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CORAL SPAWNING IN THE ORI RESEARCH AQUARIUM

Coral spawning is a unique phenomenon that occurs once a year in summer, a few nights after a full moon. In some places, such as the Great Barrier Reef in Australia, all coral species spawn at the same time on the same night.

During these synchronised, mass spawning events, layers of pink eggs are visible at the water surface, accompanied by a fishy smell.

This phenomenon has not been observed in South Africa, and relatively little is known about coral spawning on our reefs. Previous studies by ORI scientists have shown that South African corals do reproduce sexually, despite the harsh environmental conditions (lower temperature, high swell and surge) at this latitude. Yet there is more to discover about when and which coral species spawn, what triggers coral spawning, and the extent of their spawning success.

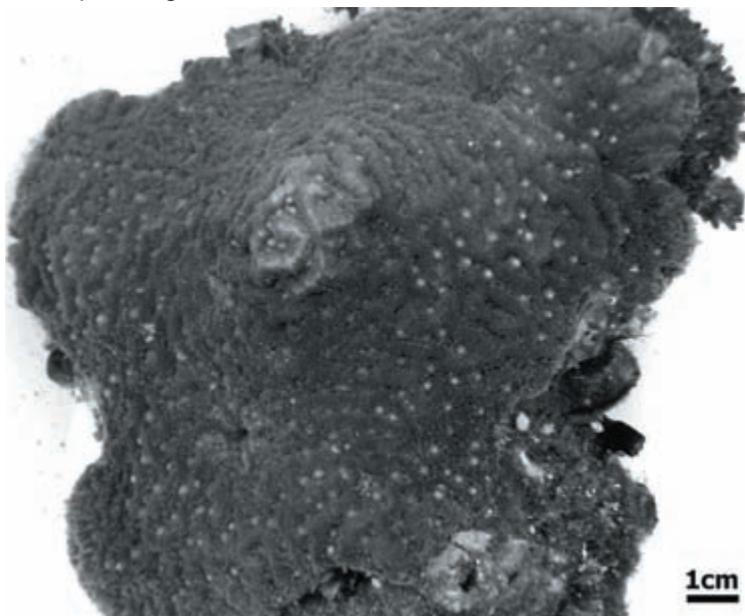


Fig 1: brain coral colony ready to spawn (above)

Since corals spawn at night, a few days after a full moon, monitoring their spawning in the sea is difficult. For this reason, coral colonies were collected and placed in the ORI Research Aquarium during February 2012, a few days before the full moon.

The colonies were monitored every evening for evidence of spawning. Nine colonies of the brain coral *Platygyra daedalea* spawned en masse one day after the full moon (Fig 1).

Polyps released bundles of eggs and sperm that separated when they reached the surface (Fig 2).

Fertilisation occurred at the water surface after the sperm and eggs mixed with gametes from other colonies (Fig 3).

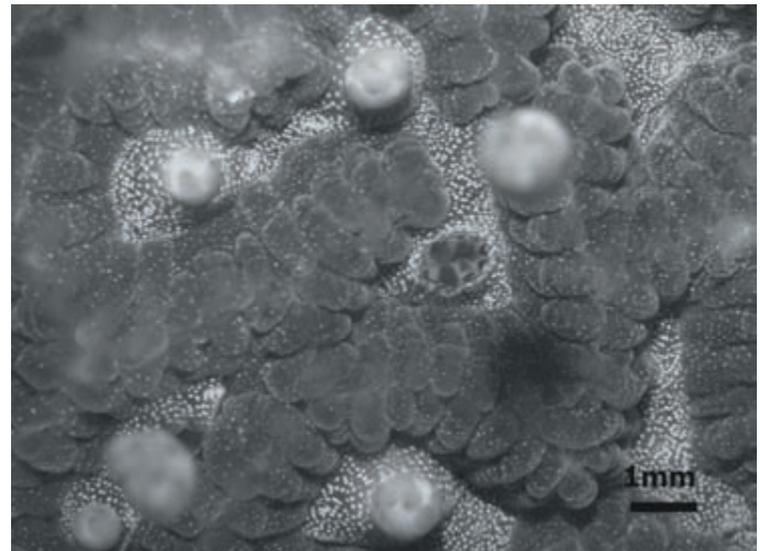


Fig 2: polyps releasing bundles of eggs sperm (above)

