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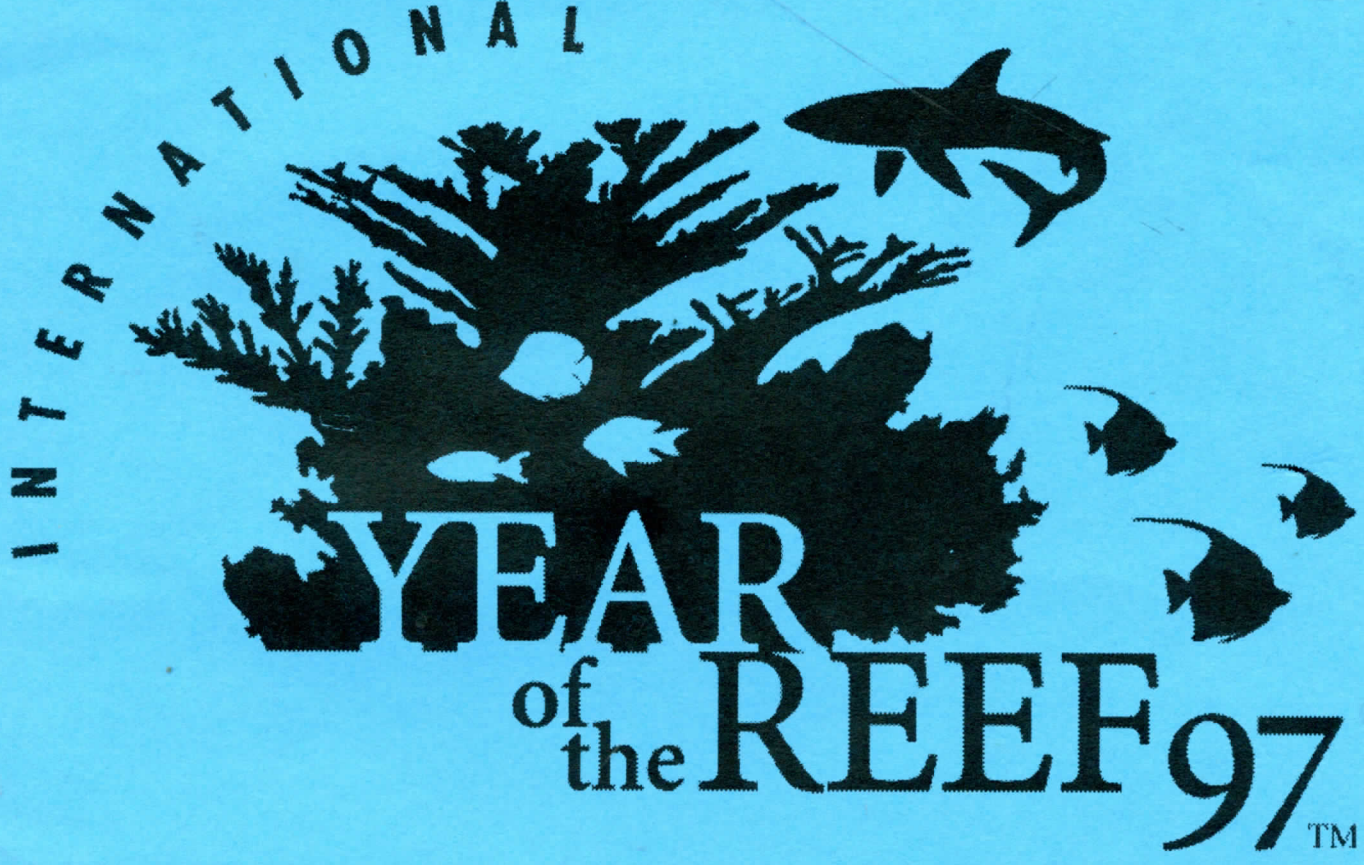
REEF ENCOUNTER

Newsletter of the International Society for Reef Studies

Number 19 June 1996



REEF ENCOUNTER No. 19 June 1996

NEWSLETTER OF THE INTERNATIONAL SOCIETY FOR REEF STUDIES

Editor Sue Wells
Associate Editor Callum Roberts

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The **International Society for Reef Studies** was founded at a meeting in Churchill College, Cambridge, UK in December 1980.

Its aim under the constitution is to "promote for the benefit of the public, the production and dissemination of scientific knowledge and understanding concerning coral reefs, both living and fossil."
In order to achieve its aim, the Society has the following powers:

i. To hold meetings, symposia, conferences and other gatherings to disseminate this scientific knowledge and understanding of coral reefs, both living and fossil.
ii. To print, publish and sell, lend and distribute any papers, treatise or communications relating to coral reefs, living and fossil, and any Reports of the Proceedings or the Accounts of the Society.
iii. To raise funds and invite and receive contributions from any persons whatsoever by way of subscription, donation or otherwise providing that the Society shall not undertake any permanent trading activities in raising funds for its primary objects.

The Society collaborates with Springer-Verlag in producing the quarterly journal *Coral Reefs*. This large-format journal is issued free of charge to all members of the Society, and concentrates on quantitative and theoretical reef studies, including experimental and laboratory work and modelling.

EDITORIAL

This issue follows hot on the heels of the previous one, and we are more than grateful to our contributors who responded so speedily to our request for copy at such short notice. We hope that with this special Panama issue we are bringing you up to date with all that is happening in and on reefs and, for those of you who may be reading *Reef Encounter* for the first time, we hope it will stimulate you to join the Society.

Once again apologies for the late arrival of the last issue, particularly to those who were confused by the call for nominations for ISRS Council Officers in a time span that would have had to defy many of the laws of nature. We have extended the call for nominations to the 31st August to ensure that everyone has the chance to get them in before the elections (see p. 4). The Society is particularly keen to broaden the geographic (and gender) spread on its council, and so those of you in under represented areas, please consider standing. A particular thank you to Amanuel Melles for her stimulating piece on the prospects for African reef scientists, which comes at an appropriate time, coinciding with the launch of the ISRS Fellowship. Through initiatives such as the Fellowship, ISRS should indeed be able to assist in answering Amanuel's challenge. Let's hear from people on other continents as to how they think ISRS and the reef research and management community could benefit them.

We want to make the next issue a really special one. Not only is this year the 15th anniversary of the founding of ISRS, but the next issue will be the 20th *Reef Encounter*. Send us your thoughts and opinions: comments on the plenaries at the Panama congress; ideas on how the international initiatives such as ICRI, IYOR and GCMRN should develop (see p. 15); whether we should be re-vamping the design of *Reef Encounter*; and whether we should be going on to the Internet. Sue is on the move again (see back cover), so please send contributions this time to Callum, who is now safely out of the hurricane belt.

Have a great Congress if you have made it to Panama, and for those who have not, rest assured that we will drink to absent friends!

Sue Wells
Callum Roberts

THE COMPLEAT REEF ENCOUNTER

No.19

"Don't tell me that pollution is killing our fish. Look in the harbour and there's plenty of fish swimming around all the garbage. They're just like them bums that live in cardboard boxes in New York and DC!"

A St Thomas fisherman speaks out against a proposed marine reserve at a public hearing in the US Virgin Islands.

ISRS COMMENT

FROM THE PRESIDENT

John Ogden

I know that many ISRS members are among the more than 1000 registrants who are reading this Special Issue of *Reef Encounter* while contemplating the exciting program of symposia, papers, discussions, and special events in the 8th International Coral Reef Symposium. On behalf of our Society, I convey our deepest gratitude to the staff members and volunteers at the University of Panama and at the Smithsonian Tropical Research Institute led by Symposium Co-Chairs Dr. Luis D'Croz and Dr. Jeremy Jackson for the "heroic" work that has gone into this magnificent event over the past 4 years. Thanks as well to all of you who have made considerable financial and personal sacrifices to attend and to help make the voice of reef science heard at a time of opportunity and optimism that these sensitive ecosystems may have the best possible chance for sound scientific understanding and management.

If you are not a member of ISRS, we invite you to visit our display in the exhibit area, to talk to representatives of the Society, to attend our Annual Meeting, and to join us in our important and challenging work. For those unable to attend, we will make every effort in these pages, in the Society Page and scientific reports of *Coral Reefs*, and through the electronic media to convey the results of the Symposium.

As we have mentioned numerous times in the past few years, this is a unique period of extraordinary global attention to coral reefs. This Symposium, the International Coral Reef Initiative (ICRI), and the International Year of the Reef (IYOR) launched here, hold considerable potential to empower the individual scientist, manager, conservationist, or policy-maker to return home with a clear idea of how to act for the long-term well-being of coral reefs and whom to call upon for information, advice, and support. The ISRS will continue to use its resources to assist communication and interchange between our members, the ICRI, the IYOR, and others concerned with all aspects of coral reefs.

The Symposium is also an important milestone for our Society. This year is our 15th anniversary and we are fortunate to celebrate it in the company of so many who care about coral reefs. We will have important discussions on our future, present three Best Paper Awards, and also the Darwin Award, the highest honour of our Society. For the first time the Society will announce an important Fellowship for graduate training in coral reef ecosystems.

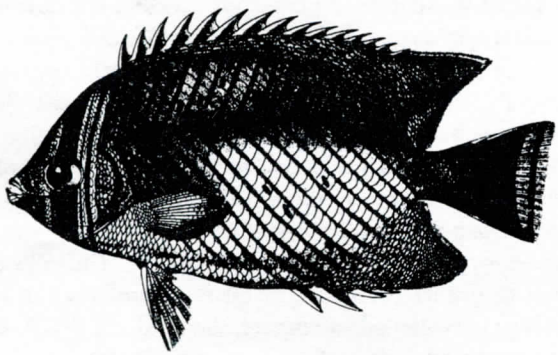
Most of all we are here to renew old friendships, to make new ones, and to establish for the next four years the collegial relationships and exchange of ideas between scientists, students, resource managers and conservationists that have been the vital matrix of the ISRS since its founding in 1981.

Have a great meeting!

IRSR NEWS

EXTENDED DEADLINE FOR ISRS ELECTIONS

Due to delays in getting the last issue of *Reef Encounter* printed, the call for nominations for officers and councillors of ISRS did not reach all of the membership in time. Two officers of the society (Treasurer and Recording Secretary) and six councillors will be elected this year and the deadline for receipt of nominations for these positions has been extended to August 31st 1996. Please send nominations by then together with a brief paragraph on the experience and interests of the nominee to the Corresponding Secretary (Callum Roberts, email: cr10@york.ac.uk; address on back cover). There is a clear need for nominations for women and for people from other parts of the world; self nominations are also welcome. An election ballot will be circulated in September.



Chaetodon trifascialis *Cuvier and Valenciennes 1830*

TREASURER'S REPORT

Financial and Membership Statement for 1995

Income	**US$**
Dues	40,621.50
Subsidy for editorial expenses from Springer	1,955.93
Interest	2,008.75
Page charges	450.00
Total	**45,036.18**

Outgoings	
Springer-Verlag for *Coral Reefs*	0.00*
Allen Press for membership services	7,875.38
Reef Encounter	4,330.00
Allen Press for membership directory	2,694.53
Editorial expenses	2,000.00
T-shirts, displays	974.59
Credit card charges	719.33
Fautin travel to Springer-Verlag meeting	265.00
Best paper plaques	240.00
Bank charges	169.20
Darwin medals	100.00
Other postage	72.31
Total	**19,440.34**

*Contrary to its usual practice of charging for *Coral Reefs* in June and December, Springer-Verlag did not bill (somewhat more than US$21,000) for Volume 14 until early 1996.

US$	**1992**	**1993**	**1994**	**1995**
Income	32,922.39	44,512.51	46,380.91	45,036.18
Outgoings	31,287.47	35,577.04	32,305.85	19,440.34
Cash assets 1 Jan	9,500.00	15,911.08	24,845.55	38,920.61

Cash assets on 1 January 1996 were US$74,658.71. This apparently large increase was due to both a US$10,142.26 overcharge by Springer-Verlag that was returned to ISRS, and the late billing for *Coral Reefs*.

The 1995 budget (*Reef Encounter* 17, p. 5) anticipated expenses of US$36,000 and income of $40,300. Interest was greater than planned because of the late charge by Springer. Membership grew even faster in 1995 than in past years (see below), prompted, perhaps, by the up-coming coral reef symposium, causing dues revenues to exceed budget by more than US$4,000. Also due to membership growth, costs for *Reef Encounter* and membership management exceeded budget. If the charge for *Coral Reefs* Volume 14 is added, actual expenses for 1995 somewhat exceed US$40,000. Thus both income and outgoings were nearly U$5,000 more than budgeted. ISRS is still not paying expenses such as communications among officers, which represent subsidies to the Society by the individuals or their institutions.

Membership 1992–1995

	mid 1992	Dec 1992	Dec 1993	Dec 1994	Dec 1995
Honorary	4	7	6	6	6
Family	15	24	23	23	24
Student	39	78	77	74	89
Individual	251	399	451	506	584
Total	**309**	**508**	**557**	**609**	**703**

1996 Budget

Income	**US$**
Dues	43,000.00
Subsidy for editorial expenses from Springer	2,300.00
Page charges	500.00
Interest	2,000.00
Other (proceeds from sale of t-shirts, NGBR, etc.)	500.00
Total	**48,300.00**
Outgoings	
Coral Reefs (printing and postage)	46,000.00**
Reef Encounter (printing and postage)	6,000.00
Editorial expenses	2,300.00
Membership administration	8,000.00
Membership directory	3,000.00
Office supplies and miscellaneous	250.00
Bank and card charges	1,000.00
Balance for best paper plaques, displays and t-shirts	800.00
Postage and shipping	200.00
Total	**67,550.00**

**This represents payment for both volumes 14 and 15.

Daphne Fautin

ISRS T-SHIRTS

These are dark blue with the Society logo in gold. Available for US$20 ($16. plus $4 shipping and handling). Specify Large or Extra Large. Buy yours at the ISRS desk at the Panama Congress or send cheques, drawn in US funds only, to: *John Ogden, Florida Institute of Oceanography, 830 First Street South, St. Petersburg, Florida 33701, USA.*

STILL AVAILABLE: Copies of THE NORTHERN GREAT BARRIER REEF: a Royal Society discussion organised by Dr Stoddart and Sir Maurice Yonge FRS, 28–29 January 1976, published in 1978, are available from the ISRS Treasurer. Prices: US$20.00 (surface mail), US$30.00 (airmail). Payment must be by US$ money order or cheque drawn on a US bank. Contact: *Daphne Fautin, Kansas Geological Survey, 1930 Constant Ave, University of Kansas, Lawrence KS 66047, USA.*

COPY DEADLINE FOR REEF ENCOUNTER 20 (due out December 1996) IS 1 OCTOBER 1996

FUTURE ISRS MEETINGS

JOINT PACIFIC SCIENCE ASSOCIATION/ ISRS MEETING, 1997

The Pacific Science Association's Scientific Committee on Coral Reefs (PSA-SCCR) is organising a joint symposium with the ISRS at the PSA Inter-Congress, 13-19 July 1997. This will be one of the major scientific events during the International Year of the Reef. A field trip is being arranged to the exceptionally beautiful Astrolabe Reef and the outstanding Marine Laboratory at Dravuni (max. 16 people), and day trips to Suva Barrier Reef and Bequa Lagoon and Reef will also be organised. *Further details available from Charles Birkeland, Chairman, Pacific Science Association Scientific Committee on Coral Reefs, Marine Laboratory, University of Guam, Mangilao, Guam 96923, USA. Tel: +671 735 2184; Fax: +671 734 6767; email: birkelan@uog9.uog.edu.*

Fungia *sp.*

UPWELLINGS

WHAT IS "RECRUITMENT LIMITATION" ANYWAY?

