no counter-current was observed. Currents on the outer shelf showed a more southward flow, whereas those in the central regions were weak and variable. Close studies of the infrared image, the vertical profiles of temperature and salinity along transects as well as the horizontal distribution of sea surface temperature and salinity, suggested the presence of upwelling around 20ºS and between Cape Frio and the Cunene river.

Oxygen values across the sections ranged between 5-6 ml/l at the surface and 0.5-1 ml/l closer to the bottom. In some sections, large volumes of oxygen-poor water (0.5-1 ml/l) occurred between 100m and 300-400m, extending offshore. Smaller volumes of these oxygen-poor waters were observed closer to shore at depths ranging between 30m and 60m.

Oral

CAGE CULTURE OF SPOTTED GRUNTER (Pomadasys commersonii) & DUSKY KOB (Argyrosomus japonicus)

A.J. Mperdempses¹ and T. Hecht²

¹. Dept. of Ichthyology and Fisheries Science, Port Alfred Laboratory, Port Alfred
². Dept. of Ichthyology and Fisheries Science, Rhodes University

A comparative study between cage culture and land-based tank culture is being undertaken in order to determine which of these two methods would be more viable, biologically and economically, on a commercial scale. The aim of this work is to determine the commercial and biological viability of spotted grunter in cage culture and to determine the extent to which kob are suitable for cage culture. The objectives were to: (1) assess production /specific growth rate (SGR), condition factor (CF), food conversion ratio (FCR), coefficient in variation (CV), and the optimal ration size of juvenile spotted grunter in cages and tanks at different feeding frequencies. (2) To determine differences in growth using SGR, CF, FCR, and CV between kob growth in cages, and kob in land-based tanks; (3) to wean juvenile and adult grunter onto artificially formulated diets; (4) to conduct a behavioural study of fish in cages, including gut analysis to determine whether fish are feeding on alternative food sources to what they are fed. Collection and transportation of seed stock: During the first year of this project an experiment was initiated to determine what the best approach would be to transport juvenile spotted grunter and kob with minimum mortalities. Land-based tank facility and cage culture facility: The tank-based experiments are being conducted at the Rhodes University Marine Laboratory in Port Alfred. Cages have been placed in the port Alfred Small Boat Harbour. The dimensions of the pilot cages are 1.5 X 2.0m (1.5 immersed and 0.5m freeboard) providing an effective volume of 3.38m³. Mesh size of nets is 18mm.

Stocking Density: The first cage experiment was designed to determine optimal stocking density. Fish were stocked in duplicate batches of 6, 12 and 18 kg/m³. Initial mean size and weight of the fish was 12.8cm and 27.4g. Feeding: An experiment to test the suitability of various feeds was undertaken in land-based tanks. The feeds tested included a moist pellet, squid heads, pilchards and a combination diet of pilchard and squid. Fish Behaviour and Feeding: Behaviour of the fish monitored through the use of an underwater video camera may give insight as to how the fish feed utilize the water column, and to what extent there is competition amongst fish.

Growout: The comparative growth experiment between kob and the spotted grunter in cages has yielded interesting results. After 8 months kob had grown from 12cm TL (23.6g) to 41.2cm (705g), while the grunter in 8 months had grown from 12.8cm (27.4g) to 24.2cm (132.5g).
THE VALUE OF Biotic RESOURCES TO TRANSKEI COASTAL COMMUNITIES

Nomalungelo Mqakama

Zoology Dept., University of Transkei

As the human population along the Transkei coast has increased in size so has the level of exploitation of coastal resources. Previous research has focused primarily on shellfish resources, there is, however, a need for a holistic study of the utilization of biotic resources. The study was conducted in the central and southern Transkei with the aim of establishing the type of biotic resources used by these communities and the pattern and intensity of use. The second part of the study attempts to assess whether traditional conservation methods exist, whether people are aware of the past and present status of resources and to determine the values placed on these resources, were made. Interviews based on structured questionnaires were used to obtain information on people's socio-demographic status, their food production and eating habits and utilization of terrestrial and marine resources. Information for the second part of the study was obtained by means of group discussions. Shellfish were not the only marine resource utilised, other resources including, sand, stones, fish and seaweed also collected. Shellfish, however, were the preferred marine resource, with brown mussel *Perna perna* being the most favoured. Although most shellfish were used as food, some were sold to hotels, cottage owners and/or tourists, when opportunities arose. Octopus tentacles and rock lobster eggs were used for medical purposes. Mussel shells were also used as spoons at various ceremonies. The value of the sea also has a social dimension to these communities. Thatch grass (*Cymbopogon validus*), which is used for the construction of roofs, was the most frequently collected veldt resource. Most questionnaire respondents visited forests with the aim of collecting firewood to supply fuel needs. The uses of the land for crop production and collection of natural resources from surrounding ecosystems were significant aspects of rural households as they are important to the communities subsistence existence. It was noted that coastal communities have some traditional management strategies. These, however, are not resource conservation strategies but strategies designed to manage conflict amongst resource users from within and outside the village. People are not opposed to conservation of resources as long as their present/traditional resource utilization practices are not altered. Most people believe that there is no need for government intervention as nature can take care of itself. Negative attitudes towards government legislation were common in communities situated next to state-owned land such as forests and nature reserves. A large gap exists between traditional resource management strategies and those of the government. Environment education and co-management of resources are two ways in which attempts can be made to overcome this gap.

DOES SUBSTRATUM TYPE INFLUENCE THE ABUNDANCE AND BIOMASS OF MID-SHORE ROCKY INTERTIDAL BIOTA?

Mandishile Mqoqi and Theresa Lasiak

Dept. of Zoology, University of Transkei, Private Bag X1, UNITRA, Umtata, 5117 South Africa

Physical factors, such as sea temperature, wave exposure, aspect, slope, and substratum type, are all known to influence the abundance and biomass of rocky intertidal organisms. Previous studies have focused primary on the influence of sea temperature and wave exposure, relatively little is known about the effect of substratum type. According to McGuinness and Underwood (1986), two different features of the substratum need to be considered, these are the material from which it is formed and the gross surface texture. Most of the studies conducted so far have been concerned with the influence of surface texture on the abundance, biomass, and size structure of rocky intertidal organisms. Differences in the nature of the intertidal communities found on different rock types have been reported by McQuaid and Branch (1985) as well as by McGuinness and Underwood (1986). Hockey, Bosman & Siegfried (1988) have pointed out that a number of different types of geological substrata are found along the Transkei coast and that these different substrata may support different intertidal communities. As this has implications for the conservation of marine biodiversity a study has been initiated to examine the influence of substratum type on the rocky intertidal biota found along the Transkei coast. The objective of the present study was to establish whether or not there are any significant differences in the abundance and biomass of the dominant organisms found in the mid-tidal area on shores composed of sandstone, mudstone or shale. The study was conducted on a geologically heterogeneous, 10 km stretch of shore to the south of the Dwe sa Nature Reserve. Three randomly-selected stretches of shore of each of the three rock types were examined. At each of these sites estimates of the abundance and biomass of the selected organisms were obtained by sampling 0.5 m² quadrats positioned randomly along a horizontal transect in the mid-shore.
Heavy metal accumulation is of growing concern in South African estuarine environments. Metal pollution from mine and industrial metal processing factories surrounding the cities find their way into natural water bodies, and rivers and ultimately into estuaries.

Estuaries are nursery grounds for most of commercial and sport fishes and prawns species. Their dynamic nature implies that fauna are already in some form of stress and an additional stress in the form of heavy metals may impact adversely on the biota. Bioaccumulation is the accumulation of metals in organisms to concentrations far above the ambient concentrations. As many South African estuaries are utilized by local communities, high concentrations of metals pose a threat to man and also to ecologically and commercially important species inhabiting estuaries.

A research project was conducted to determine temporal variations of heavy metal in the Mhlathuze Estuary. Heavy metal Bioaccumulation analysis was conducted on fish tissues (gills, liver and muscle tissues) and whole fish. Seven metals (Al, Cr, Cu, Fe, Mn, Pb and Zn) were analyzed. The study was conducted over eight seasons, from April 1996 to December 1997.

Significant temporal differences in metals Cr, Cu, Fe, Pb and Zn were found in liver tissues and significant temporal differences in AI and were found in the gills. Concentrations of Al, Cr, Fe and Pb were found to be the highest in gills. Copper, Mn and Zn were found to be highest in liver tissues. Significant temporal differences in muscle were only recorded for Pb. Muscle tissues were found to accumulate less metals when compared to gill and liver tissues. Significant seasonal differences in Cr, Fe, Pb, Mn and Zn were recorded in whole fish tissues. Metals in whole fish analyses accumulated in the order, of Fe> Al> Mn> Zn> Cr> Cu> Pb.

The spawning period and size at sexual maturity of three patellid limpets *P. cochlear*, *P. longicosta* and *P. oculus* were investigated over a 12-month period at Dwesa Nature Reserve, on the Transkei coast. Two methods of gonad assessment were used. The first, a subjective grading obtained by visual assessment of the relative size of the gonads and the second, a quantitative index obtained from the slope of the linear regression of wet gonad weight on wet somatic weight. The results show that these three limpets have multiple spawning periods with few rest stages. It was also noted that males became sexually mature at a smaller size than females.
THE POTENTIAL ROLE OF THE HOLOTHURIAN PSEUDOCNELLA SYKION AS A BIOINDICATOR SPECIES OF HEAVY METALS, BASED ON ENERGY DISPERSIVE X-RAY ANALYSIS (EDX)

M. Natasen Moodley¹, A.S. Thandar¹ and M.A. Gregory²

1. Dept. of Zoology, University of Durban-Westvilles
2. Electron Microscope Unit, University of Durban-Westvilles

Considering the general lack of funds available for the assessment and maintenance of the environment, contemporaries in the field of ecotoxicology have stressed the scientific and economic importance of bio-indicator species in pollution studies. The experiment was conducted along the Kwazulu-Natal coastline, and aimed to investigate whether the hard structures (i.e. spicules and calcareous ring) of the holothurian Pseudocnella sykion were bioaccumulating heavy metals. This could then be used to determine two sites, the soft tissues of the brown mussel Perna perna a known bioaccumulator of heavy metals, were analyzed by atomic absorption spectrometry (AA). Al and Fe were the only elements to have accumulated in mussels from the polluted area. Six adult individuals of P. sykion were collected from each site. The animals were killed by freezing to avoid the use of chemicals. Energy dispersive X-ray microanalysis (EDX) was used to analyze the elemental composition of spicules and calcareous rings. Ca, Mg and S were the major elements found may well be below the threshold of sensitivity of EDX microanalysis.

VARIATIONS IN THE MACROBENTHIC FAUNA OF THE FLOOD TIDAL DELTAS AND LOWER REACHES OF SOME EASTERN CAPE ESTUARIES

S. Ndudane, M. Bursey and R. Bally

Zoology Dept., University of Fort Hare, 5700 Alice

The Eastern Cape Province is especially rich in the diverse nature of its estuaries, with systems ranging from permanently open estuaries to estuaries that are closed for most of the year. In this study we have compared the macrobenthic fauna of the flood-tidal deltas and lower reaches of five estuaries lying within the same climatic and biogeographical region in the vicinity of East London. The estuaries concerned are four small, temporarily closed systems (Cafane, Cintsa, Igoda and Kiwane) and one permanently open system (the Nahoon). The biodiversity of the smaller systems was markedly depressed when compared with that of the Nahoon, and possible reasons for this are explored.
SYNCHRONIZATION OF THE BREEDING CYCLE AMONG POPULATIONS OF THE
BROWN MUSSEL Perna perna (MOLLUSCA: BIVALVIA) ON EXPOSED AND
SHELTERED SHORES ALONG THE COAST OF SOUTH AFRICA

N.V. Ndzipha¹ and C.D. Mc Quaid²

¹. Dept. of Zoology, University of Fort Hare, Alice
². Dept. Zoology & Entology, Rhodes University, Grahamstown

Numerous studies have been carried out on the biology of the Indian Ocean mussel Perna perna because of its commercial value and remarkable cultivation potential. Despite this wealth of published data, there still remains considerable doubt over the timing and the duration of the reproductive cycle within individuals in a population. Furthermore, there is presently very scant knowledge about seasonal patterns in breeding, settlement and growth of these species in distinct geographical localities on the Southern African coastline. Synchronous spawning offers adaptive advantages to externally breeding animals. Firstly, it enhances fertilization rates and therefore the species reproductive fitness. Spawning can also be timed to coincide with environmental conditions conducive to larval settlement and development. Generally sea temperature and food availability are considered the key factors underlying the initiation and the duration of the breeding cycle of mussels. However there are proximate local cues that trigger the proliferation, maturation and release of gametes. This study is designed to investigate the temporal differences (if any) in the timing of the breeding cycle between sheltered and exposed sites along the south eastern coast of South Africa by histology analysis of gonads and also by dry weight/shell length regressions. Most of published work on spawning is based on observations of the presence of larvae in plankton, or settlement. A more reliable method correlating the sequence of gamete development throughout the year with the period of spawning activity is used in this study to eliminate the potential error of immigrant larvae in the sites of concern. The results show some slight temporal variations in the development of oocytes within an individual and between populations. However, on an annual scale, the different populations of Perna perna were relatively synchronized.

SHELF WAVES AS A CONTROL OVER THE FLOW, TEMPERATURE AND
NUTRIENT SUPPLY IN SALDANHA BAY, SOUTH AFRICA

Greville Nelson

Marine and Coastal Management, Dept. of Environmental Affairs, Cape Town Cape.

Saldanha Bay is a semicircular indentation on the west coast of South Africa centered on latitude 33º5'S with an area 1.41 x 10⁸ m². A lightly dragged central channel drops from 12m at the centre of the bay to 40m at the mouth, which is some 6 to 7 km wide. The adjacent narrow shelf supports the passage of energetic barotropic coastal-trapped waves, with a period of 5 to 6 days. The cross-shelf component of these waves acts to drive cold water into the bay below the wind influenced layer on the eastward phase. This is the dominant driving mechanism controlling temperature and nutrient supply and consequently primary productivity.

The energetic six-day period waves appear to be forced by the synoptic field over the southeast Atlantic. Also present in the spectra are less energetic waves at three and four days. These are the freely propagating coastal trapped waves generated locally by wind, and when their phase corresponds to that of the forced wave, the amplitude is great enough to produce a shelf water penetration of 4km into the bay. Under these conditions, upwelling favourable winds exacerbate the inward movement of bottom water, which is entrained into the surface layer in the shallowest parts.

Tidal flow, generally of little significance on this coastline, can be an important factor in this bay at the spring tide. A tidal lagoon of area 5.3 x 10⁷ m² connects with the eastern part of the bay.
Oral
SEAL-LEVEL VARIABILITY IN THE SOUTHERN AND CENTRAL BENGUELA IN JUNE/JULY 1999

C.S. Nhapulo, H.N. Waldron and G.B. Brundrit

Dept of Oceanography, University of Cape, Town Rondebosch, 7700 South Africa.

A research/training cruise was undertaken as part of the BENEFIT programme off the west coast of southern Africa during June and July 1999. Sea level fluctuation at the coast has been used in an attempt to put the large scale hydrography in context at a time coincident with the Benefit training Cruise data set. South Africa and Namibia have a west coast tide gauge network stretching from Walvis Bay to Cape Town harbour. Selected data were made available by the hydrographic office of the South African Navy and after appropriate filtering and averaging techniques were applied, information relating to west coast physical forcing was available for the month period. The oceanographic implications of these data are discussed.

Poster
THE EFFECTIVENESS OF DIFFERENT TYPES OF MOLLUSCAN SPAT COLLECTORS

Asanda Njobeni and Theresa Lasiak

Dept. of Zoology, University of Transkei, P/Bag X1, UNITRA Umtata Eastern Cape 5117

Although various artificial substrata, such as rubberized hair, rope, nylon brushes, tufnol, slate, Perspex, concrete, fibreglass, and wood panels have been used to monitor the settlement and/or recruitment of molluscs, little is known about the effectiveness of the different materials. The present study was designed to compare the effectiveness of four substrata that vary in terms of surface complexity. The four substrata selected for study were grooved ceramic tiles, domestic nylon scourers, industrial scourers and rubberized mats, all of which are commonly available in South Africa. The study involved the deployment of replicate panels composed of these materials in a random block design on the shore in the Dwesa-Cwebe nature reserve. After one month the panels were retrieved and the molluscs, which had recruited to them, were extracted by immersion in 1M sodium hypochlorite and sonication. The molluscs extracted from each panel were subsequently identified and counted with the aid of a dissecting microscope. One way-analysis of variance was used to compare the effectiveness of the substrata as collectors for each of the major groups of molluscs encountered.

Poster
THE MACROFAUNA OF DUNE MOUTH BARRIERS:
A COMPARATIVE STUDY OF FOUR EASTERN CAPE SYSTEMS

L. Nqelenga¹, M. Bursey² and R. Bally

1. Zoology Dept., University of Fort Hare, 5700 Alice
2. East London Museum, 5200 East London

The mouths of temporarily open (or closed) estuaries may remain open for varying periods of time, but all eventually become closed by sand bars deposited across the mouth by longshore drift and aeolian transport. These dune mouth barriers may then remain in place for varying lengths of time before being washed away again by the next breaching of the mouth. This paper reports on a preliminary study on the macrofauna of the barriers of four closed estuaries in the East London region of the Eastern Cape Province. The macrofauna of these temporary structures feature two different components, namely an estuarine, and a marine component characteristic of the adjacent sandy beaches.
A COMPARISON OF MACROBENTHOS FROM THE UPPER REACHES OF FOUR SMALL ESTUARIES

M. Ntlabati and R. Bally

Zoology Dept., University of Fort Hare 5700 Alice

Small, temporarily open estuaries are the commonest form of estuary in the eastern Cape Province. Their small size has meant that they have often been overlooked both in scientific investigations and for development purposes, although their size also makes them vulnerable to mismanagement. In this study we have compared the macrobenthic fauna of the upper reaches of four estuaries lying within the same climatic and biogeographical region in the vicinity of east London. The estuaries concerned are four temporarily closed systems (Cafane, Cintsa, Igoda and Kiwane) draining small catchment areas on the coastal plain. The biodiversity of the macrobenthic fauna of the upper reaches of these systems is reported on and discussed.

COASTAL FOREDUNE DEVELOPMENT ON THE KWAZULU-NATAL COAST, SOUTH AFRICA

M.J. Oliver

University of Transkei

This study examines foredune evolution along a 2100 m section of coast adjacent to the Tugela River mouth, KwaZulu-Natal, South Africa. The foredunes vary in both heights and shape along the study area and form the southern most extension of the Tugela foredune-ridge plain. Sand accumulation and erosion was measured at regular intervals for a 30-month period by tacheometric surveys. A range of factors influencing foredune morphology and evaluation, including vegetation canopy density, height and distribution, wind velocity and a variety of ecological and environmental processes are examined.

The development of foredune-ridge topography depends on a large sediment supply from the Tugela River over the long-term. Periods of high discharge introduce a fresh source of sediment to the littoral zone. Reworking of fluvial sediment landwards results in wide beaches. Onshore winds transport the sand from the beaches to the foredunes. *Scaevola thunbergii* encourages rapid vertical accretion and hummock dunes are joining to form coast parallel foredunes. Under periods of reduced sediment discharge erosion of the shoreline results in steep narrow beaches. Despite a negative beach budget foredunes continue to accrete vertically. Marine erosion results in the complete destruction of embryo foredunes or their landward shift. Natural breaks in the dune crestline were attributed to changes in the delivery of sediment to the beaches. The processes operating in the study area conform to Psuty's (1989) sediment budget model of foredune development.
Poster

DISPERSSION OF WASTEWATER ALONG THE NORTHERN SHORE OF FALSE BAY

Dean Ollis\(^1\) and John Largier\(^2\)

1. University of Cape Town
2. University of Cape Town, and Scripps Institution of Oceanography

Sewage from the Cape metropolitan area is treated at the Cape Flats Sewage Treatment works and the treated effluent discharged into the Zeekoel River close to where it enters the ocean. This freshwater discharge and dispersion along the northern shore of False Bay (Strandfontein) was studied to explore the general process of open channel discharge into wave-dominated nearshore environments and to explore the extent of possible sewage-related pollution. New data are similar to those collected by CSIR during the 1980's but, given the general nature of the problem, these analyses seek to generalize the problem beyond that which was published by the CSIR. Increasing shoreline salinity with distance from the source is understood in terms of a one-dimensional advection-diffusion model, with offshore exchange modeled as a sink.

This model allows the problem to be generalized and to compare nearshore dispersion rates with those in other environments. The cross-shore exchange between surf-zone and offshore bay waters is weaker than is typically expected. This exchange appears to be dominated by identifiable rip current features, and temporally modulated by local wind forcing. Temporal variability in both wave and wind conditions (as well as seasonal variation in freshwater discharge rate) suggest that there are times when poorly diluted effluent can be expected to extend more than a kilometer along the shoreline.

