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REEF ENCOUNTER

Newsletter of the International Society for Reef Studies

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NEWSLETTER OF THE INTERNATIONAL SOCIETY FOR REEF STUDIES

Editor Sue Wells
Associate Editors Maggie Watson and David Obura

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COPY DEADLINE FOR REEF ENCOUNTER 23 (due out July 1998) IS MAY 1st 1998

The **International Society for Reef Studies** was founded at at 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.

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EDITORIAL

With this issue of Reef Encounter, we say good bye to the Nature Conservation Bureau which has produced the newsletter since issue No.5 in 1989 and which has given us invaluable service, putting up with missed deadlines, late copy, and last-minute changes, and always with good humour. Particular thanks to Martin Harvey who has been very patient in recent years as the editorial team has changed and moved countries several times. We have decided to move production of Reef Encounter to Allen Press, which ISRS already uses for membership services and mailings. We look forward to working with them. We are also taking advantage of this to introduce some new design features. We may go further with the process—let us know if you have any strong feelings about this, or any good suggestions that we should consider.

This issue features a thought provoking essay on disposable income in Asia by Chuck Birkeland whilst our currents section has something of a Caribbean flavour, with a focus on White Band Disease and the newly emerging Rapid Wasting Disease, balanced with a article about cold water corals in the North Atlantic. Those with access to the email discussion group Coral-List will have seen the growing controversy over Rapid Wasting disease, which some scientists claim is in fact *Sparisoma viride* bites. Advocates of the disease say it continues to spread on corals kept in buckets. Others ask if microbial organisms could dissolve coral skeletons at the reported rate. Is it one, or the other or both? Opinions are divided and Reef Encounter hopes to bring readers another viewpoint in the next issue. One point of clarification is required about the content of Reef Encounter. In the last issue, we published a long article which Ken Sebens kindly provided. One or two people queried whether this would not have been more suitable for the journal **Coral Reefs**. We think that in this instance we were justified in putting it in the newsletter, but we would like to remind potential contributors that we do not publish original scientific data. Further details are given in the 'Notes for Contributors' on the back cover of each issue.

As contributors to Reef Encounter will have noticed, Maggie is now taking on most of the work involved in putting together the newsletter, as I find it increasingly difficult to put in the necessary hours. We therefore think it is time to recognise her efforts, and designate her as Editor. David will continue as Assistant Editor and, for the time being, I will continue as part of the Reef Encounter team. However, I have recognised that I will shortly need to stand down, and this has created a slight problem for ISRS. Both Maggie and David are working in countries where communications are not always entirely reliable, particularly the mail service, and where natural events, such as hurricanes, can wreak havoc with deadlines. It is essential to have someone on the editorial team based in a country where such things are reliable, and who can keep the production schedule moving when Maggie and David are out of contact. We have recently received one offer of help (and would welcome others) and so there may be a new addition to the team for the next issue.

S. Wells, M. Watson, D. Obura

ISRS COMMENT

From the President

Since my last report to you in this space in July, coral reefs continue to remain high profile in the popular and scientific press. The first synoptic global survey of human impacts on coral reefs was carried out between 14 June and 31 August, 1997 for Reef Check (see **International Initiatives**). Reef Check involved surveys of 250 reefs in 30 countries by 150 teams—all volunteers. Preliminary Reef Check results were announced at an international press conference in Hong Kong on 16th October 1997. All coral reefs showed signs of human activities, and few reefs were in excellent condition. No pristine reefs were found. Even very remote reefs had been heavily fished for sharks, lobster, giant clam and, most worrying, large predator fish species such as grouper and sweetlips. In many areas of Southeast Asia, high-value target species were completely absent. The results were the first scientific confirmation of what recreational divers had been reporting for several years—coral reefs are being abused by man on a world-wide basis.