Mark A. Hixon

The mechanisms driving population dynamics of coral reef fishes (and other marine organisms with locally open populations) are controversial. During the 1960s and 1970s, it was hypothesized repeatedly that settling larvae were sufficiently abundant to saturate a reef, so that some form of post-settlement competition within and between species was the primary determinant of local population sizes. In 1981, Peter Doherty formalized the revolutionary idea of recruitment limitation, hypothesizing that larval supply is insufficient to saturate local populations, thus precluding post-settlement competition, and that variation in larval recruitment is the major mechanism driving local population dynamics. Recent literature has reported data supposedly corroborating both these hypotheses, as well as a more pluralistic alternative that both pre-and post-settlement

processes have major effects on the local density of reef fishes. At times, it seems as if the advocates of different perspectives are talking past each other (e.g., Doherty 1991 vs. Jones 1991), and I suggest that one problem exacerbating this controversy involves fundamental definitions.

Since 1981, the definitions of both "recruitment" and "limitation" have undergone vague and ambiguous changes, which have obfuscated the meaning of "recruitment limitation." Let's first consider "limitation" so that we can place the definition of "recruitment" in proper context. As indicated above, Doherty (1981) suggested that larval supply could limit local population sizes below levels where competition would otherwise occur. However, Doherty and Williams (1988) and Doherty and Fowler (1994) later expanded this definition to include the idea that limited larval supply resulted in post-settlement mortality being density-independent. There is an important distinction here because density-dependent mortality can be caused by a variety of processes – not just competition (Hassell 1986). Thus, the original definition of "recruitment limitation" predicted only that post-recruitment competition did not drive local population dynamics, whereas the later definition predicts that no source of population regulation operates after recruitment (since population regulation necessarily requires density dependence [Hassell 1986]).

The definition of "recruitment" has also evolved. Originally, recruitment was equated with larval settlement from the plankton onto reefs (Doherty 1981, Doherty and Williams 1988). Subsequently, the time of recruitment was extended to months following settlement, both explicitly (e.g., Victor's 1986 "secondary recruitment limitation," where recruitment occurs when fish become adults), and implicitly (e.g., Doherty and Fowler's 1994 sampling schedule, where new recruits were collected months after the settlement season). The problem is that, the closer the time of recruitment is defined operationally relative to the time of sexual maturity, the more linear will be the correlation between recruit density and subsequent adult density, i.e. the more likely post-recruitment mortality will be density-independent. (This is one reason why fishery biologists have long defined recruitment as occurring when subadult or adult fish enter the harvestable stock, thus assuming a linear recruit-stock relationship. Fishery biology thus focuses more on the reciprocal stock-recruit relationship, which usually covers most of the life span of the fish [see Rothschild 1986].) It is well-documented that reef fishes often face a major predatory gauntlet shortly after settling from the plankton (Hixon 1991). The greater the time between settlement and the sampling of "recruitment," the greater the possibility that such sources of post-settlement mortality have altered patterns of abundance established by larval supply. If the recruitment limitation hypothesis indeed predicts that larval supply entering a reef is the major factor driving local population dynamics, then it is imperative that "recruitment" be defined operationally as occurring as close to the time of larval settlement as logistically possible. If it is not feasible logistically to sample new recruits at the time of settlement, then density-independent mortality between the time of settlement and the time new recruits are sampled is a risky assumption that requires testing in its own right.

The bottom line is that we are now in a situation where each author will have to identify which definition of "recruitment limitation" he or she is addressing by explicitly defining what is meant by both "recruitment" and "limitation." Although recruitment limitation was originally a viable hypothesis for explaining the mechanisms underlying local population dynamics of reef fishes, it has subsequently become a vague and ambiguous concept lacking self-evident meaning.

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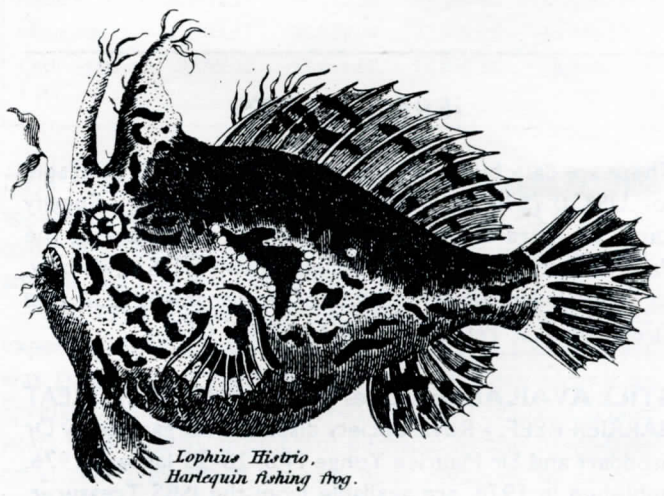


CURRENTS

PROBLEMS AND CHALLENGES FACING AFRICAN REEF SCIENTISTS

Amanuel Melles

As an enthusiastic African student of marine sciences, a little over a decade ago, I embarked with determination to make a difference in the area of coral reef research in Eritrea. This was part of an Africa-wide enthusiasm to contribute excellence to reef studies. Through this decade-long journey, I saw myself progressing from university student, to researcher and, later on, to head of a young marine science university department. Looking back, and projecting into the future, I cannot help but feel uncertainty and some pessimism. By highlighting the problems and challenges facing African coral reef scientists, I hope to attract the interest of fellow Africans and those non-Africans scientists closely involved in Africa. My hope is that something can be done to improve the dismal status of African reef science, and I strongly believe that ISRS has a role to play in this.

Africa, from the Red Sea down to Mozambique and the Indian Ocean islands has extensive reefs, which over the years have been the subject of extensive studies. Some parts of Africa have reefs which are not known very well, such as Eritrea. The majority of reef work has been carried out by foreign scientists, for example from England (Sudan, Egypt), Germany (Sudan), and France (Madagascar). In fact, when cooperation between foreign and local scientists is discontinued, research is either stopped or undermined. Thus, African reef scientists, with a few exceptions, are by and large nowhere to be seen in the reef research that is going on in the continent. They are a breed of rare species!

I think this can be accounted for by the following problems:

1. Isolation

Most African researchers are young people who have pursued advanced training abroad and returned home to work in reef science. One of the main challenges they face is intellectual isolation; the bitter truth is that most of them are not linked with each other or with the outside world. Without linkage they cannot generate or validate their ideas and plans. A scientist isolated is a scientist unable to articulate his purpose and needs, and such a scientist soon loses touch. Access to a good library with journals and books is often difficult. Only a few can afford the expensive subscription fees to journals such as *Coral Reefs* or *Marine Ecology*. And it is equally difficult to convince local libraries to subscribe to relevant journals because most operate under major financial constraints.

The advent of information technology has the potential to narrow this gap. Telephone charges are prohibitive at the moment (10 times more than in the North), but there are networks and nodes run by NGOs which can be used. If ever telephone costs come down, Dr Paul Blanchon's suggestion of putting *Reef Encounter* on the Internet (*Reef Encounter* 18, p. 5) would make good sense. Besides, as he indicated, ISRS should find a way of making *Coral Reefs* accessible to students and, I might add, researchers in Africa. The Kenya-based project on Regional Co-operation in Scientific Information Exchange in the Western Indian Ocean Region (RECOSCIX-WIO) has been helpful in promoting exchange of information and the provision of research material to African marine scientists. Such programmes should be encouraged and sustained.

2. Lack of Research Funds and Equipment

As in any other part of the South, African institutions and universities are under-funded and under-equipped. Reef monitoring does not require sophisticated equipment if a modest laboratory is available, but the recurrent cost of maintenance of equipment (boats), chemicals, fuel, and fieldwork expenses, puts an additional financial burden on already meagre resources.

With a low level of public awareness, it is difficult to find local funds or convince administrative officials of the need for reef research. It is incumbent upon African reef scientists to convince their administrators and the general public of the importance of reefs. We have to bring the science out of the laboratory into the public view. We also have to demand loudly that bilateral and regional programmes aimed at improving marine science remain focused and pertinent to Africa. Often, unnecessary and very expensive equipment has made its way into our laboratories and has then never been used! We have seen funds dwindling away, used on freelance foreign "experts" when they could have been better spent promoting research.

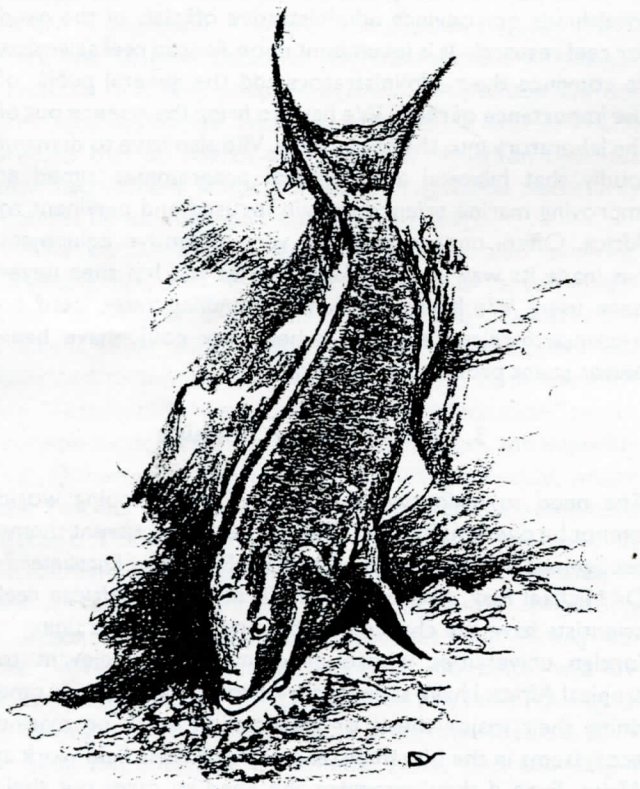
3. Lack of Proper Training

The need to train scientists from the developing world cannot be overemphasized. This has been a recurrent theme recognized by many in ISRS (Dr Maya Best, *Reef Encounter* 7; Dr Michael Risk, *Reef Encounter* 12, etc.). Few African reef scientists have the chance of attending advanced training in foreign universities whose programmes are relevant to tropical Africa. I have seen fellow Africans wasting their time doing their major thesis or dissertation work on marine ecosystems in the North instead of doing their field work in Africa. Even if they recognize the need to carry out their field work research in Africa, it is difficult to find sponsors to cover travel and research expenses. I am lucky that I found funds to cover expenses during my masters field work but I realize that I am among the minority.

African universities should tailor their own advanced training programmes with the help of universities in the developed world. "Sandwich" programmes, where students and researchers from Africa spend a limited time in Europe, Australia or North America but carry out the bulk of their work, including theses, in Africa should be devised to address this problem effectively. Few African countries are doing this yet. This also helps to keep African scientists in Africa and prevent brain drain. Often, it is easier for a researcher to continue with similar projects immediately after the completion of his/her studies, giving him/her a career link to a stable future. ISRS can help by providing scholarships to researchers and students from Africa. It is essential to

allocate funds to students who join university programmes that enable them to return to Africa for fieldwork.

Workshops, seminars and conferences are often organized in Africa that are a waste of resources. Instead of targeting relevant researchers or students of reef science, they become venues of mediocrity where people who have nothing to do with coral reefs dilute the significance of the scientific encounter. Organizers, usually development agencies and NGOs, should work together closely to form a cohesive African corps of reef scientists and use them as a springboard to improve the status of reef research in Africa. Independent evaluation of such programmes (workshops, seminars, etc.) should be carried out to see if they are producing the desired effects.



Sparisoma viride
Reproduced by permission of Henrich Bruggeman

4. Lack of Public Awareness

In Africa, the rather low public awareness of marine resources and the sea in general, makes the task of the reef scientist daunting. If there is no public support, it is virtually impossible to conserve marine resources, including reefs. We need nothing short of a drastic re-assessment of our pre-university school curriculum to see if the younger generation is aware of the sea/ocean and its resources. Coral reefs should be included in the curriculum, perhaps as part of an environmental science or marine biology course in high schools. We need to take high school students on field trips to the coast and to our laboratories so that their growing awareness becomes an ally in our efforts to conserve coral reefs and related resources.

The task of involving the public by raising public awareness and interest in coral reefs is one of the major challenges facing African reef scientists. We have to use every possible means to achieve this goal (media, group tours, T-shirts, slide shows, etc.). It is a challenge we have ahead, especially during the course of the International Year of the Reef (IYOR). This is a unique occasion in which we can do a lot, using experiences and linkages with international organizations and institutions.

5. Invisible Research

Researchers in developing countries face difficulties in producing publishable results. This is a well known fact, and is due to a number of problems including lack of training in the preparation of papers, and scarcity of technical journals, computer facilities and software. Many results end up in the grey literature. Attempts should be made to collect these in central libraries to ensure access by those doing research and conservation work. Remedial measures in the form of short-term training in computer and statistical applications, research design and methodology should be organized as part of regional reef-related workshops.

6. Emigration, Political Instability and War

Events that are beyond the control of the African reef scientist include life; others leave against their wishes because of direct or indirect interference from government officials, which makes research impossible. The net effect of political instability and emigration is to erode the already weak foundation of African reef scientists.

I have directly or indirectly experienced some of the above problems in the last ten years, and this is not a comprehensive list. The challenges are formidable. Only a concerted action can alleviate them. In Africa, we need exemplary programs that have the potential to bring about positive change, such as the one in Kenya run by Dr Tim McClanahan. We need to strengthen the Western Indian Ocean Marine Science Association. We need to face up to the challenge of the new century! I am more than willing and available to work in the field of African reef research and marine science education in any African country. In other words, I'm ready to take on this challenge myself and do the share of the task as African. I challenge all African coral reef scientists to do the same.

Two distinguished scientists have influenced my brief career in reef science and I would like to acknowledge them here: Dr Maya Best and Dr Terry Done.