Oral

THE USE OF A GIS TO UNDERSTAND THE SPATIAL AND TEMPORAL BIOLOGY OF THE CHOKKA SQUID \textit{Loligo vulgaris reynaudii} ON THE SOUTHERN COAST OF SOUTH AFRICA

Leanord J.H. Olyott, Anthony J. Booth and Warwisk H.H. Sauer

Dept. of Ichthyology and Fisheries Science, Rhodes University Grahamstown 6140 South Africa

The chokka squid, \textit{Loligo vulgaris reynaudii}, is a commercially important species supporting a large, high-value export fishery. Whilst various aspects of its life-history are well known such as its spawning areas and feeding biology, little information is available concerning its movement, recruitment patterns and paralarval ecology. This paper discusses the development of a Geographical Information System (GIS) that can be used to collate, visualize and analyze available spatial and temporal biological and fishery data. The GIS incorporated biological data collected monthly during 1998, spawning squid aggregation data and fishing vessel locations along the southeast coast of South Africa. Spatial analysis of various biological parameters, such as its reproductive seasonality and length-mass relationships, provided additional information concerning its movements related to seasonal spawning activity. Seasonal fishing patterns were noticeable, providing insight into low current research sampling methods and vessel monitoring programmes can be improved. Aspects of squid biology pertinent to fishery management were highlighted together as potential areas where research should be directed in order to develop future stock assessment models.
ASPECTS OF BIOLOGY, ECOLOGY AND FISHERY POTENTIAL OF OCTOPUS IN THE EASTERN CAPE, SOUTH AFRICA

Ane Oosthuizen, and M.J. Smale

Port Elizabeth Museum P.O. Box 13147, Humewood, Port Elizabeth, 6000 South Africa

World-wide finfish stocks are on the decline and fisheries are shifting their focus to cephalopods, resulting in an increased value of cephalopod fisheries. Squid are currently the only directly exploited cephalopod resource in South Africa. Octopus is exploited by recreational and subsistence fishermen in the intertidal area and caught as a bycatch in the lobster fishery and trawling industry, but no direct octopus fishery exists. Such a fishery is in the pipeline and the present study aims to investigate the feasibility of such a fishery to ensure sustainable use of this resource. The population structure, abundance and distribution of two species of octopods, *Octopus vulgaris* and *O. magnificus* found along the Eastern cape coast will be investigated. Investigations *O. vulgaris* include intertidal surveys of abundance and ecology and experimental fishing by means of octopus pots. Intertidal areas of different habitats (flat reef, high relief reef, wave exposed, sheltered) have been selected and are surveyed during spring tides. Preliminary results show the size of *O. vulgaris* to range 13.00-1000g, with 90% <1000g. The length of *O. vulgaris* range of 100-1200mm with 50% of the catch between 300-600mm. The sex ratio consisted of 1.65:1 females to males. Experimental fishing via octopus pots is also being conducted at different depths and geographically different areas (flat reef, high relief reef, sand). Areas of high and low predator abundance, i.e Tsitsikamma National Park vs. Algoa Bay, will be compared in assessing the abundance of *O. vulgaris*. *O. magnificus* is found in deeper water and catches of the trawling, longline and lobster fisheries along the area being monitoring for biological and ecological trends. Preliminary results show a size range of 4kg-14kg and a length range of 1000-1700mm. A sex ratio of 5:1 favoured mature males. The exploitation of an alternate resource such as octopus could lessen fishing pressure on local fish stocks; more specifically reef fish and sharks, currently exploited by squid fishermen during less productive seasons. Octopus as an alternate resource could augment local fishers and their communities in the Eastern Cape province of South Africa.

TEMPERATURE EFFECTS ON EMBRYONIC DEVELOPMENT AND HATCHING SUCCESS OF SQUID (*Loligo vulgaris reynaudii*) EGGS

Ane Oosthuizen¹, M. Roberts², W.W.H. Sauer³ and D. Baird¹

1. Chief directorate: Marine and Coastal Management, Private Bag X2, Roggebaai,
2. Dept., Ichthyology and Fisheries Science, Rhodes University, PO Box 94, Grahamstown.

*Loligo vulgaris reynaudii* is a commercially important squid species caught mainly on their spawning grounds along the south east coast of South Africa. *L. v. reynaudii* spawns in two environmentally different areas, shallow (<60 m) inshore bays and in deeper (60-130m) waters on the mid-continental shelf on the south east coast. The present study investigated the embryological development and hatching success of this species and how these would be influenced by the two different spawning environments. Temperature data collected from both these spawning areas were analyzed. Temperatures in the inshore areas were found to be warm (16-22°C) but fluctuating, whereas the deeper areas were cold (9-12°C) and stable. Large intrusions of warm water were also observed in these deeper, colder areas. The effects of these various temperature regimes on the embryonic development of *L. v. reynaudii* were investigated at both stable and fluctuating temperatures under laboratory and natural conditions. A linear relationship was defined between stable water temperature and embryonic development. An optimum development temperature range was identified between 12°C and 18°C, with abnormally developed embryos occurring outside this optimal range. Embryological abnormalities were identified and classified into types. The growth rate of early developmental stages was found to be more susceptible to variable temperature regimes than later development stages. Upwelling events in the inshore spawning areas were found to have a negligible effect on the development success of eggs deposited in these areas. Embryonic development under laboratory and natural conditions were found to be similar. The embryonic development scheme for *L. v. reynaudii* was revised and six developmental stages added to the original embryological study for the species.
FORECASTING RECRUITMENT OF ANCHOVY IN THE SOUTHERN BENGUELA: THE USEFULNESS OF ENVIRONMENTAL AND BIOLOGICAL INDICES

Suzanne J. Painting¹ and Jan L. Korrubel²

1. Marine and Coastal Management Private Bag X2, Roggebaai 8012, Cape Town
2. Depr of Mathematics & Applied Mathematics, University of Natal, Pbag X01, Scottsville 3209

Simulation studies have shown that forecasts of the recruitment strength of anchovy in the southern Benguela at the start of each fishing season could result in a valuable increase in mean annual yield to the pelagic fishery (Cochrane and Starfield 1992, De Oliveira this volume). Reliable forecasts may also contribute towards the scientific management of the anchovy stock. Forecasting on the basis of stock assessment/fisheries data alone is difficult due to the absence of long-term data and a stock-recruit relationship, and as a result of large inter-annual fluctuations in recruitment strength. Other sources of information are needed to complement the decision-making process. Many studies have attempted to show empirical relationships between environmental and/or biological data and anchovy recruitment. In general, it has been difficult to find statistically significant relationships. More recently, decision-support systems have been developed to obtain forecasts from a suite of environmental and biological indices by incorporating the information into a consistent and logical rule-based framework (Korrubel 1995). Preliminary studies have indicated that forecasts from simple deterministic systems compare favourably with observed recruitment (Korrubel 1995, Painting and Korrubel 1998), suggesting that when satisfactory validated, decision-support systems have great potential for supporting the management of the South African anchovy fishery. The objectives of this study are to validate the deterministic systems developed by Korrubel (1995) using data from 1995 to the present, and to develop a 1999 version of the model, which incorporates new technology (such as satellite imagery) and new insights into the recruitment process.

BIOLOGICAL RESPONSES TO CLIMATE CHANGE AT SUB-ANTARCTIC ISLANDS

E.A. Pakhomov¹, W.P. Froneman¹, R.J.M. Crawford² and J. Cooper³

1. Southern Ocean Group, Dept. of Zoology and Entomology, Rhodes University, Grahamstown 6140 South Africa
2. Sea Fisheries, Private Bag X2, Rogge Bay 8012, South Africa
3. Avian Demography Unit, Dept. of Statistical Sciences, University of Cape Town, Rondebosch, 7701, South Africa

Global climate change, accelerated by anthropogenic emissions of greenhouse gases is expected to have its greatest effect in polar ecosystems. The sub-Antarctic islands, with their relatively simple terrestrial ecosystems, are ecologically sensitive and consequently offer ideal sites to study responses to climate change. All the sub-Antarctic Islands of the Southern Ocean accommodate large populations of top predators, including sea birds and seals. The Prince Edward Islands (46 50'S, 37 50'E) south of Africa represent a typical example of a sub-Antarctic archipelago with consistently low air temperatures, low incident radiation, high precipitation and humidity. May of top predators are sustained by allochthonous food resources and/or forage mainly within the major Southern Ocean frontal systems located in close proximity to the islands. The simple food chains comprising top predators and zooplankton are also expected to be sensitive to climate change. Due to a southward shift in the geographic location of the SAF over the past four decades, the flow-through mode, which advects allochthonous zooplankton and micronekton to the islands, has predominated in the region of the Prince Edward Islands, favoring the offshore foragers. Consequently, their populations have increased. Incidence of the trapped-eddy mode has decreased, leading to less food for inshore foragers and subsequent decline in their populations. Populations of foragers, whose food is presumably provided by both situations, have been stable. Although populations have also been influenced by incidental mortality in fisheries, resulting e.g. in the initial decrease of Wandering Albatros, our data suggest that global climate change may have a long-term impact on top predator populations breeding at sub-Antarctic oceanic islands through its effect on the oceanic food web structure.
ACTUAL STATE OF KNOWLEDGE OF THE DEEP WATER
SPINY LOBSTER *Palinurus delagoae*

Barbara Palha de Sousa

*Instituto de Investigacao Pesqueira P.O. Box 4603, Maputo Mozambique*

The deep-water spiny lobster *Palinurus delagoae* is endemic to the South African coast. This species has been targeted since 1980 by trap fishing. Data on catch statistics from the trap fishery between 1980 and 1998, were analyzed to assess the impact fishing has had on the stock. On board biological data were also collected and analyzed.

Some recommendations such as control of ovigerous females and introduction of escape gaps to prevent the capture of immature animals were presented to the administrators in order to introduce some management measures in the fishery.

THE EFFECT OF TEMPERATURE AND SALINITY ON THE LARVAL DEVELOPMENT OF *Hymenosoma orbiculare* (CRUSTACEA, DECAPODA) REARED IN LABORATORY

I. Papadopoulos, B. Newman, T.H. Woodridge

*Dept. of Zoology, University of Port Elizabeth, P.O. Box 1600, Port Elizabeth, 6000 South Africa*

The transition from life in the marine environment to terrestrial and freshwater habits has been achieved by many brachyuran crab species, in particular members of the families Gecarcinidae, Ocypodidae, Grapsidae and Hymenosomatidae. While most of these species need a marine phase for development, others show abbreviated or absent larval development as an adaptation to their life on land or in freshwater. *Hymenosoma orbiculare* has three zonal stages and lacks the megalopal stage.

Ovigerous females were collected from Zostera beds in the Swartkops River estuary and returned to the laboratory where they were kept in 400 ml of seawater (35 ‰) at 20ºC and under a 12: 12 LD cycle until larvae hatched. After hatching larvae were acclimated (in seawater) to additional constant temperatures of 16, 24 and 28ºC, and thereafter to additional salinities of 28, 21, 14, 7 and 0 ppt, such that after acclimation each temperature: salinity combination was eventually represented by 20 individually reared larvae. Larvae were reared in glass vials filled with about 14 ml of water. Daily the larvae were checked to determine moult status and mortality, and thereafter transferred to fresh culture and fed (*Artemia* spp nauplii).

Such daily analysis continued until all larvae had either metamorphosed to the Crab 1 or had died. In all temperatures larvae at 0 ppt and 7 ppt died within a few hours of transfer to these salinities. At 28ºC no larvae were able to complete development to the Crab 1. Temperature effects were expressed mainly through development rate modification, whilst the main effect of salinity was on survival. At 16, 20 and 24ºC, 28 ppt was apparently the optimal for development. This tolerance of an apparent preference for estuarine salinities may suggest that the larvae are preferentially retained within estuaries. If so the *H. orbiculare* follows a very different larval development strategy as compared to other southern African estuarine decapods, and which may have important implications for the management of freshwater allocations to estuaries along the coastline.
The ichthyofauna associated with the upper reaches of a freshwater-dominated and a freshwater-deprived estuary in the Eastern Cape

Angus Paterson, Alan Whitfield, Leslie Ter Morshuizen

J.L.B. Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6140, South Africa

Ichthyofaunal research in southern African estuaries has concentrated on the lower and middle reaches of these systems, resulting in a paucity of information on fish communities associated with the upper reaches. This lack of research is distributing, as the abiotic and biotic processes occurring in the upper reaches of estuaries should logically have an impact on the system lower down. The paucity of information on the fish assemblages in the upper reaches, and any ontogenetic changes in their distribution undermines any efforts to manage estuarine associated fish stocks.

The purpose of this study was to address the poor knowledge base of river-estuary interface (REI) fish assemblages, and the factors, which influence them. Research was focused on two estuaries with differing freshwater inputs. The Kariega Estuary is a freshwater deprived system and has almost no salinity gradient while the Great Fish Estuary is freshwater rich and the vast proportion of the estuary has salinities below 10. Sampling was concentrated in the upper reaches off these two estuaries but for comparative purposes the entire systems were sampled on a quarterly basis. Results indicate the upper reaches of the two systems were dominated by different species. One of the interesting findings was the high number of important juvenile recreational line fish species (e.g. Argrosomus japonicus and Pomadasys commersonnii) in the upper reaches of the freshwater enriched Great Fish Estuary and their total absence from the marine dominated Kariega Estuary.

The ichthyofauna communities found in the upper reaches of both systems were also found to be significantly different from those in the lower and middle reaches. These findings have clear implications for the future management of estuaries in relation to freshwater abstraction and its effect on the nursery function of these systems.

Twelve months on: The new fisheries policy of South Africa. A scientist’s perspective and overview

Andrew I.L. Payne

Marine & Coastal Management, Private Bag X2, Rogge Bay 8012

South Africa’s new marine fisheries policy is now more than one year old. An attempt was made to implement in four months something that took four years to develop. A critical evaluation is given of the process of implementation (including failures and successes) from the perspective of a fisheries manager who is also a scientist. New structures have also been created in the department to address new government policy (including the marine fisheries policy), and some of the thinking behind that process is given. Finally, the role of the marine scientist (state-employed and other) in the future development of the process is speculated upon. From being interested bystanders of the original process, scientists are now clearly in the front line of fisheries management, so the question is asked, is that good or bad for science?
PINGERS: A DOLPHIN CONSERVATION TOOL FOR THE NEXT MILLENNIUM?

Vic Peddemonrs

Natal Sharks Board P. Bag 2, Umhlanga Rocks, 4320, South Africa

Over 400,000 cetaceans annually die in fishing nets around the world. Consequently, considerable international effort has been expended on attempts to devise methods to warn the animals of the presence of obstacles such as nets. In South Africa, the primary cause of cetacean entanglement mortalities arise from the shark net fishery set to protect bathers off KwaZulu-Natal. Research on both bottlenose (Tursiops truncatus) and Indo-Pacific hump-backed (Sousa chinensis) dolphin behaviour and movements around the shark nets has indicated that these animals appear to increase their attention when in close proximity to nets as evidenced by a significant reduction in social activities. However, gut content analysis and concomitant behavioral observations indicate that both species will regularly feed in close proximity to the shark nets, possibly as a result of the nets acting as FADs for preferred prey items. The dolphins' attention therefore requires stimulation away foraging during such periods.

Experiments using active acoustic devices ('Pingers') indicate that the dolphins do not exhibit aversive reactions to the sounds, but appear merely to be alerted to the presence of the nets. These experiments have internationally been the first detailed analysis of dolphin reactions to pingers. Results suggest that pingers may crucially contribute to reducing incidental dolphin mortalities in fishing nets, thereby possible providing an important conservation tool for the next millennium. Subsequently, large-scale deployment of pingers is being considered in the shark nets off KwaZulu-Natal to ascertain the long-term efficacy of such active acoustic devices, with special reference to habituation of resident coastal dolphin species to the sounds.

Acknowledgement: Much of this research was conducted in association with the Endangered Wildlife Trust through support from Richards Bay Minerals and AGFA, South Africa.

Poster

AN ESTIMATION OF STOCK SIZE AND EXPLOITATION OF SESARMID CRABS IN
NORTHEASTERN KWAZULU NATAL

Carsten Pedersen

School of life and Environmental Sciences, University of Natal, 4014 Dalbridge

Sesarmid crabs are known to be of great importance in mangrove ecosystems. The crabs feed on mangrove leaves, and hence contribute to the maintenance of the nutrients in the system (Steinke, T.D. et al., 1993). The local people at Kosi Bay, north-eastern South Africa, has been collecting sesarmid crabs for generations. A monitoring program of the fishery has been carried out over the past ten years (Kyle and Fielding, 1997). Data from this program provide important information on the state of the crab fishery in this area. The exploitation of the crabs has not yet been estimated, and there is a possibility of overexploitation due to the growing human population in the area. This project aims to estimate the exploitation and the total stock size of sesarmid crabs. The aims will be satisfied by analyzing the data from the monitoring program and from results obtained from fieldwork. One field trip has been carried out and a second will be carried out in the end of June. Results from the stock size and the exploitation estimates can be used to suggest changes in future management of the fishery, should changes be required.

At present data from the monitoring programme are being analysed, and the exploitation of the crab population is being estimated, with the total stock size to be estimated after the next fieldtrip.
WATER RELATIONS OF *Ammophila arenaria* AND SCAEVOLA PLUMIERI:
A GIS STUDY

Craig Peter¹, Mark Robertson² and Brad Ripley¹

1. Dept. of Botany, Rhodes University, Grahamstown
2. Dept. of Zoology, Rhodes University, Grahamstown

*Ammophila arenaria* is a dune stabilizer from Europe, which is apparently in this country. In the USA this species is an aggressive invader. *Scaevola plumieri* is an important tropical dune pioneer around the globe and is found along the east and southern coasts of South Africa. It has been shown previously that transpiration is related to vapour pressure deficit (VPD) in a predictable manner (linearly in *S. plumieri*, curvilinearly in *A. arenaria*). These relationships for individual leaves have been shown to be scaleable to whole sand dunes due to the well ventilated nature of the canopies. As VPD is calculated from ambient temperature and humidity, it is relatively straightforward to calculate transpiration from readily available climatic data. At the scale of a small dune it can be shown that transpiration water loss exceeds water input by rainfall over the immediate area of the dune. Using established climatic surfaces, which have been produced from historical records collected over a number of years, large-scale transpiration rates were calculated according to the above relationships. Water loss by transpiration was compared to water input by rain as well as to the known distributions of the two species, for the entire coastline of South Africa. In addition a model predicting the distribution of the two species, based on known distributions of the two species is presented. Problems encountered in using a raster based GIS in coastal systems (linear features) will also be discussed.

THE COMPARISON OF THE CAPE FUR SEAL SUB-PopULATION TRENDS:
ISLAND VS MAINLAND (SOUTH AFRICA AND NAMIBIA)

Ingrid Peters¹, Cecile Roos¹, Herman Oosthuizen², and John G. Field¹

1. Zoology Dept., University of Cape Town, Rondebosch
2. Marine and Coastal Management, Private bag X2, Roggebaai 8012

Intensive and indiscriminate harvesting of the Cape fur seal (*Arctocephallus pusillus pusillus*) from the 17th century to late in the 19th century reduced the population numbers dramatically. By 1893, when the first legal protection was introduced, more than 20 colonies had been extirpated. Subsequently the population numbers have increased rapidly. The population is increasing exponentially, although on some island colonies carrying capacity has been reached. Initially no mainland colonies existed, but at present they constitute more than half of the total population. It has now been suggested that once established, mainland colonies should have a far greater rate of increase in pup production than island colonies. The main determining factors being available space for harems of pregnant females and pup nurseries. This study investigates whether there is a significant difference in the rate of change of population numbers between mainland and island colonies. All the Namibian colonies and the only South African mainland colony (Kleinsee) were analyzed. Pup production was used as an estimate of total colony size. Aerial photographs were taken of all colonies at three to four intervals and the pup counts obtained were used to generate exponential regressions. Mainland colonies were found to have a faster pup production rate than island colonies (t=20. 161, d.f. = 18, p<0.05). Reasons for such a trend may be attributed to space limitation experienced on island colonies, however other possible factors have not been investigated in this preliminary study.
Poster

SCALE EFFECTS ON THE APPARENT DISTRIBUTION OF THE ISOPOD Pontogeloides latipes IN FOUR ESTUARINE FLOOD-TIDAL DELTAS

S. Pheeha and E. Dorfman

Zoology Dept., University of Fort Hare 5700 Alice

Pontogeloides latipes is arguably the most versatile of the southern African cirolanid isopods. It is a feature of both high energy and sheltered beaches, but it is also found in considerable numbers in the flood tidal deltas of estuaries in the Eastern Cape.

In this paper, the distribution of this carnivorous crustacean is investigated in terms of the effects of the scale of the sampling effort. A collection pattern covering three orders of spatial magnitude was devised, and animals were then collected using a suction sampler. This sampling regime was used in four different estuaries. The results of the study are reported here.

Oral

COMPETITION FOR PILCHARD AND ANCHOVY BETWEEN SOUTH AFRICAN FUR SEAL, CAPE GANNET AND THE PURSE-SEINE FISHERY ON THE WEST COAST OF SOUTH AFRICA

Pavitray Pillay¹, John Field¹, and Herman Oosthuizen²

1. Marine Biology Research Institute, University of Cape Town Rondebosch 7700 South Africa CT
2. Marine and Coastal Management, Private bag X2, Roggebaai 8012

The southern Benguela region, being an upwelling system, supports large numbers of pelagic fishes, seabirds and animals. Due to its large biomasses, it also supports a large commercial fishery. This purse-seine fishery competes directly for anchovy (Engraulis capensis) and sardine (Sardinops sagax) with the Cape gannets (Morus capensis) and the Cape fur seal (Arctocephallus pusillus).