Meanwhile, the Global Coral Reef Monitoring Program featured at a meeting of the national partners of the Interna-

tional Coral Reef Initiative (ICRI) in Washington, DC in October, and other coral reef monitoring and assessment programs will be announced under the auspices of the phenomenally successful International Year of the Reef (IYOR). The ICRI is planning the International Tropical Marine Ecosystem Management Symposium (ITMEMS) for Townsville, Australia in November 1998 at the end of the two year period in which Australia has hosted the ICRI Secretariat. The head of the ICRI Secretariat, Richard Kenchington, has suggested that this become a 4 year meeting focused on management, timed to fall in the middle of the 4 year cycle of the International Coral Reef Symposium (ICRS). As the ISRS has made a concerted effort to integrate science and management, particularly at the ICRS and in the pages of **Coral Reefs**, I have opened discussions with ICRI on how to best coordinate these two meetings. I would appreciate comments from the membership.

I am in contact with the Indonesian State Minister for Environment who accepted the invitation to hold the 9th ICRS in the year 2000. I have invited him to designate a representative to attend the meeting of the Society for Integrative and Comparative Biology (SICB), co-sponsored by the ISRS, in Boston, January 3–7, 1998. There will be a number of officers, councilors, and members at this meeting and we hope to begin discussions of ISRS participation in program planning and fund-raising for the Indonesian symposium. I am hopeful that this initial meeting will be followed by a second planning session at the ISRS meeting in Perpignan in (5–8 September 1998).

ISRS held an annual meeting at the VIII Pacific Science Inter-Congress during July, and Chuck Birkeland reports on the overall conference in **Meeting Reports**. I hope many ISRS members will attend the SICB meeting in Boston. In addition to a featured symposium entitled "Coral Reefs and Environmental Change - Adaptation, Acclimation, or Extinction?" there will be numerous other symposia and over 400 papers and posters presented on a variety of topics including animal behavior, comparative physiology, ecology and evolution, invertebrate zoology, developmental and cell biology, and systematic zoology.

We have solicited the second round of applications for the Sollins Fellowship through an internet communication which was sent out to a number of bulletin boards and lists. I hope that the announcement was widely seen. We will be working with the donor in the future to establish an earlier announcement of the Fellowship in these pages as some do not have access to the internet.

Finally, please join with me in wishing the Australian Coral Reef Society (ACRS) a very happy 75th birthday! The ACRS is the oldest organization in the world dedicated to the study and protection of coral reefs. It evolved from the Great Barrier Reef Committee in 1922, sponsored the historic Great Barrier Reef Expedition in 1928–29, and started the Heron Island Research Station, the first in the country. It plays a prominent role in reef science and public awareness within Australia and in the global forums dedicated to the application of science to reef management. Congratulations and best wishes to all our colleagues down under!

Very best wishes to all.

John C. Ogden

COMPLEAT REEF ENCOUNTER
No. 22

"If the whole purpose is just to see sea life, go to the Seaquarium. [Reserves] should not displace anyone so a diver from Kansas can see a grouper".

Doug Kelly, managing editor of Florida Sportsman Magazine, speaking out against marine reserves in the Florida Keys. Quoted in Miami Herald, October 13th 1996.

ISRS News

CORAL REEFS (the journal)

The Society's journal has seen a number of changes recently. Most subscribers will know that the editorial team was reshuffled at the beginning of 1997; Terry Hughes replaced Rick Grigg as Managing Editor, Alina Szmant replaced Hughes as Biological Editor, Peter Sale took up the new position of Ecological Editor, while Barbara Brown and Dick Dodge continued as Environmental and Geology Editors, respectively. Eleven new Advisory Editors were appointed to replace half of the editorial board retiring after 3–5 years service. Barbara Brown is "retiring" as Environmental Editor at the end of 1997, after many years of excellent service to the journal. Bruce Hatcher, one of our most experienced Advisory Editors, has agreed to replace her.

The volume of submissions over recent years has outgrown the original size of the journal, which has remained unchanged since its foundation 16 years ago. The solution is to make the journal bigger. This year the Panama Plenaries were published as a 147 page supplemental issue, and the four regular issues were 10% larger. Next year (1998) will

see a 50% increase of volume 17 and subsequent volumes. With this expansion, the average publication time of the journal has been reduced to a little less than 6 months, which is comparable or better than most similar journals.