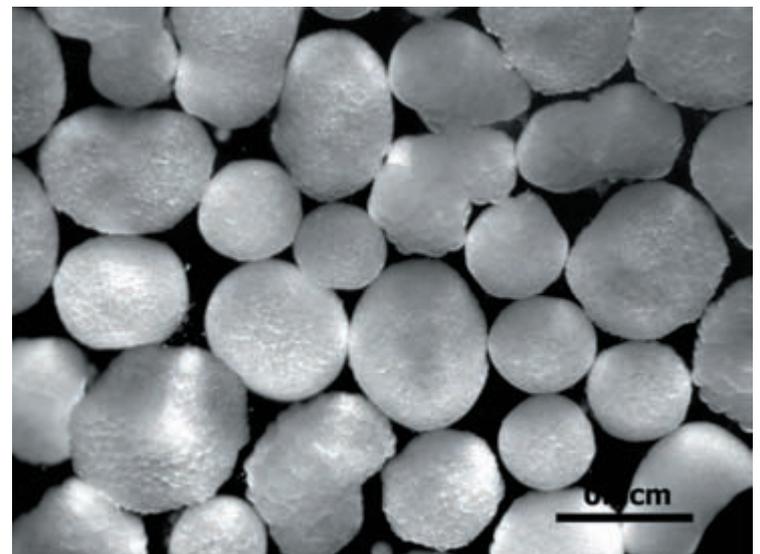


Fig 3: developing eggs (above)

The eggs were then placed in rearing bowls that had plankton netting sides to allow water circulation. Within two days, most of the eggs had developed into swimming larvae, and started searching for a place to settle (Fig 4; page 3).

Several substrates were offered for settlement in the tanks and, once they found an appropriate substrate, the larvae stopped moving and started metamorphosing, each larva flattening into a single polyp (Fig 5 and Fig 6).

Continued on Page 3

AN INCREDIBLE RED STEENBRAS RECAPTURE!

ORI Senior Scientist, Bruce Mann, may well have had a hand in a new world record, thanks to the amazing recapture of a red steenbras (aka copper steenbras, *Petrus rupestris*) during the recent Christmas holidays.

Whilst studying for his Masters with the Department of Ichthyology and Fisheries Science at Rhodes University (1989-1991), Bruce (then 25 years old) was stationed at Storms River in the Tsitsikamma National Park (TNP).

Bruce's MSc project involved the monthly collection of samples of blacktail (aka dassie, *Diplodus capensis*) and zebra (aka wildeperd, *Diplodus cervinus hottentotus*) in the TNP for subsequent biological analyses.

During one of his collecting trips, on 12 November 1989, he was research fishing for blacktail and zebra in an area known as Santer Bank south of the Bloukrans River, using sardine fillet for bait. To his surprise, he hooked and landed a juvenile red steenbras of approximately 8.3kg, with a fork length (FL) of 750mm; an extremely rare occurrence from the shore, even inside our protected areas.

According to research by Dr Malcolm Smale, this fish was approximately 10 years old and would have just reached sexual maturity. Bruce carefully measured, tagged and released the fish, but not before taking a quick photograph to prove to his colleagues that it wasn't just another 'fishy tale'!

On 27th December 2011, Andrew Gericke was fishing with his brother, Craig, and a friend, Paul Dineen, approximately six miles off Kei Mouth. That morning, Craig, who was fishing with a live bait while Andrew was skippering, hooked into a nice "copper" but unfortunately lost the fish when the leader line parted. On the next drift Andrew went down with a similar bait and within minutes also hooked into a nice "copper".

Andrew played the fish for about ten minutes and when the fish was brought aboard, they discovered that it was the same fish that Craig had tangled with earlier, as his trace was still in the fish's mouth. It was then that they also noticed that the fish had been tagged!

