ENCOUNTER
Newsletter of the International Society for Reef Studies
As you can see we have made a few changes to Reef Encounter. These have been brewing from sometime now and we thought what better way to initiate the new look than with issue number 30.

This issue sees a shift in the editorial team with Maggie stepping down as the main Editor to become the Production Editor. She feels it’s time for a smaller supporting role, but still wants to help develop our magazine and presented and produce. Kristian is now Editor following in the footsteps of a distinguished group (Brian Rosen, Barbara Sew, Callum Roberts, and of course Maggie Watson). They set high standards and provided the basic from which the team hopes to continue bringing you an engaging and interesting magazine.

With the last issue we switched production schedule, to an issue earlier in the year. Unfortunately this meant the copy deadline (1st Jan) coincided (or collided with) the IRSS subscription renewals, and the issue went to print without listing several of our sustaining members on the inside cover. The Society deeply appreciates the support of all our sustaining members and Reef Encounter would like to apologise for any embarrassment the omissions may have caused.

IRSS is a scientific society, and sometimes we wonder whether our magazine has enough ‘hard science’. But we feel our niche is making research more accessible, and helping to relate science to management issues. In this issue we have introduced a new section entitled Reef Briefs. Here we give a snippet of recent and pre-press articles in Coral Reefs. Maybe you’ll be intrigued by an article outside your own specialty!

We also cover such topics as remote sensing surveys, the first marine park in the Comoros and fishing of anemones in the Florida Keys, and our feature wonders if setting fish larvae could help sustain the aquarium industry. Earlier this year the International Coral Reef Initiative asked the society to prepare a briefing on sustainable reef fisheries and the result is printed in full in the Currents section.

Please do let us know what you think of our new look... Your comments and thoughts will decide whether we will continue Reef Encounter in this format. Send us your articles, but have a close look at the Notes for Contributors on the back cover as we’ve also changed our referencing system to contribute to the more reader friendly format.

Kristian, Maggie, Maria João and Kareenne
ReefEncounter@bigfoot.com

A few events in the last couple of years encourage me to keep faith in the value of coral reef science to the broader community, and its capacity to make a difference for the better. The first was telephone conservation I had with a public servant. This fellow – trained in science – was close to decision makers. He had the ear of an assistant to a politician in a western government whose opinion had some weight in coral reef policy. The chat was about global climate change, and the issue was the extent to which coral reefs could adapt. I off-handedly mentioned a related paper that had just come out in a peer reviewed scientific journal. I was delighted and surprised when he pressed me for details. ‘Peer reviewed papers are worth their weight in gold’ he said, or words to that effect. ‘My advice carries a lot more weight if I can back it up with a reference to a peer reviewed paper in a good journal’. We were talking ecology, but we might equally have been talking about socio-economic aspects of coral reef conservation, use and management. I believe that being a scientific paper with a clear take home message and a good pedigree can make a difference.

With their high public profile, global advocacy groups like World Wildlife Fund, Greenpeace, The Nature Conservancy and Conservation International
ISRS NEWS

2001 International Society for Reef Studies/ The Ocean Conservancy Fellowship Winner

The International Society for Reef Studies and The Ocean Conservancy awarded their 2001 Coral Reef Fellowship to Benjamin Ruttenberg, University of California, Santa Barbara. His project entitled “Larval retention and population connectivity in the Galapagos Marine Reserve” will investigate connections among regions of the park using the chemical signatures contained within the ear stones of larval fish. These signatures track the dispersal patterns of fish because they reflect the chemical composition of different bodies of water the fish traveled through. Mr. Ruttenberg will receive $14,500 for his research and will be supported for one year.

We received an unprecedented number of applicants for this year’s award, with the panel of eight scientists receiving 36 applications. Many thanks to all of the students who submitted proposals and thanks to the reviewers for giving their time to this important job. All of the applications were of the highest quality, and the selection process was very competitive. Although it was disappointing to have to decline so many worthy projects, Mr. Ruttenberg was the unanimous first choice of the judges. Congratulations to Mr. Ruttenberg and we wish him well with his research endeavors over the next year.

For information about the Fellowship contact: Peter Edmunds (Recording Secretary, ISRS), Department of Biology, California State University, 18111 Nordhoff Street, Northridge, CA 91330-8303, USA. Email: peter.edmunds@csun.edu
The Ocean Conservancy (formerly the Center for Marine Conservation) has its web site at www.oceanconservancy.org

This June I was speaking on a live radio interview, when the Interviewer hurriedly brought the interview to a close. «This was supposed to be a good news story she said, on air. ‘Sorry – I’m not so sure it is a good news story’. I had come to a place in my rambling discourse where I was speaking of wholesale transformation of beautiful reefs into coral rubble, covered in seaweeds. The interview had been spawned by Andrew Baker’s paper in Nature (June 2001) ‘Coral reefs bleach to survive change’. It showed that corals can indeed take on better adapted zoanthellae after bleaching. The response seems to be: ‘So bleaching is good for corals, is that it? What about our reefs here in Western Australia?’ Media are looking for good-news stories now. ‘OK – you can stop just telling us reefs are in trouble. Now tell us which ones, and are there natural coping mechanisms that we can do something about?’ I figure that to answer big questions like these, we need to do a great job in all the reef studies embraced by the members of this great Society. Go for it!

Terry Done
President

Summary of Mr. Ruttenberg’s winning proposal

ISRS Publications Available

Replace copies of publications you have loaned and never gotten back, or extend your run! There are small numbers of some publications (2 or 3 in some cases), so order now to ensure you get what you want.

Back issues of Coral Reefs volumes 16, 17 and 18 are available at US$15 each issue (not volume).


Copies of the Proceedings of BICRS (Panama) are available for US$200 (two volumes).

Copies of The Northern Great Barrier Reef (published in 1978 by the Royal Society) are available at US$25 each.

All prices include air-nail postage. Payment must accompany an order (that is, no electronic sales, please) — payment is to be in US$ (if by check, it must be drawn on a US bank). Send orders to Daphne Fautin, ISRS, Kansas Geological Survey, 1930 Constant Avenue, Lawrence, KS 66047 USA. Inquiries to fautin@ku.edu.

A Note of Thanks from ISRS

At the 9ICRS in Bali last October, Carden Wallace and Michael Aw donated to ISRS 40% of the income from the sales of their book “Acropora Staghorn Coral: a getting to know you and identification guide.” The book sold well and the ISRS treasury grew as a result. Thank you Carden and Michael!!!

ISRS Apology

The Society apologizes for the delay in arrivals of Coral Reefs during 2000–2001. Paradoxically, the delay was largely caused by a practice that is intended to spread your access to published papers: electronic online publishing (see instructions inside the front and zones open to exploitation. In order to measure rates of exchange between populations, ISRS will use chemical variability present in the waters of the Galápagos as natural tags in the otoliths (earstones) of a reef fish. These natural chemical tags will allow us to explicitly identify larval sources and determine rates of exchange between populations. In addition to providing information directly to the managers of the Galápagos National Park, these techniques could create a method with which to generate this elusive but essential ecological information for marine systems worldwide.

Benjamin Ruttenberg
Email: rutenberg@life.ex.ac.uk

Coral Reefs - What's Going On?

Editor Dick Dodge says:

By now you will have read the letter to the membership from ISRS President Terry Done explaining some of the recent delays in Coral Reefs (see ISRS Apology) and outlining our plans to remedy the situation. Following the productive meeting with our publishers, Springer-Verlag, in May, we are all working hard to ensure you will receive three issues of Volume 20, and hopefully all four, this year.

There are some exciting things coming up in Coral Reefs. For example, some Reports and Notes will be highlighted in Reef Encounter (see Reef Briefs). This is a great development which we hope our readership will find helpful. Submissions to Coral Reefs remain strong and please continue to send manuscripts in to the Topic Editors (see details in Coral Reefs Editors - Your Manuscript In Peer Review).

For publishing on reef studies. (Our standing among marine and freshwater journals has been consistent in the top 25% for the last decade, but we should strive to be right at the top, as we were briefly in 1992 according to citation and impact indicators). I would like the relationship between coral reef studies and Coral Reefs to reach the same level as that between medical research and the Lancet or the Journal of the American Medical Association. A paper in Coral Reefs should have standing equal to or better than one in Science, Nature, or any of our diverse disciplinary journals.

Please think of Coral Reefs as your journal of choice, and the Society will do what it can to justify that choice.

Terry Done, President ISRS

You can find their respective addresses in a recent issue, or on the Springer-Verlag web site: link: springer-ny.com/link/service/journals/00338/edboard.html.

Dr. Dave Barnes, one of three Biological Editors of Coral Reefs, is a Principal Research Scientist with the Australian Institute of Marine Science in Townsville, Queensland. He has worked on corals and coral reefs for more than 30 years, beginning his career with Tom Goreau in Discovery Bay. His current interests center around recovery of proxy environmental and climatic information from coral skeletal material. His expertise in coral growth forms, skeletal structure, growth and calcification has helped improve our understanding of how environmental changes translate into changes in coral skeletal structure, and how information is recovered from coral skeletons and interpreted. Work on proxy records brings Dave Barnes full circle; his earliest work recovered astronomical information about the history of the Earth-Moon system from coral skeletons. Between times, Dave Barnes has published on coral physiology, particularly physiological and biochemical mechanisms associated with coral calcification. He has also worked on reef community metabolism. He developed the pH-O2 technique for measuring Photosynthesis by a hundred times in the paper resolution with which productivity and calcification can be estimated from changes in the chemistry of waters flowing over shallow reef communities.

Dr. Robert C. Carpenter, one of three Biological Editors of Coral Reefs, is a full-time university faculty member and researcher at California State University. His research interests center primarily on coastal reef algal communities and the factors that affect their abundance, species composition, and rates of production. His particular interest is in how herbivores change the relative abundances of algae and other benthic reef components. This research demonstrates that herbivore effects are often the result of a modification of the physical environment experienced by the algae, especially the light and flow environments. His most recent research has focused on how light and flow drive algal metabolism across a range of spatial scales and how small-scale changes in algal abundance leads to changes in the community influences the relationship between flow and algal production.

Dr. Howard R. Lasker, one of three Biological Editors of Coral Reefs, is an expert in evolutionary biology and the functional ecology of marine invertebrates. He is a professor at the University at Buffalo, State University of New York. He researches population ecology of Pseudocorallina elegans, a common gorgonian of coral reefs throughout the Caribbean. Colonies are harvested for pseudeoheralin, a natural product that has antiinflammatory properties and which is used in cosmetics. Howard’s studies include species recruitment, growth and survivorship, and population genetics, as well as developing methods for colony propagation that can be used in mariculture. A general goal is to identify the parameters that are crucial in analyses of coral populations and to determine whether there are “ecologic profiles” that can be used to differentiate species that should be highly protected from those for which managed harvesting is ecologically sound. Howard also studies how form determines and varies with individual life spans, between individuals across habitats, and among species. This is important in understanding non-moving (sessile) taxa and their interactions with their environment and other plants/animals. Another interest is marine invertebrate life history strategies and how fertilization rates are a factor in life histories. Fertilization rates of eggs from Caribbean gorgonians vary from 0 to near 100% on different nights and at different spawning events. The fast-spawners rely on broadcast spawning species suggests a variety of reproductive strategies may be pursued by colonies and also suggests dichotomies between male and female colonies. Howard examines fertilization strategies among gorgonians using a combination of fertilization success models and other techniques.

Dr. Bruce G. Hatcher, Environmental Editor of Coral Reefs, has over 25 years experience working as a scientist, educator, and project manager in the fields of marine ecology, marine resource conservation, and integrated oceans management in 22 countries, three oceans, and four seas. Bruce works at Dalhousie University. He is a specialist with a long history of research in coral reef ecosystems and benthic community dynamics. He has published more than 75 papers and reports on related topics and secured over $5M in grants and contracts. Significant contributions include the reconciliation of the marine fishery development with marine biodiversity conservation in the Red Sea (UNDP); the implementation of integrated marine resource assessment and management projects in 12 countries of the Caribbean (FAD/World Bank); and the development of guidelines.
for environmental monitoring of the Mesoamerican Barrier Reef (World Bank-Global Environment Facili-
ty). He has taught at all levels from high school field courses, to government employee training courses, to graduate student supervision. Bruce maintains effective collaborations with natural and social sci-
entists, resource users and managers, and policy makers in both the private and public sectors. Cur-
cently he is interested in using numerical models to investigate ecological connectivity among coral reefs; new strategies for subregional cooperation in integrated marine resource management; remote sensing technologies for studying the ecology of shallow and deep water corals; and in linking ma-
rine ecosystem health to human health. Bruce is a capable fieldworker, being a certified coxswain and SCUBA dive master with over 1600 hours logged in underwater research and survey work, and having lived and worked in 16 of the Earth's less economi-
cally developed nations.