Electronic publishing

Coral Reefs is now one of more than 180 journals published on the web by Springer (at *http://link.springer.de*). You can view the contents pages of each issue and abstracts of papers without a password, but to see the full text and figures of each article you must fill out an online application form for a username and password, which is then mailed to you by Springer. There is no charge to ISRS members for this service, which is designed to compliment rather than replace conventional publishing.

The Instructions to authors have been recently revamped to facilitate electronic submission and publishing, with the new version appearing in 16(3). After acceptance, authors must now provide a copy of their manuscript on disk, and keywords for indexing. All submissions since January have been typeset from diskette, which has cut the production time by half and reduced errors in the proofs.

Special Issues: Call for papers

We must now turn our attention to attracting more, better papers. As a start, the Editors have devised a three year plan to solicit papers on broad themes for Special Issues in volumes 17, 18 and 19. The topics are: coral reef geology, reef management, and herbivory/nutrients. The first of these, in Volume 17 of Coral Reefs is entitled "Holocene and Pleistocene Reef Geology". As the title suggests, the purpose of the issue is to provide an overview of current research in this broad area. Manuscripts may be empirical or theoretical, long or short. Reviews and Reef Sites on a geological theme are also welcome. The issue (approximately 100 pages) will be published as soon as 12 papers have been accepted. Prospective authors should first contact the Geological Editor, Richard E. Dodge by fax or e-mail (fax 954-921-7764, e-mail <dodge@ocean.nova.edu>). To ensure a speedy publication, manuscripts should be submitted as soon as possible to R.E. Dodge, Nova Southeastern University Oceanographic Center, 8000 N. Ocean Drive, Dania, FL 33004, USA. Further details appear in 16(4) of Coral Reefs, including the names and contacts of Guest Editors, to whom manuscripts may also be submitted.

Apart from one Special Issue each year, the expanded journal needs to receive about 100 manuscripts (with the current rejection rate) to fill the remaining 3 issues. Last year (1996) we received 85 unsolicited papers, so there is room for still more submissions. This is where we need your help. Please consider Coral Reefs as a venue for publishing. The Society's journal is becoming bigger, faster and more visible.

Finally, my sincere thanks to recently retired and continuing Editors and Advisory Editors, and to the reviewers for their hard work.

Terry Hughes
Managing Editor, Coral Reefs

ISRS MEETING IN FIJI, 15 JULY 1997

The ISRS held a meeting in Suva, Fiji, at the VIII Pacific Science Association Inter-Congress. In conjuction with the Scientific Committee on Coral Reefs of the Pacific Science Association (PSA-SCCR), the ISRS convened a symposium on "Coral Reefs 1997–The International Year of the Reef" as well as holding a committee meeting. Steve Miller conducted the business meeting. In **Meeting Reports** Chuck Birkeland reports on an Inter-Congress resolution calling for a decade of reef conservation.

CORAL REEFS IN BOSTON

ISRS will meet jointly with the Society for Integrative and Comparative Biology (SICB) and the Ecological Society of America (ESA) at the SICB 1998 Annual Meeting, January 3–7, in Boston, MA. A highlight of the meeting will be an invited two-day symposium on 'Coral Reefs and Environmental Change - Adaptation, Acclimation, or Extinction?' Accompanying contributed paper sessions on coral and reef-related topics will also be presented. The interdisciplinary, international group of experts on subjects relating to coral reefs and the environment — biologists, geologists, geochemists, oceanographers, and climatologists - will present and integrate differing perspectives on a very basic question - what can combining modern reef and coral observations with evolutionary and fossil records tell us about assessment and protection of reefs now and in the future? In addition to SICB, the symposium is also sponsored by the Scientific Committee on Oceanic Research (SCOR), the Land-Ocean Interactions in the Coastal Zone (LOICZ) project of the International Geosphere-Biosphere Program, the International Society for Reef Studies, the New England

Aquarium, and the Ecological Society of America. This timely symposium comes at the end of the International Year of the Reef, and combines contributions from the general scientific community with the products of an international working group jointly sponsored by SCOR and LOICZ.