Amanuel Melles, 3485 St Clair Ave E, 610 Scarborough, ON M1K 1L3, Canada; aa608@torfree.net; Tel. (416) 269 0438

RESTORATION OF CORAL REEFS: POSSIBLE AND NECESSARY

Tim McClanahan

Coral reefs throughout the world are being degraded by resource use beyond levels that are maximally sustainable. Many coral reefs become unproductive through overfishing as they are colonized by inedible grazers such as undelectable sea urchins. These can, through their grazing activities, reduce both food for commercial fisheries species and the growth rates of coral reefs. Many of the heavily fished reefs in the East African region have one half the number of species and one tenth the wet weight of fish as the fully protected marine parks. Recovery of the fish and fisheries may be slowed due to sea urchins that can dominate the reef's productivity (McClanahan *et al.*, 1994). Recent experiments suggest, however, that in some cases reef recovery can be accelerated by reducing the abundance of these grazers.

A group of international marine scientists from the United States, France, Eritrea, Tanzania and Kenya, led by myself, report on a partially successful experiment to restore coral reef fishes and fisheries (McClanahan *et al.*, 1996). The study compared the effect of reducing sea urchins in eight study plots, of which four were within a recently protected marine park (Mombasa Marine National Park) and four were in moderately to heavily fished reefs. Eight additional plots were left as unmanipulated controls. We concluded that the restoration of coral reefs is dependent on the management that precedes and follows the reduction of sea urchins. Specifically, if fishing is eliminated or reduced then sea urchin reduction can result in increased numbers and species of fish. On reefs that were heavily overfished, however, there were only small increases in the numbers of fish, and living coral was reduced by as much as 30% in one year due to algae that grew over and smothered the coral in the absence of sufficient grazing. In Mombasa Marine Park, fish grazers were able to recover and stop the algae from smothering corals. Other commercial species of fish that feed on small invertebrates such as emperors or scavengers also increased in the Park's sea urchin reduction plots.

Some reefs in Mombasa Marine Park, where sea urchins were abundant, showed little recovery of fish, particularly parrot fish, even three years after fishing was stopped. A subsequent sea urchin reduction experiment to be reported at the 8th International Coral Reef Congress in Panama resulted in an increase in the abundance of fish as well as an increase in the rate of predation on experimental sea urchins. The increased predation on sea urchins indicates that the sites will not be recolonized by sea urchins later, but will be maintained in a state of low sea urchin and high fish abundance for the duration of the reef's protection. It seems that the high abundance of sea urchins was slowing the recovery of these reef areas even when all fishing was excluded. All experiments suggest that recovery of coral reefs can be accelerated by intervening and reducing grazing urchins. If this management is not done, it could be a long time before fish recover even in marine parks.

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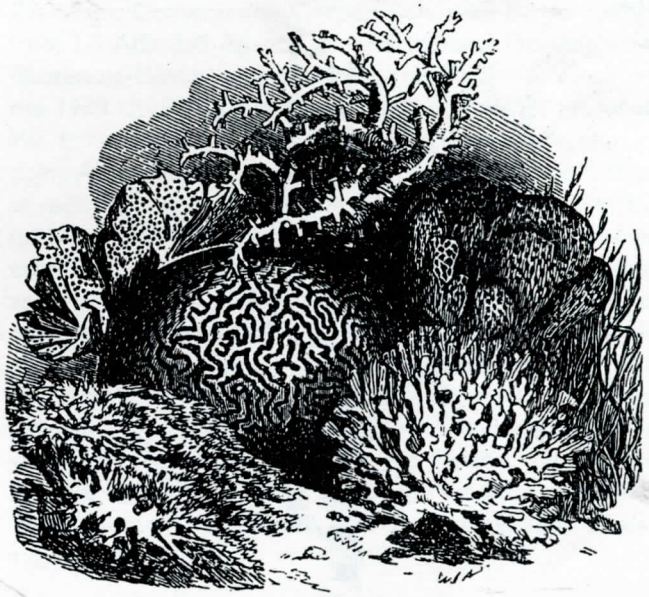


Madrepores and corals From Toilers in the Sea 1889

FEATURES

THE CARIBBEAN CORAL REEFS OF CENTRAL AMERICA

Jorge Cortés

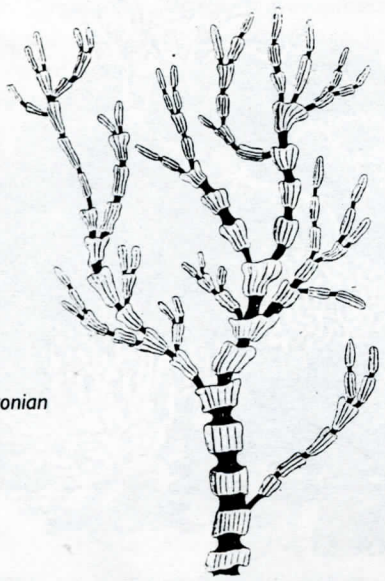
The Caribbean coast of Central America has extensive coral reefs, running from the Belize Barrier Reef in the north, south to the reefs of San Blas in Panama. As elsewhere in the world, these reefs are being threatened by human activities on land and in the water. However, apart from sections of the Belize Barrier Reef and parts of Panama and Costa Rica, the coral reefs of Central America are poorly known scientifically. The 8th International Coral Reef Congress in Panama will draw new and much needed attention to this area. This report is a brief summary of a paper that will be presented at the Congress. The recent Special Issue of *Coral Reefs* (Vol. 15(2), 1996), edited by Peter Glynn, covers topical issues relating to reefs on the Pacific coast of Central America.

Description of the coral reefs

Belize

Extending some 250 km from north to south and the largest barrier reef in the western Hemisphere, the Belize Barrier Reef is the epitome of a Caribbean coral reef. All the typical reef zones are present, as well as almost the whole suite of Caribbean coral species. In addition there are three large

atolls offshore which are unusual features for this region. Most of the reefs in Belize are in relatively good condition, and some are as close to a pristine condition as will be found in the Caribbean. The reefs of Belize are certainly the most important of the whole Caribbean, particularly as a source area for corals, octocorals, sponges, other invertebrates and fishes.



Gorgonian

Guatemala

Located in the Gulf of Honduras, Amatique Bay is a semi-enclosed bay with a strong riverine influence. It has mangrove forest, swamps, seagrass beds, and coastal lagoons, all of which act as an open estuary for the Motagua, Sarstun and Dulce Rivers. There are scattered patch reefs and isolated corals.

Honduras

The coral reefs of Honduras can be divided into two groups, based on geographic location: the Bay Islands group, and the Mosquitia Islands group. The former includes the Bay Islands, Cayos Cochinos, Bancos Salmedina (between Tela and Utila), and the Sea Mounts (between Cayos Cochinos, Tela and Trujillo). The Bay Islands have extensive coral reefs of three types: fringing, platform, and patch reefs. Fringing coral reefs occur around most of Utila, on the south side of Roatan, and at the east and west ends of Guanaja. Platform coral reefs are found on the north shore of Roatan, on the south and north sides of Guanaja, and on the north side of Utila. Patch coral reefs occur in the lagoons of the larger reefs and at Bancos Salmedina and the Sea Mounts. Coral reefs at Cayos Cochinos appear to be similar to the ones on the north shore of Roatan. The Mosquitia Islands group is characterized by fringing coral reefs around the cays, and patch reefs in lagoonal areas.

Nicaragua

The largest carbonate bank of the Caribbean lies off the Nicaraguan coast, and is dotted with patch and insular coral reefs. It is largely unexplored, but there are four main groups of coral reefs associated with cays: Cayos Miskitos, Cayos Man of War, Great and Little Corn Islands, and Cayos de Perlas.

Costa Rica

The Caribbean coast of Costa Rica comprises mainly high energy sandy beaches, interrupted by rocky promontories formed from Pleistocene and Holocene fossil reefs on which modern coral reefs are growing. Four coral reef areas are recognized: 1) recently discovered and unexplored offshore carbonate banks on the northern section of the coast; 2) bank reefs between Moín and Limón, which are at risk from pollution; 3) the largest fringing reef at Cahuita National Park which is badly degraded by sedimentation; and 4) fringing, patch, and bank reefs between Puerto Viejo and Punta Mona.

Panama

There are three extensive reef areas: Bocas del Toro, Region Central (Colón - Portobelo), and San Blas, and areas with smaller coastal coralline communities. At Bocas del Toro a whole range of coral reefs can be found, from reefs exposed to heavy sediment loads to close to pristine conditions. These reef have been little studied. The coral reefs of the Region Central have been studied in detail in the last decade as a result of a major oil spill. Those of San Blas are associated with the cays of the archipelago, and are well developed and extend from near the surface to deep waters.

Environmental Degradation

Sedimentation and over-fishing are the two main causes of coral reef degradation in the Central American Caribbean. Deforestation of the uplands, inappropriate agricultural practices, urban development and road construction are the main sources of terrigenous sediments. All the major rivers in the region have excessive sediment loads that reach coral reefs either directly, as at Cayo de Perlas, Nicaragua (Roberts and Murray, 1983), or indirectly through long shore currents, as at Cahuita, Costa Rica (Cortés and Risk, 1985). There are two sides to the over-fishing problem. Firstly, the removal of herbivores, combined with the *Diadema* die-off, has resulted in macroalgal blooms in the reefs. Secondly, corals have been damaged by traps and nets, particularly those of small mesh size. Other problems are: sewage in localized areas in some countries; oil pollution from boats or spills, as in Panama (Jackson *et al.* 1989; Guzmán *et al.* 1991); agrochemical pollution from citrus or banana plantations, as in Costa Rica (Guzmán and Jimenez, 1992); coral extraction in Nicaragua and Panama; solid wastes, as on the Mosquitia Coast of Honduras (Cruz *et al.*, 1990); dredging of boat channels; and mangrove damage in Guatemala. Tourism is now also a source of coral reef destruction, through construction, pollution, anchor damage and diver damage. This problem is recent in most areas, but it is increasing fast as the coral reefs of Central America become prime dive sites in the Caribbean.

Action

Awareness of the importance of coral reefs in the Central American region has increased in recent years. Regional and local meetings have taken place to discuss the issues of coastal management and conservation (for example: Campos and DePaco 1992; Foer and Olsen 1992), and a number of major programmes have been initiated, such as the UNDP/

GEF Coastal Zone Management Programme in Belize, the US-AID supported regional PROARCA programme, and the IDB-funded Bay Islands Environmental Management Program in Honduras. But the knowledge and degree of public and government awareness of coral reefs and their importance in the different countries is variable. In some countries (e.g., Belize, Costa Rica), effective marine protected areas have existed for several decades, while in other countries (e.g. Honduras, Nicaragua) these are only just being implemented.

The same variability exists in terms of scientific research in the region. Some coral reef areas (e.g. in Belize and Panama) have been studied in great detail over the last 30 to 40 years, while other regions (e.g. Guatemala) have been looked at systematically only in the last couple of years. Even the well studied countries have areas that have not been described and problems that have not been well documented. Research in the region is carried out by governments, non-government organizations, academic institutions, and private consortiums, and the type, quality and relevance of these studies vary between and within country. Monitoring programmes have been initiated in Belize (several localities), Honduras (Cayos Cochinos), Nicaragua (Large Corn Island), Costa Rica (Cahuita National Park), and Panama (San Blas), and include a number of CARICOMP (Caribbean Coastal Marine Productivity) long-term monitoring sites.

At present, there is a political will in the Central American region, combined with a peace process, that points toward an improvement in the knowledge and protection of coral reef areas. The first step is the initiation of basic surveys of most reef areas, combined with a clear identification of the environmental problems that are impacting those reefs. The next step is the elimination of the causes of the problems, or at least the mitigation of their impact. The Central American region has significant coral reef areas that must be studied, protected and conserved, to contribute to the development of those countries.

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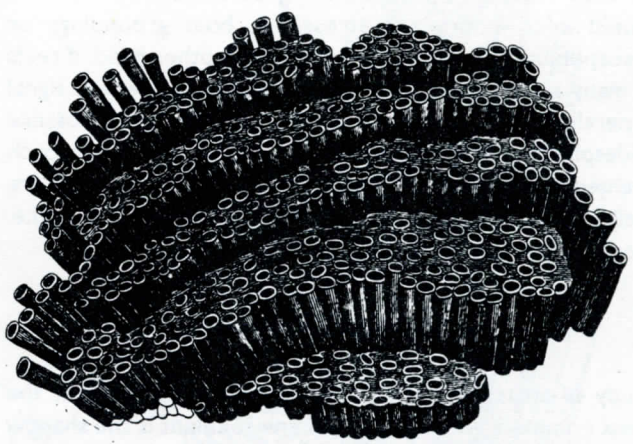
Copies are available for the cost of printing (c. US$5.00 each for hard copies; US$1.00 each for digital copies) and shipping. Further information from: *The Wildlife Conservation Society Mesoamerican and Caribbean Program, 4424 NW 13th Street, Suite A-2, Gainesville, FL 32609, USA. Fax: (352) 373-6443; e-mail: wcsfl@afn.org*



Tubipora musica

RAPID ASSESSMENT OF REEF CONDITION USING CORAL VITALITY

R.N. Ginsburg, R.P.M. Bak, W.E. Kiene, E. Gischler and V. Kosmynin

Background

Is the health of the world's coral reefs in decline? This question is of serious concern to all who study, manage, promote, and use reefs. Although coral reefs in particular areas of high stress and human impact have obviously deteriorated in recent years, the extent of this decline beyond local areas of degradation to regional and even global scales has been, and continues to be, debated. Of course, the abundance and diversity of the multitude of reef organisms vary naturally between reef environments, regions, and oceans, and these variations do not allow easy comparisons of a concept as subjective as "reef health". If an answer to the question of global or even regional reef condition is to be found, a technique for assessing reefs that can be applied rapidly and easily to a wide spectrum of reef communities and habitats is needed. Over the last two years we have developed and applied a technique for assessing the condition of the coral community of the most common reef habitat of Florida's reefs, the extensive inshore patch reefs. We propose that applying this simple technique to other reef areas will be a valuable addition to any reef assessor's tool kit, and provide a much better understanding of the distribution of coral reef degradation.

In the planning stage of the assessment, discussion centred on what we wanted our effort to reveal about the reefs to be studied. It was reasoned that an instantaneous assessment could only be expected to disclose areas of serious decline, and evidence of such decline would be shown where there was more dead coral than living. If the assessment found that reef sites with corals in serious decline were isolated, adjacent to sites with largely intact, living coral communities, we would infer a localized stress, i.e. boat groundings or susceptibility to some pollutant. On the other hand, if reefs in many areas showed significant declines, this would signal general stress or stresses, and direct attention to a possible widespread factor to explain the decline. This approach seemed appropriate for the Florida reefs because there are well established spatial variations in potential stresses (i.e. storm damage, water quality, and human use).

Procedures and Results

Study of charts and aerial photographs indicated that the most common, widespread reef environment is the shallow patch reefs that occur between the shelf-margin or bank-barrier reefs and the chain of islands that form the Florida Keys. These patch reefs are in depths of 1 to 12 m and range in diameter from a few meters to 100 m. They consist of aggregations of corals, alcyonarians and sponges, surrounded by sand and sea grass beds. The predominant genera are *Porites*, *Siderastrea*, *Montastraea*, *Diploria*, and *Colpophyllia*. Branching corals, primarily *Porites porites*, are usually of secondary importance. *Acropora* spp. are rare or absent.