Dr. Peter F. Sale, Ecological Editor of Coral Reefs, an acknowledged authority on the ecology of coral reef fishes, has worked extensively on Aus-
tralian and Caribbean reef systems for over 30 years. Peter is from the University of Windsor. The Ecology of Fishes on Coral Reefs, first published by Academic Press in 1984, is the authoritative text on the topic, which was produced and edited by Peter. A second volume, Coral Reef Fishes: Dynamics and Diversity in a Complex Ecosystem, will be pub-
lished later in 2001. Peter has published over 100 sci-
entific articles and numerous technical reports, and his lab has produced a further 50 journal articles. He played a major role in developing the science of reef ecology as a hypothesis-testing, experimental sci-
ence, and has been instrumental in building understand-
ing of the dynamics of reef fish assemblages. His work on community structure, organization, and dynamics is widely cited, and has had major impacts on ecology well beyond coral reef systems. He cur-
rently emphasizes research on population, recruitment dynamics and regional-scale ecological con-
nectivity in the Meso-American coral reef system of Mexico, Belize, and Honduras.

Dr. Peter K. Swart, Geological Editor of Coral Reefs, has been working on coral reefs since 1977. He specializes in the study of trace elements and sta-
ble isotopes in the skeletons of corals in order to in-
fer climate change records over periods of 100s to 1000s of years. In the past 20 years he has published over 50 papers on these and related geological, geo-
chemical, and biological topics. Currently at the University of Miami, he is head of the Stable Isotope Lab.

Peter is also heavily involved in the study of the South Florida Ecosystem and is head of the South Florida and Caribbean Cooperative Ecosystem Unit (SFC-CESU), a consortium of nine universities and organizations. The SFC-CESU is sponsored by the National Park Service, the United States Geological Survey, and the Bureau of Land Management to promote research in Federally owned lands in the region. Peter's ongoing research interests include studying the climate in the western and eastern Atlantic (with Dr. Richard Dodge), the flow of nitrogen through coral reefs, and the use of scleractinians as proxy indicators of climate.

Dr. Richard E. Dodge, Editor of Coral Reefs, one of the most important editors of the series, has general-
charge of all successfully peer-reviewed papers sub-
mitted by the Topic Editors. He is Dean of the Nova Southeastern University Oceanographic Center which conducts basic and applied research in bio-
logical and physical oceanography. Dodge is also the Executive Director of the National Coral Reef Insti-
tute (NCR) at Nova Southeastern University. This In-
stiute is dedicated to performing applied and theo-
retical research on coral reef restoration, assessment, and monitoring. Dodge's research has cen-
tered on the growth rates of reef-building corals, coral reef structure, fossil coral reefs, the ecology of recent corals reefs, and techniques of coral reef assessment, including mapping. He has specialized research on pollution (e.g. oil, sewage, sediment) effects on corals and coral reefs as well as mechanical damage from ship ground-
ings. Dodge developed techniques for assessing pollu-
tion effects to reefs, including historical chronology

Remembering Don McAllister

Don Evan McAllister died peacefully but much too early on Father's Day, June 17, 2001. With his pass-
ing, coral reefs have lost one of their most commit-
ted and effective defenders. Born in Victoria BC, Don was educated at UBC (BA, MA) and Univ. Michi-
gan (PhD). He had a long and distinguished career as an ichthyologist at the Canadian Museum of Na-
ture, working as a research scientist and curator. He was well known and widely respected among ichthyologists worldwide. It is through his global environmental efforts that the people of the reefs will remember him. He never forgot that coral reefs are a Developing World ecosystem.

Don founded Ocean Voice International (OVI), and re-mortgaged his Ottawa house to support publica-
tion of its magazine, see Wind, a publication that tried to bridge the gap between academic re-
search and life in a coastal village. Long before "al-
ternative income" had made it onto the radar screens of the multitudinous donors and funding agencies, Don was putting his own time and money into the Netsat Project in the Philippines, which weaned local divers off the use of cyanide for catch-
ing aquarium fish, in favor of selective hand-net-
ting. He co-funded production of the film "Coral divers say "NO" to cyanide", which has had wide dis-
bread. He and OVI produced elementary school curricula emphasizing the marine environ-
ment. He was instrumental in writing manuals on corals that could be used at the village level. At last count, these manuals were available in Tagalog, Bahasa In-
donesia, Spanish and English. More recently, he and OVI supported production of the program "People of the Reefs", which covered a coastal zone environ-
ment and health project in Indonesia. Sea Wind it-
self had a global distribution.

Early in our association, I made the mistake of misspelling his name: "MacAllister." He, a man who had put himself in personal debt to support the ecosystem he loved, replied "REAL Scots are well aware of the amount of ink saved, own a lifetime, by omitting the 'ac'. I will never forget him, at the 2000 Deep-water Coral Symposium in Halifax, con-
fronting some large, aggressive, well-funded repre-
tatives of trawling companies who were angry that Don had exposed the damage their activities were doing to the benthos in general and corals in particular. With his bristly white hair even more bristly, he said "I am truly sorry if my comments of-
fend you gentlemen, but I have to point out that the data were taken from your company's website!"

Last month, Elizabeth May, head of the Sierra Club of Canada, was on a hunger strike on Parlia-
mant Hill in Ottawa, for the relocation of people in
Cape Breton whose homes had been built on conta-
minated soil. It is a measure of the man that, as he lay dying in the hospital, he sent her flowers.

We will not soon see his equal.

Mike Risk
Email <mcalm@nrcan.gc.ca>

ISRS European Meeting, 4-7 September 2002

As you will be aware, the 2001 ISRS European Meet-
ing, due to be held in Eilat, Israel this October has sadly been cancelled. However, we are delighted to announce that the next ISRS European Meeting will be held in the University town of Cambridge, Eng-
land in September 2002. This represents a return to the city in which the Society was founded in October 1980. Accommodation and the Meeting will all be at Robinson College, one of the newer Cambridge Col-
leges with purpose-built conference facilities, for the period 4 – 7 September 2002. Proposed themes for the meeting are as follows:

- evolution of reef biota
- advances in molecular biology and their applica-
tion to reef sciences
- dynamics of reef ecosystems in space and time
- disease in the reef ecosystem
- management of reefs and marine parks
- reef geometries and sea level fluctuations
The Indices page displays thermal stress parameters extracted from the near real-time satellite SST, the derived HotSpot anomaly and DHW datasets for the satellite observations nearest the selected reefs. These locations are assumed to be the best representation of the conditions at the selected reefs. Although the SST anomaly, HotSpots anomaly and DHW charts posted on our Web site provide the global and regional patterns of the thermal stress, they are only graphical displays of the data and do not provide actual values. It is difficult, and presently almost impossible, to extract accurate numerical values for a particular location from these 2-D charts. Additionally, local scale patchiness of thermal stress makes it even more difficult to visually extract accurate information for any particular reef site, even using enlarged images. But now, through the Indices Chart, NOAA/NESDIS provides for the first time actual SST, HotSpot anomalies, and DHW data on the Web.

Currently, Indices for 24 selected reefs around the globe are available (Table 1)³. On the Indices page, the collective information of each reef site is posted in an individual cell of a table. Each cell contains the following information: reef name, latitude and longitude, near-real-time Degree Heating Weeks (DHW) value (i.e. 12 week

Table 1. The 24 reef sites selected for the Tropical Ocean Coral Bleaching Indices.

<table>
<thead>
<tr>
<th>Location</th>
<th>Selected Reef Sites</th>
<th>Lat.</th>
<th>Long.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic Ocean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bermuda</td>
<td>32N</td>
<td>64W</td>
<td></td>
</tr>
<tr>
<td>Grand Bahama Island, Bahamas</td>
<td>26N</td>
<td>77W</td>
<td></td>
</tr>
<tr>
<td>Sombrero Reef, Florida</td>
<td>24.63N</td>
<td>81.11W</td>
<td></td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>18N</td>
<td>65W</td>
<td></td>
</tr>
<tr>
<td>Virgin Islands</td>
<td>18N</td>
<td>64W</td>
<td></td>
</tr>
<tr>
<td>Glovers Reef, Belize</td>
<td>16.5N</td>
<td>87.5W</td>
<td></td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midway Atoll, US</td>
<td>28.3N</td>
<td>177.4W</td>
<td></td>
</tr>
<tr>
<td>Maui, Hawaii</td>
<td>21N</td>
<td>156W</td>
<td></td>
</tr>
<tr>
<td>Palmyra, Christmas Island</td>
<td>6N</td>
<td>162W</td>
<td></td>
</tr>
<tr>
<td>Galapagos</td>
<td>1.05</td>
<td>90.5W</td>
<td></td>
</tr>
<tr>
<td>Fagatele Bay, American Samoa</td>
<td>14.45</td>
<td>170.77W</td>
<td></td>
</tr>
<tr>
<td>Tahiti-Moorea</td>
<td>17S</td>
<td>149W</td>
<td></td>
</tr>
<tr>
<td>Eniwetok</td>
<td>11N</td>
<td>162E</td>
<td></td>
</tr>
<tr>
<td>Palau</td>
<td>7.27N</td>
<td>134.16E</td>
<td></td>
</tr>
<tr>
<td>Guam</td>
<td>13.4N</td>
<td>144.8E</td>
<td></td>
</tr>
<tr>
<td>Raine Island GBR, Australia</td>
<td>12S</td>
<td>144E</td>
<td></td>
</tr>
<tr>
<td>Heron Island GBR, Australia</td>
<td>23.55</td>
<td>151E</td>
<td></td>
</tr>
<tr>
<td>Fiji-Bega</td>
<td>18.46S</td>
<td>178.10E</td>
<td></td>
</tr>
<tr>
<td>Indian Ocean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oman-Muscat</td>
<td>23.7N</td>
<td>58.6E</td>
<td></td>
</tr>
<tr>
<td>Maldives</td>
<td>4N</td>
<td>72E</td>
<td></td>
</tr>
<tr>
<td>Seychelles</td>
<td>4S</td>
<td>55E</td>
<td></td>
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<tr>
<td>Cobourg Park, Australia</td>
<td>11.26S</td>
<td>132.29E</td>
<td></td>
</tr>
<tr>
<td>Scott Reef, Australia</td>
<td>14.02S</td>
<td>121.85E</td>
<td></td>
</tr>
<tr>
<td>Ningaloo, Australia</td>
<td>21.88S</td>
<td>113.97E</td>
<td></td>
</tr>
</tbody>
</table>
accumulation of HotSpot Anomalies), the historical maximum DHW value for the same period in the past 10 years, near real-time SST value, and the expected Maximum Temperature value (also called the Maximum Monthly Means SST (MM-MST) value) (Figure 1). Also on the page, the underlined latitude-longitude pair and 12WK Accum Today linkages have been added so users can directly connect the latitude-longitude with a map of the reef (Figure 1). The navigation bar on the left portion of the map page lists the links to the corresponding global-regional SST anomaly, HotSpot anomaly, DHW, SST contour, wind field charts as well as other related information. The 12WK Accum Today link directs the user to the corresponding two-dimensional DHW chart showing the regional thermal stress pattern over the reef area.

The bleaching threshold used for the HotSpot technique is 1°C above MMM-SST. The HotSpot anomaly charts show the SST anomalies against the MMM-SST, while the DHW charts show the accumulation of the HotSpot anomaly over the most current 12 weeks. The DHW value at any particular location, at any particular time, is the summation of the product of the HotSpot anomalies, valued at least 1°C above the MMM-SST, and their durations in weeks (a minimum of 0.5 week for our biweekly HotSpot product) over the most recent 12-week period. One DHW is equivalent to 1 week of SST at 1°C above the MMM-SST or 0.5 week of SST at 2°C above the MMM-SST. When the current SST at a reef site exceeds its MMM-SST, a red triangle warning sign is added to the left of the reef name. When the SST reaches or exceeds 1°C above its MMM-SST, in addition to the warning sign, the reef name turns red.

The Web-accessible SST time series plots show the SST variation at the selected reef sites since August 2000 through near real-time (updated twice a week as all other HotSpot products). The SST time series are produced using the same near real-time SST used for the HotSpot anomalies. The SST time series plots display the current trends in SST variation at these reefs (Figure 2). The SST bleaching thresholds (1°C above MMM-SST) for the corresponding reef site are plotted to facilitate identification of occurrence, duration, and magnitude of the thermal stress. The HotSpot anomalies and DHW values can thus be easily inferred from the SST time series plots. The plots of past SST time-series at these 24 sites from 1985 to 1999 are also provided over 2-year intervals. These time series are derived from NOAA/NASA AVHRR Pathfinder Nighttime-only SST data at 5km resolution (the Pathfinder SST global data set is the best available satellite SST data). For recent years (2000-2001), for which Pathfinder SSTs are not yet available, we are showing operationally derived nighttime-only SSTs. This time series represents information on the long-term evolution of SST and the occurrence and magnitude of thermal stress, essential for ongoing coral research and management efforts.

More reef sites will be added in response to requests from users. A user feedback form is available to accommodate requests to list new sites on the Tropical Ocean Coral Bleaching Indices page and post the corresponding SST time series.