Coral reefs, and the multitude of plants and animals that create them, are focal points for present-day concerns about biodiversity, the global carbon cycle, development and population pressures on ecosystems, and the value of natural ecosystems. They represent a paradox: representatives of the ecosystem have persisted through many major climate and global environmental changes over hundreds of millions of years, and yet they are perceived as being among the ecosystems most vulnerable to and threatened by contemporary global change. A major point of discussion will be the degree to which coral reefs are adapted to environments and climates very different from our present one — which is, in geological and evolutionary terms, unusually warm, and has had an unusually high and stable sea-level. This has important implications for very basic concepts, such as how we define a 'healthy' reef, and the kinds of changes most likely to exceed the adaptability of the organisms. Among the talks to be presented are 'Coral reefs and environmental change: Adaptation to what?'; 'Reproduction, symbiosis, and the fossil record: Do geologists care about sex?'; 'Genetic structure of coral reef organisms: Ghosts of dispersal past'; and 'Using environmental data to define reef habitat: Where do we draw the line?'

Featured speakers:

Dr. Robert Buddemeier, University of Kansas
Dr. A. Barrie Pittock, CSIRO Division of Atmospheric Research, Australia
Dr. Bruce Hatcher, Dalhousie University, Canada
Dr. Donald Potts, University of California, Santa Cruz
Dr. Robert Kinzie III, University of Hawaii
Dr. John Benzie, Australian Institute of Marine Science
Dr. Howard Lasker, State University of New York at Buffalo
Dr. Kiyoshi Yamazato, Meio University, Okinawa, Japan
Dr. Ruth Gates, University of California, Los Angeles
Dr. Robert Rowan, University of Guam Marine Laboratory
Dr. Bruce Carlson, Waikiki Aquarium, Honolulu
Dr. Terry Done, Australian Institute of Marine Science
Dr. Ron Karlson, University of Delaware
Dr. Rolf Bak, Netherlands Institute of Sea Research
Dr. John Pandolfi, National Museum of Natural History
Dr. Joan Kleypas, National Center for Atmospheric Research
Dr. Bradley Opdyke, Australian National University
Dr. Jeane-Pierre Gattuso, European Oceanologic Observatory, Monaco
Dr. Stephen Smith, University of Hawaii

For information on the meeting program in general, or for information on how to register, contact SICB at the addresses listed at the end of this article.

Society for Integrative and Comparative Biology

Until 1995, the Society for Integrative and Comparative Biology (SICB) was known as the American Society of Zoologists (ASZ). In 1995 the ASZ membership voted to change the name of this 107-year-old Society, to more accurately reflect the way the field of animal and organismal biology has evolved since the Society's inception, and to more accurately reflect the international reach of its membership. Today, SICB has a membership over 2,000 strong representing over 35 countries. SICB is committed to placing itself at the forefront of the field of integrative and comparative biology to remain a progressive and dynamic organization into the next century. The SICB Annual Meetings attract over 800 attendees from approximately 16 countries who meet to interact with fellow colleagues, participate in symposia and contributed paper and poster sessions and learn the latest in biological research and teaching. Highlights of the meetings include special symposia, plenary sessions featuring distinguished speakers, biology teaching workshops, and a career center. SICB members' receive the American Zoologist, one of the most prestigious peer-reviewed journals in its field, which publishes significant new findings pertaining to animal biology, plus book reviews and Annual Meeting abstracts. In addition, SICB publishes a newsletter twice a year to provide members with important Society information and divisional reports. Starting in 1998, SICB members will also receive the new journal Integrative Biology: Issues, News and Reviews. Members also receive substantial discounts on scientific journals, access to SICB's Web site, and free access to one of the first electronic journals Experimental Biology Online. Students can benefit from SICB by presenting a paper or poster at the Annual Meeting, receiving student support and housing at the Annual Meeting, and applying for funding opportunities through the Grants-in-Aid of Research program.

For more information, contact the SICB Business Office, 401 N. Michigan Avenue, Chicago, IL 60611-4267; 800/955-1236 or 312/527-6697; Fax 313/245-1085; E-mail: <sicb@sba.com> *or visit the SICB Web site* <http://www.sicb.org>.

