THE ORICLE

Newsletter of the Oceanographic Research Institute

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CLIMATE CHANGE CONUNDRUM

COP 17 has come and gone with mixed results, leaving behind its *Durban Package* as the rallying point for the next few years. While high pre-conference expectations were not met, the deliberations did spur on new initiatives and ideas.

Clearly, climate change has become a preferred vehicle for research support and development, although it is of concern that this may be at the expense of more immediate and urgent priorities.

It stands to reason that unless we manage our environment and its resources wisely today, there may not be the need to care for them in the future. It is thus preferable to integrate longer-term climate research and data collection into existing research projects that address more immediate issues. With this in mind, ORI analysed some of its current work to identify elements that can contribute to better understanding the issues relating to climate change.

ORI's reef biodiversity programme is designed to provide advice on management of reef usage and protection, yet a number of elements have been included to understand and monitor the effects of climate change on reef processes critical to coral survival in the region. This includes the declaration of special reference sites where critical information has been routinely collected over an extended period. The data collected involves systematic annual monitoring of the coral diversity, continuous underwater temperature recording, mapping the incidence of coral diseases and quantifying the levels of coral reproduction and recruitment success.

Given the dynamic nature of the coastal environment, and its vulnerability to climate change, it follows that ORI's Coastal Zone Unit has been working on a number of climate change related aspects within the KwaZulu-Natal (KZN) province. In particular, the development of strategies that will mitigate impacts of sea-level rise, increased coastal storm events, storm surges and coastal erosion are being pursued. This includes the establishment of a Coastal Vulnerability Index, highlighting those sections of coast potentially at risk to future coastal erosion so that coastal set-back lines will provide protection and better inform management of the coastal zone and preparedness for any future changes.

Changes in water temperatures may result in altered distribution patterns of marine organisms including those that sustain fisheries. While some may move to higher latitudes, others may move further offshore or to deeper waters where temperatures are within their respective tolerances. This could result in altered availability of resources for fisheries; clearly a huge problems for artisanal and subsistence fishers who would lose essential food security and income. One of the aims of the WIOFish project is to track changes in all WIO fisheries and so alert fishers, researchers and managers to changes in prevailing fishing conditions. With timeous knowledge, plans can be implemented to address these issues and find alternate sustainable and affordable solutions to fishing methods and/or targeting of vulnerable species.

For decades ORI has collaborated with Ezemvelo KZN Wildlife in monitoring daily resource usage along the coast. These records provide a unique insight into trends in several fisheries and especially into the species diversity of catches. Correlation with climatic events such as rainfall, temperatures and ENSO are now possible and can provide possible clues on future trends.

Estuaries and their offshore soft sediment regions are particularly vulnerable to climate variability. In order to protect these rich ecosystems from projected impacts of climate change, coastal managers need to plan and implement adaptation measures based on science. Several ORI projects already contribute to this.

The soft sediment ecosystems of the Natal Bight are being described and investigated for the first time so that future changes can be identified, including the nature, distribution, endemism and dominance of the animals that reside there. Documenting the biomass and diversity of specific animal types such as echinoderms, molluscs, crustaceans and smaller protists that precipitate calcium carbonate from seawater, will shed light on the scale of threat posed by ocean acidification.

Estuaries are also in focus. Decades of anthropogenic degradation of these systems has led to habitat degeneration, disruption of ecosystem processes and loss of provisioning services. The future health of estuaries is dependent on the gathering of information that can consider not only the immediate anthropogenic effects, but also the aggravating consequences of longer-term climatic change. Estuarine changes need to be understood from the scales of ecosystem to micro-organism; the latter is often where the first signs of change are manifest.

Two examples of ORI estuarine projects that consider climate change effects are the long-term monitoring of biodiversity in the subtropical St Lucia system and faunal changes in the more temperate Mbashe and Mbanyana Estuaries. Both are collaborative programmes involving a number of different disciplines but the focus of the Institute's role is to use macrozoobenthos as indicators of change due to climatic extremes. Already, an extended drought along the northern KwaZulu-Natal coast has yielded data of faunal response to extreme environmental conditions.

In short, information is being gathered to assist with assessment and development of products like Decision Support Systems, a Coastal Vulnerability Index, a system of coastal management setback lines and fisheries management strategies. This work is preparatory to likely far-reaching consequences of sea level rise and ocean acidification and will hopefully provide the knowledge to inform the public and capacitate managers and policy-makers to be proactive and climate ready.

The Oricle is an informal newsletter produced to keep our friends and collaborators informed about our current activities.

A SURREAL DIVING EXPERIENCE

The island of La Réunion has extensive submerged lava beds on its west coast, derived from its active volcano which erupts regularly. In a project known as Biolave, a team of divers recently surveyed submerged lava flows dated from 1977–2007 to assess the succession of benthic recruitment on these newly formed reefs.