There was a small wound around the tag, which was covered with quite a lot of growth. When they pulled on the tag it broke off cleanly from the barb, which remained locked behind one of the inter-neural spines in the flesh of the fish. Other than the small tag wound, the fish was healthy with no other marks, cuts or wounds. It measured 1120mm FL and weighed about 26.2kg. It was a short, fat fish compared to another copper that Craig caught about half an hour later on the same reef. That fish was also in good condition and approximately the same length, but was 2kg lighter. Both were male fish.



Andrew informed the Border Deep Sea Angling Association's Environmental Officer, John Rance, about this recapture and asked him to find out who had tagged the fish. John contacted Bruce who was immediately intrigued by the tag number A37170, one of the earlier tags in ORI's sequence. On his return to work, and with the assistance of the ORI Tagging Officer, Stuart Dunlop, Bruce was amazed to discover that this was the same fish that he had tagged as a student in 1989!

They calculated that the fish had been at liberty for a remarkable 22.1 years, had grown 370mm and put on 17.9kg in weight. The fish had also moved a distance of 532km. The news gave Bruce goose bumps!

In all that time, the fish had run the gauntlet from Tsitsikamma, past active commercial and recreational line fisheries at St Francis, Port Elizabeth, Port Alfred and East London, before settling down on the reefs off Kei Mouth. A true survivor at the age of 32 years old! This is a record time at liberty for a tagged teleost (bony fish) in the ORI Tagging Project.

Bruce and Stuart then contacted David Hall (Director of Hallprint Tags in Australia) who supplies ORI with their tags, and asked him what the longest time at liberty was, for any fish tagged with a tag supplied by Hallprint. To the best of David's knowledge, the longest time at liberty was 20.8 years, by a southern bluefin tuna (*Thunnus maccoyii*) that was tagged by the CSIRO in Australia. That means that red steenbras A37170 may be a world record; and, Bruce quipped "it always feels good to beat the Aussies!"

Yet again, this remarkable recapture goes to prove the exceptional longevity of our red steenbras, which have been aged up to 33 years and are likely to grow considerably older. It also provides further support for our marine protected areas such as the TNP, where juveniles of this species have been shown to be extremely resident. According to John Rance, there are also a lot of smaller red steenbras around the Kei Mouth area at the moment so it is likely that the three marine protected areas off East London (jointly known as the Amathole MPA) are also benefitting the survival of this iconic species, which has been so heavily exploited that Dept of Agriculture, Forestry and Fisheries (DAFF) is currently considering proposals for a moratorium on future red steenbras capture.

Bruce urges fishermen to think about what they're doing to the fish stocks of this remarkable species. Four fishermen on a boat, catching one each of fish this size, would be pulling a combined 132 years of red steenbras life from the ocean. The chances of survival for a fish released with barotrauma effects is slight, so please don't catch more than you need for your quota. "If you're looking for big fish, use big baits", says Bruce, "and never throw fish back in order to catch more or bigger fish later. This should be the protocol of all fishing competitions – the first fish you catch is the one you weigh..."

Anglers are reminded to be on the lookout for tagged fish. If you do happen to catch a fish with a tag in it, please carefully record the tag number, species, fork or total length (stating which length – fork or total), date, exact locality and your name and contact details. If the fish is killed, please also record its weight and take note of any tag wound infections. Photos of the fish and the tag would also be welcome. If fish are healthy, it's preferable to treat them gently and to release them again, carefully measuring the length and noting the tag number beforehand. If there is algal growth on the tag, this can be easily scraped off with your fingernail to reveal the tag number.

Information is to be sent to: The Tagging Officer, ORI, PO Box 10712, Marine Parade, 4056 or simply email oritag@ori.org.za or phone/sms 079 529 0711. Your recapture could help us learn more about our amazing fish!

Left: Andrew Gericke (holding the tagged copper in the centre) with his brother Craig on his left holding the second copper and friend Paul Dineen on his right with a dorado.