For specific information on the symposium program, please contact Dr. Robert W. Buddemeier, Kansas Geological Survey, University of Kansas at 785/864-3965 e-mail: <buddrw@kgs.ukans.edu>, *or Dr. Howard Lasker, SUNY Buffalo, at 716/645-2881 e-mail:* <hlasker@acsu.buffalo.edu>.

SOLLINS FELLOWSHIP (1997) UPDATE

I would like to express my gratitude to Professor Phil Sollins for his generosity in making this award possible, and also the members of ISRS for their support and confidence in my potential as a future coral reef scientist. Partly due to the recognition afforded by the Sollins Fellowship, the Department of Marine Science, University of South Florida has awarded me their Knight Fellowship, which will cover my living stipend for the completion of my Ph.D. Therefore the Sollins award will cover field expenses of this large scale project.

Coral Reef Conservation in Belize: Are Management Efforts Having the Desired Results?

Coral reefs are highly valued in many developing nations. They are a major natural resource supporting economic growth through tourism and fisheries production, as well as providing for local subsistence fishing. Scientists are now faced with growing pressure from managers and conservationists to understand not only how these ecosystems normally function, but also how they respond to anthropogenic alterations, including management actions.

Belize, Central America, provides a unique natural laboratory in which to study the relationship between management-linked environmental influences and reef community structure. Belize's reefs are in relatively good condition, partly due to their extent relative to the small population of around 211,000 people. The main barrier reef system runs for approximately 240 km and lies from 10 to 40 km off the mainland coast. However, there are also over 1000 cayes, including some virtually atop the reef, with expanding tourist facilities. The country's economy is highly dependent on reef-based resources, with tourism and fisheries production now the largest and fifth largest sources of foreign exchange (McField, *et al*, 1996). Through actions which alter the natural environment, and regulatory reactions which attempt to control these alterations, humans are manipulating natural ecosystems and conducting a large scale experiment. Until now, the results of this experiment have been inadequately recorded, so correlations between anthropogenic impacts and changes in the coral reef's community structure are problematic.

However, Belize has a strong Marine Protected Areas system (begun in 1982) which excludes fishing from some areas. An integrated coastal zone management program began in 1991, instituting controls on coastal development, and Belize also has a diverse assemblage of relatively undisturbed reef systems. Thus it will be possible to test potential relationships between fishing pressure, coastal development, terrigenous influences, diving pressure and the reef's community structure. The project uses video based monitoring techniques to measure the results of these large-scale manupilations. Data will establish a baseline for Belize's national coral reef monitoring program, and in the longer term could also be used to parameterize a model of reef change with respect to management actions.

In addition to the Sollins and Knight Fellowships, this work is greatly assisted by the Coastal Zone Management Project and Belize's Fisheries Department staff, including the Bacalar Chico, Hol Chan and Glover's Reef Marine Reserves. Additional logistical and field support is being provided by Wildlife Conservation Society, UCB Marine Research Center, Belize Center for Environmental Studies/The Nature Conservancy, Belize Audubon Society, Pelican Beach Resort, Rum Point Inn, and Sea Sports Belize. Thanks also to Janet Gibson and to Kent and Rita McField for temporarily converting their home into an operations center for this project.

Melanie McField

References:

McField, M., S. Wells and J. Gibson. 1996. The State of the Coastal Zone Report 1995. Government of Belize with assistance of the UNDP and GEF, Belize. 255pp.

BOB ENDEAN

Bob Endean sadly suffered a major heart attack on Heron Island just before the 75th birthday of the Australian Coral Reef Society. He died in hospital a few days later, never regaining consciousness.

UPWELLINGS

CRUSTOSE CORALLINES CONFUSION!

There is a myth that crustose coralline algae play a comparable, or even superior, role to corals in the construction of coral reefs. Philip S. Ely perpetuates these ideas in his article *Is coral vitality a good measure of reef health?* (Reef Encounter No.20, Page 8). Like others in the past, he has even suggested that the term "coral reefs" is a misnomer.