References
5 http://lorbit.net.nos.noaa.gov/orlcoral bleaching_index.html
6 http://www.osdip.noaa.gov/PSB/SSP5570/PSH_web_news.html
7 http://lorbit.net.nos.noaa.gov/orlcoral bleaching_indices_24refs.html
8 Additional sites are temporarily available at: http://www.osdip.noaa.gov/PSB/SSP5570/PSH_web_coop.html
9 http://lorbit.net.nos.noaa.gov/orlcoral bleaching_indices_24refs.phtml

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Snorkeling Without Damage

I recently observed a clever system for allowing large numbers of snorkelers on a shallow reef with virtually no impact. At the Marine Park Headquarters on Pulau Redang island in Malaysia, up to 800 people snorkel on a small reef on the busiest day of the year. There are an average of 48,000 snorkelers per year at this site. The reef is quite small, maybe 10 meters wide and a few hundred meters long. The reef consists of a dense bed of fragile branching coral-staghorn and Montipora. Further, the reef is in shallow water, about 1-2 m deep at low tide, 2-3 m deep at high tide. And yet the coral is all unbroken except for two tiny spots I found the size of a foot. The coral appears totally healthy, with no dead areas. How do they do it? First, snorkeling is only allowed at high tide. Nearby resorts bring the snorkelers by boat, and a flag on the pier indicates when the snorkelers can be there. Second, all snorkelers are required to wear a life jacket when in the water. This keeps them on the surface, and they don't need to stand up. Third, they aren't allowed to wear fins. Compliance is very high, and easy to observe, since it's in front of the park headquarters and there is a high pier. The snorkelers are virtually all beginners, so they don't mind. There is a charge for using the snorkeling area of RM5 per adult, just over US$1. More advanced snorkelers can go out to spots where the water is deeper and snorkeling use much lighter. No fishing is allowed within two nautical miles of the entire coast of the islands that are marine parks. The user fee now supports nearly the entire marine park unit including fishing law enforcement. The system was devised by the head of the local Marine Parks unit, Rahim Gor Yaman, and implemented by the able staff. An innovative and shining example.

For more information, including educational materials, see the Marine Parks website: agrolink, moa.my/dof or e-mail Rahimg@tmm.net.my

Doug Fenner Email: <d.fenner@aims.gov.au>
A New Web Site for Coral Reef Protection

You might view this electronic partnership forum as a house, a “mall” or even a meeting hall. The forum provides the space and some services in a centralized location, but there are specific rooms, shops, places or “desks”, where various activities take place.

The left-hand menu shows the major themes by which ICR-related information is organized (such as the ICR and its secretariat, Members and New Users, ICR Partners, the Global Coral Reef Monitoring Network, International Coral Reef Action Network, etc.). Users can go into each of these areas to learn about ICR (its history, secretariat, key documents…) and the main Networks that help form the ICR partnership. Keep in mind, however, that many of these are under development, and more information will be added when each theme’s stewards begin adding and updating sections with information.

By registering with the ICRForum, you’ll be able to:

- Create and submit a “Kiosk” that reflects your organization and its role in coral reef conservation and management. You can also list your organization’s website, post calendar events and news items for others to see. The Kiosks are easily searched and can help other members find information about you and your organization more readily.
- Members can post information to the Forum’s bulletin board in almost any file format for others to review and download.
- Members can open either public or private discussions, and can even select which of the Forum’s members can participate.
- Members can also have various types of information posted under the ICRForum’s “Information Resources” section. For example, this area holds an on-line Library, a volunteer section, and job postings, among other items.

Like almost any other site, this one is under development and will be undergoing additions and changes. However, its evolution is predominately up to you, as a member. So please provide feedback to ensure that this Forum reflects the performance and features needed to make a difference in communications, and in helping to effect positive changes toward coral reef conservation and management.

The ICRForum was designed, developed and continues to be support by the World Bank. Since the beginning of 2001, the ICRForum has also received significant financial support from the French Ministry of Environment in posting content and website stewardship.

For more information contact: administrator@icrforum.org

Remote Sensing Survey - What is Required?

There is an increasing range of remote sensing data sets available for coral reefs, but we still can’t consistently identify indicators of reef condition or produce reliable ways to detect change, and so monitoring coral reefs with remote images is still very much in the developmental stage. In the author’s recent survey, potential users identified what they considered to be the major constraints.

- Most think expense is the biggest limitation, but many are unsure of the actual cost of their data, perhaps because governments subsidize images, or special research allowances are made, or simply because the data is bought infrequently.
- Certainly, the cost and time involved in applying remote sensing for coral reef monitoring activities is not well understood, and as a large portion of the world’s coral reefs occur in the waters of developing countries, financial considerations are important. The need for highly trained interpreters to understand and extract the information was the other most common constraint.

In the survey we targeted approximately 250 people from coral reef research, survey, monitoring, and/or management organizations. Sixty-four responded, 62% of which were already using remote sensing. Respondents had differing information and reporting requirements: for example they were monitoring differing environments (coral reefs, seagrass beds, mangroves) and varying sizes of sites. At the moment, remote sensing is used mostly for benthic habitat mapping, coastal zone management and change detection. Rehabilitation monitoring and associated tasks are not common because they are so complex.

Remote sensing users are developing analytical techniques to go with newly discovered technologies, and although aerial photography is still commonly used for reef mapping, interpretation of satellite data is becoming more commonplace. The survey identified a strong need for further research that addresses the needs of managers.

- The survey identified a strong need for further research that addresses the needs of managers.

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You can contact them for a full review complete with graphs. Thank the many people who responded to the survey and provided other contacts and additional literature.

Balinese Biodiversity

Bali is distinctively part of the centre of maximum marine diversity! A team of 12 marine scientists (three from Indonesia and nine from the Netherlands) recently investigated how much the underwater fauna of the Lombok Strait resembles that of neighboring seas. Bali’s coral reef fauna is richer than that of Java and Sumatra, as rich as that of Ambon and North Sulawesi, and although poorer than South Sulawesi, the coral reef fauna of Bali ranks among the richest in the world.

Despite the importance of diving tourism to Bali, the Balinese underwater life has not received much attention from the scientific community. The team focussed on three coastal areas: 1) Sanur and Nusa Dua, south-east of Bali, 2) Tulamben, at the north-east coast, and 3) the islands Nusa Lembongan and Nusa Penida in the Lombok Strait. Together, these areas showed a great variety of reef habitats.

The coast of Sanur and Nusa Dua consist of slowly declining reef slopes with extensive reef flats and
beaches above and sandy reef bottoms underneath. The coastline is exposed to the Indian Ocean swell, which has its impact on the reef profile and the reef fauna. The beaches contain almost entirely of dead, hard, calcareous skeletons of foraminifera, and living populations of these were surveyed on the reef. Here, species were discovered that were previously only known from the Pacific Ocean. A soft coral species discovered earlier at North Sulawesi appeared to use a sponge as obligate substrate, which is a unique kind of symbiosis. We found a mushroom coral species that was only known from Taiwan and Ambon. In addition, a great variety of sea slugs, shrimps, sponges and other marine animals were encountered.

Tulamben is famous among divers because of a WWII shipwreck at snorkelling distance from the beach. The base of the reef slope is volcanic sand with low coral cover. Since fishing is not allowed, fish are not shy. Here, the diversity of marine life appeared higher than any other place around Bali. The islands Nusa Lembongan and Nusa Penida consist of high limestone rocks. The large water masses transported from the Pacific to the Indian Ocean, together with the oceanic swell, create special conditions here such as strong currents and cold upwelling. We discovered a new species of coral with a coloured skeleton reminiscent of candy - and therefore called candy coral. Parastic snails, probably new to science, were also found on this coral.

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Coelacanth Inspires Community Conservation

Seventeen young people from villages on the Bunaken and Manado Tua Islands within the Bunaken National Park in North Sulawesi have formed a conservation group - Team Raja Laut, or TRL. The idea came from the villagers themselves, who developed a keen interest in the Sulawesi Coelacanth (Raja Laut, King of the Sea in Indonesian) and a pride in protecting them. The TRL has conducted daily fisheries surveys to monitor for catches of Coelacanths, as well as sharks, turtles, dugongs and other protected species. Since its start in early 2006, the data collection quickly expanded to include several catches of commercially important fish and monitoring of illegal activities such as cyanide fishing, turtle egg poaching, bomb fishing.

Although TRL hasn't yet recorded any Coelacanth catches, their activities build awareness of both the Coelacanth and overall reef conservation issues within the Bunaken National Park. They've found two previously unknown turtle nesting beaches and helped in the arrest of seven cyanide fisheries. And unlike most local NGO's, TRL members live and work independently in their own villages, meeting every month to collate fisheries data and share experiences and information. So they are in an excellent position to bridge the gap between the Bunaken National Park Management Advisory Board and their own communities. As the islands become zoned into conservation, community and tourism use areas the TRL have a key role in channeling information about the Park Management Plan to their own communities, and also provide a voice for the villagers. The villagers get a say in how they would like to develop resources from the new Bunaken National Park entrance fee system spent, 80% of which is for used for conservation activities. Suggestions include a mangrove re-planting scheme on Mantehage Island and a jetty for Bunaken village to guard against reef damage at low tide. TRL have also conducted socio-economic fisheries surveys in the remote islands of Sanghir Talaud, north of Bunaken National Park as part of the WWF Wallacea Bioregion Reef Fisheries Programme, and acted as translators and field assistants for research into the role of women fishers and also catch in pelagic and coastal fisheries.

If they can secure continuing funding, TRL hope to expand to cover the entire National Park. They plan to set up a Bunaken Concerned Citizens Forum to formalize discussion between the Park Management, the villagers and other stakeholders. They may try to get official NGO status and a charter, although that might mean TRL members and resources become centralized on the mainland, rather than remaining a more effective island-wide community network.

Comment on the Article ‘Distinguishing Predation Injuries Inflicted by Drupella And Acanthaster’

The crown of thorn starfish Acanthaster planci (COTS) and the gastropods Drupella spp. are common and voracious predators of coral tissue throughout the Indo-Pacific Ocean. They typically feed at night and hide during the day, and so all we usually see is the coral skeleton exposed by their feeding. COTS and Drupella often share habitat and because the feeding scars are similar, it's difficult to determine which caused a particular coral injury. In Reef Encounter 27 (p12-13) Robin Cumming suggested ways to distinguish the scars inflicted by COTS from those made by Drupella. But there are exceptions to these features and I suggest that the only way to unequivocally attribute injury to either of these predators is to observe the perpetrator directly. The three features Robyn suggested are:

1. Drupella scars are "always at the edge of the colony" and never in the middle of live coral tissue.
2. Drupella scars often have "a banded pattern of algal covering, graded from white recently killed areas to dark old scars with heavy algal covering". In contrast, COTS scars were inflected at one point in time and developed a uniform algal covering..."
3. Drupella grazes "the branch bases first. Conversely, COTS scars were often on the tips of branches with the basal parts left alive."

Drupella do not always begin feeding at the edge of the colony. The snails can begin eating from the base of branches in the center of the colony leaving branches denuded of tissue surrounded by healthy branches. Indeed, a similar feeding pattern is shown in Robyn's Fig. 2 from her related article on Drupella aggregations. A patch of exposed skeleton is seen in the center of an otherwise healthy Acropora colony. A banded pattern is not restricted to scars inflicted by Drupella and not all Drupella scars are band. The accompanying photo shows an Acropora hyacinthus colony partially eaten by a COTS, which was hiding beneath the colony. The exposed skeleton is banded demonstrating that COTS scars are not always inflected "at one point in time". COTS may take a number of days to consume a colony particularly when the colony is large and the starfish
Robyn Replics

Robyn Cumming

An Acropora hyacinthus colony eaten by COTS. The exposed skeleton is banded as a result of the skeleton being exposed to algal colonization for different periods of time. The perpetrator was hiding beneath the colony.

Whole Reef Health?

Coral reef health is poorly defined by reef researchers, probably because it is difficult to characterize. In the past few decades scientists have described the state of the reef, the susceptibility of reefs to degradation, or the conservation value of reefs. Many papers have been written on disturbances, diseases, whether or not reefs are geologically robust or biologically fragile and vice versa. Scientists have described reefs as more or less disturbed based upon percent live coral coverage, a mortality index, coral growth rates, or the presence or absence of certain bio-indicators, for example corals and fish. Such factors are essentially based upon changes in ecological conditions in the past forty to fifty years and ignore geological conditions. Researchers judge 'health' based upon these proxies, but little has been written on what coral reef 'health' actually is.

To help with a definition, lets assume that researchers discussing the reef and using the words status, state, risk, and disturbance are discussing reef health. A measure of health should describe the present state of a system compared to optimal functioning, reproduction, stability, disease, and minimal abnormality. But like many organisms and natural systems, a coral reef has a natural equilibri- um position that will fluctuate above and below the most stable position. So when defining coral reef health we must try to measure it against an almost hypothetical baseline. When and where would such an optimal reef have existed? Did this "healthy" system exist before the 1600s when the scientific literature began to document degradation of the reef and outbreaks of Crown of Thorns Starfish? Or was it before industrialization in the 1800s, or did it exist before changes in sea level 15,000 years ago? Spatial scales are also problematic. When discussing coral reef health we are talking about the organism level, or the entire reef, or does the reef also include the other ecosystems surrounding it such as seagrass beds? Then again, each region and each reef is a unique habitat that does not have a set standard for what is healthy and what is not. Low live coral coverage in the Pacific is not a sign of bad health, but it may be for Southeast Asian reefs. Few reefs in the South Pacific have more than 50% coral coverage due to high wave energy, tropical storms, and domi-

References

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Andrew has some useful points to make that could add to the story, but a couple of his quotes are out of context. My article said Drupella scars were always at the edge of live tissue, not always at the edge of the colony as Andrew has interpreted it. So in fact there is little disagreement here. Also, in his comment on banding patterns Andrew has missed the point I was discussing 'coral species (with small closely packed vertical branches)'. His quote doesn't include this bit of the original article. The distinction is important because the length of vertical branches in plate corals is minimal and probably doesn't prevent a cut stomach from reaching the bases - the result is the entire top of the coral is devoured rather than just tips of branches. Further, in Andrew's image of a plate coral it would be interesting to know the colony size, and also the size of the COTS.