CORAL DISEASE ASSOCIATED WITH BLEACHING IN MADAGASCAR

At its 2011 Scientific Symposium, WIOMSA promoted the cause of an in-depth study of coral bleaching in the Western Indian Ocean (WIO), if and when it occurred in the next few years.

The El Niño phenomenon, a major driver of increased sea surface temperature (SST) that causes coral bleaching in the WIO, did not occur this year. However, remote sensing by satellites indicated that SSTs were increasing north of Madagascar in the so-called WIO "coral triangle".

A task force was mobilised to undertake the surveys and sampling needed to assess the extent of coral bleaching in the affected area. Justin Hart joined this task team to assess levels of coral disease off the north east coast of Madagascar in the Bay of Antongil, the target area, and the north west coast around the Mitsio islands as an unaffected control. Disease prevalence was expected to increase during coral bleaching, which in turn could affect the structure of coral reef ecosystems.

During the past two decades, the emergence and spread of infectious diseases have caused the death of many hard corals, resulting in accelerated global destruction of coral reef ecosystems. Disease infection can result in a daily loss of one

centimetre of coral tissue. Despite a concerted global effort to characterize coral diseases since the early 1990s, the ecological drivers of these epizoots and their ultimate consequences in coral reef communities remain poorly understood.

Preliminary results indicate that the intensity of bleaching and coral disease was more prevalent in the targeted area in comparison to the west coast control site. Detailed laboratory analysis of the coral samples will be conducted at ORI to determine the types and prevalence of coral disease. A return trip is planned to sample the sites during winter to determine their progress in terms of coral disease or recovery.



West coast coral disease transect

CORAL SPAWNING AT ORI

Continued from Page 1

Of the 12,000 eggs collected, 1,800 (15%) developed into larvae, and 520 (4%) settled and metamorphosed into a polyp. As these corals grow, the polyps will bud (reproduce asexually) and other polyps will appear at their bases until a new coral colony has formed. At the time of writing, the coral polyps are 0.5-1mm long.

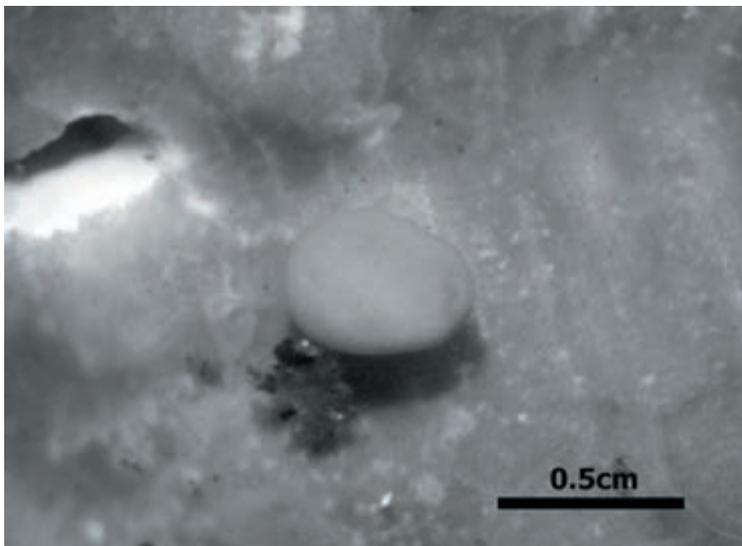


Fig 4: coral larva searching for a spot to settle (above)

Corals are key components of reef-building, and it is crucial that they maintain their reproductive capacity to ensure reef sustainability.

Aquarium experiments are providing valuable information on coral larval development and reproductive success, which cannot be determined in the field. The results of this study will also find application in reef conservation and mariculture, and will further elucidate coral life history strategies, ie the strategies that corals use to reproduce and develop.

When combined with genetic analyses, disease surveys and studies on coral recruitment and growth, the results from this work will provide a better understanding of the way that South African reefs will respond to environmental change.