Certainly most coral reef researchers agree that the present surface cover on many coral reefs, particularly sea-level reefs in high wave-energy environments, is composed to a large extent of crustose coralline algae. But the internal structure of most coral reefs is overwhelmingly constructed by corals (Macintyre, 1997). Even in the area cited by Ely – Funafuti Atoll – the three cores drilled in the reef in the late 1800s recovered no sections of crustose coralline limestone (Hinde, 1904).

It is a well-established fact that shallow water conditions with heavy wave action not only promote the growth of crustose coralline algae but also promote extensive submarine lithification. Mg calcite micrite precipitation is so abundant in these settings that there is no functional "requirement" for crustose corallines as reef binders.

References

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Macintyre, I.G. (1997). Reevaluating the role of crustose coralline algae in the construction of coral reefs. Proc. 8th Int. Coral Reef Symp. Panama City (in press).

Ian G. Macintyre, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560, Robert S. Steneck, Darling Marine Center, University of Maine, Walpole, ME 04573, Robert N. Ginsburg, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, FL 33149

A CLASSIFICATION FOR MONITORING METHODS

I work as a consultant and have been assisting the development of a volunteer diver monitoring program with the Australian Marine Conservation Society. The problem I found, and I'm sure everyone else has too, is that when sitting around a table with a group of scientists, volunteers, government representatives etc, everyone has a different idea of what monitoring is and what it should entail. The result is that discussions just go around in circles because everyone is thinking different things. To overcome this I developed a method of categorizing the different types of monitoring which I now call 'Type 1, Type 2, and Type 3'.

It's fantastic because now at meetings or even when briefing divers, we can say, 'Ok, for this site we are planning Type 2 monitoring' and everyone knows what this means and the extent of work involved. It prevents people from wanting to discuss permanent transects when we are only planning a preliminary survey. Charts can now be marked with the different 'types' of monitoring taking place and people can quickly understand what is happening at the various areas.

I'm now interested in seeing if this system is of use to others as I believe it will be. Personally I've found it makes life a lot easier. I'd like to receive feedback on what people think of it and how it works for them.

Dave Lennon, Green Marine International, 32 / 69 Stones Rd. Sunnybank Hills Q 4109, Australia
tel./fax. +61(07) 3219-5005 e-mail <gmidavid@tpgi.com.au>

TYPE ONE-No counting of organisms in the field or from video or photos taken.
Provides a general site characterization (including mapping) to help determine the need for further studies and to provide the basic information needed for planning future work. Also describes species present in order to initiate species inventory of the area.
Examples:
-Measurements, distances, depths, current speed, visibility, temp etc.
-Mapping of prominent features, bottom types.
-Recording species present but not abundance, i.e. 'counting'.
-Identification and area measurement of impacts such as anchor damage or coral bleaching.
-Photo or video documentation encouraged but not with the intention of using it for percent cover or species counts etc.

TYPE TWO-Counting of organisms but no permanent transects or permanent markers.
Surveys determine the number of different species and/or number of particular individuals per area. This is the first type of monitoring to use transects or quadrats.
Examples:
-Species counts along temporary transects or within quadrats etc.
-Percent cover estimates.
-Crown of thorns or other introduced species counts.
-Photo or video documentation encouraged and to be conducted in a way that enables future analysis for percent cover or species numbers etc.

TYPE THREE-Permanent transects or markers.
This highest level of monitoring can be used to detect changes over time, and it is the first and only type to use permanent transects or markers.
Examples:
-Installation of permanent transects or permanent markers or tags.
-Photo or video documentation to be used later to count percent cover or species numbers etc.

FEATURES

DISPOSABLE INCOME IN ASIA—A NEW AND POWERFUL EXTERNAL PRESSURE AGAINST SUSTAINABILITY OF CORAL REEF RESOURCES ON PACIFIC ISLANDS.