A natural progression from this discussion would be collaboration in further research. I look forward to hearing more on the topic!
Protecting Critical Coral Reef Habitat in the Tortugas Ecological Reserve

The Florida Keys National Marine Sanctuary (FKNMS) recently gained the final approval needed to implement a fully protected marine reserve in the remote Tortugas region of the Florida Keys, USA. The Sanctuary's Tortugas Ecological Reserve is a 517 km² (151 square nautical miles) no-take marine reserve that consists of two sections, Tortugas North (312 km² or 91 snm) and Tortugas South (205 km² or 60 snm) (Figure 1). Tortugas North includes Sherwood Forest, an area of lush coral growth, and the northern half of Tortugas Bank, an extremely productive area of the Sanctuary. Tortugas South will protect Riley’s Hump, an important spawning site for snapper and grouper and adjacent deepsea habitats for golden crab, tilefish and snowy grouper.

The no-take zone network in the Florida Keys National Marine Sanctuary is the first of its kind in the United States and abroad. The majority of these comments were strongly in favor of an ecological reserve in the Tortugas area. In the final step of the process, the Sanctuary reviewed and responded to these comments in a Final Supplemental Environmental Impact Statement (FSEIS)/Final Supplemental Management Plan, which was released in November 2000. Several other agencies are also working to safeguard the unique marine resources of the Tortugas region. The Governor and Cabinet of Florida, Florida Fish and Wildlife Conservation Commission, Gulf of Mexico Fishery Management Council, and National Marine Fisheries Service have all instituted various complimentary regulations to preserve the unique Tortugas region. The National Park Service is in the process of creating an adjacent protected area in the shallow waters of the Dry Tortugas National Park.

Figure 1. Boundary for the Tortugas Ecological Reserve, which is comprised of two sections called Tortugas North and Tortugas South. The Dry Tortugas National Park plans to implement a no-take zone within park water that will protect critical shallow reef habitats and complement the Tortugas Ecological Reserve (labeled as “DRTO Proposed RNA”).
Deepwater Reefs: Out of Sight, Out of Mind?

Most of the coral reefs that we are familiar with live in the warm, crystal-clear waters of the Earth's tropical oceans. Other coral systems exist, however, that are less familiar and rarely seen, but just as threatened by anthropogenic impact as their tropical counterparts. These are coral bioherms that occur on deep-water topographical structures such as seamounts, shelf edges and pinnacles in most of the oceans of the world. The reef frameworks are created by ahermatypic, aazoanthellate branching corals that form roughly hemispherical colonies from planar settlement or colony fragmentation. These colonies grow larger until the internal core ceases to receive sufficient water flow and dies. The dead branches are then invaded by boring organisms and the weakened structure eventually collapses. Over time, the reef structure is formed from a substrate of unconsolidated dead coral and sediment with an outer cover of living coral.

In many cases, the reef framework is a single primary species such as Lophelia pertusa, Goniocorella dumosa, Solenosmilia variabilis or Oculina varicosa. Several other species may contribute to the framework, including Madrepora oculata, Desmophyllum diaphanus, Demophyllum coriugera, Solenosmilia variabilis, and Enallopsammia spp. Madrepora oculata is probably one of the most widespread deep-water corals; in the North East Atlantic it often contributes to the reef framework with L. pertusa, and in the waters around New Zealand it occurs with the major framework builder G. dumosa. Many of the deep-water reef

For more information on the Florida Keys National Marine Sanctuary, visit www.fkms.nos.noaa.gov.

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Close up of Deepwater Oculina (Photo: John Reed, Harbor Branch Oceanographic Institution)
species are cosmopolitan (L. pertusa, S. variabilis and M. occulta), others are primarily restricted to one hemisphere (G. dumosa) or in the case of O. varicosa, exist only in a single geographic location, the Atlantic continental shelf of Florida.

O. varicosa exists over a range of depths from 4 to 150 m. The shallow-water phenotype can be found from North Carolina to the Caribbean; the colonies are small (<30 cm) with stout branches and symbiotic zoanthellae, giving the coral a golden-brown coloration. The deep-water form of these species (70-100 m) creates continuous tracts of large branching colonies on slopes and pinnacles on the edge of the continental shelf from Fort Pierce to Cape Canaveral, Florida. There are also deep-water individual colonies as far north as Cape Hatteras, North Carolina9. The deep-shelf edge Oculina reefs form natural spawning grounds for commercially important populations of gag and scamp grouper, nursery grounds for juvenile yellowfin grouper, and feeding grounds for many other fish species including black sea bass, red grouper, speckled hind, warsaw grouper, amberjack, red pony and red snapper.

Large populations of the commercially valuable squid, Illex oxyurus, are observed to spawn on these reefs, and the shelf-edge system may form part of the migration path for king mackerel. The deep-water banks also support very rich communities of invertebrates and faunal diversity on the Oculina banks is equivalent to that of many shallow tropical reefs11.

In 1984, the South Atlantic Fishery Management Council designated 315 km² (92 square nautical miles) of the deep O. varicosa banks as a Habitat of Particular Concern (HAPC) because of their value as essential habitat for many commercial and recreational species. Closure to mobile fishing gear and anchoring was enacted to protect the delicate Oculina thickets. In 1994, the reserve was closed to all bottom fishing for 10 years, and the Experimental Oculina Research Reserve (ORR) was created. In July 2000, the HAPC was extended to encompass the full extent of the Oculina banks, an area of ~1000 km² (300 mi²). Many areas of the Oculina banks show extensive mortality, with some places the live coral has been reduced to a mere skeleton. However, the causes of the damage are unknown and open to speculation. Another mystery of the banks is the apparent lack of re-colonization of the damaged areas inside the ORR. Possible explanations may include limited larval transport, insufficient settlement substrate or local environmental influences that preclude establishment of viable colonies.

Despite the value of O. varicosa as a primary component of this critical fisheries habitat, nothing of the reproductive ecology of the coral was known prior to 1998. Recent research has yielded information on ecologically relevant aspects of reproduction, such as reproductive strategy, duration of breeding season, fecundity and larval longevity10. In 1996, a reef-restoration effort was initiated by Dr. C. Koning (Florida International University and The National Marine Fisheries Service). Different types of artificial settlement substrate were deployed on the Oculina banks between 1996 and 2000 to stimulate recovery of the coral and enhance re-population of the depleted fish communities, which are dependent on the habitat. We now understand enough of the ecology of O. varicosa to make an intelligent attempt at restoration, however, the growth rate of Oculina is slow and recovery of large damaged areas will not occur in the near future.

Little is known of the ecology of other deep-water reefs, many of which are also under threat from anthropogenic impact. The effects of fishing on the deep-sea benthos are at present generally unknown12. The most obvious impact of trawling is mechanical damage caused by the gear itself. Trawl scars have been seen in many of the areas off Western Scotland and Ireland where L. pertusa reefs occur13. On the Southern Ocean Bight over the Soughy Shelf (N. audax) and on the Kristensen Shelf (Hoplasterias atlanticus) has reduced the reef complex to a low diversity disturbance community14.

Apart from direct mechanical damage, disturbance of the seabed may release clouds of sediment that can smother the corals and may inhibit future larval settlement. Drilling for oil deposits and mining of deep-sea minerals also pose threats to deep-water reef systems. As global over-fishing of shallow-water fisheries continues, there will be less fish to eat. The Oculina banks are thus in the same condition as the deep sea. These fragile deep-water reef systems are still being discovered and the protection of their prevalence is almost certainly underestimated. As always, conservation is in a race with demands. It would be a tragedy to lose these coral reefs before we can begin to understand them.

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The Mohéli Marine Park: One of the First Protected Areas in the Comoros

The Comoros islands, situated in the Mozambique Channel, are host to hotspots of endemic species of flora and fauna, making it an important regional site of biodiversity. However, the high population density has subjected the environment to great pressures, such as deforestation for agriculture, and destruction of fishing techniques (dynamite, small mesh nets etc.).

To address growing concerns over the environment the Comoro Government initiated a five year Bio-diversity Conservation Project, the Sustainable Development Project in 1996, financed by 'Funds for the World Environment' and administered by the General Directorate of the Environment with technical assistance from IUCN. One of the project's key objectives has been to establish a marine protected area in the coastal zone of Mohéli, the smallest and least populated island of the Federal Islamic Republic of the Comoros Islands, with an area of 211 km² and 32 000 inhabitants.

Both local communities and government authorities helped create the Mohéli Marine Park. Meetings and on-site visits were organized with the fishermen and the associations of 10 coastal villages. They negotiated, defined and guaranteed the sharing of duties, as well as rights and responsibilities for the management of the protected area. The input from the village meetings was then used in the park's design to define the boundaries, zoning, management and regulations. The Mohéli Marine Park was officially designated on 19th April 2001.

The coastal communities of Mohéli will continue their active participation in the management of the park with ten of the park's sixteen board members representing them. Locally recruited 'eco-guides' help to raise public awareness, and are active in policing and monitoring the park.
knowledge of the biological diversity and reef species abundance in the Mohéli Marine Park Zone remains very limited

The Regional Environment Programme (COUIE) undertook an assessment of the coral reef status in 1994. Within the park zone, living coral cover had decreased from 50% in 1994 to 25% in 1998. The decline in coral cover was largely attributed to the bleaching and mortality that occurred throughout the Indian Ocean in 1998. More recent observations, however, revealed positive signs of reef recovery. The live coral cover in the park area is now 41%. However, knowledge of the biological diversity and abundance of other reef dwelling species in the Mohéli Marine Park Zone remains very limited and to date has not been systematically studied. Recent studies have revealed that the coral species in the past was not exclusive to Mohéli but did reveal that the 850 species of fish found in Comoro waters, 250 are present in the Mohéli area.

Mhakho illet, located on the eastern side of the park, contains a breeding colony of several thousand snail-nodules (Anous stolidus), as well as several pairs of terns (Sterna fuscata) and terns (Sterna hirundo) invertebrate and fish fauna, and the size of its adjacent reef flats and sea grass beds (attracting turtles and dugongs) are the fundamental elements that will either make or break the sustainable development of the island. More recently, in 1994, studies confirmed that the vast marine area of the Nioumaco islets is an exceptional site of biological richness and diversity.

mohéli and poissons are already prohibited by the Co- mores Legal Framework on the Environment. In fact, ten marine reserve areas (5% of the park's area) have been created where all forms of exploitation are prohibited (see marine park map).

Agriculture is the main occupation of the approximately 9500 inhabitants of the 10 villages that are found within the park boundaries. Of these just over 300 fishermen, 70% of whom consider fishing to be their principal activity, still use traditional outrigger canoes though some have opted for motor boats.

The Creation of the Mohéli Marine Park represents an important step for the Comorans toward the sustainable use of its natural biodiversity while maximising economic benefits at the local level. Much remains to be done to demonstrate the possibilities for effective local resource management and to maximise the economic benefits of conservation. However, the willingness being shown, as much at the administratively and political level as at the local level, gives much optimism for the park's success. Already after only a year the fishermen have noted a significant improvement in fish catches and the reappearance of certain species of fish.

Thanks to this commitment to environmental protection, the members of the local development associations have been able to conserve the exceptional natural heritage for the benefit of future generations. At the same time communities have recognised the need for continued economic development and have seen the unique potential for the development of ecotourism in not only the marine environment but in the coastal forests as well. Already three local associations can accommodate tourists in rustic but well maintained bungalows.

The international community is invited to participate in the conservation of biodiversity in the Comores by helping to enhance environmental awareness in order to guarantee the sustainable use of Comorian natural resources. Finally, without a mechanism for the sustainable financing of marine conservation in the Comores the progress made to date may be lost in the future. To address this issue a feasibility study to identify long term funding solutions is currently being undertaken.

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A Healthy Caribbean Coral Reef Assisted by Diving Tourism

The reefs of Cozumel Island, in the Mexican Caribbean, are protected and preserved primarily by the local diving industry. Approximately 15 km of coral reef attract an average of 2000 dives per day, about 320 days per year (limited by weather). Diving along with the development of ecotourism, is within the local community. The dive and tourism industry in Cozumel is labor-intensive, and the dollars...
earned cascade through the local economy sustaining the local community.

Coccolithophores were discovered in the 70's that taking divers out to the reef was more lucrative than fishing, and rapidly converted their fishing boats to dive boats. This was spontaneous and unplanned. In 1980 the reefs were declared an Ecological Reserve, and in 1987 a National Park. Fishing within the park is rare, and since all operators know that fish, particularly large fish, are one of the principle draws for divers, punishment for fishing is significant. The fish fauna includes some very large groupers and por- rtfish, confirming the lack of fishing.