1994 Assessment

Our initial survey was carried out by diving to census a series of short belt transects, 1 x 6 m in size, at each reef. Projected diameters of individual colonies encountered in these transects were measured, and estimates of the percentage of dead tissue on each colony were recorded as < 50% living, and > 50% living. Surveys of 6 belt transects on each reef were accomplished in approximately 3-4 hours depending on weather conditions and logistics.

The results of using this method on 15 reefs spread along a distance of 100 km were promising. There was a clear indication that certain coral species composed the majority of the patch reefs and the condition of these species largely determined the distribution of healthy and degraded reefs. Species of *Montastraea* and *Siderastrea* predominate and were most sensitive to injuries, disease and predation that resulted in dead coral tissue. These corals often reach diameters greater than 2 m and these large specimens have no more than 50% living tissue. This finding was and is of particular concern because these large massive corals often occur in clusters up to several meters in diameter that we consider to be "keystone" elements of the patch reefs because they provide semi-protected habitats for large fish and invertebrate populations. The loss of these clusters would significantly change the character of the patch reefs. Variations between the patch reefs were less clearly defined. However, the impact of Hurricane Andrew (1992) was evident in the large number of recently-dead corals on some reefs in its path.

1995 Assessment

From a review of our 1994 survey, we decided to simplify and stratify our assessment. We agreed to limit our observations to the most common massive coals (*Montastraea* spp, *Diploria* spp. *Porites astreoides*, *Siderastrea* spp. and *Colpophyllia* spp.). The patch reef sites were divided into two coral habitats: areas where the massive corals were generally 1 m or less in diameter, termed "campus", and the large clusters of giant colonies. Within the campus areas we continued to measure projected diameters of the massive corals, but the estimates of dead tissue were delineated as <1/3 dead, 1/3 to 2/3 dead, and > 2/3 dead. To increase the area examined and shorten the time required for the surveys, we replaced the belt transects with a census approach. Each diver was assigned one or two genera of massive coral and swam radially from a fixed location on the reef. When their assigned coral was observed, it was measured and the amount of dead tissue estimated. Using this survey technique, we were able to census several tens of colonies of each genus at each site. More detailed assessments were made of the clusters of giant *Montastraea* colonies and other species. The percent dead tissue on the clusters was determined by point-counting live vs. dead areas along line or chain transects at marked "points" spaced at intervals of 25 cm.

Depending on the size of the cluster, the transects were stretched over the clusters in a radiating or grid pattern. This revised procedure decreased the time required to make an assessment of an individual patch reef to the order of two hours, it increased the number of colonies 1 m or less that were examined, and it refined our estimates of live/dead tissue on the clusters of giant corals.

The results from this second survey expedition extended the data base to 30 patch reefs over a distance of 200 km between Miami and Key West, and produced some useful and unexpected findings: 1) nearly 75% of the massive corals 1 m or less in diameter have more than 2/3 of their tissue living; 2) there are large variations in the amount of dead tissue on the giant clusters, but on average, they have roughly equal amounts of living and dead tissue; 3) clusters in serious decline (> 50% dead tissue) are in near-shore positions; and 4) reefs in areas of heavy human use (boating, fishing, diving) showed no more decline than reefs in areas of less usage. A manuscript that details these findings is in preparation.

Perspectives

Our surveys are by no means the first to use loss of living coral tissue as an indication of reef condition and several other reef community assessment techniques are in practice (Brown and Howard 1985, Brown 1988). Dustan (1994) summarized his use of vitality surveys of coral communities in which he determined the frequencies of various categories of decline on large numbers of individual corals as a measure of health. Gomez *et al.* (1994) proposed the use of a coral mortality index: the ratio of dead coral cover to the sum of dead and living coral. A most effective use of assessing live/dead coral to indicate condition is the work by Diaz *et al.* (1995). They made visual estimates and some counts of the "recently dead coral colonies" around the island of San Andres off the Caribbean coast of Nicaragua. In this study, "recently dead" was used for colonies that can still be identified to genus and remain in life position. The survey revealed areas where > 75% of the corals were recently dead and the companion map of the various anthropogenic impacts suggests the probable cause for the areas of significant decline.

Overall, our survey found much less degraded coral than in the study of Diaz *et al.* (ibid), but the significant local impact of Hurricane Andrew was evident. The significance of the condition of the clusters remains to be determined. Is the fact that they have only half of their tissue alive a result of their age, their shallow-water locations, the position of the Florida reefs at the margin of the tropics, general user impacts or other factors? By assessing other clusters in nearby areas and at depth, we hope to evaluate some of these possible explanations.

The method outlined here has been applied with success in two other areas. Van der Brugge and Bak used the method of our 1994 survey to identify gradients in condition of the coral community of Teluk Banten, a large bay area west of Jakarta. Peter Glynn and associates made estimates of coral vitality off the southwest coast of Puerto Rico and found that massive corals in deeper water had more living tissue than those in the shallower settings of Florida. They also were able to apply the method to assessing *Acropora* spp.

What is the role of rapid assessments of coral condition, like ours and those in practice by others, in evaluating reef condition? Clearly, rapid assessments are no substitute for more intensive and rigorous monitoring. However, if the goal is to identify and map coral communities that show significant degradation over large areas, we feel this approach deserves consideration. It is simple and can be applied by volunteers with the appropriate training, supervision, and quality control; it provides quantitative data that allows comparison of different areas, as well as baseline data for resurveys and identification of temporal change; it can be used to compare reef communities on local and regional scales; and, by disclosing a pattern, it can offer initial indications of the possible causes of significant decline.

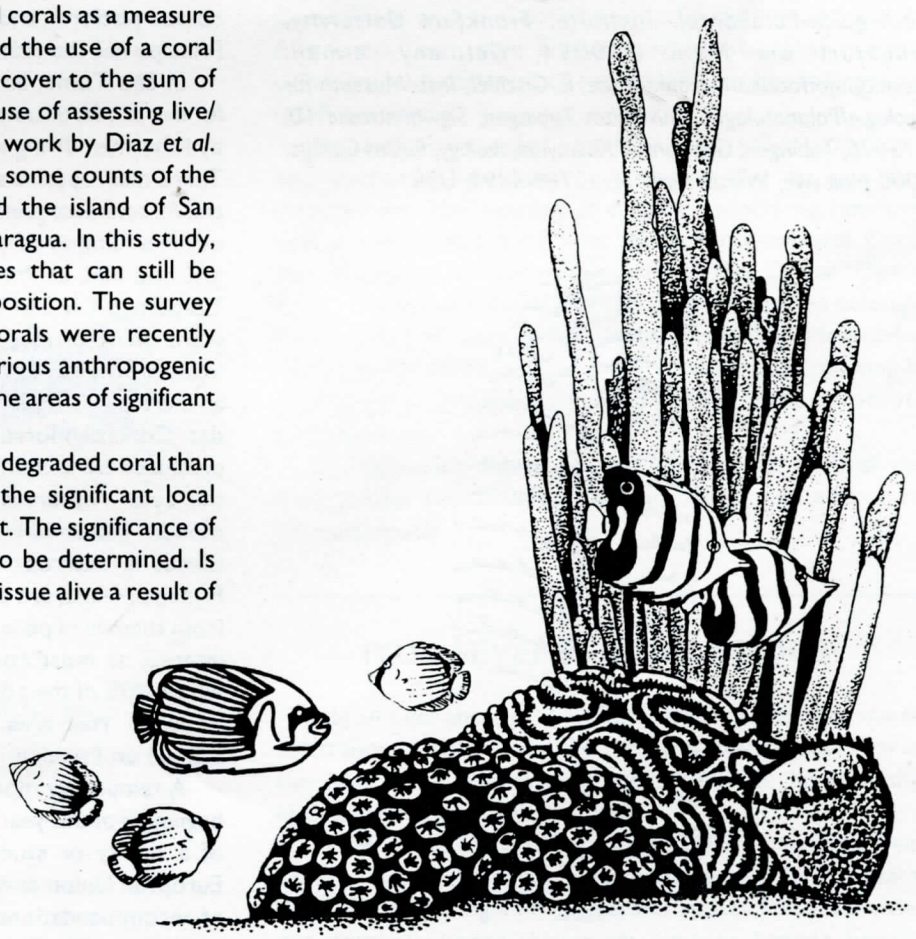


Figure borrowed from
'A National Coral Reef Strategy for Thailand'

Recommendation

Assessing coral condition is clearly a useful addition to rapid assessment and monitoring procedures. We hope to extend our surveys to other areas in the Western Atlantic and we encourage similar surveys elsewhere in the world. We welcome expressions of interest in this approach and in exchanging data. All those involved in monitoring and rapid assessments of coral reefs are urged to consider adding coral condition to their protocols.

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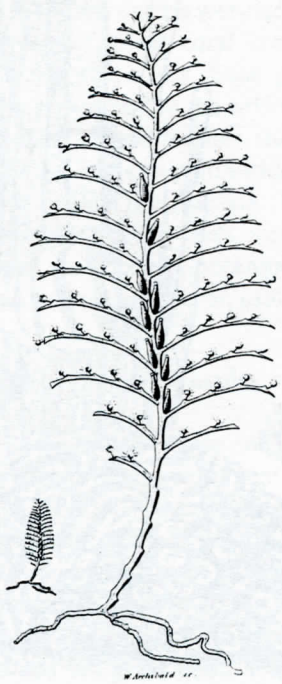

Hydroid

NEWS

CORAL MINING IN THE GULF OF GUINEA

The following report was received at the beginning of 1996. We have been unable to check the current situation, but feel that is worth publishing this information, as it concerns an area that is so poorly known to the reef science community (Eds).

The Gulf of Guinea is hardly famous for its coral reefs: coral development in the Gulf of Guinea is limited by the relatively small amount of coastal shelf and low salinity of the water. Yet the small area of reef found around the island nation of São Tomé and Príncipe has one of the highest incidences of reef endemism. Nine species of coral are known from the islands, four of which are related to Brazilian species, and several of which are endemic to either West African or Gulf of Guinea waters (Laborel, 1974). For example, *Porites bernardi* is found only in the Gulf of Guinea, both in the islands and along the continental coast. *Montastrea cavernosa guineense* is known only from three islands: São Tomé, Príncipe and Annobon and has been listed in the 1995 *List of Threatened Species for São Tomé and Príncipe* (Gascoigne, 1995). Other endemics include fish, sponges, molluscs and crustaceans. São Tomé has a limited area of reef on the north coast. Coral resources in Príncipe are probably much more important than those in São Tomé because of its larger coastal platform, and within the islands it is well known that Príncipe has the richer fishing grounds.

In São Tomé, lime is traditionally produced from coral for use as a fertiliser and as whitewash. The coral is extracted by fishermen diving and using handtools to break off pieces. Three main species are used: *P. bernardi*, *Siderastrea radians*, and *M. cavernosa guineense*. Lime production was once carried out in a number of localities but since 1975 there has been just one kiln, at Praia Melao, operated by the Direçco de Construão Civil. In the late 1980s about 15 tonnes of lime were being produced a month, representing eight lorry-loads of coral. In 1995, the kiln was privatised and since then an increasing amount of coral has been extracted in the Praia das Conchas/Morro Peixe area. In 1988, a report was produced by a UNIDO consultant which pointed out that the coral resources on São Tomé would not support a modern industrial kiln. The only other source of lime in the islands is outcrops of limestone/foraminifera deposits on Principe, which are probably very small. The lime produced from them is of poor quality, and they are in any case of less interest as most construction is occurring on São Tomé, where 90% of the population resides (Sobek, 1988). Despite its larger reef area, coral mining has apparently not yet started on Príncipe.

A temporary moratorium on mining was imposed at the beginning of this year, pending results and recommendations of a survey or study. ECOFAC, a West African regional European Union environmental project, has made a number of recommendations and is urging action to get the survey carried out. The EU will reportedly finance a coral resource survey under the terms of the EU-STP fisheries agreement,

but plans for this appear to be moving very slowly and there are fears that the moratorium will be broken. In the short-term, finding a solution to the coral mining problem is a priority in São Tomé. The small reef area is important for fishing, to the extent that fishermen based on the south coast travel to the north coast. The beaches and reefs along the north coast are also important for the growing number of tourists, many of whom go snorkelling and diving. There are a number of other pressing marine issues: sand extraction, bilge tank pollution, turtle protection. This would seem to be a prime example of a country where an integrated coastal zone management plan is required.

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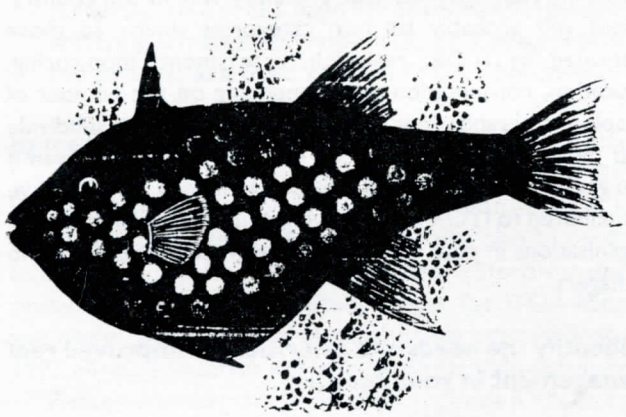


Canthidermis maculatus from São Tomé and Principe

ICRI, IYOR, GCMRN: CORAL REEFS GO GLOBAL

One can be excused for feeling confused by the growth of 'international initiatives' for reefs. However, they all have a distinct role and purpose. The International Coral Reef Initiative (ICRI) was launched at the UN Global Conference on Sustainable Development of Small Islands Developing States in Barbados in 1994, and started as a predominantly governmental initiative to promote sustainable management of coral reefs. It has held a number of regional workshops to identify needs and priorities, and the next step will be to identify ways of implementing these. ICRI has an Executive Planning Committee, and a co-ordinator who is based in the US Department of State, the US having provided much of the initial support.

The International Year of the Reef (IYOR) is closely linked to ICRI. The idea of holding such a campaign was first suggested at a 1993 meeting at the University of Miami. Although the original aim was to designate 1996 as IYOR, it was felt that 1997 would be more appropriate, allowing time for better co-ordination and planning. The main aim of IYOR is to give a major boost to research, conservation and educational activities relating to reef management throughout 1997, and to use the attention and greater resources that should come out of this to develop long-term programmes that will help to achieve the ICRI objectives. IYOR is a participatory activity and at present has no funding or formal organisational structure. However, it has an Organising Committee and a Conservation, Education and Public Awareness Committee. The intention is to establish regional or national sub-committees and working groups to promote IYOR activities.

One important goal of both ICRI and IYOR is to improve and increase research and monitoring to support management. The concept of a global monitoring network was first endorsed in 1992 at the 7th International Coral Reef Congress in Guam, as part of the Global Ocean Observing System (GOOS). ICRI partners pushed strongly for the establishment of the Global Coral Reef Monitoring Network (GCRMN) and, at the first major ICRI meeting in Dumaguete, Philippines, mid–1995, called for its establishment.