This study aims to assess whether these three predators select for the same size-class of prey seasonally. By investigating whether these three predators do indeed select the same size-class of fishes, the study will assess the potential impacts of the fishery on the reproductive and general biology of the two competing species, particularly during their crucial breeding seasons. Such information would be useful for the management of the Benguela system.
CAUSES AND CONSEQUENCES OF PARALYTIC AND DIARRHETIC SHELLFISH POISONING ON THE SOUTH AFRICAN COAST

G.C. Pitcher¹, D. Calder¹, M.L. Fernandez², J.M. Franco³

1. Marine and Coastal Management Rogge Bay, 8012 Cape Town South Africa
2. Sanidad Exterior, Laboratorio Comunitario de Referencia de Biotoxinas Marinas, Ministerio de Sanidad
3. Consumo, Estacion Maritima sn. 36271, Vigo, Spain
4. Instituto de Investigaciones Marinas, Eduarde Cabello, 6, 36208 Vigo, Spain

Of the many species of phytoplankton at the base of the marine food chain, a small number are able to produce toxins. The class Dinophyceae contain the majority of the toxic species which make their presence known in several ways, ranging from massive blooms of cells that discolour the water, to dilute inconspicuous concentrations of cells noticed only because of the harm caused by their toxins. One major category of public health impact from these blooms occurs when toxic phytoplankton are filtered from the water by shellfish, which then accumulate the toxins to levels that are potentially lethal to humans and other consumers. To shellfish poisoning syndromes, Paralytic (PSP) and Diarrhetic (DSP) Shellfish poisoning, are recognized on the South African coast. The toxin producing organisms responsible for these shellfish poisoning syndromes are identified and the associated toxin profiles presented. Changes in toxin profile, between dinoflagellate cells and shellfish, as a consequence of toxin transformation are established. The environmental factors determining the distribution and abundance of these toxic species and the incidence of shellfish poisoning are documented. Shellfish toxicities are related to cell densities and the rate of intoxication and depuration of contaminated shellfish is examined in response to the controlling environmental parameters. In addition to the intoxication of bivalve species observations are made of the accumulation of PSP toxins in non-filter feeding shellfish such as abalone. PSP-induced mortalities of shellfish, pelagic fish and other consumers in the food chain are also reported. The threat of these shellfish poisoning syndromes to aquaculture and fisheries on the South African coast is assessed.

MORE OR LESS IN THE NEW MILLENNIUM? MULTISPECIES PERSPECTIVES

Eva Plaganyi

Dept. of Maths and Applied Maths, University of Cape Town, Rondebosch 7701, South Africa

In the last decade there has been a growing perception worldwide that it is not always effective to base fisheries management policies solely on single-species considerations. However, while the need for multispecies fisheries management has been recognized for a number of years, progress in this field has been impeded by the difficulties in building adequate models, which can provide realistic scientific advice. Although there is an abundance of multispecies and ecosystem models in the literature, there is a paucity of multispecies models/approaches that can usefully be incorporated into practical fishery management. Further progress needs to be made if multispecies considerations are to result in tangible fishery management advice in the new millennium. This paper reviews worldwide progress in multispecies approaches to fishery management and makes recommendations for advancing fishery management in South Africa beyond the single species model.
CIRCULATION PATHWAYS OF THE ACC AND AGULHAS ACROSS THE SOUTHWEST INDIAN RIDGE AND THEIR EFFECTS ON NUTRIENT AND PHYTOPLANKTON DISTRIBUTIONS

Raymond Polland

Southampton Oceanography Centre, Empress Dock, Southampton, S014 3ZH UK

Circulation pathways and transports of the Antarctic Circumpolar Current (ACC) and Agulhas Return Current (ARC) around the complex bathymetry of the Southwest Indian Ridge and Del Cano rise have been established from two hydrographic surveys and two-year long moorings from 1993-1995. After crossing the Southwest Indian Ridge in a 110 Sv Polar Front flow concentrated at 48ºS, 34ºE, the ACC fragments. The southernmost flow reconcentrates on the northern flank of the Conrad Rise. Another branch continues east south of Marion Island, much of it turning north into the Crozet Basin around the eastern flank of the Del Cano Rise but west of the Crozet Plateau. Some of this northward flow turns west as part of anticyclonic flow round the Del Cano Rise before returning east as part of the Crozet front. This flow carries high nutrients into the Crozet Basin, leading to high phytoplankton biomass at the Crozet Front. The anticyclonic flow also transfers water from the Mozambique Basin across the Southwest Indian Ridge between the Del Cano Rise and the Prince Edward Islands. A final 10 Sv from the concentrated Polar front turns sharply north to the west of the Prince Edward islands, re-entering the Mozambique Basin and returning east again with the Subtropical front at 42ºS. There is little evidence of transport directly from the Enderby Basin into the Crozet Basin, northeastwards over the Del Cano Rise. The Subtropical Front and ARC together transport 90 Sv across 38ºE in the Mozambique Basin, 20-25 Sv of which turns back at the Madagascar Ridge. 60 Sv from the ARC continues into the Crozet Basin. Eddy variability from both data and moorings is low over the bathymetry of the Del Cano Rise and Conrad Rise, so the strong currents found are believed to be permanent features.

LAND-OCEAN INTERACTIONS IN THE COASTAL ZONE: A POST 1960S ENVIRONMENTAL CHANGE IN THE NORTHERN BENGUELA LARGE MARINE ECOSYSTEM

David E. Pollock

Marine and Coastal Management, Private Bag X2, Rogge Bay, 8012 Cape Town

A severe decline in production and yields of rock lobsters in the Namaqualand (N. Cape) and Namibian regions began in the 1960s and catches have never recovered since. Due to the collapse of these northern sectors, the overall yield from the rock lobster resource as a whole in the BCLME declined from over 16000 tons prior to 1955 to less than 5000 tons after the 1960s. Lobster growth rates on the Nmaqualand and Namibian coasts are stunted, and size at maturity of females is small. It is quite clear that lobster production along this 740 km coastline is severely constrained by the presence of oxygen-depleted shelf waters, which often restricts lobsters to very shallow depths. However, there is anecdotal evidence that this was not always so, as prior to the 1960s fishermen reported making consistently good catches in depths up to 55m off both the Namibian and Namaqualand coasts. Subsequently, stunted growth apparently resulted from the population being forced to occupy a much smaller, shallow-water habitat due to the presence of oxygen-depleted bottom waters further offshore.

Density-dependent effects on lobster growth and survival, together with reduced availability to capture in a high wave-energy shallow-water environment, appears to be severely constraining fishery yields. The present study suggests that a large increase in primary productivity must have taken place after the 1960s, which caused an intensification of oxygen-depleted bottom waters in the diatom-rich coastal waters of Namibia. These bottom waters spread southwards along the Namibian and Namaqualand coasts under the influence of a well-documented poleward undercurrent. Chemical analyzes of subterranean groundwaters in the rivers draining the western escarpment (19-25ºS) display exceedingly high levels of dissolved silicate, a key nutrient for diatom production. Coastal upwelling waters within the same region have been found to have unusually high concentrations of dissolved silicate (up to 50 g at Si/l on occasions). High Si:N and Si:P ratios stimulate the production of diatoms (esp.large, chain-forming species, e.g. Delphineis and Chaetoceros spp. which, by virtue of their rapid sinking rates, speed up the process of nutrient recycling and drive primary productivity at an enhanced rate. Decay of the large quantities of phyodetritus so produced causes oxygen depletion of subsurface waters. This paper shows how an analysis of rainfall patterns in the ephemeral river catchments of Namibia reveals marked change after the 1960s. It appears that seepage of subterranean groundwaters from these rivers in the most likely sources of hyper-productivity in the coastal ocean in this region and that an increase in the delivery of dissolved silicate associated with the increased rainfall after the 1960s the key to the observed ecosystem changes.
OVERVIEW OF OPERATIONAL OCEANOGRAPHY IN SOUTHERN AFRICA

Ephan Potgieter¹, Bruce Spolander¹, Sidney Bilski² and Craig Matthesen²

¹. Racal Environmental and Metocean Services
². Racal Survey (South Africa), A division of Racal Electronics South Africa, Ottey 7808, Cape Town

Recent developments offshore Southern Africa have highlighted the role of operational oceanography in global commerce. Offshore oil and gas, mineral extraction, telecommunications, shipping, defence and fishing are all examples of industries that face challenges due to the poorly understood marine environment in which they operate. Managing these challenges requires the input of specialists from a variety of marine related disciplines; physical oceanographers, meteorologists, biologists and chemists. This paper aims to enhance awareness of the market for marine science, both on a regional and international scale.

The market for operational oceanography, and hence expertise, is expanding due to both new technologies (which enable operation in new environments) and increasing environmental concern (legislative requirements and public awareness). An example of this is the offshore oil, gas and mineral industries, which are operating in ever-deeper water as a result of technological advances. This has necessitated quality data collection for design, operational and impact assessment purposes. A case study approach will be used to illustrate these issues.

AN ASSESSMENT OF THE KWAZULU-NATAL SOUTH-COAST SKIBOAT FISHERY,
WITH NOTES ON THE EFFECTIVENESS OF DAILY BAG LIMITS

Pierre Pradervand¹ and Mark Maritz²

¹. Oceanographic Research Institute P.O. Box 10712, Marine Parade, 4056
². University of Natal, Private Bag, Durban, 4041

KZN's south coast skiboat fishery is one of the province’s most popular boat-based fisheries, targeting a variety of both pelagic and non-pelagic fish species. The fishery consists of a commercial, a recreational and semi-commercial component operating off a variety of vessel types. The recreational component is an open access fishery which is regulated by a suite of management procedures incorporating daily bag limits (DBL), size limits and closed seasons. Assessments of the south-coast skiboat fishery, as well as quantification of the effectiveness of control measures in this fishery, are at this stage rather preliminary in nature, and restricted to unpublished reports.

Data from the National Marine Linefish System and independent access-point surveys are used to provide a description of the recreational and semi-commercial components of this fishery, giving insight into the catch composition, catch frequency, as well as the seasonality of primary target species. The effectiveness of the current (DBL) in reducing fishing mortality (F) is also determined, and amendments to reduce (F) to rates which, will result in values of spawner-biomass-per-recruit corresponding to 35% of that of an unfished linefish stock, are proposed.
Since January 1997 seasonal blooms of the Chrysophyte *Aureococcus anophagefferens* have been a regular occurrence in Saldanha Bay. The most of frequently impacted area has been a tidally flushed 'dam', which is used as an oyster grow-out site (seafarms). The bloom reached maximum extent during the latter half of summer in 1998, when the entire Saldanha bay and Langebaan Lagoon system turned a very unusual and distinct golden brown colour (109 l-1) that persisted for 6-8 weeks. This picoplankter was first described in 1988 after very similar blooms (aptly named 'brown tides') impacted coastal embayments along the mid-Atlantic coast of the United States in the mid-1980s. The Saldanha Bay observations represent the only account of this bloom organism outside the United States. The persistent re-occurrence of this *Aureococcus* bloom in Saldanha Bay now threatens the continuation of oyster farming at the Seafarms site. Prior to 1997 monthly sales for the period January to April typically exceeded 50000 oysters. Subsequent to the appearance of the *Aureococcus* blooms in 1997, these monthly sales have declined dramatically and in 1999 have not exceed 10000 oysters. In addition to the impact on oyster growers, mussel farmers in Small Bay were also negatively affected, particularly in 1998. Instead of obtaining typical yields in excess of 70 kg per rope for that time of the year, the yield of market size mussels in March 1998 dropped to about 20 kg per rope. *Aureococcus* appears to inhibit bivalve feeding either as a consequence of its small size or due to the production of toxic or inhibitory substances. The possibility exists that the Seafarms site now acts as a refuge seed stock that can at times invade the whole Bay system. It has been suggested that the ability of *Aureococcus* to efficiently utilize organic nitrogen, particularly as urea, provides a physiological basis for its success under conditions of low inorganic (NH₄ and NO₃) availability. Nitrogen uptake experiments conducted with our local species show that both NO₃ and NH₄ were shown to be taken up by *Aureococcus*, though NH₄ is utilized more efficiently than NO₃ and with a greater capacity. Urea was also taken up by *Aureococcus* but in a complicated fashion suggesting inhibition at high concentrations. The fact that *Aureococcus* is physiologically better equipped to exhibit reduced nitrogen such as NH₄ and urea rather than NO₃, confers a competitive advantage under conditions of restricted physical input of NO₃ such as occurs at this oyster culture site. Local recycling processes such as excretion and decomposition, in making reduced nitrogen available, would serve to maintain the bloom in the system. *Aureococcus* has the added advantage of a size-based refuge from heavy grazing pressure and sinking losses that act in concert to extend the duration of blooms. External inputs of reduced nitrogen (pollution) would compound the problem.

Oral

**TOWARDS PRIORITIZING CAPE ESTUARIES FOR CONSERVATION**

*Kim Prochzka* and *Charles Griffiths*

*Zoology Dept. and Marine Biology Research Institute, UCT, Rondebosch, 7701 South Africa*

The C.A.P.E. project funded by the Global Environment facility of the World Bank, and run under the auspices of WWF-SA, aims to prioritize areas for the conservation of biodiversity in the Cape Floristic region. It includes terrestrial, freshwater, coastal and estuarine components. This project presents us with a unique opportunity to evaluate the current state of our estuaries and the biodiversity they contain. The project is ongoing until May 2000, and this presentation will thus cover progress made. Biodiversity data have been collated for each estuary within the C.A.P.E. region which stretches from the Olifants River to Port Elizabeth, as well as for a large number of estuaries outside of this area in order to put the C.A.P.E. region into a wider context. These cover species richness of aquatic macrophytes, benthic invertebrates, fishes and birds, as well as counts of bird populations made at each estuary. The threats to estuaries have been identified, and data regarding the current physical state.
INTERTIDAL INSECTS AND MANGROVE MITES: 
A NEW BIODIVERSITY INITIATIVE

Serban Proches, David J. Marshall and Kaajial Ugrasen

In the present context, when understanding overall biodiversity is an essential objective, secondary marine arthropods still represent a gap in the faunistic, ecological and biogeographical knowledge in most parts of the world. Thirty-four marine mite species and a few insect genera have been recorded from our region. The records however are incomplete, being based on ad hoc collections, mainly from the rocky-shores. Very little is known about how the species are distributed along the coast, their levels of endemism, their spatial ecology and abundances, their interactions and their bioindicative potential, all which contribute to our understanding of the biodiversity and usefulness of this faunistic group. The terrestrial background and airbreathing habits make them a specifically interesting group, as it may present completely different patterns in distribution and ecology, compared to primary marine groups. Understanding these differences could lead to advances in marine science in general. Finally, as mites are usually good indicators of the environment damages, littoral mites could be a good group to study for monitoring human impact in coastal ecosystems.

In particular, very interesting data could be provided by the study of the southern African microarthropod fauna of mangrove ecosystems. Surprisingly few faunistic studies have been undertaken on the mangrove communities, with no known studies having considered the microarthropods of the southern African mangroves. Pristine mangroves in particular provide an ideal situation for examining intertidal microarthropod ecology. Furthermore, due to their patchy distribution, characterized by rapid changes, mangrove communities also offer ideal conditions for studying island-like biogeography and population dynamics.

Quantitative sampling from mangrove pneumatophores is relatively simple compared to the sampling of microarthropods from other intertidal habitats, for example rocky shores. Numerous microarthropods inhabit the fungal and algal films of the pneumatophores and stems of the mangrove trees. Considering their cryptic microhabitats and behaviour pattern, the mangrove microarthropods could respond differently to disturbance to the other biota.

Preliminary data presented here show important densities of halacarid mites, collembolans and dipteran larvae occurring in the algal communities (Bostrychietum) on Avicennia pneumatophores. Most of these arthropods belong to undescribed species.
AN ASSESSMENT OF THE IMPACT OF NEARSHORE DIVER-OPERATED DIAMOND MINING ON MARINE BENTHIC COMMUNITIES NEAR LODERITZ, NAMIBIA

Andrea Pulfrich and Andrew J. Penney

Pisces Research & Management Consultants

Nearshore diver-operated marine diamond mining along the Namibian coast has attracted criticism from the rock-lobster industry, who are concerned about possible negative impact on rock-lobster resources in mined areas. A study, initiated by NAMDEB Diamond Corporation, was undertaken to investigate whether mining activity reduces rock-lobster abundances in the mined or adjacent areas, either by direct lobster mortality or through degradation of preferred habitat and food sources.

During 1998 and 1999, 66 dives were conducted in a mined area south of Luderitz to compare the seabed geology, benthic community composition and rock-lobster density in mined and in mined areas. Multi-dimensional analyses showed separation of benthic communities between areas dominated by different sediments. A strong association of rock-lobsters was found with rock- and boulder-dominated seabed with comparatively few lobsters being in gravel or sand areas. Other benthic organisms also showed groupings related to seabed type and community diversity was higher on rock and boulder seabed than in sand and gravel areas.

Mining activity targets gravel-filled gullies between reef ridges in the 15-30m depth range. By removing gravel, mining exposes expanses of previously embedded boulders, effectively converting sparsely inhabited gravel gullies into boulder beds, potentially suitable for subsequent rock-lobster occupation. Newly exposed boulder areas are initially barren. They soon become colonised and, within a year, species richness is statistically comparable with unmined reef and boulder areas. Although the actual structure of the developing communities remains different from benthos in unmined areas for a number of years, this appears to have no negative effect on rock-lobster densities. The impact of mining is highly localized in gullies. Rock-lobsters and associated benthic communities within metres of the edge of mined gullies remain unaffected. The effect on benthic communities of dumping of overburden and fines is minimal where these are returned directly into mined boulder gullies. However, dumping on adjacent reef converts such reef into boulder or gravel areas. Due to the high natural re-dispersion of sand and gravel in the high wave-energy environment, dumping does not appear to have had a significant negative impact on benthic communities in the study area. Overall, seabed type appears to play a greater role in structuring benthic communities in the study area than mining activity. Mining is essentially restricted to depths in excess of 20m, periodically influenced by low oxygen events, and naturally avoided by rock-lobsters for a large part of the year.

Poster

LINEFISH STATUS REPORT: THE NATAL STUMPNOSE AS AN EXAMPLE

P.V. Radebe and B.O. Mann

Oceanographic Research Institute, PO Box 10712 Marine Parade 4056 KwaZulu Natal

Based on detailed literature surveys, all available information about 70 priority species in South African linefishery has recently been compiled into individual species status reports. Major aspects covered in the report include: distribution, habitat, migration, fishery sectors targeting this species, biology and population dynamics, biological reference points, current status indicators, current regulations and research priorities. This poster uses Rhabdosargus sarba commonly known as Natal stumpnose as an example to illustrate the format of the status reports and to highlight areas where there are gaps in our knowledge. R. sarba is a sparid bream that is common in subtropical and tropical inshore waters and estuaries throughout the Indo-Pacific. It is fairly abundant in KwaZulu-Natal waters where juveniles and sub-adults are conspicuous members of estuarine fish communities. Past research on their biology has been focused on diet, food selectivity and habitat as well as some aspects of their reproductive biology. The status report for R. sarba revealed that little information is available on the age and growth of this species. Further, the status of the stock and biological reference points are unknown. These aspects are currently being addressed in a research project at ORI and progress will be indicated on the poster.
HIGH RESOLUTION MARINE GEOPHYSICS: A VALUABLE TOOL IN MARINE SCIENCE

Peter J. Ramsay

In the past decade, the field of marine geophysical remote sensing has made huge advancements. These advances have been particularly noticeable in the development of sonars, sub-bottom profilers, swath bathymetry systems and associated digital processing. Technological advancements in the survey industry have increased the ability of scientists to acquire massive amounts of data in relatively short periods of time. This has resulted in the geophysical interpretation of sonar imagery becoming more and more an exercise in data management. The challenge for current and future processing of digital marine geophysical data is to present an appropriate level of information to the end user.

Most modern marine geophysical instrumentation is digital and does not suffer from the 'noisy' records produced by earlier analogue systems. Digital side-scan sonar systems are now able to produce near aerial photographic quality images of the seafloor, which aids greatly in seafloor interpretation and makes the technology available to non-geophysicists. The computing power available for processing sonar data has created an evolution of processing software, which allows the marine geophysical instrumentation to be exploited to their fullest potential. The image resolution that this technology is producing enables the scientific community to make assessments of seafloor environment, which were impossible a few years ago.

The most visible application of computerized systems for marine geophysics has been the development of side-scan sonar mosaics of the seafloor. In these, the sonar records are geo-corrected and overlaid to provide a composite image of the seafloor. This mosaic, together with the seafloor bathymetry, can then be imported into a GIS system. This database can provide the physical basis on which biological, engineering and oceanographic data can be superimposed to provide the scientist with a complete view of the seafloor environment.