The Coccolithus reefs boast coral species richness as high as any in the Caribbean1 and some of the world's most spectacular sponge fauna and cavern systems2. Fish are diverse and very abundant3. The island is low and porous, with no surface runoff4, and has springs along the shoreline which release sediment-free water. The Yucatan Current brings oceanic water across the reefs before reaching the city, minimising human effects. Strong currents necessitate drift diving, so anchors do not damage the reefs. Although there is doubt as to some dolphin damage, it is so minor that the reefs remain covered from the moderate damage of Hurricane Gilbert in 1988 while receiving 2000 dives per day. The Yucatan Peninsula, about 12 km to the west of Cozumel, provides protection to the reefs which are along the southern boundary, limiting hurricane damage5. Mass bleaching has not been observed on these reefs even when most other Caribbean reefs were heavily bleached. Perhaps this is due to the currents. Coral diseases other than black band (which is uncommon) have not been observed, though Acropora palmata is uncommon and A. cervicornis is rare, for unknown reasons. Although the mass Diadema urchin die-off of 1983 occurred in Cozumel as well as the rest of the Caribbean, limiting coral bleaching did not result. Dense fish populations (including herbivores) and currents that sweep human nutrients away from the reefs may have been responsible for the lack of a macroalgae bloom. Black coral collecting is carried out below the 50m depth limit of the park; which is carved locally and sold to tourists6.

Coccolithus reefs boast coral species richness as high as any in the Caribbean1 and some of the world's most spectacular sponge fauna and cavern systems2. Fish are diverse and very abundant3. The island is low and porous, with no surface runoff4, and has springs along the shoreline which release sediment-free water. The Yucatan Current brings oceanic water across the reefs before reaching the city, minimising human effects. Strong currents necessitate drift diving, so anchors do not damage the reefs. Although there is doubt as to some dolphin damage, it is so minor that the reefs remain covered from the moderate damage of Hurricane Gilbert in 1988 while receiving 2000 dives per day. The Yucatan Peninsula, about 12 km to the west of Cozumel, provides protection to the reefs which are along the southern boundary, limiting hurricane damage5. Mass bleaching has not been observed on these reefs even when most other Caribbean reefs were heavily bleached. Perhaps this is due to the currents. Coral diseases other than black band (which is uncommon) have not been observed, though Acropora palmata is uncommon and A. cervicornis is rare, for unknown reasons. Although the mass Diadema urchin die-off of 1983 occurred in Cozumel as well as the rest of the Caribbean, limiting coral bleaching did not result. Dense fish populations (including herbivores) and currents that sweep human nutrients away from the reefs may have been responsible for the lack of a macroalgae bloom. Black coral collecting is carried out below the 50m depth limit of the park; which is carved locally and sold to tourists6.

A pier was constructed at the very northern end of the Ecological Reserve in 1996, next to the existing pier to accommodate increasing numbers of cruise ships. The construction area had scattered corals but no reef, though Paradise Reef was quite close. A Reefkeeper's survey and report recommended the pier be constructed outside the Reserve and away from the reefs6. Construction proceeded after about 20,000 corals and other organisms in the construction area were moved7.

Cozumel reefs appear to contain one of the Caribbean's most healthy reefs, in spite of or rather because of, heavy diving use. Dive tourism can be sustainable, non-destructive, eco- nomically beneficial, and even help save reefs.

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Figure 1. The giant Caribbean anemone (Condylactis gigantea) can reach over 25 cm in diameter, and has tentacle tips packed with powerful stinging cells. This species provides refuge for various invertebrates and small fishes, including ecologically important cleaner organisms. (Photo: Ed Green)

Figure 2. Florida Keys sites surveyed by the authors for densities of the giant Caribbean anemone (Condylactis gigantea) during 1999-2000. Not shown are 32 sampling locations in the Dry Tortugas region, 117 km west of Key West.

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Undergraduates In Research

Can undergraduates do worthwhile science? Yes - with good planning you can get high quality data. What you need is a programme explicitly designed to include undergraduate students as research partners. Research at the Western Washington University’s Shannon Point Marine Center and at the Caribbean Marine Research Center in the Bahamas has been doing just that. Our work focused on how zooxanthellae in corals and tropical anemones respond to high irradiance (UV and photosynthetically Active Radiation) and high temperature stresses. A total of 18 students over three years helped study changes in animal-algal biomass parameters and photosynthetic performance of zooxanthellae, changes in photosynthetic pigments of zooxanthellae, and changes in the optical spectra of symbiotic associations during bleaching.

What do undergraduates bring to research? For a start, the pool of potential researchers is usually large, and with the lure of coral reefs you’ll attract the best students from any discipline. You’re also likely to find greater ethnic and cultural diversity, widening opportunities for these groups in science careers. You can often include future teachers who rarely get to do research during their training. Undergraduates may even help you target funding. In our National Science Foundation (USA) funded work, involving undergraduates leveraged the funds for our research. And because the grants provided financial support, no potential student was excluded. Our students were paid full-time during the summer and part-time during the following academic year. By including undergraduate partners you meet funding agencies’ and scientists’ needs to address human impacts and broaden the educational significance of research.

Which students should you target? We decided we needed a 12-month commitment from each student, so they had to at least one year left at college. This meant they could participate full-time in summer research and work on data analysis and
Seeking Sustainable Solutions: Fishing And Coral Reefs

A Statement From The International Society For Reef Studies

Earlier this year ISRS was asked to prepare a statement on sustainable reef fisheries for the International Coral Reef Initiative.

Coral reef fisheries have an important place in many human societies. But problems of unsustainable fishing are commonplace, and their detrimental social and ecosystem consequences can be far-reaching. Sustainable solutions are a major challenge.

The vision: sustainable fishing for food security and other benefits

Sustainably fishing diverse coral reef species could open up many economic opportunities for local communities, businesses, and government administrations. Sustainability, which can be measured by long-term reliability of stocks, protection of the coral reef habitat, and avoidance of detrimental cascading ecosystem effects, can also protect other properties of coral reefs that are of great value to humans. In particular, sustainable fisheries can:

- Contribute to food security and to the cultural, social and economic fabric of local communities;
- Make money through nature-based tourism and diving revenues. These revenues are highest from beautiful and diverse coral reefs that retain abundant fishable species – some species may be worth more alive than dead. Well regulated fisheries or aquaculture for the aquarium and curio trades can also generate wealth;
- Save money by having healthy, growing nearshore coral reefs that protect the coast and remove the need for expensive beach restoration projects (the economic effects of chronic overfishing can flip a reef barrier from a state of net growth to net erosion).

The problems: unsustainable fishing undermines food security and ecosystem processes

1. Many reef-based fisheries across large expanses of the tropics have disappeared or become severely diminished under pressures from both local populations and distant markets. Predatory fish, which are vulnerable to most fishing gears, usually disappear first. Fishers may take fish before they reach their most productive size (Growth Overfishing). Intense exploitation can drive numbers so low that there are not enough individuals to maintain a viable population (Recruitment Overfishing). This can in turn cause a progressive shift in the balance of species on the reef (Ecosystem Overfishing) and distort the trophic pyramid, i.e. take the natural balance of energy flow from the bottom to the top of the food chain. Some fishing techniques, such as dynamite and cyanide fishing, harm the reef and the complex environment fish and other creatures need to survive (Destructive Fishing).

2. Scientific evidence shows that when unsustainable fishing depletes the trophic pyramid, ecosystem-wide declines over large areas of coral reefs can occur, including more frequent incidences of:
   a) Under-grazed reefs, where seaweeds preempt space formerly occupied by corals, and prevent coral recovery after natural or anthropogenic disturbance;
   b) Over-grazed reefs, where an overabundance of invertebrates that graze on forming food of the reef (notably sea-urchins), erodes reef structure much faster than it acerates;
   c) Over-irradiated reefs, by invertebrates such as crown-of-thorns starfish and coral-eating gastropods.

Unsustainable fishing in concert with other anthropogenic pressures

3. Detrimental effects of unsustainable fishing are exacerbated by other anthropogenic pressures such as land-based pollution by sediments, fertilizers, sewage, toxins and trash.

4. Unsustainable fishing may itself exacerbate the poorly understood, ecosystem-wide impacts of coral bleaching and diseases of coral reef organisms. The future extent, frequency and intensity

continued on page 52
Juveniles Recruited to Sustain Aquarium Industry

A settlement stage yellow tail snapper (Ocyurus chrysurus) hovers amongst seagrass (Photo: Maggie Watson).

The chances of a fertilized egg making it all the way to become an adult reef fish are exceedingly small. Now researchers want to side-step some of that mortality in order to supply a sustainable aquarium trade and, at the same time, conserve coral reefs. A damselfish swimming amongst the corals and rocks in a well kept aquarium seems a serene enough creature, but a few rough calculations will leave you marveling at a journey of survival against tremendous odds. Now don’t leap to conclusions about the villainous aquarium trade - the journey from reef to aquarium is only a small part of the tale. To begin with, unless our fish is one of only around 25 species of marine ornamental fish bred in captivity, it started life as a tiny larva developing in open water. The vast majority, i.e. approaching 100% of larvae, will perish before they return to shallow water. Then, often timing their arrival to the darkest nights of the month to avoid visual predators, the minute fish must negotiate a ‘wall of mouths’ before settling to the bottom. Survival rates will vary, of course, both between species and over time. But for the few that make it to the end of their pelagic (open water) phase and then through the settlement process, around two thirds may die within a day of settlement. After a month only 10% of the fish that settled may remain alive. Those kinds of numbers have set researchers thinking - if you could harvest just a few fish before they meet their ‘mortality hurdle’ at settlement, your fishing impact should be minimal.

Blue tang (Acantthurus coeruleus) are yellow as juveniles. This fish settled less than 24 hours previously, and is still partly translucent (Photo: Maggie Watson).

Baby fish aren’t much good for eating, but juveniles are preferred by the aquarium trade. They cost less to ship, and they are often prettier than the adults. Researcher Vincent Dufour is so sure that there is a market that he has set up a company, AquaFish Technology (www.aqua-fish.com). Dufour found that ‘crest nets’ (shaped like funnels which catch the waves) set on reef crests around Pacific atolls will filter huge amounts of water flowing over the reef and through the lagoon. They can catch thousands of larval reef fish during a big settlement pulse. In one crest net on Moorea Atoll, Dufour’s team averaged over 100 fish per night, many of which were ornamental species.

AquaFish hopes to contribute to a sustainable aquarium fishery, and Dufour and colleagues are not alone in thinking the idea has merit. Cathy Hair, Johann Bell and colleagues at the Coastal Aquaculture Centre in the Solomon Islands (run by ICLARM – The World Fish Centre) have been looking into village-based ‘grow out’ of larval fish. The idea is to provide coastal people with an alternative livelihood, and hopefully relieve some of the fishing pressure on coral reefs. Between November 1999 and June 2000 the team caught more than 1,170 fish from 70 species that were suitable for further rearing in on-shore tanks supplied with flowing seawater. The team used both light traps, based on designs developed in the 1990s by Peter Doherty at the Australian Institute of Marine Science (AIMS), and crest nets. The two methods both have their advantages. Light traps caught fewer kinds of fish than crest nets but more damselfish (Pomacentridae), many of which are ornamental species.

Settlement stage filefish (Monacanthus spp.) like to hang out around weed or other floating objects. The water here is so still you can see their reflections (Photo: Maggie Watson).

Sadly, ethnic violence in the islands has slowed research. Hair, an Australian, was evacuated in June last year and spent the next six months working up data at AIMS, where Doherty is a collaborator on the current phase of the project. Some research by local Solomon Islands staff has continued, but the constraints imposed by the political situation are frustrating real progress. Before the troubles began Hair and colleagues were feeding their fish on eggs (roe) from a variety of large fish, on creatures the fish picked from live rock, on plankton that came through the seawater pump, and on prepared food supplied by Mike Rimmer of the Queensland Department of Primary Industries. Some fish, however, could not digest the shrimp so that species and trig-gerfish were all easy to rear. Painted cray Panulirus versicolor showed promise once cannibalistic individuals were isolated, and the delicate cleaner shrimp Stenopus hispidus also showed potential for rearing. But early juveniles are notoriously picky eaters and some families such as butterflyfish did not take well to the tanks.

About the same time, John Munro and colleagues (including the author) were working on another ICLARM research project investigating larval fish...
supply to islands in the Eastern Caribbean. When gluts of settlement stage snapper larvae were caught in light traps (up to 407 yellotail snappers *Ocyurus chrysurus* in one light trap in a single night), Munro suggested keeping the fish in floating cages, illuminated at night by subdued lights. The lights would attract plankton for the fish to eat. The experiment was a first tentative step towards investigating the feasibility of helping re-stock new marine protected areas. The idea was that where previously overfished reefs were suffering severely reduced natural recruitment, light trap caught larvae or juveniles could be reared in cages for several weeks. Once past their ‘mortality hurdle’ they could be released to help rebuild stocks. Whether the idea will work is still far from clear, and the team continues to investigate relative mortality rates in the wild and in captivity, feeding preferences, behaviour on release, etc. But several advantages were immediately apparent from the research. Floating mesh cages are cheap aquaculture tanks, and you don’t need expensive equipment to maintain water quality. Plankton, much of which is attracted to light, is the natural food of many early juvenile fishes. Perhaps this low-tech approach would also be useful for village based ‘grow out’ of fish larvae for the local trade?