The following pieces provide updates on each of the international initiatives, and contact names and addresses. Do participate!

IYOR FEVER IS CONTAGIOUS!

People all over the world are interested in and determined to do something for coral reefs and the International Year of the Reef is an unparalleled opportunity to harness this enthusiasm and energy.

IYOR will be a precursor to the 1998 International Year of the Oceans, recently approved by the UN General Assembly following a Portuguese proposal. IYOR activities can continue under this much broader banner beyond 1997.

Unlike other initiatives, IYOR is a grass roots effort that is building up from broad objectives, just as coral reefs begin with polyps. The general objectives are to promote efforts in:

- **C**apacity building for reef management
- **O**utreach and education
- **R**esearching patterns of degradation and their causes
- **A**ssessing the condition of coral reefs worldwide
- **L**eading sustainable management efforts for reefs

And just as coral reefs provide almost unlimited opportunities for life styles, so IYOR encourages individual and group initiatives. The following is a brief summary of current and planned activities with suggestions of how readers can participate in them or develop their own programmes.

IYOR activities underway

IUCN – The World Conservation Union has given wholehearted support to IYOR and will be incorporating it into its new Marine Programme, starting with a coral reef session at the World Conservation Congress that will be held in Montreal, September 1996.

An IYOR 'Speakers Bureau' is being drawn up to provide speakers for seminars and public events throughout the year at aquariums, schools, museums and other such venues. By volunteering to take part in this, you can make a substantial contribution by helping to explain to the public the threat to coral reefs and the processes that make these such special ecosystems. If you are interested, please contact one of the organisers below, specifying your area of expertise and any slide show or other materials that you would be prepared to present. We hope many ISRS members will sign up to this.

The previous issue of *Reef Encounter* (No. 18, p. 13) described many of the research and assessment activities underway. New initiatives include: an assessment of impacts on the much-visited reefs of Curacao, led by Manfred Van Veghel of Reef Care Curacao; and an assessment of Florida inshore patch reefs (see p...). The results of many of the IYOR-linked surveys will be presented in a special one-day session at the Panama Congress.

We also listed in the previous issue many of the educational activities underway and being developed in the USA, through the Coral Reef Alliance (CORAL) and the American Association of Zoological Parks and Aquariums. These include a travel exhibition of coral reef photography by the world's leading underwater photographers, educational CD-ROMs and videos, and a national coral reef poster contest. Materials for teaching high school and middle school students about reefs are being developed as a co-operative effort of the Jean-Michel Cousteau Organization and the University of Miami, funded by the Miami Rare Project.

In the UK, two meetings of organisations and individuals working on or involved in reefs have been held to develop ideas for a UK IYOR campaign. Some 20 groups are either already participating or have plans to do so, including several volunteer organisations (Coral Cay Conservation, Raleigh International, Frontier, Operation Wallaceana), the Natural History Museum, the BBC, London Zoo and Aquarium, the World Conservation Monitoring Centre, and researchers and students at the universities of Cambridge, York and Bangor. A Listserver has been established to facilitate communication between the UK participants, and plans are being made for a UK launch of IYOR at the end of this year or beginning of 1997. Many of the organisations produce newsletters or magazines and these will run articles and news items on coral reefs throughout 1997, including the dive magazine *Dive International.* There will be a number of displays, photography competitions, and special events for school children. A special 'coral reef' award will be offered in the 1997 BP Conservation Programme (which was set up to encourage university and other expeditions to carry out conservation activities). The next stage is to involve British scientists, of which there are many carrying out field work on reefs and involved in reef research and training activities.

Why not launch IYOR in your country or join with neighbours in a regional effort?

Regional or country committees are one very good way to generate and execute IYOR activities. The following is a brief suggestion of how you might get started:

1. Organise a meeting of individuals and organisations involved in reef research, education and management

This could include NGOs, educational institutions, universities and research institutes, marine parks, and representatives of reef user groups (fishermen, tourist operators etc.). A good chairperson, an agenda of the main topics for discussion, and someone to take notes are the main requirements. Start by reviewing reef activities that are underway in the country. These will probably fall into categories similar to those identified by IYOR: research, assessment, monitoring, education, conservation etc. Depending on the number of people and organisations involved, it may be wise to subdivide into more specialist groups to take action further. Even if you get no further than holding such a meeting, you will have contributed to IYOR by improving communication between organisations in your country and between researchers and managers.

2. Identify the needs and priorities for improved reef management in your country

Some countries will already have done this through their participation in ICRI workshops, or national priority setting activities. Once you have a list, identify the organisations that are best suited for following up on different recommendations. Which activities already have funding? Are funding sources available for others? Can organisations collaborate with each other to improve reef management efforts? Make sure you involve government officials, as well as agencies and individuals involved with ICRI. They may be able to provide, or help to locate, funds and they will certainly provide encouragement.

3. Develop a programme of activities

Start with current activities that can be built on or existing project proposals, rather than trying to build an entirely new programme. Virtually all countries with reefs have some form of research, education or management initiatives underway or in the pipeline.

How can IYOR help you?

The IYOR logo is available for use by individuals and organisations carrying out research, education and management work that relates to the general goals and objectives of IYOR, described above. In order to limit its misuse, we are requesting that those who wish to use it fill in a form obtained from the IYOR organisers and return it to them for circulation to relevant people for approval. We hope to see the logo used in a variety of ways, such as:

- support of research projects: scientists may want to use the IYOR logo and name when seeking financial support. In addition to completing the form, please send a short abstract of your project.
- support of activities carried out by non-profit organisations: This covers a wide range of education, public awareness and conservation activities. Please complete the form and indicate also your affiliations to other major conservation organisations or agencies, and any other endorsements.
- **fundraising for reef research, conservation and education projects: we do not wish to raise funds for IYOR as a whole, but we do want to see increased resources going to reef projects worldwide.** Use of the IYOR logo or name solely for the commercial gain of individual or corporations is not permitted. **Use of the logo for commercial purposes will be permitted provided all, or a proportion of the profits, are used to fulfil IYOR objectives**

By the time you read this, a colour leaflet will be available in Spanish and English, giving general information about IYOR. We are looking into opportunities for translating it into other languages later in the year. We also plan to produce fact sheets on topics such as educational materials available, research programmes underway under the IYOR banner; and names and addresses of participating organisations. By 1997, all these materials will be available for wide distribution.

Please remember that IYOR cannot provide funds directly, and that the organisers and co-ordinators are working in a voluntary capacity, and may not always be able to get back to you instantly. If you or your organisation would be willing to put in time to general co-ordination activities, do let us know – but we don't want to distract you from specific IYOR activities that you may be able to develop! For more information contact:

IYOR Programme Coordinator: *Dr Robert Ginsburg, RSMAS/ University of Miami, 4600 Rickenbacker Cswy, Miami FL 33149. Fax: (305) 361-4094/4632. E-mail: rginsburg@rsmas.miami.edu*

Conservation and Public Awareness Committee co-chairs: *Stephen Colwell and Sue Wells, c/o The Coral Reef Alliance, 809 Delaware St., Berkeley, CA 94710. Tel: 510-528-2492; Fax: 510-528-9317; Email: CoralReefA@aol.com.*

For information on UK activities, contact: *Vanessa Guest, 5, Pendragon House, Port Pendennis, Falmouth, Cornwall TR11 3XX, UK. Fax: (44) 1276-855273; e-mail: 101341.16@compuserve.com*

"There is something in the psychology of mankind to which coral reefs never fail to appeal." J. Stanley Gardiner, 1931

INTERNATIONAL CORAL REEF INITIATIVE

Launched by a partnership of governments and organisations, ICRI was conceived as a means to focus global attention on the need for urgent action on the conservation and sustainable use of coral reefs. Following the International Workshop in Dumaguete, Philippines in 1995, five regional workshops have been held at which participating countries have developed strategies for implementing the *Call for Action* and *Framework for Action*; a Middle East workshop will be held in the near future.

ICRI Workshops:

Region	Dates	Host Nation	Sponsor	No.Countries participating
Global	29 May–2 June 1995	Philippines	US, Japan, UK, Sweden, France,Australia	44
Tropical Americas	5–8 July 1995	Jamaica	USA, UNEP	32
Pacific	27 Nov–1 Dec 1995	Fiji	Australia, SPREP, UNESCO	22
South Asian Seas	29 Nov–3 Dec 1995	Maldives	UK, UNEP	6
East Asian Seas	18–22 Mar 1996	Indonesia	Japan, UNEP, Denmark	11
East Africa /W. Indian Ocean	25–29 Mar 1996	Seychelles	France, UNEP, World Bank, IUCN	7

One goal of the regional workshops, as with IYOR, has been to foster better communication between scientists and managers, a theme that will also be taken up at a special symposium to be held by ICRI during the 8th International Coral Reef Congress in Panama. The workshops were also used to begin to consider GCMRN national and regional nodes (see below). ICRI is also encouraging its partners to increase bilateral support for coral reef management and research activities, and a number of projects are now being developed. Over 73 countries have now participated in ICRI events.

Through ICRI, high level governmental support has been obtained for sustainable coral reef management, and

priority requirements have been brought to the attention of international fora such as the UN Commission on Sustainable Development, the Second Conference of Parties to the Convention on Biological Diversity, and the Conference of Parties of the Ramsar Convention. ICRI materials (the *Call for Action* and the *Framework for Action*, the video *The Fragile Ring of Life*) have been distributed worldwide: the Smithsonian Institution is preparing a travelling exhibit to premier at the Panama Congress; ICRI information is available on the World Wide Web; and IUCN will soon bring a home page on line.

The next phase of ICRI, which will be discussed at Panama, will contain two elements:

- Greater leadership and activity at the regional level, building on the strategies developed at the regional workshops.
- Continued promotion of global attention on the plight of reefs and the need for urgent action to reverse the decline in their health, to ensure that international momentum is maintained and that there continues to be impact on international and regional donors, finance institutions and national priorities of member governments.

The existing Executive Planning Committee (EPC) will be re-constituted as a Co-ordination and Planning Committee, with the goals of working towards ensuring that the regions assume responsibility and leadership for taking ICRI forward, and providing a mechanism for promoting global attention and action.

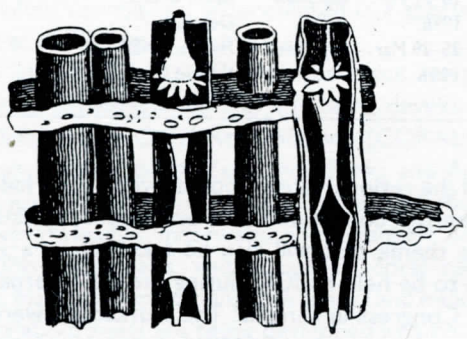
Further information from: *Peter Thomas, ICRI Co-ordinator, OES/ETC, Room 4325, Department of State, Washington, DC 20520, USA; Fax: 202-647-5247; e-mail: pthomas@state.gov*

and from the WWW: *http://coral.aoml.noaa.gov./icri/icri/html*

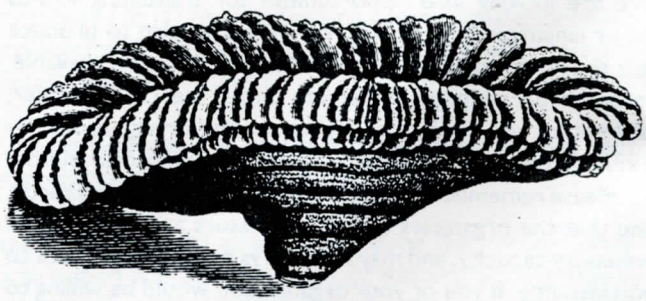
GLOBAL CORAL REEF MONITORING NETWORK

The Global Coral Reef Monitoring Network (GCRMN) is part of ICRI and is being set up to provide research and monitoring information on coral reefs and related ecosystems aimed at more efficient management and long-term conservation. It is co-sponsored by IOC, UNEP and IUCN, and based at AIMS (Australian Institute of Marine Science, Townsville) and ICLARM (International Center for Living Aquatic Resources Management, Manila), and receives expert advice from a Steering Committee with experience in science and management of coastal resources.

The concept of global coral reef monitoring has been discussed for many years. For example, in December 1991, a group of reef and mangrove experts called for immediate monitoring and selected the methods developed during the ASEAN-Australia Living Coastal Resources project as the basis for global monitoring. At the 7th International Coral Reef Symposium in Guam, 1992, many scientists and managers reported their willingness to participate in global monitoring but at that time funding was not available for a coordinated programme. A Global Task Team (IOC-UNEP-WMO-IUCN) was formed in 1992, and reported in 1994 that immediate anthropogenic impacts were more threatening for coral reefs than the potential posed by global climate change. The US State Department has funded the first year of the GCRMN coordinator through the IOC. Funding will be requested from major donor countries and organisations to run the Regional Nodes and activities in countries for up to five years.



Polyp structure of Tubipora musica



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GCRMN Objectives

The overall objective is to gather high-quality and widely distributed data on reef status and determine long-term trends resulting from global climate change and anthropogenic stresses to assist effective management and conservation. To achieve this it will be necessary to:

- establish an interacting global network of those wanting to monitor coral reefs;
- design biological, physical, social, cultural and economic monitoring programs to discriminate the causes of change and then provide training;
- assemble monitoring data into regional databases and develop predictive models for the GOOS Coastal Zone Module;
- involve local users and managers in the collection, analysis and interpretation of data for reef management at the country level;
- prepare periodic reports of reef status for major international forums and agencies;
- prepare funding proposals to ensure ongoing activities of the GCRMN.

How will the GCRMN function?

The GCRMN will function as a network of about six Regional Nodes that will coordinate and provide training and database support to participating countries and institutes. The following areas are likely to have Regional Nodes: Western Indian Ocean, Middle East, South Asia, East Asian Seas, Pacific, and Caribbean and Intra Americas. Two sub-Nodes have already been selected in the Western Indian Ocean: in Mauritius to assist the French-speaking islands, and in East Africa for continental states. Regional Nodes will be established in a country or institution that can provide the following support:

- training in standard monitoring methods, data entry and database operations;
- preparation of regional summaries; and
- transmission of regional summaries to ReefBase, the international database at ICLARM.

Each Regional Node will coordinate budgets for countries in the region, assist with funding proposals and provide a communication network. The Nodes will be located within existing organisations e.g. a Government Department (Environment, Fisheries etc.), University or Environmental Institute, prominent international organisation, or NGO. Each Node will have a coordinator and staff to provide training in monitoring of corals and fish, socioeconomic aspects of reef use in the community, and basic database operations. There may be a need to equip Regional Nodes and countries with scuba and field monitoring equipment, as well as computers. The use of local charter boats will be recommended.