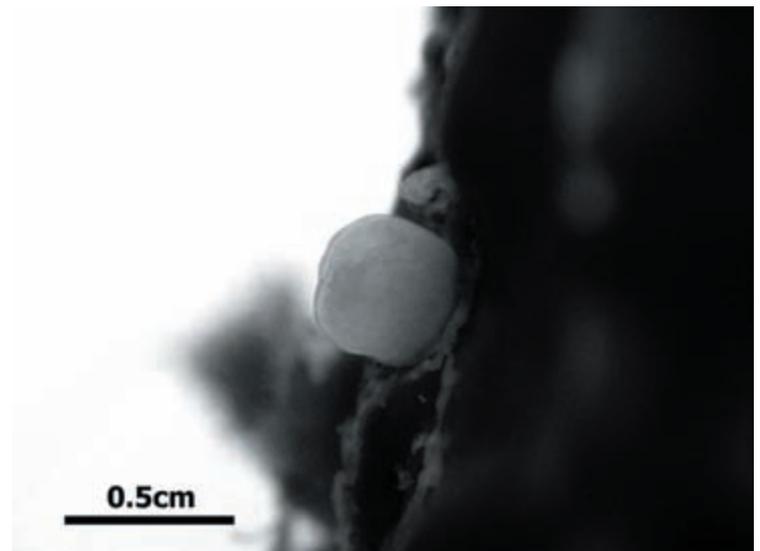
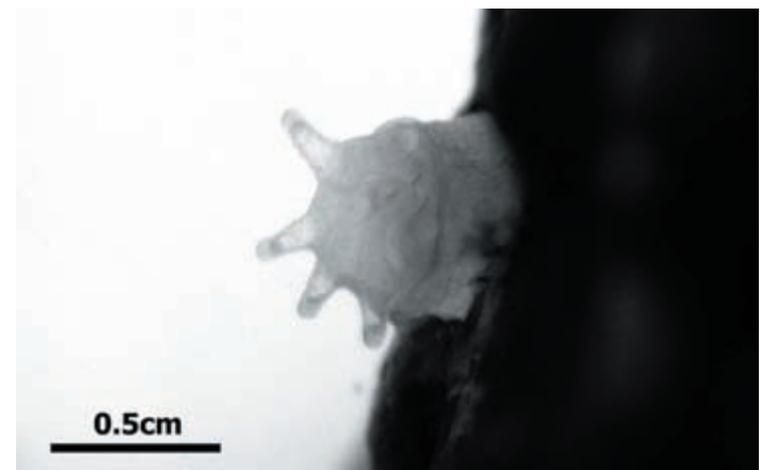


Fig 5: settled coral larva flattening before metamorphosis (above) and Fig 6: polyp metamorphosis completed four days after settlement (below)



STUDENT CORNER

Two ORI students, Phanor Montoya-Maya (PhD) and Alan Foulis (MSc), are nearing the end of their respective projects and both are hoping to hand in their theses within the next few months.

Phanor's PhD on coral genetics is supervised by Prof Mike Schleyer of ORI and former ORI student, Dr Angus Macdonald, who is now based at the University of KwaZulu-Natal.

Alan's MSc on the shortfin mako shark forms part of the South Western Indian Ocean Fisheries Programme and his supervisors are Prof Johan Groeneveld of ORI and Dr Sheldon Dudley of the KwaZulu-Natal Sharks Board.

Ecologically relevant genetic connectivity within southeast African marginal reefs

Marginal reefs along the south-eastern African coast, from Bazaruto Island in Mozambique to Leadsman Shoal in South Africa, have drawn the attention of reefs scientists and managers as these coral communities are said to illustrate the possible future of true, tropical coral reef communities under the current trends of climate change.

However, limited knowledge of the interdependence of south east African coral communities, in terms of genetic exchange, hinders their effective management. Accordingly, coral population genetics of *Acropora auctera* and *Platygyra daedalea* are being examined to assess the level of contemporary, small-scale connectivity between the reef systems and its significance to reef resilience. This work is aimed at improving reef management in the local and regional context.