We experimented with solar powered and shore-powered lighting for floating fish cages, but waterproofing the lights can be tricky and expensive, and each floating cage needs a separate light. Biofouling can also clog the fine mesh needed for small fish, and exclude the light. Our most promising development is a simple ‘plankton pump’ (designed by Robert Power) which uses a single light to attract plankton at night, and then utilises the same principle as the air lift pumps seen in many aquaria to circulate fresh, plankton rich water to floating cages or to tanks on shore. Alternately, plankton rich water can be diverted to holding tanks, and fed to the fish the following day – so the natural cycle of day and night can be maintained for fish that use sight to catch food. So far, survival and growth rates have been promising for the snappers that we caught, and also for surgeonfish, filefish, damselfishes, butterflyfish and lobster larvae.

To make such ‘grow-out’ techniques more accessible to poor communities, we have also tried to reduce the cost of the light traps needed to catch the fish in the first place. Traps designed for scientific research are usually prohibitively expensive. We developed modular light units which are easily swapped between traps and are easier and cheaper to fix when they go wrong.3 And together with Steve Simpson (now studying at AIMLS), we investigated building the bodies of traps from five gallon buckets studded with funnels adapted from transparent drink bottles.4 The traps may not be quite as efficient as the expensive versions, but they cost a fraction of the price, and they do catch fish.

So is the idea of growing-out larvae for the ornamental fish trade viable? With the ‘farm gate’ prices of many ornamental fish starting at around $0.50 US for the more common species5, trading 50 individuals from common species per month would still provide more money than many dynamite fishers make.6 However, there are still plenty of drawbacks. For example, the most valuable species are often the least available, and these are not likely to be the species caught in great numbers in either light traps or creel nets. And in some parts of the Pacific very small fish, called tinies, fetch up to 30% less than adults. More importantly, supply of larvae is likely to be highly unpredictable in space and time. If collectors depend on ornamental media for their living they could be driven to destructive fishing techniques such as cyanide fishing when catches of larvae are low. The best way round this problem would probably be to use a wide variety of species and to make this kind of aquaculture just one part of a diverse livelihood. Most importantly of all, any fishery – even for tiny fish - will still need to have a sustainable yield if it is to be economically viable.

**References**


**Maggie Watson and Robert Power worked together on ICLARM’s Caribbean Marine Protected Areas Project in the British Virgin Islands. Their emails are Maggie@apertext.com and rpow@surfbi.com**

**Ancient Overfishing**

We think of overfishing as a modern scourge, but new research suggests even the original Native American inhabitants of the Caribbean outpaced their resources. Steve Wing from the University of Otago in New Zealand and Elizabeth Wing of the Florida Museum of Natural History investigated middens (household garbage dumps) from five Caribbean islands inhabited during the Ceramic Age. The researchers identified the ancient catch by comparing fish remains with those from modern and prehistoric fish middens. They then worked out the relationship between bone measurements and fish weights in order to estimate size. Between the early (1850-1280 BP) and the late (1415-560 BP) settlements, remains of reef-dependent parrotfish, surgeonfish, snappers and groupers got smaller at all sites. But open water fish (such as jacks and herrings) didn’t seem to change. At several sites these pelagic fish came to dominate the catch, suggesting the fishery had moved offshore. The researchers also used mean trophic level analysis which combines fish biomass and position in the food chain to give an overall picture of the catch. Over time, they found a significant shift away from top-level carnivores towards omnivores and herbivores - a pattern that is characteristic of overfishing on many reefs today.


**Fish That Eat Fish That Eat Fish**

The leopard grouper (*Plectropomus leopardus*) is a voracious hunter, preying on at least 20 different families. But surprisingly, it doesn’t take advantage of the bonanza of juvenile reef fish settling to the Great Barrier Reef during each summer recruitment season. On the contrary, it may even improve juvenile.
Threshold Temperatures Challenged

When it comes to predicting bleaching, threshold temperatures are not very meaningful to either corals or humans say William Fitt and colleagues in a review in Coral Reefs. If only it were that simple! Bleaching can be caused by solar radiation as well as or even instead of temperature, and is complicated by other factors such as the length of exposure and underlying seasonality. Corals can lose half their algal symbionts before a human can see a colour change. And even when corals look white they can retain as much as 20-50% of their original algal population, with many of these symbionts still in good health. So using visible bleaching to indicate an upper thermal limit for survival doesn’t tell us what is actually going on in corals and their symbionts. Fitt and colleagues provide a framework for interpreting thermal tolerances and thresholds while showing how sublethal effects are related to other variables when considering the physiological limits of corals.


Many filefish disappeared immediately after the bleaching, and in March 1989, no juvenile or adult fish were seen in the study area. O. lon- girostris show strong site fidelity, and even on the outer reef, where bleaching had been less severe, numbers were low, so Kokita and Nakazono conclude the fish died. The numbers of corallivorous butterflyfish also declined, but those populations did not disappear, suggesting the long-nosed filefish was hardest hit.


Grazing the Dead

Eating fragments of dead organic matter and the microorganisms growing on them may be as nutritious as grazing algae. Researchers Purcell and Bellwood at James Cook University tested detritus at windward sites on Lizard Island, Great Barrier Reef, and found that grazing is associated with communities of small algae growing on dead coral. Many moving and grazing fishes may get some, or in some cases most, of their nutrients from detritus. It may even be more digestible than algae if the chemical plants make to deter grazers have broken down. But detritus didn’t accumulate much on windward reefs. So unlike freshwater systems, where fish must balance an abundant supply of detritus against its generally poor food quality, detritivores on reefs may face a trade-off between high food value but scarce supplies.

Purcell SW & Bellwood DR In Press. Spatial patterns of epilithic algal and detrital resources on a windward coral reef. Coral Reefs.

Papers précised by Maggie Watson

This article is of a Conferential nature...

Have you missed him? Have you? Well worry no more - Spyhopper is back, and feeling refreshed by a little break in the sun. Spyhopper writes from his hotel room, looking out over the glorious view of Cobahapelegella beach. It is Session 6 of the XVth Cerulean Conference of Spicule Stud- ies. Or, if like Spyhopper, you were out most of the night at the Discotheque (Ed – Club to the younger generation), it’s a rest morning.

Absolutely amazing things, spicules. For example, did you know that the universal mean size of a spicule is without exception, 2709 times the length of the nuclear radius? And that if a spicule were an insect of approximately anti-size, it would be capable of supporting a structure of the weight of the Chrysler building?

No, neither did Spyhopper. Of course, the likelihood of using any of these amazing facts is about, ooooh, nil. But that doesn’t matter, because Spyhopper is having a fabulous time. Conferences, for Spyhopper they’re a chance to catch up with old friends, have a few drinks, perhaps fall into the pool in a hilarious manner that will be recounted for years to come, probably embarrass himself by making a pass at someone he shouldn’t (or wouldn’t normally anyway). After all, why spend money on a first class ticket to a far flung conference venue, throw money hand-over-fist at the recommended hotel, and dine in expensive restaurants if the objective is to do some work? Blimey, Spyhopper can do that at his humble desk!
And this venue is certainly conducive to relaxation. The lecture theatre is a work of art, and the poster presentation area is rather fabulous. The programme has that wonderful ‘shiny paper’ small and goes into considerable detail about the history of the Spicule Society and its founder, Arthur Poole who, as it turns out, was related to Charles Darwin through a series of bad marriages and good fortune. Very interesting stuff. Did Spy- hop mention the coffee? Simply divine- and served with those claily little pastries that melt in the mouth. Just the thing to remedy the most appalling hangover.

Yesterday was ‘excursion day’. The delegates got an air-conditioned tour of the finest sights on this lovely island. Unfortunately Spyhopper doesn’t re- call many details. By the time he got to the confer- ence centre on the14th, he had only secured the last seat on the bus —over the back wheel which in turn went over every pothole on the road. Thankfully Spyhopper recovered in time for the plenary barbeque. The traditionally pit- roofed boar was exceptional, and the band first-rate. But just then Spyhopper was accosted by a sus- ciuously young looking man brandishing a clip-board. Spyhopper was so mesmerised by the fellow’s shirt — printed with an intricate design of spicules — that he failed to perform his trademark eyebrow flash and raised glass salut in time to justify a brisk shamble towards a fictitious acquaintance.

Trapped! And By Jove, the fellow had a petition! Spyhopper had to concentrate, but it turned out to be a plea to hold conferences in more accessible places at lower prices. The youth even decreed the combi- nation of non-renewable carbon based pollutants (he must have meant propellants – his accent was a little thick) expended during the three days of train to Cebanahanagelpu.

Trying to lighten the conversation Spyhopper re- marked that he hadn’t met the young man previous- ly, and professed his breathtakingly busy busi- ness card. His reward was a rather indirect reference to the relative locations of the main auditori- torium and the conference bar (at the opposite end of the conference centre) followed by a jib comment about ‘travelling’ and the looming costs.

Broken Out sessions? Spyhopper considered suggesting that if the fellow wanted exercise he should try the Discotheque, but thought better of it. Instead, he proffered the underline well reasoned argument of mature years – Flamboyance Fosters Po- litical Recognition. It is one’s duty to endure the twinges of guilt in order to boost the cause of spicules in the national consciousness of the host na- tion. And anyway, why not have a bit of fun?

Thoughts anyone?

Oceanographic Processes of Coral Reefs: Physical and Biological Links in the Great Barrier Reef

Non-coral reef scientists are often shocked that we don’t have reasonable answers to many questions that are obviously important to coral reef man- age- ment. Aside from the fact that we don’t know where most coral communities are or how humans affect them1,2, very few multi-disciplinary scientific studies have been conducted at scales of space and time that are appropriate to guiding the manage- ment of major reef systems3. This situation is chang- ing, albeit gradually, and the country in the lead is Australia.

Oceanographic Processes of Coral Reefs is a collection of 20 high-quality chapters by well-known re- searchers, centered on the interplay among physical and biological processes governing the function of coral reefs, mangroves and seagrasses. Some chapters, such as the two on terrestrial impacts on the reef, are well focused. Chapter 16, “The Effects of Situa- tion on Tropical Coastal Ecosystems” by Miguel Fortes, are very useful reviews of recent research, ap- plicable to any tropical coastal situation. Perhaps because my own focus is coral reefs I was astounded to discover the importance of crabs to mangrove forests outlined in “Water Circulation in Mangroves and Its Implications for Biodiversity” by Eric Wolanski and co-authors. The next 17 chapters cover a wide range of topics, including community processes such as the decay of seaweed, the distribution and diversity of coral reefs, and the role of marine protected areas. The book ends with Frank Talbot asking “Will the Great Barrier Reef Survive Human Impact?”.

In summary, this book is a comprehensive treatise on the ecology of coral reefs. The book is valuable to scientists interested in coral reef processes, and those interested in the fate of coral reefs in an era of global change. The book is also useful for those interested in the ecological processes of other coastal ecosystems. The book is well written, and the quality of the chapters is high. The book is highly recommended to anyone interested in the ecology of coral reefs.

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Carbonate Platform Systems: Components and Interactions

Three years (29, five with special publications) after "Carbonate Ramps" from editors Paul Wright and Trevor Burchette, we have "Carbonate Platform Systems: components and interactions," edited by Inasalco, Skelton and Palmer, a volume which arises from the 1999 Lyell Meeting on "Organism-environment feedbacks in carbonate platforms and reefs." The emphasis on interactions and feedbacks here was felt by the editors to be timely in view of the rise to prominence in recent years of Earth Systems Science. If, like many people, you've never really been sure what Earth Systems Science is exactly, you may be interested in the Pennsylvania State Earth System Science Center (est. 1985) web-site definition: "The multi-disciplinary search for links between the Earth's physical processes and past and future global change involving "extensive research related to the global water cycle, the biogeochemical cycles, Earth System history, and human impacts on the Earth System." If, on this basis, you are eagerly anticipating a volume that brings together research databases from around the world, you're in for a treat.

The volume is divided into 2 parts. Part I is titled "community-level processes and products" and of the things that caught my attention is its wealth of accompanying ecological data and information on carbonate production rates. There's also an interesting account of palaeoecological changes in coral bioerosion over geological time from Berry and Bertling, although the causes for these changes remain obscure. Those interested in things PreCambrian will be drawn to a phylogenetic case study of South African oolitic and stromatolitic communities by Wright and Altmann. At the other extreme of geological time, those concerned with modern day coral bleaching and El Nino Southern Oscillation will turn to Glynn's contribution. The latter is grouped into the vaguely titled "Larger scale aspects Part II" together with the latest in a series of papers by Gischler & Lomando describing growth of Quaternary sequences in Belize. If you are looking for a controversial read, you might enjoy the paper by Keesling Flugel and Golonka. This study attempts to calculate relative carbonate production rates of reefs through Phanerozoic time and concludes that although the controls on reefal production are too complex to allow reliable predictions, or biotic factors represent more important controls than physico-chemical parameters. All in all, an eclectic collection from which to pick and mix. At £60 (Geological Society members £40) this is one that you will probably like to see in your institution's library rather than see as a must for your office shelf.