The basic monitoring method will be line transects, assessing 'lifeform' categories and total fish counts, with specific counts of 'target' fish. As people gain more experience, monitoring will be performed at species level. Local communities will be questioned on their use of reef resources and how management may be improved. Institutes already monitoring reefs will be invited to cooperate with the GCRMN to have replicate assessments conducted over global scales. They will be encouraged to use the basic methodology, in parallel with existing monitoring programmes. Existing or planned Marine Protected Areas (MPAs) will be the main monitoring sites to provide data on the resources and effectiveness of management. This will be coordinated with the World Bank, IUCN/CNPPA, GBRMPA Global Representative System of Marine Protected Areas project for site selection and questions asked by MPA management.

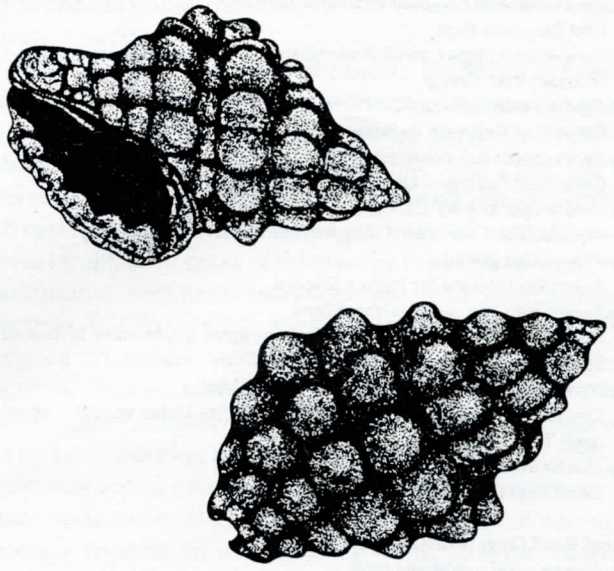
The West Indian Ocean sub-Nodes are prepared to start their monitoring programmes in the second half of 1996. A Workshop will be held during the Panama Congress (27 June), chaired by Dr Joe Connell, to discuss the development of the GCMRN.

For further information, contact: *Dr Clive Wilkinson, Coordinator, Global Coral Reef Monitoring Network, c/o Australian Institute of Marine Science, PMB No. 3, TOWNSVILLE MC 4810 AUSTRALIA. Tel: +61 77 534 372 or +61 77 724 314; Fax: +61 77 725 852; e-mail: c.wilkinson@aims.gov.au*

or

Dr John McManus, ReefBase Project Leader, International Center for Living Aquatic Resources Management, MCPO Box 2631, 0718 Makati, Metro Manila, Philippines. Tel: +63 2 818 0466 or +63 2 817 5255; Fax: +63 2 816 3183; e-mail: j.mcmanus@cgnet.com

Illustration by Doris Engelhardt



WORLD WIDE WEB UPDATE

Kristian Teleki

Like coral reefs, the World Wide Web is a dynamic environment which is subject to disturbances borne from the increasing demand for information and improvements in the latest computer and web browser technology. These disturbances happen on variable time scales and can often make addresses obsolete overnight. There is clearly a copious amount of information to be gleaned from the Internet, but slowly we are beginning to realise that with inadequate guidance or knowledge of how to access it, 'surfing the Net' can be a vastly overrated activity and a waste of time. In the last issue of *Reef Encounter* I tried to provide some guidance, but already the pitfalls of creating such a list are evident with addresses having changed. These links are meant to be a starting point from where other similar links can be reached. I am providing another list of sites of interest but, given the dynamic environment of the World Wide Web, be warned that some of these may already have changed by the time you want to access them. Therefore, your first point of contact when looking for a particular subject should be one of the search engines:

http://www.altavista.digital.com/
Altavista
http://lycos.cs.cmu.edu/
Lycos

New Links of Interest

International Year of the Reef
http://www.coral.com/IYOR/

Link Lists
http://coral.aoml.noaa.gov/coral_links.html
Excellent list of coral related links

Research
http://www.ualberta.ca/~pblancho/index.html
Reef Resource Page
http://www.uni-stuttgart.de/UNIuser/igps/researchfiles/reefgroup.html
Stuttgart Reef Group
http://www.bio.usyd.edu.au/CRRI/crri-ind.html
Coral Reef Research Institute
http://www.cofc.edu/~coral/coral.html
Coral Reef Ecology – University of Charleston
http://www.cgiar.org:80/ICLARM/
International Centre for Living Aquatic Resources (ICLARM)
http://www.aims.gov.au
Australian Institute for Marine Science
http://www.aims.gov.au/pages/cbase.html
CoralBase – A Taxonomic and Biogeographic Information System for Scleractinian Corals
http://www.ncl.ac.uk/~nmscmweb/mscm/temp.html
Centre for Tropical Coastal Management Studies, University of Newcastle upon Tyne
http://www.uvi.edu/coral.reefer/index.html
Coral Reef Ecology Page

Coral Reef Organisations
http://www.coral.org/Home.html
Coral Reef Alliance
http://www.aloha.net/~sos/index.html
Save-Our-Sea
http://www.demon.co.uk/coralcay/home.html
Coral Cay Conservation (CCC)
http://www.blacktop.com/coralforest/
Coral Forest

Miscellaneous Links
http://ucmp1.berkeley.edu/cnidaria/anthozoalh.html
Life History and Ecology of Anthozoans
http://128.200.5.5/
Cnidaria Home Page
http://crusher.bev.net/education/SeaWorld/coral_reefs/introcr.html
Sea World – Basic Coral Reef Information
http://www.earthwatch.org
Earthwatch
http://student.uq.edu.au/~s304599/acrs.htm
Australian Coral Reef Society
http://www.erin.gov.au/portfolio/gbrmpa/gbrmpa.html
Great Barrier Reef Marine Park Authority
http://www.une.edu/glover/glovindx.html
Glovers Reef Marine Research Station
http://www.earthisland.org/ei/index.html
Earth Island Institute (EII)
http://www.envirolink.org
The EnviroLink Network
http://www.edf.org
Environmental Defence Fund
http://www.si.edu
Smithsonian

Aquariums
http://makaha.mic.hawaii.edu:80//aquarium/
Waikiki Aquarium
http://www.neaq.org/
New England Aquarium
http://www.mbayaq.org/
Monterey Bay Aquarium
http://www.bendtech.com/attractions/vanaquarium/
Vancouver Aquarium

TWENTY YEARS ON – CHAGOS REVISITED

Four atolls and offshore banks in the Chagos Archipelago, central Indian Ocean, were visited by a large group of scientists earlier this year, having not seen marine or island researchers for about twenty years. This is partly because another atoll in Chagos, Diego Garcia, is home to a UK/US Defence facility, so non-military personnel generally find it difficult to obtain access to any part of the area. The opportunity to revisit was offered two years ago and so in January 1996, 30 scientists, supported by two 85 foot ketches, carried out a research programme of six weeks.

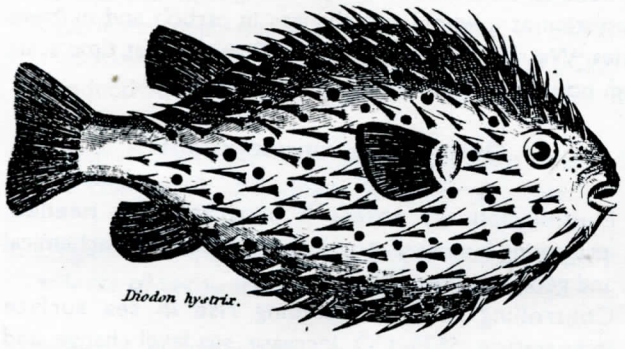
Several threads connected the research projects. Permission to visit centred on the requirement by the island's authorities of a management plan. High on the agenda for this largely uninhabited region therefore was an assessment of where Chagos is, in biogeographical terms, in the Indian Ocean; whether or not it is a stepping stone, a source or a sink for species in an ocean whose rim is seeing severe degradation. The approach taken was largely one of molecular biogeography, using insects, turtles, reef fishes, corals and shrimp. By plugging in to wider programmes, it is expected that the degree of isolation or mixing with other regions can be quantified. Extensive biological surveys and traditional taxonomic and ecological work was also done in time-honoured manner for these groups and more, but these were more or less automatic products resulting from the field work.

A span of 20 years since the area was last visited meant that change over this period could also be assessed, an important time span for an area so unaffected by disturbance, and which is the most distant of all, in this ocean, from any significant industrial or other human activity. Changes on reef slopes were measured, and island vegetation and bird changes were assessed. In general, the islands' natural Indian Ocean hardwood trees are gradually recovering and replacing the coconut introduced when copra was a globally important product. A peat bog discovered 20 years ago was cored for analysis of its fossil pollen and hence pre-man vegetation. Nutrient exchange between island and reef, mediated mainly by birds, was also examined, and several marine and island botanical and productivity projects, some coupled with remote sensing, are attempting to derive estimates of atoll-scale production.

Several unexplained geological aspects of the islands and alleged raised reefs were examined, with fossil rocks, corals and soils recovered for dating. Additionally, a *Porites* coring programme recovered cores for estimating past sea temperatures. This is particularly important in Chagos, given that this region is now thought to be important in the early stages of ENSO events.

Because Chagos is the most remote part of the tropical Indian Ocean, further projects examined species and sediments for trace contaminants. Given that perhaps half of all contaminants entering the marine system come via airborne and aerosol routes rather than from direct discharges, use will be made of Chagos to determine background levels of the world's equatorial region. The results may be salutary. Generally, the condition of the reefs and islands is extremely good. Its uninhabited nature has sheltered it from the problems affecting many Indian Ocean reefs. Its management presently is easy, given the difficulties of reaching it. And no, there was no coral bleaching. Perhaps it can remain an oasis in the desert.

Charles Sheppard, Department of Biological Sciences, University of Warwick; e-mail: sh@dna.bip.warwick.ac.uk



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REEFBASE

REEFBASE 1.0 – CORAL REEF INFORMATION ON CD-ROM

Over 3,700 publications related to studies of coral reefs and their resources have been published since 1978 when the first International Coral Reef Symposium was held in India (ASFA, 1978-95). However, for every published paper in abstracted journals, there are probably more than ten others which were published for local or restricted distribution or never published at all (theses, dissertations, environmental impact assessments, consultancy reports, student surveys, project reports etc.). Lately, multi-disciplinary approaches to the study of coral reef systems have considered the ever growing human populations dependent on these systems. Information on human behaviour, and the political, socioeconomic, and cultural variables which can be used in assessment, prediction and potential management are becoming an important part of the coral reef literature.

ReefBase has been created for scientists, academics, students, resource managers in government and private institutions, divers and other coral reef enthusiasts and the primary objective is to facilitate the informed management of coral reefs. The Version 1.0 CD-ROM is the first release, two and a half years after the project was formally started in November 1993, and is designed to be run on fast 486 or Pentium PC's. It is the preliminary result of our efforts to summarize available knowledge about coral reefs in a simple, compact package.

Like an electronic encyclopaedia, ReefBase presents information on coral reefs in a relational database designed to accommodate the full spectrum of coral reef related references. The reef is the basic unit, and coverage is necessarily very broad, including ecological surveys on benthic and reef fish communities, existing stresses on reefs, harvest values for different types of fisheries by reef, coastal tourism. mariculture activities, oceanography and management practices. ECOPATH 3.0, the ICLARM developed software designed to model aquatic ecosystems is attached as a ReefBase feature and the RAMP (Rapid Assessment of Management Parameters) sub-database on coral reef related human behaviours has also been incorporated. With ReefBase, a user may access country related information on protected areas, socio-economics and fisheries and prepare country summary reports on ecological variables, stresses, coastal tourism and harvest based on the reef records.

A simple but powerful query system designed to answer a wide range of questions is installed into this first ReefBase release. This feature allows a user to search the database for reef records that match the specifications set in a query

statement created by simply clicking on choices within list boxes. For example, a user may choose to list all reefs where destructive fishing practices and coastal tourism both occur. Entries in the Year and Country/Region sections set spatial and temporal limits to the query statement. Thus, clicking on Caribbean and 1986-1996 would limit our previous query to the past ten years. The system would then calculate the mean and standard deviation for numeric fields and print out a summary that would include fields that the user specifies in the report form options.

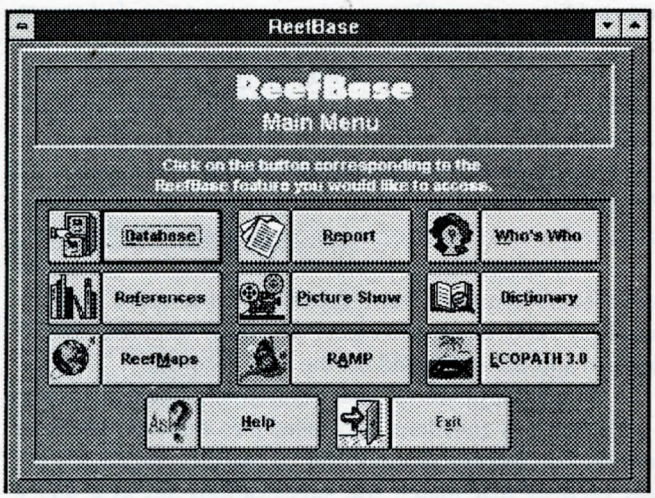
We have tried to make ReefBase 1.0 as comprehensive and user-friendly as possible by adding visual features such as aerial, underwater, and land-based photographs and satellite images. The donation of photographs from many sources has greatly enhanced this feature. We have also included a series of about 150 standard-format reef maps prepared by the World Conservation Monitoring Centre (WCMC). These maps show land and sea areas, simple bathymetry, coral reefs and mangrove forest, and are fully referenced to enable the user to assess the quality and reliability of the source information. These maps comprise the most extensive collection of coral reef maps available, and they are accessible by either zooming in from world and regional maps, or by jumping from an information form on a reef to a relevant map. WinMap, an enhanced version of the low-level geographic access system first introduced in FishBase, provides geographic displays of data in ReefBase, such as the locations of all recorded bleaching. WinMap also provides a means of accessing data geographically; for example, clicking on a dot representing a given reef stress brings up the information on the occurrence.

The release of ReefBase 1.0 would not have been possible without the financial support of both the European Commission, which funded the initial phase of the project, and the Netherlands Government, which has provided funding since September 1995. We also acknowledge the donations of material, photographs, literature and databases from researchers and other private individuals, institutions and government and non-government organizations who have enthusiastically replied to our call for assistance. We acknowledge that this first release will have errors and room for improvement. We would greatly appreciate any comments and suggestions you would have on the data and structure of ReefBase so that next year's Version 2.0 release will be as useful as possible to those who need it.

ICLARM Contribution No. 1269

For further information, please contact: *John W. McManus, ReefBase Project Leader, International Center for Living Aquatic Resources Management (ICLARM), MCPO Box 2631, 0718 Makati, Metro Manila, Philippines. Fax: (63-2) 816-3183. Email: j.mcmanus@cgnet.com*

For matters related to maps and charts: *Mark Spalding, ReefBase Project Co-Leader, World Conservation Monitoring Centre, 219 Huntingdon Road, Cambridge CB3 0DL, U.K. Fax: +44 (0)223 277136 Email: mark.spalding@wcmc.org.uk*



MEETING REPORTS

INTERNATIONAL WORKSHOP ON RESPONSE OF CORAL REEFS TO GLOBAL CHANGES

This meeting took place 4–6 March, 1996 at Tsukuba, Japan. Thirty-two reef and marine scientists were invited from the U.S., Australia, France, Philippines and Japan. The workshop objective was interdisiciplinary identification and evaluation of new research fields, and prediction of responses of coral reefs to global changes with a time scale of 100 years. Eighteen talks were given at an open symposium and a closed expert workshop was held on 6 March to discuss the future research plan and compile the implementation plan.