Poster

NON-GENICULATE CORALLINE ALGAE OF THE SOUTH AFRICAN SOUTH COAST -- BIODIVERSITY AND SPECIES COMPOSITION

Carmen Ras and Derek Keats

Coralline algae (Rhodophyta, Corallinales) are calcified red algae that occupy substantial areas of hard substrate within the ephotic zones of the sea. These non-geniculate coralline algae are abundant in tide pools, crevices and rocky surfaces. Although they exist in all of the world's oceans, their species composition and biodiversity still require more research attention. Various studies have been made on the taxonomy of South African non-geniculate corallines, as well as in other geographical areas. Sufficient information on the coralline algae of the west coast of South Africa has been reported or is in process. However, the biodiversity of non-geniculate corallines on the South African south and east coast are little known. This study will therefore mainly focus on the understanding of the coralline algal biodiversity in South Africa. Comparisons with existing records of taxonomic descriptions of the coralline species found in South Africa, as well as in other locations of the world will be essential. The morphological and anatomical characters observed in the different coralline species will also be noted.
It is well known that the South Indian Ocean exhibits prominent variability on interannual, decadal and multidecadal scales with the Agulhas Current system often playing an important role. Whether or not this current also shows significant variability on seasonal time scales is a question that is yet to be fully resolved. Lack of extensive hydrographic observations presents difficulties as does short record of satellite altimeter data in determining the extent of any seasonality in the Agulhas Current. A recent modelling and satellite data study by Matano and co-workers has suggested that bottom topography is important in preventing the westward propagation of barotropic Rossby waves generated in the central /eastern South Indian Ocean from reaching the northern Agulhas Current and hence obscuring the seasonal signal. In this study, application of an eddy-permitting regional ocean model and available data suggests another process may be of significance in addressing the question of seasonality in the Agulhas Current - namely, the relationship through the Mozambique Channel to the location of the South Indian anticyclone and associated easterly winds.

Another aspect of South Indian Ocean variability that needs to be better understood is the evolution of the El Nino Southern Oscillation (ENSO) signal in the region and its relationship with other modes of variability. This aspect is particularly important for diagnosing the mechanisms associated with South African rainfall variability and observational and modelling results that shed further light on the complex relationship involved will be discussed.

**THE EFFECTS OF RIVER GEOMORPHOLOGY ON THE SEDIMENT COMPOSITION OF BAY-HEAD DELTAS IN ESTUARIES OF THE SOUTHEASTERN COAST OF SOUTH AFRICA**

**J.S.V. Reddering**

Council for Geoscience, P.O. Box 1774, 6000 Port Elizabeth

Many estuaries on the southeastern coast of South Africa contain unusually coarse-grained sediment bars at the tidal head and this presentation explains their origin. Landscape development of southern Africa over the past 5 million years produced steeply grading continental margins with deeply incised river channels and estuaries occupying drowned river valleys. During the drowning process the erosion base rose, changing the valleys to areas of deposition. Because tidal sea water invaded the drowned valleys, this deposition took place in estuaries. Estuaries therefore best develop on submerging coasts. Valley shape varies according to the erosion competence of the host bedrock and the extent of incision. The tidal reach of an estuary depends on the gradient of the valley floor. On the steeply sloping coastal regions of South Africa, estuaries are generally short. The resulting cramped channel capacity influences the tidal prism and tidal-mouth dynamics.

Sediment in estuaries is derived from the coast (beach and dune sand) and from the land (suspended mud, and bedload sand and gravel). Deposition in the mouth area takes place by deposition on flood-tidal deltas that grow landward. At the head of an estuary bedload sediment accumulates on the bayhead delta that grows seaward. In the middle estuary between the two delta systems lies an area where mud deposition takes place. This depositional situation adjusts itself for rising sea level and ever-increasing depositional accommodation space. When sea level stabilizes at a fixed level the valley fills with sediment and the estuary matures. In the mature state of most present-day estuaries, the distinction between sedimentation in the upper, middle and lower estuary reaches blurs somewhat.

Most sedimentation in the upper reaches takes place during river floods discharging from rivers with steep gradients. At the tidal head of an estuary the sediment-bearing flood water encounters an abruptly reduced slope. Stream power of the channel falls abruptly at these sites, and although most floods are able to carry sand farther downstream, gravel is generally deposited at the tidal head of estuaries.

The gravel beds are generally intertidal, localized and best developed in estuaries with the shortest tidal reach. Besides prevailing coastal conditions, river geomorphology has an important control on the shape, tidal dynamics and sedimentation behaviour of estuaries.
THE ENVIRONMENTAL EFFECTS OF COASTAL AND MARINE MINING – SADC PROJECT AND REQUEST FOR COOPERATION

J.S.V. Reddering¹, V. Petzel² and G. Schneider²

1. Council for Geoscience, PO Box 1774, 6000 Port Elizabeth, South Africa
2. Namibian Geological Survey, (Get details – to come

The South African Development Community (SADC) operates a variety of initiatives for economic development of the SADC countries. One of its branches, the mining sector, has a subcommittee on mining and the environment. This subcommittee meets its objectives by executing (currently) seven projects, each led by a different country.

The project on marine and its environmental effects serves to compile a database containing mineral deposits and key environmental components. The objective is to have this database available for ready conflict and impact reference if any mining activity is planned between the EEZ boundaries in the open ocean and the high tide level on land of any SADC country. The project also extends to the SADC lake areas.

To be useful the database must be as complete and contain as much relevant information as possible. The format chosen is a map-supported database (GIS) and was prepared at the Namibian Geological survey, but requires data to be added from most coastal SADC states, including South Africa. Any aspect of environmental or commercial importance that can be plotted on a map and could be influenced by mining related activities should appear in the database. The Namibian sector of the map is fairly complete and contains mineral deposits, fishing grounds of different types, cetacean habitat, bird-breeding areas, coastal nature reserves etc. Other SADC coasts will host other important environmental and commercial concerns, such as turtle breeding grounds, corals, prawn grounds, special lake environments and many others.

This information is not only of value to the mining industry. The SADC Inland and Marine Fisheries Sectors have requested access to the non-mining component of the database. It will be a comprehensive single database of the main components of the SADC marine environment. Data added later can be used for modelling, environmental management, resource planning etc.

If any delegate has any contribution to make, or knows of suitable data sources, we would like to meet. GIS-ready data are obviously preferable, but map/chart data can be digitized. We need the map projection in both instances.

This is one of those cooperative projects where you are likely to get out more than you put in.

Oral

WATER USE AND NUTRIENT BUDGETS OF DUNE PIONEER SPECIES GROWING ON THE EAST COAST OF SOUTHERN AFRICA

B.S. Ripley¹ and N.W. Pammenter²

1. Botany Dept., Rhodes University, P.O. Box 94, Grahamstown, 6140 S.A.
2. Dept. of Botany, University of Natal, Durban, 4041 S.A.

Water relations and gas exchange data suggest that the dune species Arctotheca populifolia, Scaevola plumeri and Ipomoea pes-caprae are not limited by the supply of water. Water budgets constructed for S. plumeri show that in low rainfall years plants transpire more water than is supplied by rainfall, suggesting a dependence on ground or long-term stored water. Comparison of d018 values of water distilled from underground stems of S. plumeri with ground and rainwater values indicates that plants utilise ground water except after substantial rainfall. High transpiration rates may be advantageous in obtaining nutrients in a low nutrient environment. Nutrient concentrations in soil and ground water are such that, the volume of water transpired would be adequate to supply the nutrients assimilated during growth if the water source was ground water or soil water. The transpiration of salt containing water results in the foliar accumulation of salts, which may determine leaf senescence and growth preferences.
CRABS FOR SALE, -WHO'S INTERESTED??

Wendy Robertson¹, Alke Kruger¹, Nikki James², Mark Maritz², Carsten Pederson²,
Vuyiswa Radebe², Santosh Bachoo³, Neervanna Jagdeep³, Shamilla Nankumar³ & Kavina Rambali³

1. Oceanographic Research Institute, P.O. Box 10712, Marine Parade, 4056
2. University of Natal-Durban, King George V Ave, Durban,
3. University of Durban-Westville, P. Bag 54001, Durban

The crab market in KwaZulu-Natal was investigated through a series of questionnaire surveys directed at fishing companies, retail outlets and shoppers. A mean of 260 mt of the deep water crab *Chaceon macphersoni* arrived legally in markets in KwaZulu-Natal in 1997 and 1998. Half of this was caught off KwaZulu-Natal by prawn trawlers operating in water depths >150 m, and most of the rest was caught off Mozambique. In addition, about 20 mt of the shallow water (estuarine) species *Scylla serrata* were imported from Madagascar in 1998. A few other locally caught crabs were also landed, but the quantities were negligible.

Fish shops account for an estimated 88% (by weight) of the retail crab market in the Durban area, supermarkets account for about 8% and restaurants account for the rest. The availability of crab fluctuates seasonally and half of the fish shop owners interviewed claimed that they could double their crab sales if more crab was available. Most crab is bought and sold in the whole frozen state, although a few shops sell small quantities of frozen portions (mostly *Scylla*). Retailers showed little interest in live crab. The retail price of crab ranged from R17 to R75 per kg depending on the size of the crabs. Assuming a mean price of R35 per kg, the total annual retail value of crab in KwaZulu-Natal is about R9.5 million. The retail value of the crab component of the trawl fishery off KwaZulu-Natal is thus about R4.75 million.

Data collected during the consumer survey were analysed by race group because the popularity of crab clearly varies among different cultures. Of the 812 shoppers interviewed, 80% of Indians, 50% of Coloureds and Whites and only 15% of Blacks ate crab. *Chaceon* was by far the most commonly bought species, largely because of its availability, but most shoppers also rated it more highly than *Scylla*. Most people who bought crab acquired it from fish shops in the frozen state, although tinned crab and crab sticks (crab-flavoured fish) were also popular amongst Whites. There was little demand for live or sectioned crab. There is thus potential to increase the supply of crabs to KwaZulu-Natal. Possible ways to achieve this would be by expansion of the local fishery, development of mariculture or by increasing importation.

Page 123
EVIDENCE OF LATITUDINAL FLUCTUATIONS OF WATERMASSES IN THE SOUTH ATLANTIC DURING THE LATE QUATERNARY FROM ICE-RAFTED DETRITUS OFF THE WEST COAST OF SOUTH AFRICA

John Rogers¹, Amanda Rau¹ and Min-Te Chen²

¹ Dept. of Geological Sciences, UCT, Private Bag, Rondebosch 7701, South Africa
² Inst of Appl. Geophysics, National Taiwan Ocean University, Keelung 20224, Taiwan, Republic of China

During the 19th Century there were several well-documented reports of icebergs sighted in latitudes as low as 36 degree S, immediately south of the Cape of Good Hope. Subsequently, faceted and striated ice-rafted detritus (IRD), including gneiss boulders, was trawled from the continental slope west of Cape Town (34 degree S). Routine research-trawls for demersal fish on sandy bottoms on the outer shelf recovered geologically exotic boulders of amphibolite and granite as close to the equator as 32 degree S of Namaqualand, SW of the Orange River. During surveys of manganese nodules on the continental rise, SW of Cape Town (37 degree S), bottom photographs revealed IRD cobbles and the sampled sediment was rich in IRD granules, as were the younger, outer parts of the manganese nodules. These regional observations are now being complemented by detailed studies of a giant piston core, the 22m-long MD962080 from the western continental slope of the tip of the Agulhas Bank in latitude 36 degree 16 minutes South and longitude 19 degree 28 minutes East in 2488m of water. Although the sediment is primarily a foraminiferal ooze, there is a significant abundance of sand-size quartz, mainly very fine sand, with traces of angular very coarse sand, interpreted as ice-rafted detritus. This quartzose sand has been concentrated by wet-sieving, dissolving calcareous microfossils with dilute hydrochloric acid, floating off siliceous sponge spicules and radiolaria with sodium polytungstate and magnetically separating the slightly magnetic glauconite pellets from the quartz. Oxygen-isotope determinations on a single species of plankton foraminifera, Globorotalia inflata, have shown that the abundance of quartzose very fine sand increases with the delta-O-18 value in the calcite of the foraminifera. This is interpreted as a cooling of Sea Surface Temperature (SST) due to the preferential loss of the lighter Oxygen-16 isotope during evaporation, its temporary entrapment in the polar icesheets during glacial periods (polar and subpolar Ice Ages) and the consequent enrichment of surface water in the Oxygen-18 isotope. This implies that the SST over the tip of the Agulhas Bank cooled significantly during glacial periods and that icebergs were able to drift to lower latitudes than is the case in the modern interglacial Holocene epoch. This may also mean that the Subtropical Convergence shifted significantly equatorwards and that the Agulhas Current was unable to exchange heat with the South Atlantic Ocean to the same degree as is the case today.

WATER MASSES AND HEAT FLUXES IN THE SOUTHERN OCEAN

R.E. Roman and J.R.E. Lutjeharms

Ocean Climatology Research Group, Dept. of Oceanography, UCT 7700 Rondebosch, Cape Town

In order to understand global warming detailed information is required on the forces that drive climate change. The ocean plays an important role in the distribution of heat and the absorption of greenhouse gasses. These gasses are transported to the deep ocean during water mass formation. A hydrographic section was carried out along the Greenwich meridian during the austral summer of 1993 in order to fulfill this objective. Temperature and salinity sections show the existence of three distinct frontal zones namely the Subtropical convergence at 41°13’S, the Subantarctic front at 45°13’S and the Antarctic Polar front at 50°30’S. The locations of these fronts are consistent with previous findings. These fronts are regions of water mass formation and form clear boundaries between surface water masses. The five different water masses that are observed in the Southern Ocean are Subantarctic surface water, Subantarctic Mode water, Antarctic surface water, Antarctic Intermediate water and Circumpolar Deep water which is further demarcated into Upper Circumpolar deep water (UCDW) and Lower Circumpolar deep water (LCDW). The characteristics of UCDW and LCDW are changed by interaction with North Atlantic Deep water. The heat flux across this hydrographic section was obtained by vertically integrating the meridional velocity and temperature fields. Studies have shown a net heat loss within this sector of the Antarctic Circumpolar current of which the Subantarctic front and the Polar front form the northern and southern boundaries.
Crustose coralline algae (Rhodophyta, Corallinales) are calcified red algae, which are widespread in intertidal and subtidal areas. Several studies have been conducted on crustose coralline algae, in South Africa, but most have been directed at the West Coast. Therefore, consistent documentation of the crustose corallines of the East Coast of South Africa is still lacking. Although Mesophyllum (Melobesioideae) and Hydrolithon (Mastophoroideae) have been well documented for the East Coast, other genera, like Sporolithorn, Spongites, Lithophyllum, still need to be examined. The biodiversity of coralline algae will be the main focus during this study. Taxonomic descriptions of coralline algae found in South Africa will be compared with studies done in other locations of the world. During this study there will be looked at the number of species in the area, a comprehensive species list will be compiled, as well as determining the geographical affinities of the east coast coralline algae.

Oral

AIR-SEA EXCHANGE OVER AN AGULHAS EDDY AT THE SUBTROPICAL CONVERGENCE

M. Rouault and J.R.E. Lutjeharms

Dept. of Oceanography, University of Cape Town, 7700 Rondebosch, South Africa

The oceanic region south of Africa plays a key role in the control of Southern Africa weather and climate. This is particularly the case for the Subtropical Convergence region, the northern border of the Southern Ocean. An extensive research cruise to investigate this specific front was carried out aboard the research vessel during June and July 1993, the first time this has been done in this region in winter. A strong front, the Subtropical Convergence was identified, however its geographic disposition was complicated by the presence of an intense warm eddy detached from the Agulhas current. The warm surface water in the eddy created a strong contrast between it and the overlying atmosphere. Oceanographic measurements (XBT and CTD) were jointly made with radiosonde observations and air-sea interaction measurements.

The air-sea interaction measurement system included a Gill sonic anemometer, an Ophir infrared hygrometer, an Eppley pyranometer, an Eppley pyrgeometer and a Vaisala temperature and relative humidity probe. Turbulent fluxes of momentum, sensible heat and latent heat were calculated in real time. All these measurements allowed a thorough investigation of the net heat loss of the ocean, the deepening of the mixed layer during a severe storm as well as the structure of the atmospheric boundary layer and ocean-atmosphere exchanges.

A comparison between surface wind speed measured with the satellite ERS1 and surface wind speed calculated by the ECMWF model shows that ECMWF model does not seem to take into account oceanographic heterogeneity such as a warm eddy, the Agulhas Current and STC. The wind speed seems to accelerate above the eddy. This is due to the transfer of the flux of momentum that is increased above the eddy due to the atmospheric instability created by the temperature difference between the eddy and the air.
SIMULATION AND QUANTIFICATION OF AN UPWELLING INDUCED RETENTION PROCESS USING A BAROTROPIC MODEL

Claude Roy¹, Pierrick Penven², Alanin Colin de Verdiere³ and John Largier²

1. Marine and Coastal Management, Private Bag X2, Rogge bay 8012 South Africa
2. Oceanography Dept., University of Cape-Town, Rondebosch 7701, South Africa
3. Laboratoire de Physique des Ocean, Universite de Bretagne, Victor Le Gorgeu, 29200 Brest, France

In a coastal upwelling system, mesoscale physical processes such as filaments, coastal jets or eddies are key processes to which the life history strategies of the marine living resources are adapted. Using a simple hydrodynamic model of the southern Benguela upwelling, an attempt is made to quantify the importance of some of these processes for the recruitment of local sardine and anchovy populations. In the southern Benguela, sardine and anchovy spawn on the Western Agulhas Bank. Eggs and larvae are transported to the west coast nursery grounds by a coastal jet current. Once the larvae reached these nursery grounds, retention within the favorable coastal domain is a key to larvae survival and recruitment of the two species. The Cape Columbine-St Helena Bay area is one of the main nursery grounds along the West Coast of South Africa. In this area, the interaction between the upwelling process and the topography results in the formation of an upwelling plume in the lee of cape Columbine. The plume and the associated circulation patterns provide a retention mechanism allowing larvae and early juvenile to be maintained within the coastal domain. The dynamic of the plume is studied using a set of numerical experiments. It is shown that an equatorward wind forcing produces a cyclonic eddy in the lee of Cape Columbine. A balance between advection and bottom friction regulates the evolution of this eddy. The eddy contributes to create a dynamic boundary between the coastal and the offshore domains. Retention induced by the eddy is quantified in the model using a tracer. The magnitude of retention is positively related to the wind for weak to moderate wind intensities. For strong wind intensity, retention reaches a maximum or slightly decreases. This is in agreement with previous results relating recruitment success with wind speed.

Benefit Oral

DISTRIBUTION OF MAJOR ZOOPLANKTON GROUPS IN THE NORTHERN BENGUELA CURRENT REGION DURING AUSTRAL WINTER

C. Ruby¹, C. Rogers², B. Maritz², V. Hashoongo³, L. Arendse⁴, D. Gianakouras⁴, C. Giddey⁴, V. Herbert², S. Jones⁴, A. Kemp³, H.M. Verheye⁴

1. Institutode Investigacao Pesqueira, liha de Luanda C.P. 2601, Luanda Angola;
2. Dept. of Nature Conservation and Oceanography, Cape Technikon, P.O. Box 562, Cape Town 8000, South Africa
3. Ministry of Fisheries and Marine Resources, National Marine Information and Research Institute, P.O. Box 912, Swakopmund, Namibia
4. Marine and Coastal Management, Biological Oceanography, Private Bag X2, Rogge Bay 8012, Cape Town, South Africa

Zooplankton was collected in the northern part of the Benguela Current region during July 1999, as part of the SADC/BENEFIT Training cruise. Samples were collected between Walvis Bay (Namibia) and Luanda (Angola) using a 200 µm meshed Bongo net hauled obliquely from 200 m to the surface. During a week-long zooplankton identification workshop subsequently held in Swakopmund, the samples were analyzed and distribution patterns of major zooplankton groups along the coast and across a transect off Walvis Bay were examined. Taxonomic groups common to most samples included copepods, euphausiids, and chaetognaths in addition to gelatinous zooplankters such as medusae, salps, and siphonophores. It is noteworthy that amphipods, cladocerans, decapods, doliolids and ctenophores were either poorly represented on not at all observed in the samples. A striking feature was the occurrence of elevated abundance of zooplankton, predominantly calanoid copepods, in the region of the Angola-Benguela front, as well as far offshore off Walvis Bay. Patterns of distribution and community structure are discussed in relation to hydrographic features prevailing across the shelf off Walvis Bay and relative to the Angola-Benguela front, evident from satellite-derived surface temperature and ocean colour.
LONG WALK TO FOOD? INVASIVE BLACK MUSSEL INCREASES LIMPET MOVEMENTS

Carlos Ruiz, and Nina Steffani

Zoology Dept., University of Cape Town, Rondebosch 7700

The genus Latrunculia du Bocage is interesting and enigmatic both from a systematic and from a biogeographic point of view. Du Bocage described the type of species (Latrunculia cratera) from Cape Verde in the Atlantic Ocean. He distinguished it from genera by the presence of novel microscleres (amongst other features), which he termed spinulated acanthomicrorhabds. Unfortunately, the type species was lost soon after designation, and subsequent taxonomists failed to identify other groups of characters, which clearly differentiate Latrunculia sponges at the genus level. Consequently, any species possessing spinulated acanthomicrorhabds was assigned to the genus Latrunculia. A review of the current status of the genus reveals that many non Latrunculia species have been assigned to it, because they show little homology with each other... aside from the presence of spinulated acanthomicrorhabds. This has created many uncertainties, as well as an unstable relationship in this group at all systematic levels. The poster reviews and redefines the specific diagnostic characters of the genus Latrunculia and provides a framework for the recognition and establishment of new species.