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World Atlas of Coral Reefs

A coral reef "atlas" has been on the cards for many years, and it is good to see such a volume now in print. Less of an atlas than a "compendium" of information on reefs, this is a handsomely illustrated publication, containing a wealth of information. Produced with the support of UNEP ICLARM, NASA, the Aventis Foundation, PADI, the Marine Aquarium Council, ICRI and the Duvelarton Trust, it attempts to make the difficult marriage between a popular reference work and something that will also appeal to scientists.

Part I provides a general introduction to coral reefs, and is not so different from that found in many of the other semi-popular or popular books on reefs published over the last decade. Parts II-IV are the main meat of the atlas and consist of the regional and country reviews, comprising various maps as well as general descriptive text. The maps are the focus of the publication. The introduction gives the impression that reef mapping dates only from 1994, but Chapter 3 provides an interesting discussion of reef mapping, referring to earlier work from Darwin onwards, on which the atlas maps have been based. Each regional chapter has a bathymetric map, with more detailed maps of subregions or, in some cases countries, that show natural terrigenous features (fjords, rivers, topography, ridge Michelle) on which the reefs and reefs. The maps are based on the reef information available

available on the US Defence Mapping Agency Operational Chart Service, at a scale of 1:100,000. Data were then added from the 1988 IUCN/UNEP Coral Reefs of the World volume, and additional material was gathered on an opportunistic basis, with particular focus on those countries where existing input was poor. This has allowed a new calculation of total area of reef now estimated at 284,300 km², as a new calculation of total area of reef now estimated at 284,300 km².
the records of coral diseases in each country need careful qualification; and it needs to be understood that the per capita fish consumption is taken from FAO fishery statistics and does not directly relate to reef-fish consumption. And don't get confused by the dive centers that feature on the maps, which are just those where certified training is provided; they are not a guide to the numerous and rapidly increasing number of dive shops where you can rent a tank and take to the water.

The atlas is not intended as a management tool, but the somewhat gloomy picture of conservation efforts on reefs is disappointing. Of course, the authors are entitled to their views, and Chapter 2 gives a good overview of the types of management interventions that are being used to protect and manage reefs. However, the descriptions of what is happening at regional and country level are often negative. The focus is on marine protected areas (MPAs), since UNEP-WCMC hosts the global database for protected areas, and lack of effective management is heavily emphasized. The many efforts underway with fishing communities, the tourism industry for decades, coastal zone management agencies and other organizations to introduce sustainable management of reefs both inside and outside MPAs tends to be overlooked. Most people would agree that there is a long way to go before MPAs are effectively managed. Nevertheless, there has been an immense change over the last 20 years. When the IUCN/UNEP Directory of Coral Reefs of the World was published in 1988, fewer than 250 MPAs included coral reefs; the current total listed in the new atlas stands at 960, and this includes only those MPAs that are legally gazetted. Given the many community based initiatives (there are over 400 in the Philippines alone), and the growing number of private sector preserves, there has clearly been a major change over the last two decades.

However, in a welcome gesture, 150 free copies are to be made available to 'ground-based conservation initiatives in countries that are home to coral reefs in developing countries'. One of the first requirements of any reef management program is a map from which decisions about resource use and human activities can be made. The scale at which the atlas is designed means that it cannot be used in this way but it may encourage local efforts, which now involve not only scientists but also volunteer divers, fishermen and other reef users. This attractive publication should be inspirational, and help people to understand the part that they and their reefs play in the global picture.

Sue Wells, Co-ordinator, Marine and Coastal Programmes, IUCN Eastern African Regional Office Email csmy@iucnafrica.org


This book's title promises guidance to those of us who have been lucky enough to wonder just what's so special about these soft corals and associated habitats.

'Equal value to professional scientists, students, divers, aquarists and nature enthusiasts' proclaims the cover note. How does it live up to this promise? Very, very, well. It grabs your attention, it holds it, and it delivers the goods.

It feels satiny texture, and you fan through its 264 beautiful pages. The intellectual rewards are not far beneath the surface. This is unquestionably a book for many types of professional scientists to take on field trips. For those wanting to make an identification, there is an outstanding 20 page introduction to the 23 families and 90 genera, lavishly illustrated with representative photographs (in as much as is possible in such a diverse group). Ninety genera are represented, typically one per double opening. On the left is a standard formatted text and excellent line drawings of diagnostic features. On the right is a full page of four to eight panels of color photographs that illustrate both the variety within the genus and the detailed features that an intent diver would see through his or her face mask. The pictures are of such uniformly high quality, they will help the naturalist make a generic identification with a high degree of confidence — be it with only a mental picture from a just finished dive, or with a fresh specimen, or a close-up photograph. The propensities of the genus to occupy different habitats — silty or clear, shallow or deep, is recorded — a useful added clue to identification. Known zoogeographic distributions are also reported, but as the authors note, many are poorly known. If this book were needed for no more than an identification guide to the genera, the thoughtful selection and the excellence of the photographs, and the accompanying text would warrant its purchase. As the world’s leading soft-coral specialist Dr Frederick Bayer states, it will remain a cornerstone for information about genera and families of the Indo-West Pacific Octocorallia for decades to come.

So too do most of the other forty or so pages have a lasting feeling about them. The authors succeed in creating relatively jargon free introductions to Coelenterate and soft coral classification, and their biology, enriched again by stunning photographs and excellent line drawings. Histology, anatomy, reproductive biology and nutrition are all briefly and engagingly covered. Techniques for anatomical and ecological study are discussed, as are issues for aquaculture.

A selectively-referenced introduction to the relations of octocorals physical environment covers storms, waves, current, light, nutrients, sedimentation, salinity and temperate with temperature, including valuable insights on soft-coral bleaching. The references and examples in this section are dominated by works from Fabricius and collaborators on the Great Barrier Reef and thus carry the authority of hundreds of hours of first-hand observation. They also include references to some of the most innovative work done in any form of spatial ecology in recent years which quantitative ecologists would do well to follow up. However despite the predominance of Great Barrier Reef examples, there are sufficient examples from other authors and places to reassure the reader of the generality of the broad environment-octocoral relationships described.

I found very few typographical errors or mistakes in referencing to Figures or Tables. The text occasionally slips into the vernacular. The statement 'some irresponsible bioprospectors have nearly wiped out local populations of desired invertebrates' is one example where it did. It was also where one might have expected reference to the efforts to isolate and synthesize active compounds as the way of the future, rather than the more destructive harvesting and extracting. I felt the 'surveying octocoral communities' section could have been used to more strongly promote the value of size and abundance versus percent cover as the way to go, but that's probably just my personal bias coming through. These minor quibbles do not detract from the book's many outstanding qualities. This is a book that will reward all with an interest in coral reefs, and I heartily recommend it to you.

Terry Done


BOOKSHELF

Field Guide to Coastal Fishes of Mauritius


A field guide to coastal fishes of Mauritius has just been published by the Albion Fisheries Research Centre (AFRC) of the Ministry of Fisheries of Mauritius and the Japanese International Cooperation Agency (JICA). It is the result of two years of research into fish biodiversity in Mauritius by scientists of AFRC under the guidance of Dr. H. Terashima from JICA.

The field guide mainly describes the fishes from fringing coral reefs. Most were photographed in their natural habitat (at twenty sites around the island from the surface to 30 meters). A few specimens were sampled in deeper waters (up to 62 meters) and some were found in the local market and photographed in the laboratory.

Much of the published information in the guide is developed from a fish database set up at AFRC in 1998. This database is still being upgraded as additional specimens, some not yet described, are sampled during routine field surveys. At least three hundred and forty fish species have been recorded.

The most common species around the island belong to the families Labridae, Serranidae, Pomacentridae and Chaetodontidae, although another 59 families were found, and many rare and endemic species are described in the manual.

The manual orders fish according to their evolutionary status. Scientific, common and vernacular names (local but also Japanese) are included for each fish species along with information on maximum attainable size, feeding habit, morphological characteristics, geographic distribution, preferred habitat and known behavior. For many species there are is local information, such as whether the species is commercially fished or is considered toxic in Mauritius.

The beautiful photographs accompanying the descriptions should make this manual very appealing and easy to use for everyone from local fishermen to fisheries scientists. The manual is concise but very informative and will hopefully be valuable for field identification of coastal fishes of Mauritius and of the South West Indian Ocean.

The price of the book is Mauritian rupees Rs. 200 (present exchange rate: US$=Rs328). There will be a reduction for an order of more than 10 copies at Rs175 per book. Shipping charges are additional and please contact the address below for details:

The Documentation Unit, Albion Fisheries Research Centre, Albion, Petite Riviere, Mauritius Email: fish@intnet.mu, Fax: (+230) 234184
K. Ruby Mothien Pillay
Email: kameruby@intnet.mu

minimizing the time and money which is required commodities which many are short of these days. For this reason Reef Conservation UK (RCUK) evolved out of the original IYOR-UK committee.

Before RCUK there were few networking opportunities for coral reef researchers working in UK. This limited the scope for establishing collaborative research projects, disseminating results and building links between academics, students, consultants, NGOs and aquaria. This was aided by the establishment of a RCUK list-server, but more importantly the RCUK committee has organized one-day meetings every year since 1998. These conferences have been extremely successful, with over 100 delegates at a time.

A core component of the RCUK meeting has been a series of presentations from a range of subject areas including academic and student research, reef expeditions, conservation initiatives and tropical aquaria. Talks are selected to provide a broad overview of status of coral reef research in the UK and to expose the entire community to a variety of topics. The informal setting of the meeting facilitates discussions and information exchange throughout the day.

RCUK Newsletter

There have been occasional newsletters since RCUK began, but is now produced on an annual basis in order to further boost the lines of communication within the UK.

This has been an ideal way of letting other UK reef workers know what reef related work/interests individuals and organizations/ departments are currently pursuing or are planning. The newsletter has included short articles, news items and announcements and details of current research, survey work, expeditions, educational initiatives etc.

Grant scheme

Although RCUK receives no core funding, the annual conference and charitable donations have provided sufficient funds for a small grant scheme (maximum £300). Funds are only for UK-based applicants/researchers/organizations who are conducting research or projects related to the study of coral reefs and adjacent environments and can encompass disciplines such as media, education, public awareness, ecology, resource management, and mapping. RCUK grant recipients are requested to give an oral presentation or a poster at the annual meeting.

To date RCUK has provided funding for the following projects:

- Conversion of a diving etiquette video to allow it to be shown by airlines en route to the Red Sea.
- Acoustic sea floor mapping in the San Andreas Archipelago, Colombia.
- Surveying the effects of sedimentation on reefs in Fiji.
- RCUK has also provided two grants for environmental education in Honduras. Initial funding provided snorkeling and interpretative materials, and the second extended this work by facilitating the production of a series of 'Reef Briefs' for distribution in local Honduran communities.

RCUK aims to expand its activities in the future with plans to promote a role as a forum for cooperation and networking across the UK and internationally, and is increasing its funding from grants from a range of sources, including the UK Department for International Development.

If you are interested in being kept informed about the activities of RCUK please contact ruck@hotmail.com or have a look at the RCUK website:

www.rcuk.org.uk

Kris Tulloch, Cambridge Coastal Research Unit;
Alistair Harborne, Coral Cay Conservation, The Tower, 13th Floor, 125 High Street Colliers Wood London SW19 2IG UK Email carl@coralacay.org;
Heather Hall, London Zoo, Regents Park, London NW1 4RY UK Email cheater.hall@lzl.org;
Liz Wood Marine Conservation Society, 9 Gloucester Road, Ross-on-Wye, Herefordshire, HR9 5BU UK Email lwood@golnet.co.uk

WHO'S WHO

Reef Conservation UK (RCUK)

In 1996 individuals and organizations involved with, and having interests in, coral reefs came together to discuss International Year of the Reef (IYOR). Not only was this an opportunity to formulate the United Kingdom IYOR strategy, but it also opened new lines of communication and collaboration between individuals and groups in the UK who had never been in contact before, yet had similar interests and were involved in similar activities. It seemed both beneficial and appropriate to maintain these established links and to generate more. The advantages of increased communication between coral reef people in the UK were obvious, maximizing efforts for coral reef conservation and awareness, while

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Resilient Reefs

Not all corals succumb to bleaching! Some show resistance (i.e. coral colonies don't bleach or partially bleach but don't die) or resilience (colonies bleach but recover to reestablish reef communities). Recognizing these patterns of resistance and resilience in our management strategies for Marine Protected Areas (MPAs) is a new concept that could reduce the impacts of bleaching on coral reefs worldwide. This is sensible, but also essential, if these areas are to survive the increased frequency and intensity of bleaching events predicted by many experts.

These were the conclusions emerging from a recent meeting of 12 international leaders in coral reef science and management. Coral bleaching, like the witnessed over large areas of the Caribbean, Indian and Pacific Oceans during the 1997-98 El Nino Southern Oscillation (ENSO), has the potential to kill on a larger scale than any of the localized, destructive activities on reefs linked more directly to people. Now The Nature Conservancy (TNC), who together with World Wide Fund for Nature (WWF) hosted the meeting at the Bishop Museum in Honolulu Hawaii, think that certain ecological factors favor survival or recovery of corals and other organisms affected by bleaching. The meeting outlined a general approach for a global program to test and verify this possibility, and worked out a list of likely factors. The group confirmed that policy makers and resource managers should be including resilient reefs within MPA networks. The emphasis is on the need to help bleached reefs recover by protecting them from other anthropogenic impacts that are far easier to tackle through MPA planning and management than seemingly unmanageable threats like global coral bleaching linked to climate change.