Hosted by the French authorities, various specialists were invited to participate in the expedition, covering marine life on the reefs from seaweed to fish. ORI's Michael Schleyer undertook biodiversity assessments of the sponges, soft corals, gorgonians and ascidians, while Mathieu Séré examined coral diseases on the reefs and Lola Massé the extent of coral recruitment.

The expedition was a major undertaking as, for obvious reasons, there is little infrastructure in the vicinity of the volcano. The organisation of the expedition was nevertheless excellent and daily trips were mounted by three dive boats from a nearby harbour, taking three teams of five divers some distance to the dive sites.

Approaching the dive sites was an experience itself as the boat neared a desolate, dark landscape of seared black lava that had poured down the mountainside into the sea. On entering the water, one was introduced into an utterly surreal seascape of jumbled, massive blocks of lava, many as large as small reefs in their own right.

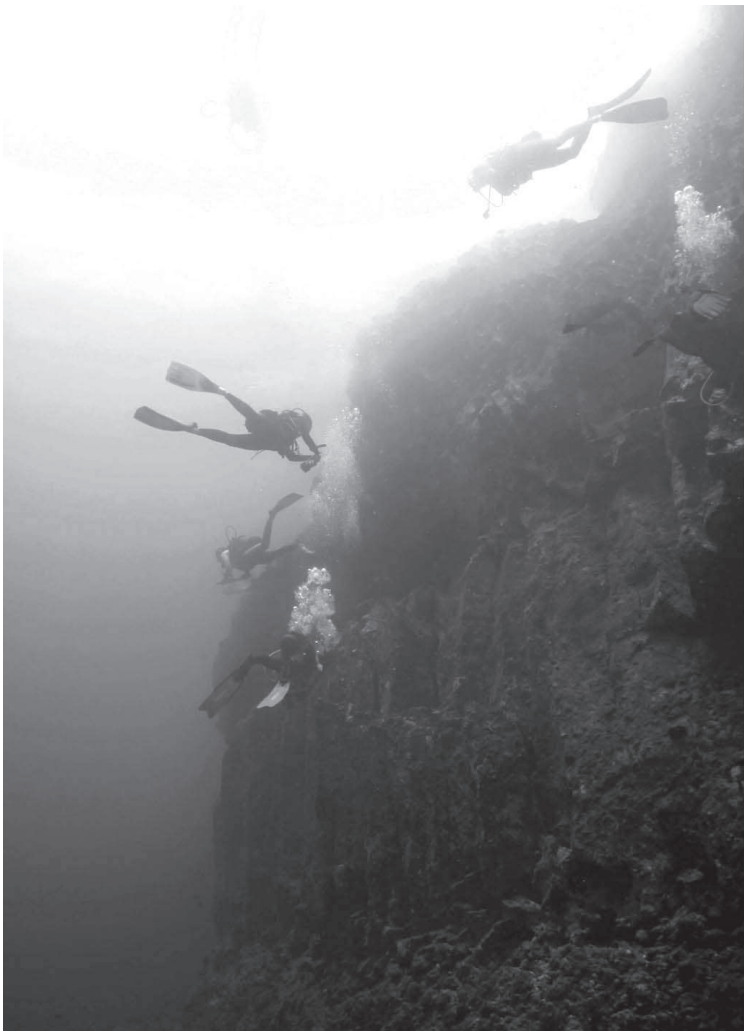
Some of the reefs ended in walls that dropped to undiveable depths and, elsewhere in their shallower stretches, the reefs had large patches of black sand.

Michael Schleyer approaching the dive site

While the 1997 lava flow had a reasonable coral cover (~65%), the coral diversity was not as high as anticipated and the cauliflower coral, *Pocillopora*, was the most prevalent.

More recently formed reefs had a sparse benthic cover and, in terms of the biota ORI was sampling, mainly resilient forms were found. These constituted tough carpets of soft coral; thin, leathery crusts of ascidians; and hard sponges - fragile forms with more structure were absent.

The rich biodiversity anticipated of a coast open to the tropical Indian Ocean was thus not encountered, indicating the harshness of the environment. This is thought to be attributable to the hardness of the rock, smothering by the volcanic sediments, freshwater seepage through the porous lava and huge temperature disruptions caused by successive lava inflows.



Coral reef specialists assess the biodiversity on newly-formed reefs off the island of La Réunion

A photographic record was made of the benthos on each section of the newly-created reef. Representative samples were collected and preserved and these will now be identified in specialist laboratories.

When the results are synthesised with the findings of the other specialists, the full assessment will provide a picture of how colonisation of newly-formed reefs progresses, informing us further of recruitment processes and the likely future of other disturbed and climate-impacted reefs.