A PROBLEM IN TAXONOMY: THE SPONGE GENUS Latrunculia

Toufiek Samaal¹ and Michelle Kelly²

1. P.O. Box 78-138, Grey Lynn, AUCKLAND, New Zealand

The patellid limpet Patella argenvillei is commonly found in intertidal rocky shores of the Southern African West Coast, where it can attain high densities (>200 individuals/m2) due to collective feeding and subsidy by subtidal kelp. In the last three decades, the Mediterranean black mussel Mytilus galloprovincialis has become established on the West Coast, where it is now the dominant mussel species with an estimated 74% of intertidal mussel biomass. M. galloprovincialis completes exploitatively with P. argenvillei for primary space, reducing limpet access to subtidal kelp. Many exposed rocky shores on the West Coast, previously dominated by P. argenvillei, are now occupied by Mytilus. Because of this, the limpets are only found in aggregations in small patches that are remnants of the previous limpet belts (‘established patches’), or isolated on the mussel bed, or in patches cleaned of mussels by the effects of wave action (‘cleaned patches’). The present study investigated the effects that Mytilus encroachment is having on the movement patterns of limpets, by comparing homing and mobility of limpets on these three substrata. Limpets were tagged and their positions monitored every 12 hours during five tidal cycles and at one-month intervals for three months. Short homing frequency was higher (81.46%) on the remains of natural habitat (established patches) than on newly-created patches (64.59%) and on the mussel bed (56.57%). On a monthly basis, homing on established and cleaned patches was similar (43.27%, 32.76%) and much higher than on the mussel bed (8.26%). Non-homing P. argenvillei were most mobile on mussel bed and most sedentary on established patches, both on short and medium-term periods. Large limpets generally moved more small limpets on all substrata types. Small limpets on mussel bed frequently moved into cleared patches (23.66%), while limpets on all other categories seldom changed substratum. Mytilus encroachment on P. argenvillei populations induces a behavioural shift towards increased limpet mobility and reduced homing frequency by limiting access to subtidal kelp and increasing dependency on alternative food sources. Limpet population structure also seems to be altered by the mussel bed, which offers a good settlement place and increases limpet recruitment, but reduces survival of large individuals.
SHALLOW WATER SPONGES OF THE WEST COAST, SOUTH AFRICA

Toufiek Samaai¹, Michelle Kelly² and Mark J. Gibbons¹

1. Zoology Dept., University of the Western Cape, Private Bag X17, Bellville 7535
2. P.O. Box 78-138, Grey Lynn, AUCKLAND, New Zealand

Much of our early, reliable scientific knowledge on marine taxonomy comes from reports published in the late 1800s. Although there have been a handful of more recent reports, all have focussed their attention on the sponges (and other invertebrates) of either the south or east coast of South Africa. This has left a gap in knowledge along the west coast. At present the sponge fauna of South Africa is thought to consist of about 298 species, 25% (75 species) of which are also distributed along the west coast of South Africa.

In 1996 an attempt to rectify this situation was initiated, when an inventory of the sponge fauna of a selected region along the west coast of South Africa was made. To date 151 species in 48 genera and 31 families (11 Orders, 2 Classes, and 288 specimens) have been collected, of which only one species seems to belong to the Class Calcarea. Of the 151 species collected, 46 are new, which increases the number of species known to occur only on the west coast to 74. At present the number of species identified for South Africa is 449, 16% (74 of 449) of which are contributed by species collected on the west coast. The most striking aspect of the west coast sponge fauna (based on underwater observations) is its low species richness (i.e., number of species per unit area) and high levels of dominance (i.e., one or a few species representing most of the individuals in the community). Taken overall, the west coast seems to have a very high abundance of species belonging to the family Microcionidae (Poecilosclerida). These patterns are discussed, and some generalities on the affinities of the South African sponge fauna to that of neighbouring countries are made.

BIRTH CONTROL MEASURES IN SQUID

Warwick Sauer¹ and Yolanda Melo²

1. Dept of Ichthyology and Fisheries Science, Rhodes University, Grahamstown, 6140, South Africa
2. Depr of Marine and Coastal Management, Po Bag X2, Roggebaai, 8012, South Africa.

More precise methods for calculating actual fecundity in loliginids are required. True semelparity is now accepted to be the exception rather than the norm, making actual fecundity estimations notoriously difficult. Tagging studies, histological examination of the ovary, and aquarium maintenance have confirmed the chokka squid, *Loligo vulgaris reynaudii*, to be a serial spawner. Females were found to move between spawning sites within the general spawning area off the South Coast of South Africa, the ovary was characterized into eight different stages, and chokka squid deposited three batches totaling 8 140 eggs over a thirty six hour period in captivity. This confirmation of serial spawning provides a number of obstacles when estimating actual fecundity. Detailed investigation of the ovary adds even further to our woes. Oocyte atresia, previously unknown in loliginid squid, has now been identified as a regular phenomenon during the reproductive cycle of this species. Atresia takes place in all stages of oocyte development, but is more prevalent in the late yolkless and vitellogenic oocytes. Follicular atresia lowers the number of maturing oocytes in the ovary and true fecundity will certainly be overestimated if follicular atresia is not considered. Two further results may, however provide some solutions to this complex issue. Firstly, the atretic oocytes are useful as an index of chokka squid reproductive capability. Spent squid can now be positively identified from the percentage of atretic oocytes in the ovary. Secondly, post-ovulatory follicles were found in the ovary of actively spawning females, and the rate of breakdown of these follicles may provide us with answers on the number of batches spawned. Analysis of the rate of resorption of post-ovulatory follicles in the ovaries of squid collected at regular intervals over one spawning cycle may provide the number of batches of eggs spawned.
A review is given of the unusually rich biodiversity yet marginal nature of South African coral reefs. They are limited in extent and threatened to a varying degree by natural phenomena and human perturbations. On the East African coast, such factors include coral bleaching, damage by crown-of-thorns starfish, human recreation and fishing.

Climate change plays a role in the first-mentioned; this is being monitored on a local reef. A further comparative review is given of the status of the South African reefs relative to those elsewhere in East Africa and their likely future in the light of leading recent research.

**FEMALES AND JUVENILES FIRST: A FISHERY DILEMMA**

**M.H. Schleyer**

*Marine and Coastal Management, Private Bag X2, Rogge Bay 8012, Cape Town*

The indiscriminate nature of most marine industrial fishing methods in use today results in the incidental capture both of non-target species and of undesirable sizes of target species. Rock lobster fisheries provide excellent examples of this phenomenon; almost all of those using baited traps are managed using minimum legal sizes and, consequently, have problems with landing undersized specimens. The fishery for the west coast rock lobster *Jasus lalandii* is no exception. Once they are removed from the water, rock lobster are vulnerable to damage from numerous sources. Even sublethal injury may result in significant reduction in individual productivity through decreased growth or reproductive potential. In a fishery maintaining a harvest rate of roughly 30%, as is the case here, such wastage may have severe repercussions for the resource. In an attempt to reduce these losses, 20% of the fishing gear used by the west coast rock lobster industry was modified to include grids designed to allow undersized lobster (mainly females) to escape the traps before they are hauled. The efficiency of this gear in comparison with standard commercial gear was tested over a range of fishing grounds using a simple experiment.

Initial analyses indicated that the ratio of undersized to legal-sized rock lobster caught was substantially smaller for escape-grid traps than for commercial traps. This suggests that the escape-grid traps tend to achieve their goal. However, escape-grid traps also caught fewer legal-sized specimens than commercial traps, implying that they are less efficient. A simple model was constructed to resolve this conflict. It describes the likely repercussions of varying the proportion of escape-grid traps in the commercial gear on the effort required to land any given mass of legal-sized specimens and on the concomitant reduction in catch of undersized specimens.

Results suggest that reductions in the catch of undersized rock lobster achieved by including escape-grid traps in the commercial gear could not justify the increase in fishing effort that would be required by the industry to land its annual quota. Given this inefficiency and the feeling amongst commercial fishers that escape-grid traps are more dangerous to operate in heavy seas than regular commercial traps, some alternative method must be sought to reduce the catch of undersized rock lobster in this fishery.
Algoa Bay is a wide, southeast facing log-spiral bay on the south coast of South Africa. The city of Port Elizabeth has been established in the sheltered western sector of the Bay, and as it has developed, so more effluents have been discharged into the local marine environment. A number of projects have investigated ocean structures and the extent to which this sector of the Bay has become polluted. A review is given of past results, extending to a more detailed analysis of a recent measurement programme. This has involved about two years of monthly sampling over a grid of stations, as well as data from moorings and coastal sites; sediments were also sampled on one occasion. The results demonstrate the variability inherent in the area, even in sheltered corners adjacent to the harbour. Dispersion of the pollutants occurs into the wider reaches of the Bay, while phytoplankton uptake of nutrients appears to be coping with much of the additional input. There is a definite localised impact of effluent from coastal discharge points, but at the same time there does not appear to be any long-term trend indicating that a build-up of pollutants is occurring.

Successful gene flow among populations of marine organisms requires dispersal of either gametes, larvae or adults. Within populations of marine invertebrates, larval dispersal has been found to have a substantial effect on gene flow among populations. Two pulmonate limpets, occurring abundantly along the coast of South Africa, show different types of larval development. *Siphonaria capensis* produces egg ribbons from which planktonic larvae emerge after approximately five days and then live planktonically for 2 to 3 weeks before settling. *S. serrata* produces egg masses from which completely metamorphosised juvenile limpets hatch after approximately 28 days. These contrasting modes of reproduction are expected to have an enormous effect on gene flow among populations of the respective species. The potentially high levels of dispersal within *S. capensis* should result in low levels of similarity within populations but high genetic similarity among populations, with high gene flow occurring along the coast. *S. serrata* is expected to show high genetic similarity within populations as "relatives" will not disperse far from one another. However, *S. serrata* should show high levels of genetic differentiation among populations due to low levels of dispersal and hence low gene flow. Gene flow is very difficult of measure directly in natural populations and so numerous biologists turn to indirect estimations, often generated from allozyme data. In this study, 20 allozyme loci were screened for each species, of which 5 and 4 loci within *S. capensis* and *S. serrata*, respectively, were found to be polymorphic. Single locus frequencies within all populations of both species were found to be in Hardy-Weinberg equilibrium and this implies that all populations must be maintained by at least some outbreeding. Genetic differentiation, estimated as FST, a measure of allele frequency differentiation among subpopulations was found to be higher in *S. serrata*, the direct developer, (FST =0.40 +/-0.28) than in *S. capensis* (FST =0.25 +/-0.08). The two species were also found to have vastly different levels of gene flow, which was measured using Nm values. Nm estimates the number of individuals exchanged between populations in a single generation and this showed high gene flow among *S. capensis* populations; with the greatest amount of gene flow occurring along the Transkei coast (Nm =46.11). Gene flow in *S. serrata* was found to be very variable but low, particularly along the Transkei coast (Nm =8.21). Thus, *S. capensis* is indeed dispersing relatively long distances, while *S. serrata*, the direct developer, is showing limited gene flow and higher differentiation among populations.
**THE PIRATA PROGRAM AND A PROPOSED EXPANSION THROUGH THE SOUTH EAST**

*Jacques Servain* and PIRATA Steering Committee

PIRATA (Pilot Research Moored Array in the Tropical Atlantic) proposes to install and maintain an array of 12 moored ATLAS buoys during the years 1997 to 2001 on the Tropical Atlantic. The principal objective is to monitor the meteo-oceanic surface variables and upper ocean thermal structure at key locations in the tropical Atlantic. The measurements are transmitted via satellite in real-time, and are available to all interested users in the research or operational communities. PIRATA can be considered as a pilot expansion in the Atlantic of the TAO system which was successfully implemented in the Pacific during the TOGA years. PIRATA is realized as part of a multi-national effort involving Brazil (INPE, DHN), France (IRD, M1t1o-France, CNRS/INSU) and USA (NOAA/PMEL).

The first phase of PIRATA implementation (1997-1998) coincided with a warm event which occurred in the whole tropical Atlantic, and which developed during the end of the largest ENSO event ever registered. Three years of measurements will only barely touch on the issues of seasonal to interannual variations in the tropical Atlantic, and will not relate decadal scale variability. Therefore, based on the initial successes of the program, the PIRATA Steering Group recommended a transitional phase towards the development of a sustained climate observing system for an additional five years, to 2006. This extension will allow for a full demonstration of the utility of PIRATA data, and a smoother transition to operational status, if warranted under auspices of CLIVAR, GOOS and GCOS. Furthermore, the Steering Group encourages consideration of scientifically sound pilot expansion projects that build upon the original PIRATA array, and invites collaborations with other nations and institutions interested in implementing a sustained climate observing system in the tropical Atlantic. That could be the case for an expansion of the PIRATA array through the south-east (i.e. in the vicinity of the Angola’s dome/front) according a special agreement linking institutions from South Africa / Namibia / Angola to the PIRATA community.

Benefit Oral

**HIGH PRESSURE LIQUID CHROMATOGRAPHY ANALYSIS OF PHYTOPLANKTON PIGMENTS**

*Heather Sessions¹, Ray Barlow¹* and *Janet Botha²*

1. *Marine & Coastal Management, Private Bag X2, Roggebaai 8012, Cape Town*
2. *National Marine Information & Research Centre, Swakopmund, Namibia*

Detailed pigment data, derived from the high pressure liquid chromatography analysis of phytoplankton samples, are useful to determine the in situ distribution patterns of chlorophyll a as well as provide chemotaxonomic information regarding the composition of the community. Various accessory pigments are key signatures of different phytoplankton groups. For example, fucoxanthin is associated with diatoms, peridinin with dinoflagellates, hexanoyloxyfucoxanthin with nanoflagellates such as prymnesiophytes, and zeaxanthin indicates the presence of small cyanobacteria. Selected pigment data from the 1999 BENEFIT training and research cruise will be presented to illustrate the distribution of chlorophyll a along sections of the cruise track, and the appropriate changes in phytoplankton community structure.
Oral

SATELLITE OCEANOGRAPHY INTO THE NEW MILLENNIUM (WITH EMPHASIS ON OCEAN COLOUR)

F A Shillington

Dept. of Oceanography, University of Cape Town, Rondebosch 7701

Satellite oceanography has been come of age with multi-year time series of observations now available for SST, dynamic topography at basin scales, more recently ocean colour (e.g. seaWiFS). Shorter datasets exist for surface wind (e.g. NSCAT on ADEOS) measurements. Some of the satellite measurements are possible through clouds (e.g. TOPEX) and others have their utility severely curtailed by clouds and other atmospheric interference. Most of the emphasis in this presentation will be on what satellite measurements of ocean colour can do for the ocean community. Applications of satellite derived ocean colour fall into three basic categories: (a) synoptic fields of chlorophyll pigment as an index of phytoplankton biomass, which can be used to quantify carbon flux at regional to global scales, (b) as an observational link between coastal ecosystem processes and the physics of the mixed layer, (c) general problems of coastal zone management including the management of fisheries. The requirements for coastal monitoring need high spectral resolution, high spatial resolution (0.1 to 0.5 km), and rapid time sampling. Although it might appear that one satellite with a suitable sensor is sufficient, problems with sunglint indicate that it would be better to have a number of complementary ocean colour sensors in orbit at any one time. In the 2000-2005 era, (see e.g. IOCCG 1999). Status and plans for satellite ocean-colour missions: considerations for complementary missions. Yoder, J.A. (ed.), Reports of the international Ocean-Colour Coordinating Group, No 2, IOCCG, Dartmouth, Canada) Instruments like MODIS, Meris and GLI will be orbiting the earth, and with advances in algorithms for interpreting high chlorophyll concentrations (case 2 waters), will be providing new improved chlorophyll measurements in the coastal zone. Examples will be given of the various types of satellite remote sensing in southern African waters.

Poster

IDENTIFICATION OF LEARNING DIFFICULTIES IN A SECOND YEAR BOTANY MODULE (PHYLOGENETIC SURVEY OF PHOTOSYNTHETIC ORGANISMS) AND COMPUTER-BASED INTERVENTION

N.G. Sikiti and D. Keats

Botany Dept., University of Western Cape, Private Bag X17, Bellville 7535 South Africa

The purpose of this investigation was to identify learning comprehension problems experienced by University of the Western Cape second year Botany students within the context of a module entitled Phylogenetic Survey of Photosynthetic Organisms. This course has a strong emphasis on marine algae and their phylogeny. The study attempted to identify the common sources of problems that led to comprehension failure during resource-based learning.

Two complementary methods were used for gathering information, questionnaires and interviews. For the pre-test, ten third years (volunteer) Botany students were interviewed about their experience of resource based learning and data were analyzed to enable planning of modifications to computer-based learning resources. The post-test was done with a class of fourteen second year Botany students to evaluate the effectiveness of modified resources. The results indicated that majority of the students were willing to learn about and incorporate computer resources in their learning process to improve their comprehension.
PREDICTING INTEGRATED CHLOROPHYLL A FROM SEA SURFACE TEMPERATURE DERIVED FROM SATELLITE IMAGERY

Nonkqubela Silulwane, Betty A Mitchell-Innes, Anthony J. Richardson and Frank A. Shillington

1. Oceanography Dept., University of Cape Town, Rondebosch 7701
2. Marine and Coastal Management, P/B X2, Roggebaai 8012, Cape Town

Chlorophyll a is an important direct and indirect food source for pelagic fish. In this study, we estimate the total integrated chlorophyll a from sea surface temperature on the western Agulhas Bank, a major spawning ground for pelagic fish. There are three steps in this process. First, a predictive relationship between surface chlorophyll a and temperature is derived. Second, vertical profiles of chlorophyll a are related to sea surface temperature. It is known that there is a continuum of profiles ranging from profiles with no chlorophyll a peak for cool temperatures, through profiles with a surface chlorophyll a peak at intermediate temperatures, to profiles with a subsurface peak at warm temperatures. Last, from sea surface temperature derived from satellite imagery over the spawning season of pelagic fish, integrated chlorophyll a will be estimated. In the future, estimates of integrated chlorophyll a will be used as an index of productivity to relate to pelagic fish recruitment.

Oral

APPLICATION OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN MARINE GEOSCIENCE SURVEYS

David Sinclair

Council for Geoscience, Bellville

Geographic Information Systems (GISs) play an increasingly significant role in assisting with natural resource issues. Given their applicability to spatial data, geology is a field in which GIS has particular application potential. To date, while GIS has made an important contribution to the identification of terrestrial mineral reserves, little use of GIS has been made in the identification of marine mineral reserves. In the context of a growing demand for marine minerals, GIS is a potentially valuable tool in the identification and evaluation of marine mineral resources. This paper investigates the methodology and initiates the development of a model which can be utilised as a predictive tool for the marine mineral industry. The model is developed within the context of the Algoa Bay study area, and so takes into account the specific geographical and geological attributes of that area. However it’s generic approach means that it is suitable for any geographical area in which there is the required data. The development of the model requires an understanding of the potentials, parameters and applicability of GIS in general and in particular its application within the marine environment. The identified mineral deposits can be assessed in terms of potential economic viability with additional Expert input with regards to the extraction and environmental costs incurred.
A PRELIMINARY STUDY OF THE MACROINVERTEBRATE FAUNA ASSOCIATED WITH THE OYSTER, SACCOSTREA CUCULLATA AT PARK RYNIE BEACH, KWAZULU NATAL

V. Singh and G.K. Moodley

Dept. of Zoology, University of Durban-Westville, Private Bag X54001, Durban, 4001

The Natal rock oyster, Saccostrea cucullata forms conspicuous bands on rocks in the upper balanoid zone. Oysters are extremely valuable as they are commercially exploited, harvested for subsistence purposes or collected for fish bait. Growing concern over the effects of harvesting has led to the need for a detailed description of the macroinvertebrate fauna associated with S. cucullata because community structure and habitats of these macroinvertebrates are disturbed during harvesting. Interstices and crevices between individual oysters in the dense beds provide a safe habitat for a great variety of macroinvertebrate fauna, offering protection from predators and harsh physical conditions (such as strong currents, wave action, desiccation and temperature extremes at low tides). Initially, a study was conducted to determine the smallest practical quadrat size that could be used. A quadrat size of 0.04 m² was chosen for further work since more than 90% of the total number of species found were present here. Thirty eight taxa representing six phyla (Cnidaria, nemertea, Sipunculida, Annelida, Arthropoda and Mollusca) of associated organisms were recorded. Gastropods and crustaceans were the most species rich groups, represented by 14 and 9 species respectively. Although polychaetes and bivalves were represented by only five species each, numerically they accounted for 31.55% and 23.16% of the total number of organisms, respectively. Polychaetes were dominated by Pomatoleios kraussii, which comprised 66.82% of the polychaetes, and 12.93% of the total number of macrofauna species associated with Saccostrea cucullata. The phylum Nemertea represented the lowest recorded group, comprising 1.23% of the total. Presently, indiscriminate harvesting of oysters results in exposure of bare rock and in order to minimize disturbances to the associated fauna, an improved technique for oyster removal needs to be introduced.