Goal: To predict the response of coral reef ecosystems to global climatic change in the next century.

To predict responses of coral reefs to climatic changes for their preservation, management and sustainable development, we need to evaluate and predict responses of a coral reef ecosystem as a whole and changes in carbon and nutrient cycles. We should approach the 100-year target time scale from both longer and shorter time scales.

Overarching considerations:

- Multidisciplinary research programs are needed, integrating biological, physical, chemical, biogeochemical and geological disciplines;
- Controlling factors, including rise in sea surface temperature (SST), CO_2 increase, sea level change, and accompanying changes in nutrient cycles, should be considered, particularly changes in SST and nutrient cycles related to ENSO.
- Suitable subjects for study: coral reef ecosystems including various reef organisms (corals, seagrass, algae, fishes,

invertebrates); carbon and nutrient cycles in coral reefs; and fluxes between atmosphere, land and ocean.
- Time scale: long-term (over 10 years) studies to understand natural variability (bleaching, response to stress, reproductive cycles) are needed. A shorter time scale approach by observation and a longer one, based on geological studies, should be integrated.
- The space scale should range from aquariums to the field. A broad geographical scope of field studies (pan-tropical) is necessary. The Ryukyus could provide a valuable transect to demonstrate environmental variations. To cover the vast area we should consider construction of a network of stations across the entire environmental gradient of interest, and possible use of research vessels.

Recommended research plans:

1. Geological Studies

- Reconstruction of SST, precipitation, CO_2, nutrient cycles by coral band analysis with a high time resolution (months);
- Analysis of past global climate change related to specific geological events (termination of glacial age);
- Change in reef geomorphology and community structure with past climatic changes;
- Change in carbon and nutrient cycles with past climatic changes.

2. Physical Processes

- Dynamics of fine sediments with changes in wave and current stress;
- Study of the circulation of the South China Sea from the Philippines to Japan to understand larval transport and predict changes through climate forcing;
- Changes in upwelling due to heat flux increases, ENSO and other altered circulation patterns;
- Changes in precipitation and related runoff effects (nutrients, sediments,etc.).

3. Biogeochemical

- Carbon: primary production, calcification and related air-sea CO_2 fluxes;
- Nutrients: supply demand and export of C, N and P;
- Mesocosm experiments to study the effects of pCO_2 on productivity and calcification of reef organisms and communities;
- Organism studies of the processes and mechanisms for recording pCO_2 and temperature in coral bands.

4. Organism Responses (i.e. experimental study of effects of temperature and UV on corals)

- Influence of temperature on coral growth, respiration and carbon uptake/release;
- Comparative bleaching and other physiological responses of corals and algae (effect on primary producers);
- Long term experiments on shifts in thermal tolerance of corals;
- Experiments to mimic the magnitude and form of expected natural changes in thermal or light stress;
- Larval survival under UV stress.

5. Community Responses

- Natural experiments at "hot spots", i.e. sites that have a high probability of thermal excursions in the near future;
- Experimental heating of lagoons or reef flats;
- Mesocosm experiments to manipulate community responses;
- Effect of temperature over an entire year on processes such as reproductive cycles along north-south gradients;
- Calcification dynamics and community changes in relation to sea level rise;
- Changes in community composition and effects on various community components and characteristics (productivity rates, species composition, guilds, "keystone" species).

For further information and for copies of the abstracts and proceedings (published as separate volumes), contact: *Hajime Kayanne, Dept. Geography, Univ. Tokyo, Tokyo 113 Japan. Tel: +81-3-3812-2111 (ext. 4573); Fax: +81-3-5684-0518; e-mail: kayanne@geogr.s.u-tokyo.ac.jp*

CORAL REEF FISH GET RED LISTED

Patricia Almada-Villela

For the first time, a group of 31 scientists from nine countries met during 29 April–1st May 1996 at the Zoological Society of London to examine the status of marine fishes for inclusion in the IUCN Red List of Threatened Animals. The meeting was sponsored by WWF's Endangered Seas Campaign, IUCN-The World Conservation Union and the Zoological Society of London. The workshop, organised at very short notice, had three objectives: a) to evaluate the applicability of new threatened species criteria to marine fish; b) to evaluate candidate marine fish for inclusion in the 1996 Red List and c) to develop recommendations for inclusion of marine fish issues within the IUCN Species Survival Commission programme.

A broad range of species were assessed and to achieve this workshop participants were divided into four groups: coral reef fish, seahorses and pipefishes, tuna/billfish/sharks, and other teleosts. Participants in the Coral Reef Fish working group included: Don McAllister (Coral Reef Fish Specialist Group(CRFSG)/Ocean Voice International), Patricia Almada-Villela (CRFSG/Ocean Voice International), Callum Roberts (University of York/CRFSG), Sue Wells (CRFSG), Elizabeth Wood (Marine Conservation Society/CRFSG), Yvonne Sadovy (University of Hong Kong), and Gene Huntsman (National Marine Fisheries Service). Arturo Acero (Universidad Nacional de Colombia) provided information on some species and Elodie Hudson (Zoological Society of London) provided assistance with data input and applying the new criteria.

A total of 148 species, representing 40 families and 18 orders, were examined in detail by the workshop, of which 118 were classified as threatened globally. Of these, 62 were evaluated by the coral reef fish group. Three species of reef fish were classified as critically endangered: *Epinephelus drummondhayi* (Speckled Hind), *Epinephelus itajara* (Jewfish) and *Epinephelus nigritus* (Warsaw grouper). Three were listed as endangered: *Anisotremus moricandi* (Brownstriped grunt); *Epinephelus striatus* (Nassau grouper); *Pagrus pagrus* (Red porgy). A further 42 were listed as Vulnerable, 9 as Data Deficient and 3 as Lower Risk (near threatened). Twenty eight of the fishes considered as Vulnerable were included as such on the basis of their highly restricted distributions and current threats to reef habitat within their ranges. Species with wider distributions included the Humphead Wrasse (*Cheilinus undulatus*), Hogfish (*Lachnolaimus maximus*), Mutton Snapper (*Lutjanus analis*), Cubera Snapper (*L. cyanopterus*), Rainbow parrotfish (*Scarus guacamaia*) and Queen Triggerfish (*Balistes vetula*). A report of the full workshop has been produced by the Zoological Society and is available directly from them.

It is likely that the list of reef fishes at risk will increase as a result of better knowledge of the status of these fishes around the world. To this effect, the IUCN CRFSG is currently carrying out a global assessment of the conservation status of the reef fish fauna. One of the Group's projects is a Country Survey of the Status of Coral Reef Fishes and Habitats, which involves the collection and analysis of information on a country by country basis. Results from this study will be reported in a World Status Report which, together with other components of the Group's programme, will result in an Action Plan for the Conservation of Coral Reef Fishes.

The Coral Reef Fish Specialist Group will be very grateful for any further information on coral reef fishes at risk from any knowledgeable individuals, groups or agencies. Please send information to: *Dr Patricia Almada-Villela, Co-Chair, Coral Reef Fish Specialist Group. 60 Newington, Willingham, Cambridge CB4 5JE, UK. Tel: +44 0-1954 260520; Fax: +44 0-1954 202291; email: palmada@aquacon.demon.co.uk.*

Copies of the meeting report can be obtained from *Elodie Hudson, Institute of Zoology, Zoological Society of London, Regent's Park, London, NW1 4RY, U.K. Fax. +44 (0)171 483 2237; e-mail e.hudson@ucl.ac.uk.*

BOOK REVIEWS

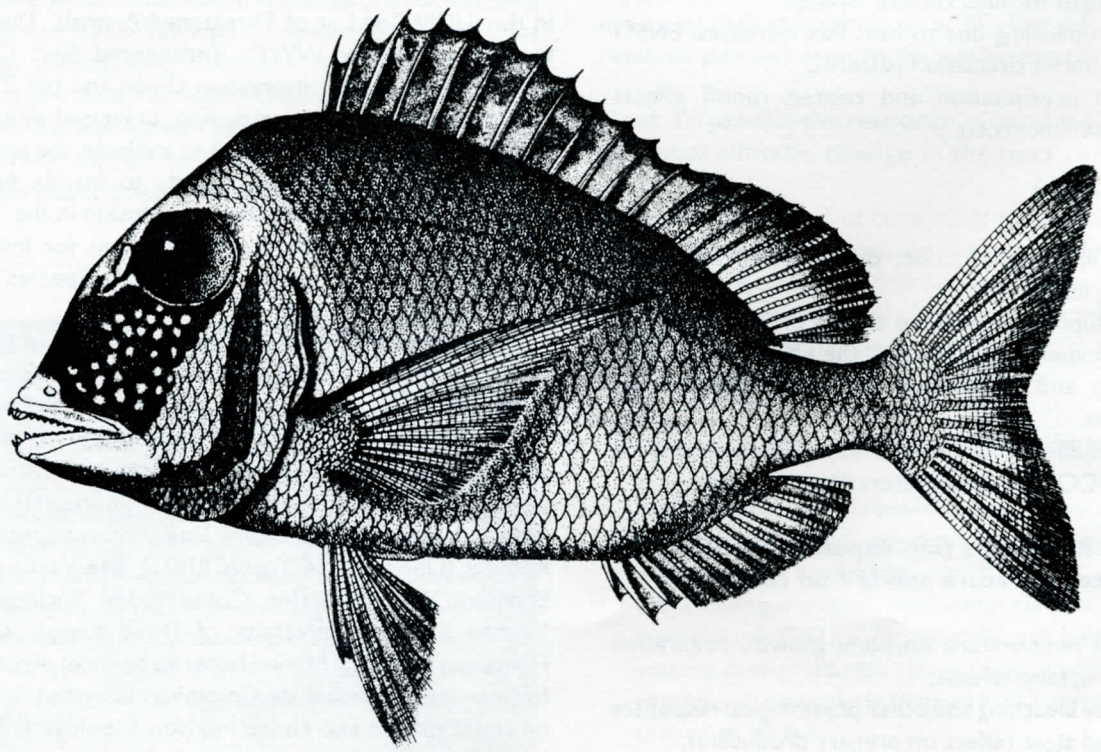
CORALS IN SPACE AND TIME

J.E.N. Veron

321 pp. ISBN 0 86840 390. 1995. The University of New South Wales Press. Available from Australian Institute of Marine Science, Fax 6177-716135. Price Au$34.95 plus Au$4 postage.

Two aspects of Dr Veron's book are testable by molecular methods. The first is his proposal that evolution in corals is primarily 'reticulate' i.e. it follows a net-like pattern of evolutionary paths rather than the familiar branching trees of Darwinian evolution. The second is his links between coral systematics and the fossil record (expanded in Veron *et al.* 1996, a review article in *Coral Reefs*).

These two subjects are of considerable ongoing importance to coral morphological taxonomy, molecular systematics and palaeontology. The issue of reticulate evolution represents a major paradigm shift that goes to the theoretical basis of coral taxonomy and systematics, our understanding of what coral biodiversity really means,



Calamus pennatula *Cuvier and Valenciennes 1830*

how species distinctions are maintained in nature, and what the real needs of coral conservation are. The linking of the fossil record to taxonomic and genetic studies of living organisms is well advanced through the work of Veron and his colleagues and will be a major milestone in invertebrate systematics.

Virtually all understanding of the mechanisms by which species are formed, how species are interrelated, and how they are maintained as taxonomic entities, come from terrestrial biology and genetics. In the ocean, Veron proposes that surface currents are the pathways of genetic connectivity and it is the changing patterns of ocean currents, correlated with glacial intervals, that primarily drives changes to the genetic composition of populations, races and species. Darwinian natural selection is a secondary process. This major paradigm shift predicts that few species can exist as genetically isolated units, that binominial nomenclature does not serve to distinguish these units, that species-based studies of all kinds (laboratory and field) are open to a wide range of qualification, that cladistics based on morphology is fundamentally faulted and that 'molecular clocks' are unlikely to yield meaningful results.

Corals are by far the best group of organisms to study concepts as fundamental and as wide-ranging as that described above. The taxonomy and biogeography of corals has a solid Indo-Pacific-wide foundation. The Plio-Pleistocene fossil record of Indo-Pacific species is well-known. The reproductive behaviour of corals is known in detail not found in other marine invertebrates. Genetic methodologies have now been well established for corals. This work has been primarily undertaken in Townsville (AIMS and James Cook University) by Veron and his colleagues.

STROMBUS GIGAS: QUEEN CONCH BIOLOGY, FISHERIES AND MARICULTURE

Richard S. Appeldoorn and Bladimir Rodriguez (eds)
Fundacion Cientifica Los Roques, Caracas, Venezuela. 1994. 358 pp. ISBN 980-6200-84-5. Available from: Distribuidora locus, No. 9497 POBA International No. 100, P.O. Box 02-5225, Miami, Florida, 33102-5255, USA. Price US$30.00 (USA and Caribbean), US$45.00 (other continents). Cheques payable in US dollars to the above address.

Seen from below the Queen Conch is an extraordinarily beautiful mollusc; from above it looks like an algal covered rock slowly ambling through meadows of seagrass, peering from below the lip of its shell through beady eyes mounted on mobile stalks. The conch is distinguished among molluscs in having the ability to turn algal skuz into delicious flesh, and there lies its downfall. It features prominently within the cuisine of virtually every Caribbean nation.

The conch lives in shallow waters of the Caribbean, often within wading depths and almost entirely within snorkelling distance. For hundreds of years the people of the region have been snacking on conch *ad libitum*. However, with the advent of commercial fisheries the conch's lifestyle has made it highly vulnerable to overfishing. It has suffered precipitous declines throughout its range transforming populations from dense aggregations of gregarious snails into scattered wanderers roaming the plains in search of lonely mates. This sorry history of overfishing and stock collapse has led to the recent listing of conch on Appendix II of the Convention on International Trade in Endangered Species (CITES).

This book brings together contributions from the foremost conch scientists and managers in the Caribbean and derives from a meeting of the same name held in July 1991 in Caracas, Venezuela. 17 of the chapters are in English with a further 8 in Spanish. They cover almost every aspect of the biology, exploitation and management of conch and the volume provides an excellent review of this species. The book describes how throughout the Caribbean efforts are now underway to rebuild conch stocks, and to supplement wild sources with mariculture projects. Both efforts have had only mixed success to date. Several chapters reveal that even the most obvious management measures have often been applied too late, or have not been properly enforced. In many places moratoria on fishing have been the final solution to chronic mismanagement of stocks. Mariculture efforts have had successes and failures. Large scale hatching of conch eggs and production of post-larvae are now routine, but the high costs of feeding juvenile conch still preclude the economic production of individuals large enough to be sold. The survival of hatchery-reared juveniles released into the wild to help restock depleted populations has been disappointingly low. Nevertheless, there have been vigorous efforts to overcome both problems, notably by Alan Stoner and colleagues working in the Bahamas.