An example of the Island's impressive landscape - from blocks of black lava in the foreground to the towering volcano in the background

STRONG ORI PRESENCE AT WIOMSA 7

From humble beginnings and a handful of delegates fourteen years ago, the WIOMSA Scientific Symposium has grown to be the largest gathering of marine scientists and environmental managers in the region.

The 7th WIOMSA (24-29th October 2011) attracted 500 delegates back to Mombasa, Kenya, the same town and venue where the inaugural Symposium was held. Appropriately, ORI was well represented with four staff and six students presenting their results.

The theme of "Coping with Global Change" was presented in 220 oral presentations held in five parallel sessions supplemented by a suite of 242 posters.

The range of subjects was wide. These included the biology and management of harvestable organisms in the light of change; from sea cucumbers, oysters and prawns to lobsters and even shoemaker spinefoot fish.

The sessions were complemented by policy and governance talks, sessions on mariculture, the effectiveness of MPAs, the impacts of climate change and variability and how this would affect mangroves and coral reefs. Several presentations dealt with fisher migration and the economics of natural resources.

It was evident that increasingly research in the WIO region is covering the pivotal ecological, social and policy angles which, when viewed holistically, are integral if successful environmental management of the region is to be assured.

Each person within the ORI group delivered either an oral presentation or a poster. The orals were all of a high standard and well-received, as were the posters.

Highlights of these two categories were PhD candidates Phanor Montoya-Maya and Mathieu Sèrè. Phanor received a prize for third-best student presentation with his talk entitled "Ecologically relevant genetic connectivity in the broadcast-spawning coral, *Acropora austere*, on south-east African coral reefs". Mathieu's poster, titled "Identification and spatio-temporal patterns of coral diseases on La Rèunion Island coral reefs" won him the award for best poster overall.

These fine achievements were rewarded with prizes at the symposium.

The titles and themes of the oral presentations delivered by the ORI staff and students in general covered a diversity of topics. This is testament to the strength and technical spread of the science currently underway at the Institute which remains at the forefront of WIO regional research.

With networking in mind, and being a key part of any symposium, the 7th WIOMSA did not disappoint. The closing function on the Friday evening was held at Fort Jesus, an impressive fort built by the Portuguese in 1593. It was a magnificent setting and a great way to say "farewell" to new friends, until the next WIOMSA scientific symposium, which is scheduled to take place in Madagascar in 2013.

ORI's oral and poster presentations:

Michael Schleyer – *management implications of southern African coral reef research*

Johan Groeneveld – *spiny lobsters' vulnerability to fishing*

Sean Fennessy – *similarities and differences in SWIO demersal fish diversity*

Camilla Floros – *fish as indicators of diving pressure on South African coral reefs*

James Robey – *trends in prawn and langoustine trawl fisheries in the SWIO*

Stuart Laing – *an economic valuation of the Maputaland Coral Reefs*

Phanor Montoya-Maya – *genetic connectivity regarding Acropora austere on south-east African coral reefs*

Lola Massé – *effect of temperature on larval development of a coral at high latitude* (poster)

Mathieu Séré – *identification and spatio-temporal patterns of coral diseases on La Réunion Island coral reefs* (poster)

Maggie Reddy – *is the shallow water spiny lobster, Panulirus homarus populations in the SWIO region genetically panmitic or structured? Implications for regional management* (poster)

Mangroves of South Africa Handbook

In 1977 a number of KwaZulu-Natal biologists teamed up to produce a handbook entitled *In the Mangroves of South Africa*.

Now, more than 30 years on, several of the original - *albeit* slightly greyer - authors, plus new colleagues, teamed up again to develop a new and greatly amplified version of this very popular and authoritative publication.

ORI's Rudy van der Elst and Fiona MacKay compiled a chapter on the economic importance of mangrove ecosystems and associated fauna; considering their role in providing environmental goods and services such as nursery habitat for valuable resources and carbon sequestration.

This Wildlife and Environment Society handbook was launched at Adams bookshop in Durban recently.

Rudy van der Elst (above left) pictured with fellow biologists at the Durban launch of In The Mangroves of South Africa.

STUDENT CORNER

Two student projects, both supervised by ORI Senior Scientist, Fiona MacKay, form part of ACEP (African Coelacanth Ecosystem Project), a multi-disciplinary programme which investigates the ecosystem functioning of the KwaZulu-Natal Bight.

Macrobenthic biodiversity of the KZN Bight
by Liesel Hein

It is well known that the offshore waters of the KZN Bight are oligotrophic; yet the area sustains rich resources and fisheries. What is the source of these nutrients? Could they be supplied by the Thukela River, the Durban lee eddy from the south or the St Lucia upwelling in the north?