SURFACE DISTRIBUTION OF MICROPHYTOPLANKTON OF THE SOUTH-WEST INDIAN OCEAN IN THE REGION BETWEEN CAPE TOWN AND THE PRINCE EDWARD ISLANDS

A.R. Slaughter, P.W. Froneman and E.A. Pakhomov

Southern Ocean Group, Dept. Rhodes University, PO Box, Grahamstown, 6140 South Africa

Surface chlorophyll alpha (chl-a) concentration, microphytoplankton (>20 µm) species composition and distribution in the south-west Indian Ocean in the region between Cape Town and the Prince Edward Islands was investigated during three cruises of the South African National Antarctic Programme in early Austral autumn (April/May) 1996-1998. Samples were collected at ±30 nautical mile intervals for the analysis of size fractionated chl-a and the identification and enumeration of microphytoplankton species. Peaks in total chl-a were recorded at stations occupied on the vicinity of the Subtropical Convergence during the three cruises. Increased chl-a concentrations were also recorded at stations occupied in the vicinity of the Sub-Antarctic Front in 1996 and 1998 and in the neritic waters of the Prince Edward Islands in 1997 and 1998. A peak in total chl-a was also recorded in the open waters south of the STC in 1998. At stations where elevated chl-a concentrations were recorded, microphytoplankton generally formed a substantial contribution (up to 25%) to total chlorophyll. Outside these regions, total chl-a was almost entirely dominated by nano- and picophytoplankton. Numerical analyses showed that distinct microphytoplankton groups separated by the major oceanic fronts are found in the different water masses in the region between Cape Town and the Prince Edward Islands. The importance of the fronts as biogeographic boundaries to the distribution of microphytoplankton, however, demonstrates a high degree of temporal variability. This variability appears to be related to prevailing oceanographic conditions in the region of the fronts which result in cross frontal mixing or in the formation of eddies which transfer microphytoplankton across the fronts.
Oral

PRELIMINARY INVESTIGATIONS ON THE POSSIBLE CONSEQUENCES OF NON-FATAL ATTACKS ON OCTOPUS

C. D. Smith and C.L. Griffiths


A total of 189 Octopus vulgaris were collected from the kelp beds of Windmill Beach, Miller's Point and Buffels Bay, along the west coast of False Bay, as part of a project to determine the population biology of this species. On analysis of these specimens it was found that octopuses at Buffels Bay (mean Mantle Length (ML)=109.4mm) were significantly smaller than octopuses at Miller's Point (mean ML=130.7MM, P<0.001) and Windmill Beach (mean ML=144.5mm, p<0.0001). Furthermore, male and female gonadal somatic index (GSI) for octopuses at Buffels Bay (MGSI=1.28; FGSI=0.99) were higher than that for octopuses at Miller's Point (MGSI=0.85, P<0.05; FGSI=0.19, P<0.01) and Windmill Beach (MGSI=0.84, P<0.05; FGSI=0.23, P<0.05). Octopus growth and maturation are known to be effected by complicated interactions between light duration, light intensity, water temperature, food supply and genetics, but these factors are probably similar between Windmill, Miller's Point and Buffels Bay, as these sites are within 20km of each other. However, the frequency of occurrence of octopus arm amputations inflicted by catsharks was significantly different between the sites ($x^2=19.27$, df=2, p<0.01). Amputations were more frequent in octopuses at Buffels Bay (63.6%) than in octopuses at Miller's Point (39.1%) or Windmill Beach (8.7%). In contrast, mean food volume was low for octopus at Buffels Bay (0.7 ml), and higher for octopus at Miller's Point (2.29 ml) and Windmill Beach (2.49 ml). This data suggests that octopus foraging time at Buffels Bay could be limited due to increased non-fatal predatory pressure. Hence, small octopus size and previous maturity of octopuses at Buffels Bay are probably a result of reduced food intake, which is ultimately a consequence of increased non-fatal predatory pressure. Moreover, fecundity is also reduced, as it is dependent on octopus size.

Poster

A COMPARISON OF THE EFFECTS OF CATCHMENT DEGRADATION ON FIVE ESTUARIES IN THE EASTERN CAPE

L. Sogayise and R. Bally

Zoology Dept., University of Fort Hare, 5700 Alice

Estuaries are important and valued features of the landscape. By virtue of their position at the interface of sea, river and land, estuaries support a distinctive assemblage of birds, fishes and invertebrates as well as characteristic floral communities such as mangrove swamps and salt marshes. The majority of estuaries in the Eastern Cape are both small and closed and are characterized by a lack of diversity of the benthic macrofauna. This is probably due to a reduction in recruitment from the sea, although human activities in the catchment contribute to the paucity of the macrobenthic fauna and to the chemical state in the estuaries.

This paper reports on a comparative study made of the catchments of small estuaries in the East London region of the Eastern Cape Province, and the relationships between the status of the catchment with the condition of the estuaries, as indicated by the benthos and physico-chemical properties determined in each system.

Poster

USING THE RESEARCH SUBMERSIBLE JAGO TO OBSERVE PLANKTON: THE VERTICAL DISTRIBUTION OF THE LEPTOMEDUSA Aequorea aequorea

Conrad Sparks and Mark J. Gibbons

Zoology Dept., University of the Western Cape, Private Bag X17, Bellville 7535

Observations on the vertical distribution of megaplankton were made during and descent of the research submersible Jago at two sites off the Orage River mouth. Although two species of medusae were seen, quantitative data could not be obtained for Chrysaora hysoscella (Scyphozoa). The other species of medusa, Aequorea aequorea (Hydromedusa: Leptomedusae) was common, and observations on its vertical distribution could be made. This species shows a negative relationship between depth of occupation and thermal stratification, implying that populations move into deep water as the thermocline deepens. These data are compared with results obtained from other studies of this species.
The environmental impact of raft mussel-culture in Saldanha Bay was studied using the macrobenthos, sedimentation rates, benthic respiration rates and nutrient fluxes (nitrate, nitrite, ammonium, phosphate and sulphide) as indices. For 3 years, twice a year, a submersible respirometer attached to benthic domes was used to measure in situ sedimentary respiration rates simultaneously with benthic nutrient fluxes at a raft and reference site. Sediment below domes was analysed for macrobenthic abundance and biomass, nutrient concentrations and granulometry. Macrofaunal community disturbances and further multivariant analyses identified significant environmental impact from the mussel raft. Deposit feeders dominated both sites; under rafts carnivores were invariably second to deposit feeder in trophic dominance, this position being replaced by suspension feeders at the reference site. Between sites overall macrobenthic biomass was greater at the reference site, SOD (ml hr⁻¹) was similar, whilst respiration rates as ml h⁻¹ g⁻¹ dry wt of fauna was 10 times greater under rafts. The sedimentation rate within the farm was high but variable around 300 kg organic carbon m⁻¹ yr⁻¹ (3 x outside) and 45 kg nitrogen m⁻¹ yr⁻¹ (2 x outside). Consequently, sediments below rafts contained a significantly higher organic carbon (4-7%, compared with 1-3% at reference site), C: N ratios (9-12%, compared with 16-33%) and total reducible sulphide (0.04-0.1% compared with 0.01-0.02%). Phosphate release rates were similar around 1 umol l⁻¹ hr⁻¹ whilst at the raft site there was substantial nitrate demand (4 umol l⁻¹ hr⁻¹) and massive ammonium release (18 umol l⁻¹ hr⁻¹). The implications of advanced eutrophication and disturbances in macrobenthic communities in the mussel farm are discussed in terms of the environmental stability of Saldanha Bay and the need to develop a trophic model to describe ecosystem impacts.
The Zululand coast is backed by a continuous dune cordon that rises in places, to a height of more than 100 metres and a width of 2 kilometres. It comprises a complex system of stacked dunes of various types and ages. This paper documents the geomorphological, mineralogical and geochemical variation within a small part of the dune cordon, providing useful constraints on the identification of individual dune systems and their age relationships.

Three geomorphologically distinct dune types are recognised within the dune cordon. 1) A system of weathered parabolic dunes located on the most inland portion of the dune cordon. 2) A central, less weathered system of high, asymmetric parabolic dunes. 3) A system of coastal, relatively unweathered small parabolic dunes.

The mineralogy and geochemistry of borehole samples reveal a complex stacked internal dune structure comprising five distinct units, with characteristic internal composition, that are separated by palaeosols. Heavy mineral ratio values (e.g. ilmenite+rutile+zircon / other heavy minerals) reflect the extent of weathering and correlate closely with the three dune types. Organic carbonate and pyroxene contents define two distinct units within the younger central and coastal parabolic dunes. Downhole trends in the bulk composition ratio MgO/TiO₂ further distinguish an upper and a central unit within the coastal dune system.

The implications and applications of molecular genetics to fisheries management: the case of the perlemoen, *Haliotis midae*

Several recent studies that have applied molecular genetic techniques and markers to marine organisms have revealed a lot more population structure than was predicted in view of high dispersal potential. It appears that recruitment patterns are relatively localised, even in broadcast spawners with pelagic larval stages. This has important implications for stock recognition, the delineation of biogeographic boundaries and the conservation of marine biodiversity. A case in point is the perlemoen, *Haliotis midae*, which, despite its range spanning three recognised biogeographical zones, is currently managed as a single stock. A mtDNA analysis of wild and hatchery populations has revealed that there is a major genetic sub-division of the population at Cape Agulhus and a smaller sub-division at Cape Point. This is in contrast to results of a study that used more traditional methods (allozymes) and which did not reveal any sub-divisions. The two stocks of perlemoen identified (east an west of Cape Agulhus), differ in terms of haplotype frequencies and also in terms of genetic diversity assayed. Hatchery cohorts from two farms (one using east coast broodstock and one using west coast broodstock) both revealed significantly reduced genetic diversity and skewed haplotype frequencies relative to their source populations. The implications of these results for mariculture and fisheries management of perlemoen are discussed. Also, the implications for other species along the South African coast is discussed.
Oral

A USER-FRIENDLY SOFTWARE PACKAGE FOR STORING ESTUARINE DATA IN A LOGICAL FORMAT

Susan Taljaard¹ and Lara van Niekerk²

1. CSIR, p O Box 320, Stellenbosch 7599, South Africa
2. WAM Technology cc, Office 246, Eikestad Ma*, Stellenbosch 7600, South Africa

The CSIR, in collaboration with WAM Technology cc, developed a user-friendly data storage facility for estuarine data using Visual Basic 5.0 and Microsoft Access '97. The challenge was to develop a system that would be flexible enough to deal with relatively small data sets consisting of a large diversity of data types and data formats. Data and information on individual estuaries are stored in separate modules in the database (i.e. Microsoft Access*97), making the system very flexible. Currently data can be captured under the following disciplines and topics:

- General Information (i.e. classification, catchment, beneficial uses, problem sources, literature, expertise comments and photos)
- Topography (i.e. mouth surveys, cross sections and mouth observations)
- Hydrodynamics (i.e monthly flows and water levels)
- Biogeochemistry (i.e water column and sediments)

Provision has also been made to allow for future expansion of the data storage facility to include biological and sedimentological data sets. Available data and information are accessed via an user interface (created in Visual Basic 5.0). Data can either be exported in digital format (compatible ASCII format) or print-outs can be produced. Graphical displays, maps and photos can also be exported in digital format (usually *.wmf, *.bmp or *.jpg) or print-outs can be produced for use in, for example reports and visual displays. Our presentation will explain the structure of the storage facility in greater detail and will also display examples of different output formats. Additional uses of the system will also be explored. For example, the CSIR is making the software shell available to other organizations involved in the collection and capturing of estuarine data in the beta-version of the software can be downloaded from our web site: www.csir.co.za/environmentek/estuaries/.

Poster

DOES THE INTENSITY OF RECRUITMENT OF VARIOUS ROCKY SHORE MOLLUSCS VARY WITH DISTANCE AWAY FROM THE DWESA-CWEBE NATURE RESERVE

Tembaletu Tanci and Theresa Lasiak

Dept. of Zoology, University of Transkei, P/Bag X1 UNITRA, Umtata 5117

One of the supposed function of marine protected areas is the improvement of stock and yields in adjacent exploited areas as a result of either active or passive emigration. Whilst there is evidence to suggest that juvenile and sub-adult forms of mobile species, such as fish, disperse from marine protected areas into adjacent exploited areas, the export of larvae of sedentary species, such as shellfish, has yet to be demonstrated. The primary objective of this study was to look for circumstantial evidence to support this notion by establishing whether or not the intensity of recruitment of various rocky shore mollusks varied with distance from an MPA. This study involved the deployment of artificial substrata, in the form of nylon brushes, at low-shore sites within and to the south of the Dwesa-Cwebe nature reserve. After one month brushes were retrieved and the mollusks which had been recruited to them were extracted by immersion in 1M sodium hypochlorite and sonication. The mollusks extracted from each brush were subsequently identified and counted with the aid of a dissecting microscope. Analysis of variance were used to compare the intensity of recruitment of the major mollusks among sites.
THE SOUTH AFRICAN RECREATIONAL ABALONE FISHERY-FROM EXPANSION TO DECLINE?

Rob Tarr and Angus Mackenzie

Marine and Coastal Management, P. Bag X2, Rogge Bay 8012

The recreational fishery, like the commercial fishery, started as open access with the only limitation on annual take being the daily bag limit of 5 per person (reduced to 4 in 1991), and the size limit of 11.4cm. From 1988 a permit system was introduced and data from permit sales showed a steadily increasing trend. In 1991 permits required the applicant's telephone number, providing a database of telephone numbers. A professional survey company was contracted to carry out annual telephonic surveys of permit holders to determine annual landings of this sector as well as demographic and other information. Results confirmed fears that this sector was expanding, and this growth continued to a high of 548 t in 1993/94 which was 89% of the current commercial total allowable catch. Thereafter landings fluctuated around 480 t, from about 34000 permit holders. In 1997/98, the season was changed to weekends and public holidays only and further recreational permit sales were stopped. However the weekends-only ruling was overturned in court. The stoppage of permit sales remained, which resulted in a large drop in estimated recreational landings to 221 t for 1997/98, similar to the estimated landings for 1988. The season for 1998/99 was again changed to weekends only, and reduced to four months. Preliminary data indicate that landings have declined below levels previously recorded. Field data on size composition of catches have been collected from shore-based monitoring by students, and these results will also be presented.

MACROBENTHOS OF PERMANENTLY OPEN VS. TEMPORARILY CLOSED ESTUARIES OF THE EASTERN CAPE: WHERE ARE THE DIFFERENCES?

P. Teske and T.H. Wooldridge

Zoology Dept., University of Port Elizabeth

Despite their numerical dominance along the South African coast, temporarily closed estuaries have to date received relatively little scientific attention. This study compares the macrobenthic fauna of six permanently open estuaries with that of seven temporarily closed estuaries of the Eastern Cape, in order to determine similarities and differences with regard to community structure.

Categories under investigation were:
Presence/absence of species, number of individuals, diversity, and community patterns.
It was found that both types of estuaries have similar estuarine endemic and freshwater species components, but some of the open systems have an additional marine component. Only a single species was found exclusively in temporarily closed estuaries. In most cases, the number of individual animals was greater in closed systems, whereas two open estuaries, the Kromme and the Kariega, had the greatest diversity. This was, however, attributed to the presence of many marine species, which are well established in these two systems because of low freshwater input.

Community patterns were also found to be very similar in both types of estuaries. An endemic sand fauna and an endemic mud fauna could be identified, which tended to be more distinct in closed systems. In open estuaries, the endemic sand fauna usually overlapped with marine fauna.
The southern African subcontinent, lying south of the tropic of Capricorn, contains over 430 species of echinoderms. The composition of the classes, excluding the holothuroids, has been well documented by Clark and Courtman-Stock (1976) and their zoogeography analyzed by Thandar (1989). A monographic representation of the holothurian fauna is currently in progress and will add a few more species to its composition. This paper details the composition of the 140 holothuroid species known to date, analyses the distribution of the approximately 80 nominal species known from more than one locality, and speculates on their origin. All six orders of the class are represented and are distributed as follows: Dactylochirotida 7 species, Dendrochirotida 54 species, Aspidochirotida 39 species, Elasipodida 18 species, Molpadida 6 species and Apodida 16 species. There are altogether 19 families and 70 genera, giving genus: species ratio of 1: 2. There are no endemic families. The three recognized faunistic provinces are the tropical province reaching down to Maputo in Mozambique, the subtropical province from Maputo down to Port St. Johns in the Eastern Cape Province and the temperate province from Port St. Johns to Walvis Bay in Namibia. The 80 species here considered include the following components: cosmopolitan 6.3%, tropicopolitan 2.5%, Indo-Pacific 50.6% Atlantic 2.5% and Endemic 38.0%. If only shelf species are considered the distribution is as follows: cosmopolitan 0%, tropicopolitan 2.9%, Indo-Pacific 55.9% Atlantic 1.5% and Endemic 39.7%. Over 50% of the recorded species occur in the subtropical province of KwaZulu-Natal. This is not only due to the frequency of collection but also to the continuous invasion from the north, due to the south-bound Agulhas current and from the south, perhaps due to the north-bound counter-current close inshore. Except for a few Atlantic species, the fauna is clearly of Indo-Pacific origin but the further south and west the fauna was carried the more it became specialized, so much so that only two truly shallow-water Indo-Pacific species occurs west of East London.

Poster

SEASONAL CHANGES IN THE STANDING STOCK OF SHRIMP
Palaemon peringueyi (STEBBING, 1915) AT THE QORA RIVER ESTUARY
B. Thembani

Dept. of Zoology, University of Transkei, Umtata, South Africa

The shrimp, Palaemon peringueyi was sampled in Zostrea capensis beds during 1997 from January to December. Sampling was done monthly during low tide using an open-ended 0.5m sq. aluminium box. This sampling box was placed over Zostera and content scooped with a net to yield shrimp standing stock. Over 4600 shrimp were captured within wide ranges of temperature (13-30°C) and salinity (5-38‰). The standing stock of shrimp showed a unimodel seasonal variation. Shrimp numbers and biomass varied, with summer/autumn peaks from November to March (density 226-1064m⁻², dry mass 0.16-1.17gm⁻²). Following the floods which occurred in June, Zostera was washed away resulting in the decline in shrimp population. However, Zostera re-established two months later.

Oral

THE DISTRIBUTION, ABUNDANCE AND DIVERSITY OF SIPHONOPHORES ALONG THE EAST COAST OF SOUTH AFRICA

D. Thibault, F. Parker and M.J. Gibbons

Zoology Dept., University of the Western Cape, Private Bag X17, Bellville 7535

Patterns in the distribution, diversity and abundance of Calycophoran siphonophores collected along the east coast of South Africa (Port Elizabeth to Tugela River Mouth) during May/June (1990), October (1990) and February (1991) were examined. In excess of 40 siphonophore species were identified, some of which were new to the area. Dendrograms of percent similarity were constructed for the 90 odd samples collected. Patterns of diversity and zoogeography generally conformed to the large-scale hydrological features of the east coast. Highest values of diversity and evenness were generally recorded from the northern and offshore (oceanic) samples, and were strongly indicative of Agulhas Current water. Lowest values of diversity and evenness were recorded at the inshore stations in the extreme south of the sampling area. These samples were characterised by the presence of dense populations of Muggiaea atlantica, which is indicative of cooler, productive waters. Samples between these regions were of moderate diversity and contained species from both assemblages, indicating some mixing of water masses.
A COMPARISON OF DIETS OF BENTHIC-FEEDING FISH FROM FOUR CLOSED ESTUARIES OF THE EASTERN CAPE

X. Thwala¹, G. Brett² and R. Bally²

1. Zoology Dept., University of Fort Hare, 5700 Alice
2. East London Museum, 5200 East London

The benthic-feeding ichthyofauna and their diets were investigated in four small closed estuaries in the vicinity of East London in the Eastern Cape Province. In each of the four estuaries (Cefane, Cintsa, Igoda and Kiwane), fish were collected from four stations from the upper reaches (one station), middle reaches (2 stations) and lower reaches (1 station). Fish were collected by means of a seine net, preserved in 10% formalin and brought to the laboratory for identification to species. Representative numbers of each species from each station were dissected open, and their stomach contents identified as far as possible. This paper therefore presents information on the species composition, distribution and diets of benthic-feeding fish from these estuaries.