While the Queen Conch is restricted to the tropical Atlantic, those interested in the biology and management of molluscs in the Indo-Pacific will find much to interest them. There are numerous exploited congenerics in the Indo-Pacific, as well as close analogues of Queen Conch within the genus *Lambis*. Richard Appeldoorn and Bladimir Rodriguez are to be highly commended on a fascinating and useful book. We can only hope that fishery managers will take heed of the experiences described and act fast to place management of this wonderful species on a sustainable footing.

Callum Roberts

BOOK SHELF

CORALS OF OMAN

Steve L. Coles
106 pp., 82 colour plates. 1996. ISBN 0 9527446 0 0. Richard Keech, Thornes, Hawes, North Yorkshire DL8 3LJ, U.K. Available from the author in English or Arabic for US$15.00 including surface postage, or +US$4.00 by air. Bernice P. Bishop Museum 1525 Bernice St., Honolulu, HI 96817, USA. Tel. 001-808-847-8256; Fax: 001-808-847-8252; e-mail: slcoles@bishop.bishop.hawaii.org

The Oman coastline includes the southern Arabian Gulf, the shores of the Gulf of Oman, and the Arabian Sea coast

extending nearly half way to the southern tip of the Arabian Peninsula. The corals that inhabit these waters are exposed to one of the most unusual physical environments in the world. High summer water temperatures and large annual temperature ranges occur along the northern shorelines, in contrast to low summer temperatures and elevated nutrient concentrations and algal blooms in waters affected by Arabian Sea upwelling. Depending on the area where they occur, corals may be continuously exposed to temperatures well above 30°C or less than 18°C during the summer months, or they may routinely experience daily temperature variations of more than 8°C.

This book summarizes the environmental characteristics of the four coastal areas of Oman where corals occur. Descriptions of the common species of hard and soft corals follow, with colour photographs provided for each species. The ecological factors affecting growth and survival of corals in Oman are then described and the natural and man-related disturbances to Oman's corals and coral reefs are discussed. The book is written to provide the layman with the essential knowledge for understanding and identifying Oman's corals and coral reefs, but it also provides the professional coral biologist with much information not previously available for this relatively unknown area. It will hopefully stimulate interest in the ecology of corals in this region and promote measures for their protection.

CHARTING PAPUA NEW GUINEA'S COASTAL RESOURCE DEVELOPMENT: LESSONS FROM A PARTICIPATORY WORKSHOP
COASTAL RESOURCE ISSUES IN PAPUA NEW GUINEA: A PHOTO TEXT COLLECTION

Available from Greenpeace Pacific, Private Mail Bag, Suva, Fiji, for US$8.95 each or US$14.95 for the pair. At least the latter can also be obtained from Tory Read, Greenpeace, 568 Howard Street, San Francisco, CA 94105.

The first is a 67-page booklet that chronicles planning for, implementation of, and the follow-up to a workshop held in 1993. It was written "so that others could learn from the experience," to quote the foreword. Its focus is, therefore, human interactions, and the environmental issues that were the *raison d'etre* for the workshop receive little attention. These are given more attention in the second companion, 55-page booklet. For a copy of the proceedings of the PNG coastal resources management workshop, write to Biodiversity Support Program, 1250 24th Street NW, Washington, DC 20037 USA.

MARINE/COASTAL BIODIVERSITY IN THE TROPICAL ISLAND PACIFIC REGION

Vol. 1 Species Systematics and Information Management Priorities

Ed. J.E. Maragos, M.N.A. Peterson, L.G. Eldredge, J.E. Bardach, and H.F. Takeuchi

Vol. 2 Population, Development and Conservation Priorities

Ed. L.G. Eldredge, J.E. Maragos, and P.L. Holthus

Available from: Publication Sales Office, East-West Center, 1777 East-West Road, Honolulu, HI 96848, USA. Fax: 808-944-7376; e-mail: ewcbooks@ewc.bitnet

These are the proceedings of two workshops held in November 1994. Vol 1 is available now, and Vol. 2 should appear later this year. Further information from: *L.G. Eldredge, Pacific Science Association, P.O. Box 1900, Honolulu, HI 96817, USA. Tel: (808) 848-4139; Fax: (808) 847-8252; e-mail: psa@bishop.bishop.hawaii.org*

ANNOUNCEMENTS

SOCIEDAD MESOAMERICANA PARA LA BIOLOGÍA Y LA CONSERVACIÓN

The Sociedad Mesoamericana para la Biología y la Conservación (Mesoamerican Society for Biology and Conservation) was formed on 14 January 1996, at Lake Yojoa, Honduras, by a group of biologists from five countries and numerous branches of the biological sciences. The new society, the first of its kind in Mesoamerica, will serve biologists and conservationists throughout Central America and southern Mexico.

Members will receive the quarterly news bulletin *Mesoamericana* which will include news in Spanish and English of current projects, meetings, and literature, as well as biographical sketches on founding members, and short, non-technical articles of general use to biologists working in Mesoamerica. The Society initially intends to publish technical articles in proceedings of annual symposia or congresses. The first issue of *Mesoamericana* will be published in June 1996. The first meeting is planned for 21–22 June 1996, at the Universidad Nacional Autónoma de Honduras, Tegucigalpa, when the Society's membership will approve its statutes and elect a board of officers and trustees. The meeting includes a one-day symposium on Mesoamerican biology, with invited papers and an open poster session.

The cost of basic membership is US$20 for 1996 (includes 3 issues of *Mesoamericana*). Founding memberships will be available only through the end of 1996. Founding members (US$50) and founding institutions (US$200, which includes a subscription to the bulletin) will be acknowledged in the bulletin. Donations larger than US$200 are welcome, and donors will be recognized in print as benefactors.

Membership fees or other donations may be sent to: *Oliver Komar, Department of Zoology, Ohio Wesleyan University, Delaware OH 43015. Tel. (614) 369-0175; e-mail: ookomar@cc.owu.edu* Checks should be made out to "Mesoamerican Society for Biology and Conservation" or "Sociedad Mesoamericana para la Biología y la Conservación."

Mesoamerican residents have lower membership costs, and should contact the acting secretary: *Silvia C. Chalukian, Departmento de Recursos Naturales y Conservación Biologica, Escuela Agricola Panamericana, Apartado 93, Tegucigalpa, Honduras. Tel. (504) 76-6140; fax (504) 76-6234; e-mail eapdrn@ns.hondunet.net or eaphpcs@ns.hondunet.net*

For more information about the bulletin, contact the editor: *Carlos René' Ramirez Sosa, 4a. Avenida Sur #1, Apopa, San Salvador, El Salvador. Tel: (503) 336-0152; e-mail: crrlc@cunyvm.cuny.edu*

SCOR WORKING GROUP 104 – CORAL REEF RESPONSES TO GLOBAL CHANGE: THE ROLE OF ADAPTATION

The objective of this SCOR (Scientific Committee on Oceanic Research) working group is to issue a major series of papers addressing the mechanisms of acclimation and adaptation that have enabled corals and reef communities to persist through the climatic and environmental changes of the Quaternary, and to discuss how these mechanisms relate to present-day anthropogenic and climatic stresses.

The target date for working group completion is late 1997-early 1998. The Working Group will meet at the 8th International Coral Reef Symposium in Panama (in June 1996) to identify key issues, authors, and specific implementation plans and schedules. Because of the breadth and importance of the topics being addressed, the Working Group actively solicits input and participation from interested members of the research community. At the ICRS8 meeting a day-long workshop will be held on Thursday June 27. This workshop is open to all interested parties; it will generally be structured around discussions of specific topical areas led by members of the Working Group, with the intention of providing a forum for general presentation of ideas or identification of issues. A tentative agenda will be available at the Symposium.

Anyone wishing to promote or introduce discussion of a specific topic related to the purpose of the workshop should contact one of the organizers, R. W. Buddemeier or R. D. Gates, at the Congress. Contact or submission of relevant material outside of the ICRS8 is also encouraged. For additional background information on the working Group, see:

Buddemeier, R. W. 1995. Coral Reef Responses to Global Change: The Role of Adaptation: SCOR Working Group104. *Reef Encounter* 17:19-21.

or http://ghsun1.kgs.ukans.edu/welcome.html.

R. W. Buddemeier, Kansas Geological Survey, University of Kansas, 1930 Constant Avenue, Lawrence, KS 66047, USA. Tel. (913) 864-3965; Fax: (913) 864-5317; e-mail: Bob_Buddemeier@msmail.kgs.ukans.edu

POSTER MAP: CORAL REEFS AND MANGROVES OF THE WORLD

A poster map showing the global distribution of coral reefs and mangroves has been produced by the World Conservation Monitoring Centre, generously supported by BHP Petroleum. The aim of the poster is primarily as an educational and awareness-raising tool for high-school students and the wider public, and its production coincides with the International Year of the Reef. Illustrated text boxes cover reef definitions, biodiversity issues, and the threats facing coral reefs and mangrove forests. Free copies of the map will be given to all of the participants of the ICRS in Panama. A further 4000 copies will be available for distribution (including 500 in Spanish). It is hoped to get these into the hands of people who will really benefit (eg. schools, NGOs, local communities, *particularly those in developing countries*). Funding is limited, but there should be sufficient to supply multiple free copies to NGOs and other user groups on request (large organisations may be asked to cover postage costs). Please get in touch if you are interested, and pass this message on. Applicants should give information on how they will further distribute copies. Given funding restraints it may not be possible to respond to requests from individuals.

Please contact: *Information Officer, World Conservation Monitoring Centre, 219 Huntingdon Rd, Cambridge, CB3 0DL, UK. Tel: +44 (0)1223 277314; Fax: +44 (0)1223 277136; e-mail: info@wcmc.org.uk*

DIARY

Conferences

25-29 November 1996, Townsville, Australia,
GREAT BARRIER REEF: SCIENCE, USE AND MANAGEMENT

This major international scientific conference will review and report on contemporary scientific research and future initiatives in a range of human use, management and ecological issues. It will be hosted by the Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef (CRC) and Great Barrier Reef Marine Park Authority. It will follow precedents set by the 1983 inaugural reef science conference of the CRC also held in Townsville. The aim is to look through a public window of more than a decade of marine research and to bring together the present state of knowledge on how reef systems work in response to human influence and use. A key result of the conference will be the setting of common goals and research priorities for science to help support management and wise use of the Great Barrier Reef.

Conference themes include: pressures on reefs, islands and cays; changing world heritage area values; people and the reef; effects of mainland activities; and oceanography and reef connectiveness. Leading Australian marine scientists will address the conference and all participants are invited to submit short poster papers for publication in the proceedings. Registration costs per person will be kept to a minimum of A$250, allowing for increased participation by coral reef and other marine scientists. For further information contact: *Ms Jan Crossland, GBR'96 conference secretary, Great Barrier Reef Marine Park Authority, PO Box 1379, Townsville, Qld. 4810. Tel. (077) 500 700; Fax (077) 72 6093; e-mail: jan_crossland@gbrmpa.gov.au*

MEMBERSHIP

The annual subscription for individual membership of ISRS is currently US$60, provided renewal payments are made by 1st March each year. Individual and Family Members receive the journal *Coral Reefs*, the newsletter *Reef Encounter* and other periodic mailings. Family membership is US$70. Student membership costs US$10 and benefits include all of the above except the journal *Coral Reefs*.

Members outside Europe should add US$20 for airmail delivery of *Coral Reefs* (copies will otherwise be sent surface mail).

Renewals received between 1 March and 30 April will cost US$20 for a student member, US$70 for a full member and US$80 for a family membership. Those received after 1 May will cost US$25, US$80 and US$90 respectively. New memberships will be at the base rate of US$10, US$60 and US$70 regardless of what time of year they join.

Institutional subscriptions to *Coral Reefs* must be placed directly with Springer-Verlag.

Subscriptions to the Society should be addressed to: *International Society for Reef Studies, P.O. Box 1897, Lawrence, Kansas 66044-8897, USA.*

NOTES FOR CONTRIBUTORS

The aim of *Reef Encounter* is to provide a magazine-style newsletter on any aspect of reefs, the livelier the better. In addition to news, meeting and expedition reports and announcements, we aim to have discussions and debates about particular issues concerning ISRS or the broader field of reef science in general. *Reef Encounter* does not publish original scientific data, so please do not submit such papers. The newsletter aims to complement the journal which carries scientific papers, in that it provides an outlet for book reviews, discussion of issues of general interest and a correspondence column (Upwellings). It also carries short reviews of recent trends and developments in reef research or events that bear on reef studies. In the tradition established by the first editor, *Reef Encounter* is cheerfully illustrated, with cartoons, newpaper cuttings and other entertaining material.

Please note that *Reef Encounter* is an entirely voluntary effort. We do not have funds to pay authors, and the editors are also unpaid. Please help ISRS by submitting material on a regular basis and in a form that does not require too much editing.

To save time and postage, we shall not normally acknowledge submitted material and this will not normally be refereed or returned for corrections. Opinions expressed and errors of fact will have to remain largely the authors' responsibility. No published item should be taken as ISRS opinion unless indicated.

Please help by sending items of not more than 2,000 words in length and in double-spaced typescript or, preferably, on diskette or by e-mail using Wordperfect or DOS-Text and in an IBM compatible format. You can expect some gentle editing for flow and sense and to address our readership as appropriately as possible. Illustrations should be of a size compatible with our format. Black line drawings are preferable. Diagrams should have legends and/or captions to explain all symbols, abbreviations and shading patterns etc. Maps should have a scale and indication of orientation. Use *World List* abbreviations in references. Please use metric, or imperial-with-metric units, but not imperial units on their own. Do not forget to give your name and full address, or any other contact address where applicable.

We have no regular reprint system, but contributors will receive a free copy of the relevant issue.

DEADLINE FOR COPY FOR REEF ENCOUNTER 20 (DUE OUT DECEMBER 1996) IS 1 OCTOBER 1996; please send to:

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Fax: +44 1904-432998
Phone: +44 1904-434066
e-mail: cr10@york.ac.uk

or

Until mid-September 1996, Sue Wells can be contacted at:

Coastal Resources Center
University of Rhode Island
Narragansett,
RI 02882-1197 USA

Fax: (401) 789-4670

Camera-ready copy produced by: The Nature Conservation Bureau, 36 Kingfisher Court, Hambridge Road, Newbury, RG14 5SJ, UK.

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I/we enclose a cheque (in US$ ONLY please) of *:

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Bank drafts and cheques to be made payable to: INTERNATIONAL SOCIETY FOR REEF STUDIES. If a receipt is required, please request it at the time of payment.

Send completed application form and your cheque to: *International Society for Reef Studies, P.O. Box 1897, Lawrence, Kansas 66044-8897, USA.*