The group plans to work with managers around the world to evaluate how vulnerable existing MPAs are, and to check the practicality of the new management approaches. To be useful, the environmental factors must be reliable and not respond to changes in atmospheric and oceanographic circulation caused by MPA events. They include physical features that reduce temperature stress, reduce harmful bleaching products, decrease light stress, and so promote bleaching tolerance. Connectivity within and among reefs, strong recruitment, and several other ecological factors should also correlate with recovery where reefs are effectively managed.

The plan is to test how reliable these factors are through worldwide assessments, research and monitoring. The research is necessary to provide scientific feedback back up the observations and limited empirical data we have at the moment. At the same time, new MPA selection criteria and design principles will be prepared and distributed so managers can apply, verify and refine the guidelines. The IUCN World Commission on Protected Areas (WCPA) will play a key role in this process. The aim is to assimilate both the results of research and feedback from managers in time to discuss the way forward at the IUCN WCPA 5th World Parks Congress in 2003.

It could change the way we tackle coral reef conservation globally. If you, your project or programme want to get involved, contact Rod Salm (TNC) rsalm@tnc.org or Gilly Llewellyn (WWF) gillie.llewellyn@wwfus.org.

Mitigating Coral Bleaching Impact through MPA Design

May 29-31, 2001 • HONOLULU, HAWAII

Fishy Business in Durban

The 6th Indo-Pacific Fish Conference in Durban (20-25th May 2001) presented a star line up. Dr Ben Ngubane, South African national minister of Arts, Culture, Science and Technology opened the meeting. And before the first plenary a special guest was introduced none other than the spirited 94 year-old Marjorie Courtenay-Latimer, who saved the first coelacanth for science way back in 1938. Jack Randall from Hawaii, the doyen of Indo-Pacific fish scientists, began the plenary talks, presenting a pictorial overview of reef fishes in the Western Indian Ocean and highlighting the diversity and endemism of fishes in the region. Lynnesh Beckley gave a synopsis of marine ichthyology in South Africa, discussing the oceanography of the sub-continent, the accumulation of knowledge about South African fishes and the biogeography of coastal fishes. Dr Kent Carpenter completed the plenary session by describing recent advances in the study of phylogenetic patterns in sparid fishes based on both morphological and molecular evidence. This work is particularly relevant to South Africa as it has the highest diversity of sparid fishes in the world and the results challenge the traditional delineation of sub-families by dentition patterns.

The IUCN specialist group on sharks and the Society for the Conservation of Reef Fish Aggregations met during evening sessions. Kendall Clements chaired a timely discussion on the much debated use of the Aggregation Model to manage reef fish stocks.
of molecular and morphological characteristics for reef fish systematics.

Many of the contributed papers for sessions on coastal and reef fishes, systematics, marine protected areas, deep-sea fishes, pelagic fishes, estuarine fishes, fish larvae, reproductive mechanisms in fishes and chondrichthyans will be published as a special issue of Marine & Freshwater Research in early 2002. The conference was hosted by the Oceanographic Research Institute, in collaboration with scientists from the Natal Sharks Board, JLB Smith Institute of Ichthyology and the South African Museum.

Lynnath Beckley

Regional Experts to Meet in Maputo

If you’re involved in reef-related research and management in the Western Indian Ocean you’re invited to the next International Coral Reef Initiative (ICRI) Regional Workshop, to be held in Maputo, Mozambique from the 26th to the 28th of November. The workshop will discuss work already done, plan future activities and prepare a series of recommendations for consideration by the ICRI Coordination and Planning Committee (CPC) Meeting, which will follow the workshop (29th and 30th). The Annual Meeting of the CORDIO Program, which will focus on ‘Research for Management of Coral Reefs of the Indian Ocean’, will be held in conjunction with the workshop and CPC. Country Status Reports and Action Plans presented at the meeting will be fed into the Second International Tropical Marine Ecosystems Management Symposium (ITMEMS 2) scheduled for the Philippines next year, and the ICRI Report to the Rio+10 Conference.

In addition, the Third Conference of the Parties to the Nairobi Convention will be held the following week (December 5th - 7th), so the Workshop is an excellent opportunity to prepare recommendations for this important Meeting.

The Workshop is organized by UNEP-EAF/RCU and the CORDIO East Africa Coordination Office. You can find more details on the websites for ICRI (www.icriforum.org) and CORDIO (www.cordio.org). Alternatively, contact Rolf P. Payet (UNEP-EAF/RCU, Email: rolphap@seychelles.net, Tel: +(248) 2255154) or David Obura (CORDIO, Email: dobura@africaonline.co.ke or dobura@hotmail.com, Tel: (254) 11 484673).

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DIARY

Second International Conference on Marine Ornamentals

Collection, Culture and Conservation
November 26 - December 1, 2001 Wyndham Palace Resort and Spa in Walt Disney World® Resort Lake Buena Vista, Florida, USA

The conference will focus on helping to create an economically and environmentally viable future for the dynamic marine ornamentals industry and its diverse clientele through:

- Outreach activities in the conservation and husbandry of marine ornamental species.
- Improvements in the methods for the collection and distribution of wild marine ornamental species.
- Increases in the variety, quantity and availability of cultured marine ornamental species.

For more information, visit the conference website or contact: Ms. Beth Miller-Tipton, CMP, Director, Office of Conferences and Institutes (OCI), Marine Ornamentals '01 - Conference Coordinator, University of Florida Leadership and Education Foundation, Inc. (UFLF), Institute of Food and Agricultural Sciences (IFAS), PO Box 110750 Building 639, Mowry Road, Gainesville, FL 32611-0750 Tel: +1-352-392-5930 Fax: +1-352-392-9734 Email: btmiller-tipton@mail.ifas.ufl.edu, Website www.ifas.ufl.edu/conferweb/OMO
Seeking Sustainable Solutions: Fishing And Coral Reefs
A Statement From The International Society For Reef Studies

of bleaching are predicted to increase under the influence of global climate change.
5. Because of these other anthropogenic pressures, it is more important than ever that reefs should be fished sustainably if they are to continue to support food security of local populations, and to offer other sustainable opportunities for local income generation.

Management problems: competition for core fisheries
6. Several key factors make coral reef fisheries difficult to manage:

a) The greatest pressures on reef fisheries can in some cases be generated by demand from international markets for reef products that are insensitive to the capacity of the coral reef ecosystem to meet those demands, let alone local needs. Products include frozen products, live fish for restaurants, and live corals and reef rock for aquaria.

b) Coral reef fisheries that recruit through long-distance larval dispersal can effectively be transboundary stocks, a viable fishery in one country, requiring well managed parental stocks in another.

c) Coral reef fisheries take an enormous diversity of creatures compared to fisheries in temperate seas, which may target only a few species. The data required for conventional management techniques that depend on an understanding of each species' biology and life history characteristics are prohibitively expensive for most countries with coral reef fisheries.

d) Catches are often brought ashore at numerous and disparate landing sites, making enforcement of quotas or even monitoring catches problematic.

e) Coral reef fisheries are often the last resort of the landless poor. Where no alternative incomes are available there may be no economic 'brake' on exploitation even where intense fishing drives catches, and hence earnings, very low.

f) Coral reef fish have a bi-partite life cycle which is still poorly understood. Although adults are relatively sedentary, fertilized eggs and developing larvae disperse away from the natal reef. How far they travel before they return inshore is a topic of considerable debate between proponents of 'widespread dispersal' and 'local retention'. If larvae are widely dispersed, managing an adult population of reef fish may not guarantee a healthy stock if that managed population depends on an upwelling source of larvae for replenishment. This is particularly relevant to Small Island Developing States where larval dispersion may act across international borders separating healthy and overexploited reef systems. Conversely, if larvae are locally retained (and there is mounting evidence that at least a proportion of larvae may return to near their natal reef) local actions have local consequences. Where local retention is significant, poor ecosystem and fisheries management may cause declining stocks; but good management will lead to local recovery of fished populations.

g) Because of the patchy nature of coral reefs, recruitment overfishing of the replenishing population (whether local or upstream) can lead to local extirpation of an exploited species. If this happens, recovery may take decades rather than years, and may not happen at all without interventions such as stock enhancement.

Towards international solutions
7. International solutions are required for two problems:

a) Unsustainable pressures on local stocks generated by international market forces, and;

b) The overfishing of one country's coral reef fisheries through overexploitation and habitat destruction of parental stock in another.

We believe there is an urgent need for interventions that are based on a) knowledge, understanding and regulation of the chain of supply from local fisher to international market place; and b) consideration of coral reef fisheries, where appropriate, as transboundary stocks that require management through bilateral and international agreements targeted at protection of reef habitats, spawning aggregation areas and parental stocks.

Towards locally effective solutions
8. Despite the difficulties described above, coral reef fisheries research can draw some general conclusions:

a) Effective habitat management (for example through rigorously enforced No-Take Zones and amelioration of pollution) is a critical tool for management of the fisheries of coral reefs and associated habitats. Habitat management refers not only to coral reef areas, for at certain crucial periods in their lives, reef fish may need habitats away from their normal adult environment. For example, many commercially important groups and snappers aggregate to spawn, and protecting these aggregations should be a priority. Also, it may be important to protect inshore nursery habitats such as seagrasses and mangroves where some juvenile fish live before they move to their adult reef environment. Protection of such habitats may require that measures be taken to reduce pressures from coastal development or pollution.

b) On their own, No-Take Zones will not be sufficient to halt reef declines. Reductions in effort and elimination of destructive fishing are also needed.

c) The scientific consensus is that a balance of widespread dispersal and local retention affects larval replenishment of reefs. Irrespective of the exact balance, coral reef fisheries need a network of interacting management initiatives at a variety of spatial scales in order to remain sustainable.

Call for action
9. The International Society for Reef Studies calls on the International Coral Reef Initiative (ICRI) to draw attention to the serious problems posed by unsustainable fishery practices and failure in integrated coastal zone planning. The ICRI further calls for immediate and effective action to ensure the sustainability of coral reef fisheries.

We believe that solutions will need to be implemented through complementary international policies, regional agreements, and local management prescriptions. We note that the 'Code of Conduct for Responsible Fisheries' of the FAO Fisheries Department provides an excellent conceptual and institutional foundation for promoting the special needs of coral reef fisheries and ecosystems.

10. We believe that such actions will require both international and local interventions, and a 'whole coral reef ecosystem and society' approach to management. Attention should be paid to the nature of the fishery, the stocks themselves, their encompassing ecosystems, and the pressures exerted by both local needs and foreign markets. Effective management institutions and expertise must be supported where they exist, and established where capacity is lacking.

11. We believe important ingredients of international policy development, regional agreements and local management should include local, regional and international appraisals of stocks and fishery practices, market forces, broader ecology, and socio-economic particulars that canvas:

a) the relative pressures of local, regional and foreign demands on the reef fisheries;

b) alternative uses of coral reefs for activities such as nature-based tourism;

c) the development of non-reef options for food security;

d) the efficacy of tools and practices supporting sustainable fishing within the local socio-economic, cultural and ecological context, such as:

- expansion and enforcement of no-take areas of appropriate sizes and in appropriate locations;
- regulation of total allowable catch;
- aquaculture - that is neither polluting, nor dependent on coral reef production for its artificial food supply - to reduce fishing pressure on the reefs;
- methods for reef restoration and biodiversity augmentation of reef species, including aquaculture of valuable specimens for the aquarium trade;
- amelioration of other detrimental effects on coral reef habitats and fisheries (such as destruction of adjacent habitats, and the input of poisons including fresh water, oils, and fertilizers).
Notes
1 The International Society for Reef Studies is the premier professional society focusing on the science and management of coral reefs. The Society has a membership of over 1000 researchers and supporters from more than eighty countries. We are part of the international Coral Reef Initiative, tasked with ensuring that issues concerning the well-being of coral reefs and allied human populations are kept before the public, as well as appropriate governments and inter-governmental agencies.
2 The ISRS Statements 'Coral bleaching - a global concern' and 'Diseases or coral reef organisms' are printed in Reef Encounter Nos. 24 and 25, and available thereon on the ISRS website at www.ucwif.edu/issr.

Complet Qual Reef Encounter

"We were happy to see the sea floor on these shallow Caribbean Banks - shoals - consists largely of sandy bottom, with intermittent rock outcroppings and coral heads spaced widely apart. (All the better to avoid them during the pouring of pilings for foundations!)
An excerpt from a trip report by Prince Lazarus to the Principality of New Utopia (www.new-utopia.com or www.nuresort.net)

The Moheli Marine Park: one of the first protected areas in the Comores. B. Paris
A healthy Caribbean reef assisted by diving tourism. D. Fennes, J. Castello
Condylactis gigantea - a giant comes under pressure from the aquarium trade. Florida M. Chiappone, D.W. Swansom, S.L. Miller
Undergraduates in research. G. Muller-Parker
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Cover image: Cowfish (Lactophrys spp.) approximately 2 cm long (Photo: M. Watson).