A PRELIMINARY INVESTIGATION OF THE GENETIC AND MORPHOMETRIC VARIATION AMONGST POPULATIONS OF THE KNYSNA SEAHORSE HIPPOCAMPUS CAPENSIS FROM THE KNYSNA AND SWARTVLEI ESTUARIES

Zaahir Toeffie, Casper J. De Villiers and Mark J. Gibbons

Five species of seahorses are believed to be found around South Africa. Of these, the Knysna seahorse, Hippocampus capensis, is the most restricted in its distribution. This endemic species is largely confined to the Knysna and Swartvlei estuaries, but has been reported from other neighbouring estuaries. The Knysna sea horse is believed to be a relic of a population which once moved freely along the south coast but which became isolated in the estuaries. This hypothesis was investigated by examining the extent of variation between the populations from the Knysna and Swartvlei estuaries using both morphometric and molecular techniques. Principal component and discriminant function analysis based on 14 morphometric and five meristic variables revealed slight morphometric differences between the two populations. 400bp of mitochondrial DNA (cytochrome b) sequence showed between 0.5 - 1% sequence divergence between the Knysna and Swartvlei seahorses. The implications of these results are discussed.

ECOLOGICAL MODELING OF THE PLANKTONIC FOOD WEB IN ST HELENA BAY DURING AN UPWELLING RELAXATION PERIOD (ANCHOR STATION EXPERIMENT 1987)

F. Touratier¹, J. Field² and C. Moloney¹

1. Marine Biology Research Institute, Zoology Dept., UCT, Rondebosch 7701, South Africa

A multidisciplinary oceanographic expedition was conducted in St Helena Bay (Benguela ecosystem, South Africa) from March to April 1987, to understand the influences of an upwelling on this pelagic ecosystem which is a very important retention area for fish larvae. The St Helena Bay ecosystem is modelled by using a 1D (vertical) model representative of the planktonic food web. The ecological model is used to simulate both the carbon and nitrogen biogeochemical cycles, and the main constituents are, ammonium, silicate, small and large phytoplankton, bacteria, micro- and mesozooplankton, detritus, and dissolved organic matter. Results of the model reproduce several important characteristics during the Anchor Station experiment: the chi a maximum concentration (ca. 80 mg/m3), the sedimentation processes of the bloom, and the spatio-temporal evolution of the mesozooplankton. The model is then used to evaluate the efficiency of the planktonic food web to recycle the nitrogen (mainly which is actively taken up by the phytoplankton just after the main bloom during the relaxation period.
AN INVESTIGATION OF THE GELIDIUM HARVESTING INDUSTRY OF THE EASTERN CAPE PROVINCE

E. Tronchin¹, J.J. Bolton¹, and R.J. Anderson²

1. Dept. of Botany, University of Cape Town, Private Bag, Rondebosch, 7701
2. Seaweed Unit, Marine and Coastal Management, Private Bag X2, Roggebaai 8012

Gelidium (Rhodophyta), an economically important seaweed genus, occurs along the Eastern Cape Coast where it has been exploited for at least four decades. The Gelidium harvesting industry is well developed along most of the province's seaboard though less developed in the eastern region: an area formerly constituting the Transkei homeland. Seaweed harvesting operates on an informal basis along this stretch of coast (from the Kei River in the west to the Mtamvuna River in the east) and little is known about the industry to date. Three Gelidium species, namely G. Pristoides, G. pteridifolium and G. abortiorum have been exploited along the former Transkei coastline since 1976 and are presently being exploited by two companies: Taurus Products Pty) Limited and Wild Coast Industries. The Industry has been investigated and available records of exploitation returns have been analyzed. A detailed documentation of the industry's past and present has been compiled. Certain aspects of the industry where knowledge is lacking have been highlighted for future investigation. Those involved in this industry and researchers alike have in the past experienced difficulty in differentiating between species of Gelidium. New information is provided on the identification of these species and the closely related G. Capense.

FEEDING SELECTIVITY OF JUVENILE CAPE HORSE MACKEREL (TRACHURUS TRACHURUS CAPENSIS)

N.M. Twatwa¹ and C. Van der Lingen²

1. Zoology Dept., University of Fort Hare, 5700 Alice
2. Marine and Coastal Management, p/Bag X2, 8012 Roggebaai, Cape Town

The cape horse mackerel Trachurus trachurus capensis is considered to be primarily zooplanktivorous, feeding during the day on near-bottom aggregations of crustacean zooplankton such as copepods and euphausiids. Field data have shown that horse mackerel may feed selectively, and a laboratory study was conducted to test this hypothesis. Juvenile fish were offered a mixed assemblage of zooplankton, and the composition and size distribution of the prey were determined at the beginning and end of an 80-minute feeding period. A sub-sample of horse mackerel was also collected at the end of the feeding period for stomach content analysis. Whereas the large copepod Calanus agulhensis accounted for 10% by number of the zooplankton at the initiation of feeding, it accounted for only <0.1% at the end of the feeding period: horse mackerel stomach contents were dominated by Calanus (30±19%). Similarly, whereas prey items >1200 Fm total length comprised 13.5% by number at the beginning of the feeding period, they were reduced to <0.3% at the end. Selectivity indicates that horse mackerel show positive selection for prey > 1000 Fm total length, and for prey items such as decapod zoea larvae, cyprid larvae, and Calanus.

These results substantiate the belief that Cape horse mackerel select their prey on the basis of size and/or species.

GOOD SCIENCE/BAD SCIENCE VERSUS PURE SCIENCE/APPLIED SCIENCE: ISSUES FOR ENHANCEMENT OF QUALITY IN POSTGRADUATE TRAINING

A.J. Underwood

Centre for Research on Ecological Impacts of Coastal Cities
Marine Ecology Laboratory A 11, University of Sydney, NSW 2006 Australia

Social needs for science -- particularly environmental science and issues for management of natural resources have never been greater. Marine and coastal themes are assessments of environmental impacts, how to retrieve damaged habitats, how to quantify and monitor changes in biodiversity. These are the key issues in sustainable development. Many marine scientists are poorly equipped by training or expertise to contribute to these needs. This paper describes training for problem-solving, using examples from marine ecology. The themes are general skills and logical structures (what is the problem? How might it be solved? Have I solved it?). In addition, the relationship between so-called basic or pure experimental science and managerial responses to issues and problems will be described. Implementation of management is usually an uncontrolled experiment. Scientific contributions must therefore revolve around skills in planning, implementing and interpreting experiments. Finally, methods of training in recognition of the context of social need will briefly be discussed.
AN INDEX OF HEALTH OF THE SOUTHERN BENGUELA SYSTEM FROM MONITORING SEABIRDS

Les G. Underhill¹ and Robert J.M. Crawford²

1. Avian Demography, Unit University, of Cape Town, Rondebosch, 7700
2. Marine and Coastal Management, Private Bag X2, Rogge Bay, 8102

It is expected that in the new millenium summary indices of environmental health will play an increasing role in politics and decision making. Therefore, it is necessary to develop summary indices of environmental health that are of equivalent use to summary indices of the economy, e.g. inflation rate. Seabirds are good indicators of a wide variety of concerns in marine ecosystem management, including conservation of biodiversity, marine pollution, exotic introductions, status and distribution of prey resources and episodic events. The paper will address means of using seabirds as an index of environmental health in the southern Benguela system, and report on how the seabird index has changed over the past 40 years. It will discuss issues such as target population sizes and how the index might be expanded to include other elements of marine ecosystems.

NEARSHORE MARINE GEOPHYSICAL SURVEY TECHNOLOGY

P. Van Den Bossche¹ and C. Bosman²

1. Marine Geoscience Unit, Council for Geoscience, P. O Box 572, Bellville, 7535
2. Marine Geoscience Unit, Council for Geoscience, P.O Box 18091,Dalbridge, 4014

This presentation deals with the aspect of nearshore marine geophysical survey technology, and aims to provide insight into using state-of-the-art survey equipment on a 6m semi-rigid craft. This vessel can be launched from some of the most remote beaches, and in some of the world's roughest surf conditions. Such survey methods may appear extreme and unnecessary, but are often required nowadays. More and more information is required in remote and hostile areas for scientific, exploration and engineering purposes This form of survey method is unique in the country, as it combines the use of: a Klein system 2000 digital side-scan sonar acquisition system and tow-fish, which is capable of obtaining extremely high-resolution seafloor imagery (100kHz and 500kHz); a GeoAcoustics GeoPulse sub-bottom profiler which is capable of achieving 15 metres of penetration and achieving resolutions better than 0.2 metres in the vertical plane; an Odom digital echosounder with a 200kHz transducer to collect bathymetric data with an accuracy of 0.01% of the depth; and a Fugro SeaStar 12 channel differential GPS (DGPS), which is capable of sub-metre accuracy. Using this combination of equipment, modified to suit the confines of a 6m Gemini semi-rigid inflatable, allows data to be collected virtually from the beach, and extending well offshore The Marine Geoscience Unit of the Council for Geoscience (South Africa), have adopted this form of survey methodology, and have designed and customised equipment to provide some of the most advanced technology in nearshore marine surveying. In doing so, they have achieved remarkable results. Applications of this survey technology lends itself to: geological seafloor mapping; port and coastal engineering; the marine minerals industry; local councils; the offshore oil and gas industry; marine and estuarine conservation bodies; wreck, artefact and debris location surveys for shipping, insurance and archaeological concerns; and many other applications.
A COMPARITIVE ANALYSIS OF THE DYNAMICS OF SEVERAL EAST AFRICAN ARTISANAL FISHERIES - ARE THERE LESSONS FOR SOUTH AFRICA?

Rudy P. van der Eist

Oceanographic Research Institute Marine Parade, Durban, KwaZulu-Natal

Throughout the West Indian Ocean, artisanal fishing is an exceptionally common activity. However, while the objectives of these fisheries are directly linked to subsistence and socio-economic well being of the communities concerned, the nature of these operations varies enormously. Many of these fisheries are in fact very large scale operations driven and limited by a range of dynamic factors. These need to be identified before any successful management approach can be designed or implemented.

ORI had for years been actively collaborating with other African research partners in the study of many of these fisheries and this paper reviews some of the common factors as well key differences between a selection of them. While threats and impediments to their sustainable development varies, they are often not directly linked to the fishing communities concerned. This is particularly challenging for the implementation of a co-management strategy. As South Africa grapples with its own approach to subsistence and artisanal fisheries development, there are likely to be valuable lessons we can learn from these fisheries.

Examples are presented from Puntland (Somalia), Tanga (Tanzania), Gazi (Kenya), Angoche and Maputo (Mozambique) as well as St. Lucia and Kosi Bay (South Africa).

THE EFFECTS OF A FRESHWATER RELEASE ON THE DYNAMICS OF THE KROMMEESTUARY

L. van Niekerk, P. Huizinga and R van Ballegooyen

CSIR, p O Box 320, Stellenbosch 7599, South Africa

In November 1998 the CSIR took part in a joint investigation on the effects of the release of 2 million m$^3$ of freshwater from the Mpolo Dam on the Kromme Estuary for the Department of Water Affairs and Forestry.

The purpose of this test release was to assess whether the 2 million m$^3$ of water annually reserved for the estuary,-could be more effectively utilized by one major release instead of several small releases on a weekly or monthly basis.

The results indicated that after the release reached the estuary, it formed a layer of almost fresh water with low salinity concentrations at the surface. After 10 hours this layer was approximately 0,5 m thick and increased to approximately 2,5 m after five days. Salinity concentrations in the bottom layer near the upstream end of the estuary remained close to those of seawater (about 35 ppt) both during and shortly after the release.

The salinity concentrations in the estuary returned to pre-release levels after approximately one month. This means that the effects of the release on salinity concentration at the mouth of the estuary probably were also only noticeable for this period. This resulted in a smaller than expected (positive) Impact on the ecology of the estuary, which also is important information for future estimates of freshwater requirements of estuaries.

The return to pre-lease salinity concentrations within one month is considerably faster than predicted by earlier investigations undertaken with the 1-dimensional Mike-11 model. Improved results can probably be obtained with this model by increasing the dispersion coefficients.

Promising initial test results have been obtained with a 3-dimensional model available at the CSIR which can simulate stratification in estuaries.
Oral

POPULATION DYNAMICS AND EXPLOITATION POTENTIAL OF THREE MULLET SPECIES IN THE SWARTKOPS ESTUARY

Q. Van Staden, D. Baird and P.E.D. Winter

Zoology Dept., University of Port Elizabeth, P O Box 1600, Port Elizabeth, South Africa

An assessment of the Swartkops estuarine mullet fauna was conducted in the upper reaches of the estuary due to the general consensus that there is potential for a mullet fishery. Population dynamics were studied and production models were applied. Estimates of population parameters were done both manually, where possible, and via use of the FiSAT package.

The three mullet species studied were Liza dumerili (groovy mullet), Liza richardsonii (southern mullet) and Mugil cephalus (flathead mullet). Brief analysis of the by-catch was done, since it formed part of an Honours project.

The swept area method was used to obtain samples. A 12mm stretched mesh seine net, with 30m x 3m dimensions, was used as more effective gear was not available. Physiochemical parameters studied were oxygen, temperature and salinity. Temperatures ranged between 12°C (June 1998) and 28°C (February 1999). Salinity varied between 8 and 28ppt, depending on the tide. Oxygen concentration varied between 0.5-10mg/L.

The following length-weight relationships were obtained: L. dumerili (L=0.0208W^{2.9824}), L. richardsonii (L=0.0187W^{3.0343}), M. cephalus (L=0.0178W^{3.0687}). Growth was described by the Von Bertalanffy growth equation. Standard length and wet weight measurements were used. The resspective growth curves were. L_t= 34.18(1-e^{-0.2076(t-0.037)}); L_t= 39.567(1-e^{-0.198(t-0.1525)}); L_t= 51.13(1-e^{-0.362(1+0.1123)}). Natural mortality (M) was estimated using Pauli’s empirical formula. Respective values obtained were 0.53, 0.49 and 0.35. Total mortality (Z) was estimated via manipulation of the catch curve, and the Beverton & Holt equation in the FiSAT package. Total mortality is currently still under investigation. Respective values obtained were 0.84, 1 and 0.74. Fishing mortality (F) was obtained by the difference of the Total mortality and the natural mortality, i.e. Z- M = F.

CPUE and abundance of species at each of the sites were displayed in table format and pie charts. respectively in terms of numbers and biomass. Gonadosomatic indices (G.S.I.) were used as an indication of the spawning time. Recruitment patterns are similar as discussed by previous workers. Fish biomass estimates were made using Virtual Population Analysis (VPA) and the Thompson & Bell model was used as a prediction model. Further production model analyses are still under investigation Costs and benefits that are associated with a fishery were discussed, and a few recommendations were made.

Oral

THE FORAGING ACTIVITY OF Patella granularis ON DIFFERENT SUBSTRATA ON ALONG THE EASTERN CAPE COAST

Laura Vat and Alan Hodgson

Dept. of Zoology and Entomology, Rhodes University, Grahamstown, 6140

The nocturnal foraging activity of Patella granularis on an aeolian platform and quartzitic reef was studied in spring and autumn. In each study, three groups of limpets (7-10 individuals per replicate) were observed simultaneously at both shores. A further 30 individuals were translocated from the aeolian shore to the quartzitic shore and vice versa in order to determine whether any observed differences in foraging activity were a function of endogenous rhythms or habitat. Individuals from both shore types displayed a similar foraging pattern of a relatively rapid outward phase, a slower foraging phase and a rapid homeward phase. Resident P. granularis homed to a fixed scar on both types of substratum, however some scar abandonment occurred during the course of the experiment. Although foraging distances varied among individuals, the mean distance travelled by P. granularis on aeolian sandstone was less than the mean distance travelled by limpets on quartzitic rocks (aeolian = -12cm in spring and -18cm in autumn; quartzitic = -40cm in spring and -36cm in autumn). Translocated individuals at both sites took a minimum of one tidal cycle and a maximum of one week to begin homing to a fixed scar. Initially the mean distances travelled by the transferred limpets echoed those of the source group. However, after a maximum period of one week, the translocated limpets travelled similar distances during foraging to those recorded for resident individuals. It is suggested that the distances foraged by P. granularis are controlled by food abundance, with individuals inhabiting aeolian substrata, where there is a greater abundance of food (11.76Fg chlorophyll a/cm²), travelling shorter distances to obtain a similar amount of food than those inhabiting quartzitic substrata with less food (2.28Fg chlorophyll a /cm²).
OPTIMAL PREY SIZES DURING THE LARVAL DEVELOPMENT OF CLOWNFISH (AMPHIPRIONAE) BASED ON MOUTH AND PREY SIZE

Niall G. Vine, Giles Churchill, A. Gordon and Thomas Hecht

Dept. of Ichthyology & Fisheries Science, Rhodes University, Grahamstown

The rearing of marine fish through the larval stage is one of the major bottlenecks in marine aquaculture today. Due to their small size and subsequent requirement for smaller food, the larvae require constant attention in terms of providing the right size food at the right time. The culture of livefood is expensive and labour intensive and it is therefore beneficial to know when larvae are capable of progressing from one prey item to another thereby optimising livefood production. Clownfish larvae are fed the marine rotifer Branchionus sp. and brine shrimp Artemia sp. until metamorphosis when they can then be weaned onto a dry, artificial diet. This experiment was designed to investigate the relationship between mouth size and fish age in clownfish. With a knowledge of the sizes of the two prey items we are able to suggest a feeding strategy based on these morphological considerations thereby reducing the unnecessary use of livefood.

AND PRODUCTIVITY IN THE NORTHERN BENGENLA REGION

Nina Vordewuelbecke1, Domingos da Silva Neto2 and Mike Lucas1

1. Zoology Dept, University of Cape Town, Rondebosch
2. Research Fisheries Institute, Iha de Luanda, PO Box -2601, Luanda, Angola

Some of the major issues of interest to phytoplankton ecologists in the Benguela upwelling region concern climate change, biogeochemical cycles of carbon and nitrogen and the transfer of phytoplanktonically fixed carbon through various trophic levels to commercially important fish stocks. Pelagic and demersal fisheries are important commercial activities for Angola, Namibia and South Africa. Recent recognition that environmental variability exerts an important control on fish stocks, spawning success and the recruitment of juveniles into the fishery has prompted renewed efforts to understand these environmental influences. Furthermore, any measurement of in situ chlorophyll concentration as an index of phytoplankton biomass provides further information for the accurate calibration of ocean colour satellites such as SeaWiFS. By this means, daily, monthly and seasonal trends in phytoplankton biomass variability at the sea surface (to one optical depth) can be effectively monitored over ocean basin scales.

Between Walvis Bay and the beginning of the Angolan-Benguela frontal region at approximately 17°S, the chlorophyll distribution was generally characterised by high diatom dominated (>10µm) chlorophyll concentrations inshore over a broad and shallow shelf region. Concentrations typically ranged from 2-5 µg.I-1 within a relatively shallow euphotic zone of 20-35m as nominally defined by the 0.1% light depth. A frequent observation was the presence of the colonial diatom, Phaeocystis spp. close to the surface while lower down in the water column, the large single celled diatom Coscinodiscus was common. This led to a rather characteristic bi-modal sub-surface maxima in the chlorophyll profiles. Offshore, in deeper water, low concentrations «1.0 µg.l-1 chi. a) of nano- and picoplankton «10µm) dominated the community biomass, accounting for -90% of the biomass. Low concentrations of chlorophyll contributed to the optically clarity of the water column and a typically deep euphotic zone of between 40-85m depth.

Rates of primary production in inshore surface waters were within the range 2.42-25.55 mg C m-3 h-1 while offshore, the range was 0.14 -1.09 mg C m-3 h-1. Integrated production over the euphotic depth was within the range 15 mg C m-2 h-1 to as high as 247 mg C m-2 h-1; approximately equivalent to about 2 g C m-2 d-1.
Although Forbes (1978) reports that the postlarval stages of Callianassa kraussi have taken over the role of dispersal from the larval stages, it is possible that the distribution of adult callianassids may not be restricted solely by the dispersal and settlement in the early postlarval stages (Posey 1986; Tamaki & Ingole 1993). It was therefore predicted that the spatial and temporal variations in the densities and distributions of juvenile and adult Callianassa kraussi within an estuary might serve as an indication of the dispersal and recruitment patterns of this species. A catastrophic flood in November 1996 removed an entire population of Callianassa kraussi from the low salinity upper reaches of the Gamtoos estuary (site 3), where this species is able to live but not breed (Forbes 1973). This defaunated area facilitated the investigation of whether the role of dispersal was solely reliant on the postlarval stages of Callianassa kraussi. Adult Callianassa kraussi were found to colonize the defaunated upper reaches of the estuary ahead of the postlarval stages. This migration corresponded with the highest bottom salinity of 22.5 ppt being recorded at this site (site 3) during this study. Early postlarval stages of Callianassa kraussi were found in the plankton around the time of the September 1998 equinox, and appeared to migrate from the mouth region (site 1) to the middle reaches (site 2), as reflected by population structures. Although the exact mechanisms responsible for the dispersal and recruitment of Callianassa kraussi have not yet been determined, the dispersal of postlarvae from site 1 corresponded with a relatively high population density and strong tides, while the migration of Callianassa kraussi adults to site 3 corresponded with a shift in salinity from near freshwater to more saline conditions. It would therefore appear that the early postlarval stages are responsible for dispersal when con specific adults have already colonized a specific area, while the adults take over the role of dispersal when there is an absence of Callianassa kraussi in the given habitat.