Little research has been done to understand the shelf community dynamics of the Bight and how these three oceanographic features may play a role in maintaining the ecosystem as a whole. This project examines changes in marcobenthos biodiversity and population dynamics relative to direct and indirect process drivers, including the Agulhas Current. Ultimately, we hope to understand the relative importance of the three main nutrient inputs in maintaining ecological function across the Bight.

Sampling has been conducted during "wet" and "dry" seasons at sea from the *FRS Algoa* during which three replicates (along with environmental data) were taken from stations all along the length and width (up to shelf edge) of the Bight.

Preliminary results reveal variability in the marcobenthos, seemingly related to the different potential sources of nutrients. There is high biodiversity across the Bight, with the northern Richards Bay stations having the highest biodiversity value but with lowest individual species counts. In contrast, the southern Durban stations and middle Bight Thukela stations have the highest species richness and individual counts but have a much lower biodiversity value due to the uneven spread of individuals among species.

In terms of the geographical range of the four main taxa found, echinoderms seem to be mostly restricted to the northern parts of the Bight, molluscs in the middle region of the shelf opposite the Thukela mouth and polychaetes and crustaceans seem to be the overall most dominating taxa across the KZN Bight. Several species may even be new to science or new distribution records. The connectivity among WIO regions seems clear as many species from Mozambique and Madagascar have also been found.

Macrobenthos distribution and trophic guilds within three hydrographic feature areas of the Natal Bight
by Candice Untiedt

Recognising that the shelf area, known as the Natal Bight, is rich in biodiversity and has complex hydrographic features and sources of nutrients, it is important to understand the functioning of the ecosystems through analysis of tropic guilds. This project is designed to contribute to understanding the distribution and trophic structure of macrobenthos in three localised areas of posited nutrient input namely: Durban, Thukela and Richard's Bay.

More than 200 substrate grab samples for sedimentary and benthic infaunal analysis were taken at sea in February and August last year and to date over 1500 species of macrobenthos have been found.

This has proven to be a challenging yet exciting task as the identification guides for South African macrobenthic taxa were written prior to the 1990's and much of the taxonomy has since been updated. Our work will contribute to existing taxonomic knowledge by identifying new species and corroborating existing species and distribution records. One example of the latter is a polychaete worm belonging to the family Onuphidae, *Nothria conchylega* a deposit feeding or carnivorous, cosmopolitan species found from shallow depths to 5200 m. This species has been recorded from shelf edge depths (40-150m) in both Durban and Richards Bay.

Nothria conchylega is the type species for the genus Nothria and is characterised by its prolonged anterior parapodia (feet) and flattened tube. These tubes are composed of a thin inner lining, the animal then actively selects large shell fragments, trims them to fit together and orientates the fragments with the flat or concave side against the lining so as to create the flattened structure (Fauchald, 1982). Species of Nothria are able to transport these tubes from one location to another by carrying them with their prolonged parapodia.

SOME RECENT PUBLICATIONS INVOLVING ORI STAFF & STUDENTS

Diemer, K.M., Mann, B.Q. & Hussey, N.E. 2011. Distribution and movement of scalloped hammerhead Sphryna lewini and smooth hammerhead *Sphyrna zygaena* sharks along the east coast of Southern Africa. *African Journal of Marine Science* 33(2): 229-238.

Macdonald, A.H.H., Schleyer, M.H. & Lamb, J.M. 2011. *Acropora austera* connectivity in the south-western Indian Ocean assessed using nuclear intron sequence data. *Marine Biology* 158(3): 613-621.

Maggs, J.Q., Mann, B.Q., Els, M. & Govender, R.D. 2011. National Marine Linefish System: Recreational angling data collection by Ezemvelo KZN Wildlife: 2010 Annual Report. Oceanographic Research Institute, Durban: 51p. (ORI Unpublished Report 292).

Mann B.Q., Khumalo, M.C., Maggs, J.Q. & Mthethwa, D. 2011. Boat Launch Site Monitoring System (BLSMS): 2010 Annual Report. Oceanographic Research Institute, Durban: 53p. (ORI Unpublished Report 294).

Oceanographic Research Institute. 2011. Annual Research Report 2010. Oceanographic Research Institute, Durban: 61p. (ORI Unpublished Report 290).

Steyn, E., Floros, C.D. & Schleyer, M.H. 2011. Biodiversity assessment of the proposed Umhlanga tidal pool site at Lighthouse Reef. Oceanographic Research Institute, Durban: 18p. (ORI Unpublished Report 293).

Steyn, E. & Schleyer, M.H. 2011. Assessment of management options for the East Coast rock lobster *Panulirus homarus.* Oceanographic Research Institute, Durban: 22p. (ORI Unpublished Report 295).

ORI is the research division of the South African Association for Marine Biological Research (SAAMBR)