Comprehensive sampling was undertaken on Two-mile Reef (TMR), the most heavily-used reef in the region. Reefs to the north and south of TMR were also sampled to include potential sources and sinks of coral larvae. Despite the paucity of symbiont-free tissue and genome information available for the two coral species of interest, the project has managed to produce several nuclear markers suitable for population genetic analysis. The laboratory work has been completed and, as a result, contemporary genetic connectivity is now being estimated using individual-based statistical methods, namely assignment and spatial autocorrelation analysis.

Preliminary results suggest significant genetic variation between the studied reefs, associated with a pattern of isolation by distance. At the finer scale, there is significant spatial genetic structure for colonies within 10 metres of each other, which suggests either limited dispersal or high levels of self-recruitment in these two species of corals. These estimates of inter- and intra-population connectivity suggest South African reefs are isolated from northern reefs at ecological time scales, which may limit their ability to recover from large-scale damage. If that is the case, a new management strategy may be needed.

The importance of making informed management decisions cannot be underestimated if we are to succeed in preserving the genetic biodiversity of our marine resources. Indeed, the outcomes of this study are being used to assess the resilience potential of coral communities in the south western Indian Ocean to anthropomorphic and other sources of disturbance.

by Phanor Montoya-Maya



An assessment of shark catch in the South African pelagic longline fisheries in the south west Indian ocean (SWIO) and notes on the life history of the shortfin mako (*Isurus oxyrinchus*) shark

Petersen *et al* (2009) have shown declining bycatches of pelagic sharks in the South African long-line fishery for tunas and swordfish, raising concerns that shark populations may be under pressure in some areas. Given their position as apex predators in marine ecosystems, substantial fisheries-induced declines in shark numbers may adversely affect trophic functioning.

Sharks are generally vulnerable to over-exploitation as a result of their life history strategies which include slow growth, low fecundity, late maturation and longevity (Gilman *et al.* 2008, Werner *et al.* 2006, Dulvy *et al.* 2008).

The South West Indian Ocean Fisheries Programme (SWIOFP), together with ORI and the KwaZulu-Natal Sharks Board, have been working together to improve the information base that can be used to assess the impact of long-line fisheries on pelagic sharks. The aims of this study are to assess the quantity, species composition, and trends in catch-per-unit-effort of pelagic sharks in the pelagic long-line fisheries of South Africa.

One of the pelagic species targeted in South Africa is the shortfin mako (*Isurus oxyrinchus*). Therefore, it is vital that the status of this species and its life history characteristics are understood for this region. The aim of this study is to elucidate these characteristics, as a reference point for management in this region.

Alan conducted his biological sampling on board the FV Drifter 2, which targets shortfin mako out of Cape Town. About 25 tonnes of mako are caught on the vessel per three week fishing trip. The crew were very accommodating whilst Alan was on board, helping him to collect samples such as shark vertebrae for aging, gut contents, and morphological measurements.

This project is in the final stages of lab work, to be followed by the write up. Alan expressed his gratitude to SWIOFP, which funded the project.

by Alan Foulis



SOME RECENT PUBLICATIONS INVOLVING ORI STAFF & STUDENTS

- DE FREITAS, A.J. 2011. The *Penaeoidea* of southeast Africa IV - The family *Penaeidae*: Genus *Penaeus*. *Investigational Report*. Oceanographic Research Institute (59): 1-125.
- GRIMMER, A. 2011. Accretion versus bioerosion on the Maputaland reefs in South Africa – The major processes. MSc *cum laude*. University of KwaZulu-Natal, Durban. 79p.
- HART, J.R. 2011. Coral recruitment on a high-latitude reef at Sodwana Bay, South Africa: research methods and dynamics. MSc *summa cum laude*. University of KwaZulu-Natal, Durban: 67p.
- STOW, C.A. 2011. Spatial and temporal variations in macrozoobenthic communities in KwaZulu-Natal temporarily open/closed estuaries. MSc thesis. University of KwaZulu-Natal, Durban: 227p.

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