Poster

ICHTHYOFANAAL ASSEMBLAGES IN DIFFERENT TYPES OF EASTERN CAPE ESTUARIES

P.D. Vorwerk, A.K. Whitfield, P.D. Cowley and A.W. Paterson

J.L.B. Smith Institute of Ichthyology, Private Bag 1015, Grahamstown 6140, South Africa

Southern African estuaries have been classified into five main types based primarily on physico-chemical characteristics. Although these characteristics are usually shared by estuaries of the same type, there is often spatial as well as temporal variation in these conditions. This investigation intends to identify which primary factors influence the structure of fish assemblages in estuaries.

The study comprises ten Eastern Cape estuarine systems of varying sizes and mouth conditions. They include a range of temporarily open/closed systems; the small Klein Palmiet and Ngculura; the medium-sized East Kleinemond, Mpekweni and Gqutywa; and the larger-sized Mtati, Mgwalana and Bira. In addition, the permanently open Great Fish and Keiskamma estuaries have also been included in the analysis. All systems were sampled bi-annually (during winter and summer) using seine and gill nets.

A cluster analysis has resulted in the fish assemblages grouping according to estuary type and size. The estuarine species Atherina breviceps and Glichristea aestuaria were responsible for most of the dissimilarity between the fish groups, with marine taxa (e.g. Rhabdosargus ho/ubi and Liza richardsonil) and other estuarine species contributing to a lesser degree to the community separations. Preliminary results indicate that the main factors influencing fish assemblage structure should be identifiable.
THE QUANTIFICATION OF BYCATCH AND DISCARDS IN THE SOUTH AFRICAN DEMERSAL TRAWLING INDUSTRY

S.A. Walmsley-Hart¹, WH.HSauer¹ and R.W.Leslie²

1. Dept. of Ichthyology and Fisheries Science, Rhodes University, Grahamstown 6140, South Africa
2. Marine and Coastal Management, Private Bag X2, Cape Town 8001, South Africa

Bycatch and discards within the world's fisheries has received a great deal of scientific and public attention over the past decade. In 1994, the FAO estimated that some 27 million tons of fisheries catch is subsequently discarded, a figure representing approximately one-quarter of the world's total landed catch. Demersal trawling is a particularly unselective form of fishing with high levels of bycatch and discarding. Quantification of these discards is important to determine possible effect of discarding quota species from the demersal fishery, to investigate the discarding of species from other fisheries, such as linefish species and also to determine the effect of fishing on non-target species. In South Africa there are few estimates of discarding in trawl fisheries. An investigation into the Durban prawn trawl fishery and an estimate of demersal discards based upon research data are the only estimates for the South African industry. To remedy this, a programme was initiated in 1995 to make preliminary estimates of bycatch and discarding in the demersal trawl fishery.

The programme aims to investigate the discarding of quota and non-quota species and to determine whether the potential for enhanced utilization exists for currently discarded fish species. Data collection is via observers aboard commercial trawlers. Physical data on the ship's position, trawl depth and duration are collected along with biological information such as the mass and length frequency of the discards species. Preliminary results indicate that in the West Coast fishery 62% of the total catch by mass is retained, 27% is discarded as offal and 10% is composed of discarded fish. Retained hake accounts for 55% of the total catch and discarded hake 6%, approximately 7.3% of the total hake catch. The possible consequences of this discarding will be discussed along with the potential for the utilization of currently discarded fish and associated problems. The distribution of retained and discarded hake along with length frequency distributions is currently being investigated in a GIS system and will also be discussed. Similar data for catches on the South African South Coast are currently under analysis and will be discussed.

Poster

CLAY AND DUNE DEVELOPMENT ON THE ZULULAND COASTAL PLAIN

Chris Ware, Pascal Sudan and Greg Whitmore.

School of Geology and Computer Sciences, University of Natal, Durban 4041

The characteristics and occurrence of clay in part of the northern KwaZulu/Natal coastal dune cordon is currently under investigation. Preliminary results include clay mineralogy and chemistry from select cross-sections through the dune cordon. Dune stratigraphy is discussed with relation to the recent informal division of the Maputaland Group.
Separate, single-species studies have shown that anchovy *Engraulis capensis* are primarily size-selective particulate-feeders, whereas sardine *Sardinops sagax* are primarily non-selective filter-feeders. Also, anchovy have higher ingestion rates (mass-standardised) on prey > 600 Fm TL than do sardine. These two species, therefore, may be considered as trophodynamically distinct. A laboratory experiment was conducted to assess whether sardine and anchovy show different feeding responses when presented with the same food environment. A mixed shoal of adult anchovy and sardine were allowed to feed on zooplankton, after which the fish were killed and their stomach contents analysed. As predicted, anchovy particulate-fed and sardine filter-fed during the experiment. The higher variability found in anchovy stomach contents reflected their individual foraging behaviour compared to sardine, which remained in a shoal while feeding. On the basis of fish mass, anchovy ingested greater numbers of zooplankton than did sardine; surprisingly, however, anchovy ingestion rates were only significantly higher (p < 0.05) higher for *Centropages* spp. (mean size 1 255 ± 289 Fm) and cladocerans (mean size 531 ± 161 Fm). Also, anchovy fed more selectively on these two prey categories than did sardine. Although these data concur with results from single-species studies, they did not show as clear a trophic distinction as would be expected between anchovy and sardine.

**Oral**

**SATELLITE REMOTE SENSING OF RAINFALL OVER THE OCEAN**

S. White, F. Couvreux and M. Rouault

*Ocean climate research group, Dept of Oceanography, University of Cape Town, 7700 Roodebosch*

Until the advance of satellite remote sensing, accurate rainfall measurements over the ocean have been limited. Rain gauge networks over the oceans are confined to ship, atoll, and island sites, which are scarce and often not representative of ocean conditions. The Tropical Rainfall Measurement Mission (TRMM) satellite is a joint U.S.-Japan satellite mission beginning in December, 1997 to monitor tropical and subtropical precipitation. TRMM provides systematic measurements of rainfall between 35°N and 35°S. The TRMM satellite carries three rain-measuring instruments: the TRMM Microwave Imager (TMI), the Visible Infrared Scanner (VIRS), and the Precipitation Radar (PR). The TMI product gives the rain rate, cloud liquid water, precipitable water, cloud water ice, precipitable ice, and latent heat at fourteen vertical layers with a 0.5°*0.5°* horizontal resolution. It has a wide swath and can make quantitative rain measurement over oceans. The PR product, with a narrower swath width, provides a vertical rainfall profile, rainfall measurement over land and ocean, and improves the accuracy of TMI measurements by providing better rain structure information at a higher resolution (0.1°*0.1°). The TMI is to be used jointly with PR data to get precipitation measurement.

We are comparing TRMM monthly data to the CPC Merged Analysis of Precipitation data (CMAP)(79-98). CMAP gives monthly precipitation estimates above land and ocean by merging rainguage data with five kinds of satellite estimates, (GPI, OPI, SSM/I scattering, SSM/I emission and MSU) over a 2.5° grid resolution.

The National Center for Environmental Prediction (NCEP) has produced a NCEP Reanalysis data set of atmospheric fields in support of the research and climate monitoring communities which covers the period 1949 until present. NCEP assimilates data into an operational forecast model which produces data at 17 different atmospheric level on a 2.5°*2.5°* grid. Precipitation is a variable completely determined by the model and is therefore less reliable.

TRMM and CMAP satellite data give the most accurate rainfall estimate over the ocean. NCEP data is not as accurate, however it covers a much longer period. TRMM, CMAP, and NCEP mean monthly rainfall values will be presented above large ocean areas as well as rainfall snapshots over the Agulhas current during a TRMM orbit.
INTERNAL STRUCTURE OF PART OF THE ZULULAND COASTAL DUNE CORDON FROM HEAVY MINERAL ABUNDANCE RATIOS

G.P. Whitmore, R. Clarke, R. Uken and P. Sudan

School of Geology and Computer Sciences, University of Natal, Durban 4041

The Zululand coastal dune cordon extends from Mtunzini to Lake Kosi and north into Mozambique. The unconsolidated, Holocene to Recent dune complex is up to 2 km wide and comprises a series of vertically stacked dunes that in places attain a height of almost 100 m. The dunes overlie a Pleistocene barrier-lagoon complex called the Port Durford Formation. Heavy mineral abundance ratios calculated from a dense grid of borehole samples are used to define the internal structure of part of the Zululand coastal dune cordon. Twelve different heavy mineral abundance ratios have been investigated in order to determine their utility in identifying dune packages. Ratios have been plotted as successive vertical and horizontal cross-sections in order to determine 3D trends. Results indicate that the dune cordon can be divided into an older, relatively altered, inland unit overlain by a younger, relatively unaltered coastal unit. These units are overprinted by a northward trend of increasing sediment maturity and many small local anomalies.

COMPARISON OF THE RELATIVE DENSITY AND SIZE STRUCTURE OF SURF ZONE FISHES BETWEEN PROTECTED AND UNPROTECTED AREAS ALONG THE CAPE SOUTH COAST

Margit Wilhelm1, C.G. Attwood2, C.L. Griffiths1

1. Marine Research Institute, Zoology Dept., University of Cape Town, Rondebosch 7701
2. Marine and Coastal Management, Cape Town

Marine protected areas (MPAs) seem to be one of the few efficient measures for controlling South Africa's declining shore-angling fishes. Recent comparisons and evaluations need to be done between MPAs and open areas. Catch per unit effort, cpue, (fish. angler-hour⁻¹) and age-frequency data for shore angling catches (from 1993 -1999) of three areas were compared to evaluate the impact of shore angling on coastal fish stocks. The areas of comparison were: De Hoop MPA, fully protected from any fishing pressures, Goukamma Nature Reserve (East of De Hoop), an area with limited access for shore anglers, and the fully exploited area between Cape Point and Arniston (West of De Hoop MPA). Research cpue has stayed more or less constant for galjoen Dichistius capensis, blacktail Diplodus sargus capensis, bronze bream Pachymetopon grande, zebra D. cervinus over the past seven years and silver kob Argyrosomus hololepidotus, white steenbras Lithognathus lithognathus, belman Umbria canariensis, barbel Gelechthyes feliceps, white musselcracker Sparadon durbanensis, elf Pomatomus saltatrix, spotted Mustellus mustellus, spotted gulley shark Triakis megaloptus and lesser guitarfish Rhinobatus annulatus for the past five years at De Hoop. This showed that stable populations exist in De Hoop MPA, which could serve as basis for comparison with other areas. Catch rates were generally five times higher in De Hoop MPA than on the outside (De Hoop average = 1.65 fish. angler-hour⁻¹; and Goukamma = 0.28 fish. angler-hour⁻¹). Despite some comparison problems with the different results, fishing pressure is shown to have a major impact on the densities of fish populations. The age-frequency data of De Hoop demonstrate that mostly much older individuals are found at De Hoop than in the open area, which supports the hypothesis that fishing decreases the mean age of a population. Age-frequency distributions and mortality rates for Goukamma data were not calculated because of the absence of length measurements and unreliable weight estimations of the fish. Instantaneous annual fishing mortalities for blacktail Diplodus sargus capensis, white steenbras Lithognathus lithognathus and white musselcracker Sparadon durbanensis in the open area were calculated as 0.1, 0.1 and 0.4 y⁻¹ respectively. This showed that the De Hoop MPA is effective in providing protection from fishing pressures for fish species important to shore anglers.
Oral
PRELIMINARY INVESTIGATION OF VERTEBRAL GROWTH RINGS IN THE WHALE SHARK, *Rhincodon typus*, FROM THE EAST COAST OF SOUTH AFRICA

Sabine P. Wintner

*Natal Sharks Board, Private Bag 2, Umhlanga Rocks 4320, South Africa*

Growth rings (GR) in vertebral centra of four female (420-750 cm precaudal length), 10 male (422-770 cm), and one unknown sex (688 cm) whale shark, *Rhincodon typus*, were examined using x-radiography. GR counts were made from scanned images and count precision was determined using the average percentage error index and the index of precision \( D \), and was 4.19 % and 3.31 %, respectively.

The female and male with the lowest number of GR, had 19 GR (420 cm) and 20 GR (670 cm), respectively. The female and male with the highest number of GR, had 27 GR (750 cm) and 31 GR (770 cm). In eight animals maturity was assessed and of these, three males were mature at 670 cm (20 GR), 744 cm (24 GR) and 755 cm (27 GR). A female of 445 cm (22 GR) cm was adolescent.

A linear relationship between centrum diameter and length was assumed and back-calculated lengths at number of GR are presented. Von Bertalanffy parameters could not be calculated from both observed and back-calculated values as a linear relationship between length and number of GR was evident.

Poster
ESTUARINE COPOPOD RESPONSE TO A REGULATED FRESHWATER RELEASE FROM AN UPSTREAM IMPOUNDMENT

T.H. Wooldridge

*Zoology Dept., SAB ICRM, University of Port Elizabeth*

Two large storage reservoirs on the Kromme River South Africa, severely reduce the natural supply of freshwater to the estuary. The larger Mpofu dam is 18 km from the coast and 4 km from the tidal head. Present management policy provides for a total annual freshwater allocation of 2 x 10^6 m^-3 ( <2% of the mean Annual Runoff from the catchment). The estuary is now marine dominated and the present study was commissioned to evaluate the response (magnitude and persistence) of abiotic and biotic components in the estuary to a single release of the annual allocation. The present contribution focuses on the response of copepod populations endemic to the estuary. The freshwater pulse released from the dam created high stratified conditions for about two weeks, after which salinity profiles returned to euhaline conditions recorded prior to the release. Of three endemic species of copepods recorded in local estuaries, only two were present throughout the study in the Kromme. It is likely that persistent euhaline conditions were not suitable for the hatching of resting eggs of *Acartia nataensis*. The other species of copepods (*Pseudodiaptomus hessei* and *A. longipatella*) showed no shift in population distribution and no significant change in population densities following the release. It is concluded that mixing of the water column is very important to provide benefit for endemic populations in the estuary. This was not achieved by releasing freshwater a few days before spring tides and a maximum release rate from the dam (16 m^-3 sec^-1). The release rate may have been too high and better results might be achieved by reducing the flow rate. Ideally, a regular base flow with intermittent releases of freshwater pulses into the estuary is suggested, but competition from other users of the resource is considerable.
MID HOLOCENE PALAEOENVIRONMENTS FROM LAKE NHLANGE, NORTHERN KWAZULU-NATAL, SOUTH AFRICA

Ian Wright

Palaeoenvironments are described from 5 vibracores taken from within Lake Nhlange, the largest waterbody within the Kosi system which comprises a series of lakes linked to the sea via a large tidal sand-flat. The mid to late Holocene lagoonal palaeoenvironment has undergone minimal sedimentation since the Last Glacial Maximum (18,000 BP, oxygen-isotope stage 2). Shelf-margin gravity slumping has transported typical shallow water, intertidal molluscan assemblages into deeper subtidal environments. The lake bathymetry exhibits a drowned Last Glacial Maximum palaeofluvial channel topography, preserved by the post-Last Glacial Maximum (Flandrian) transgression which formed a large coastal dune barrier, trapping the lakes behind it. The palaeoestuary mouth was located at Bhanga Nek, until approximately 3,000 BP, but has been relocated 13 km north, approximately 1,500 BP, to where it now maintains an open inlet through the coastal barrier. An abundant Holocene molluscan assemblage combined with detailed sedimentological descriptions indicate that the conditions within Nhlange have changed over the last 5,000 years from a deep coastal estuarine/lagoonal system, with free tidal exchange to a predominantly freshwater lake. The molluscan assemblages indicate a subtropical, temperate lagoonal environment similar to Durban Bay (prior to anthropogenic changes) with a number of species including Paphia textile indicating a warmer climate. A modern analogy of the palaeoenvironment would be that of the inside edge of Bazaruto Archipelago, Mozambique.

PARASITISM OF CAPE HOTTENTOT, PACHMETOPON BLOCHII (VAL.), BY THE FISH LOUSE, ANILOCRA CAPENSIS LEACH, 1818, IN FALSE BAY (SOUTH AFRICA)

Ruth Wright, Y. Lechanteur, K. Prochazka, C.L. Griffiths

The frequency of parasitic infection, the biology of the parasite, and host-parasite relationship between Pachymetopon blochii and the ectoparasitic isopod, Anilocra capensis, were investigated in False Bay, southwestern Cape. A total of 129 parasitised fish and 129 non-parasitised fish were collected and the sex, length and weight of these fish were recorded. The position, frequency, sex and length of the parasites were recorded. Of the False Bay P. blochii population 6.16% were infested by A. capensis. Anilocra capensis individuals attach to a specific location on the host, however they did not select a specific side or sex of the host fish. Anilocra capensis individuals were more frequently attached in pairs than alone on the host fish. No parasitised P. blochii individuals smaller than 14.8 cm, or longer than 31 cm were collected, however non-parasitised fish larger than 31 cm were collected. Smaller fish (in terms of length) appear to be more susceptible to parasitism by A. capensis. Anilocra capensis individuals are most likely protandric hermaphrodites, displaying three 'stages' with increasing size; firstly a functional male, then an intermediate stage, most likely a 'transitional stage' between the two sexes, and lastly a functional female. The lengths of A. capensis were positively correlated with the host P. blochii total lengths, thereby suggesting that parasite and host growth is concurrent. The length-weight regressions of parasitised and non-parasitised P. blochii individuals were significantly different, suggesting that infection by A. capensis has a negative effect on the condition of the host. Due to the low frequency of parasitic infection by A. capensis within False bay, it is thought that this infection will not have any major impacts on the fishery for P. blochii in the southwestern Cape.
THE POSSIBLE EFFECT OF FUTURE WIND REGIMES ON PELAGIC FISH RECRUITMENT

Shona Young

Environmental and Geographical Science Dept., University of Cape Town

Climate change is not a recent phenomenon. Although climates have changed radically in the past, it is the alarming rate and unpredictable nature of the change in the last few decades that are of great concern. Pelagic fish have highly variable recruitment and are sensitive to environmental fluctuations. There is an optimal area of wind intensity and turbulence where the winds are moderate and considered optimal for anchovy recruitment.

This study compares present day GCM (Global Circulation Model) winds (1985-1995) to a future wind scenario of doubled CO$_2$ in the atmosphere, addressing changes in wind speed, direction and frequency in the major upwelling areas of the world. The data used are from NCAR's Climate System Model. This model represents our best current understanding of the global climate system. The study aims to evaluate the effect of these changes on pelagic fish recruitment.

Comparisons between present and future wind data indicate a number of potential changes in the wind regimes over the next few decades. Results from the southern Benguela system, taking an average for the co-ordinates 34.9°S, 16.9°E and 34.9°S, 19.7°E (near Cape Point) for the anchovy spawning period from October to March, show that there is an expected increase in the U and decrease in the V wind components, suggesting an increase in SE winds. As the southern Benguela is on the right hand side of the optimal environmental window, an increase in SE winds could negatively impact anchovy recruitment. Results from further north in the southern Benguela current (29.3°S, 14.1°E) for the same period shows that there is a decrease in the SE winds in the northern parts of the southern Benguela. This is likely to be as a result of a southwards shift of the South Atlantic High Pressure Cell. Possible changes in the wind fields for other upwelling systems are also analysed: these are then interpreted in terms of the optimal environmental hypothesis.

Eocene Bryozoa build-up in Austria and its possible recent equivalents

Kamil Zagorsek

Institut fur Palaontologie, GEOZENTRUM, Althanstrasse 14, A-1090 Wien, Austria

Eocene Bryozoa build-up in Austria have been found in borehole Helmberg 1 (Salzburg). The whole succession started with large foraminifers biostrome intercalated with algae build-up. These layers are about 25 m thick. Than occurs bryozoan marls with thickness about 6 m and upper most part of borehole is formed again algae bioherm. This sequence is unique within the Eocene Alpine-Carpathians region.

Thanks to new laboratory method (Zagorsek, 1999 in press) the Bryozoa from bryozoan mar's could be studied. Up to now, all together 52 species has been determined. Most of the Austria species formed erect zoarial growth forms, only few of them are encrust g. Free living and other growth forms are presented only very rare. The most similar associations have been described in South Africa, New Zealand, Australia, and around the Antarctica. No similar recent associations are known from Northern Hemisphere.

The comparison with recent associations have been made according to ratio between number of species in any grown forms, according to ratio between number of species belong to Cyclostomatous and Cheilostomatida Bryozoa and according to Anascan and Ascoporian ratio. Due to this comparison, Austrian Eocene Bryozoans biostrome is he most similar with Bryozoa association described by Hayward & Cook (1983) from eastern South Africa coast.
DISTRIBUTION OF AN AMPHIPOD CHARACTERISTIC OF ESTUARINE FLOOD-TIDAL DEL TAS: EFFECTS OF SCALE ON *Urothoe serrulidactylus*

M. Zatu and E. Dorfman

Zoology Dept., University of Fort Hare, 5700 Alice

The amphipod *Urothoe serrulidactylus* is one of the dominant crustaceans of the flood-tidal deltas of the Eastern Cape. It is present in large numbers in both permanently open estuaries as well as in smaller temporarily open systems. This study examines the effects of sampling scale on the distribution of this species in four small estuaries. Specimens were collected at scales of 1 m, 5 m and 50 m at each estuary, in order to determine what the effects are of scale on the distribution of this amphipod.