Chuck Birkeland

The rapid economic growth of Asian nations, especially mainland China, is putting a new kind of pressure on marine resources of Pacific islands, pressures qualitatively different than those of western economies. The increase in disposable income in Asia, the particular interest in rare and living seafood as a display of wealth, and the logistics of transporting live fishes across large distances in ships or airplanes creates an overwhelming influence of high prices. The rapid increase in dollar value of reef resources overrides management policies, traditional practices, and law. Fishermen are compelled to risk their lives and businessmen are willing to risk confiscation and fines. Depreciation and logistic expenses exclude sustainability as an option. The economically expedient methods of collecting coral-reef resources are exceptionally wasteful and work against sustainability. We must recognize that this economic pressure is different from previous pressures so that it can be accommodated into management plans. Hope can be found in the demonstrated ability of Palau and the Federated States of Micronesia to stand up to corporations economically larger than their nations.

Growth in China

The gross national product of mainland China grew by more than 10 percent in 6 of the 14 years up to 1995 and by more than 7 percent in 11 of those years (New Scientist, 7 January 1995). This long period of substantial growth breaks all records, even those of the Japanese and Taiwanese economies during their most spectacular periods of economic development. Economists predict that this expansion will continue at 7 to 8 percent per year through the remainder of this century (New Scientist, 7 January 1995). Furthermore, the population of China is growing at 14 million a year, a small growth in terms of percent, but large in absolute numbers.

More than 80 million mainland Chinese now have a disposable income (Naisbitt 1996), and the average disposable income in Hong Kong is now higher than in Europe (New Scientist, 7 January 1995). Disposable income encourages demand for exotic, high-priced, or frivolous materials that were previously unavailable or items bought for the primary purpose of displaying wealth.

One example is the demand for meat. As the population grows, the people of China need more food to feed more people. Rice is prevalent in the Chinese diet, but as their economy grows, the affluent portion of the population, mainly in urban areas, demands a greater prevalence of meat in their diet. In a plenary talk in Beijing for the XVIII Pacific Science Congress in June 1995, Peter Raven admonished the host country for the conversion of large tracts of grain fields to pasture for cattle. As the grain fields were converted to pasture, and as some of the remaining grain is used to feed livestock rather than people, China changed in one year from a net exporter of 8 million tons of grain in 1994 to a net importer of 16 million tons, the second largest importer of grain in the world (Brown 1996). Although 80 million persons with disposable income is a large group in absolute terms, they are still a small portion of the total population of mainland China. Yet the disposable income of this small portion of the population has had a major impact on the agricultural and economic functioning of the largest nation (in terms of population) in the world. This disposable income is also a powerful influence of a new and unrecognized type on the economics and resource management of Pacific islands, a type that is incompatible with sustainability.

Seafood is an especially valuable source of protein. Kenneth Sherman told me that the South China Sea has been overfished to the extent that virtually all the catch consists of juveniles. As the demand and dollar value for seafood increases, and as the resources are being depleted near the continent, the fishing boats are moving into the tropical western Pacific. There are approximately 3.8 million marine fishermen working out of mainland China, two hundred thousand out of Japan, and many more out of Taiwan and Korea. The Ting Hong Corporation alone has hundreds of ships working in the tropical western Pacific.

Disposable income encourages the purchase of frivolities. About 20 million seahorses were collected mainly for aphrodisiacs in 1994 alone (Prein 1995; Vincent 1996). Male seahorses brood the juveniles, and the fecundity of seahors-

es is simply not high enough to sustain this fishing pressure. Although aphrodisiacs are a hoax, disposable income is money that can be used recklessly. With the drastic increase in disposable income available from China, the price of seahorses has risen to US$ 850 per kg. It is unreasonable to expect local fishermen to consider careful management of a resource for sustainability when the present market value is so high.

Effects of increased dollar value

Disposable income accelerates not only the demand in Asia, but also the price of items from coral reefs. With newly acquired spending money, rare or live fish for dining become a symbol of wealth, desired primarily as a display of success. One grouper was purchased in Hong Kong for US$ 10,256 (South China Morning Post, 28 November 1996). A Napolean wrasse *Cheilinus undulatus* sold for US$ 180 per kg and the lips of *C. undulatus* have been served for US$ 225 (Johannes and Riepen 1995; Dayton 1995). Sharkfin soup is served as a broth without a substantive content of sharkfin, yet it costs US$ 80 for a small bowl in Guam. The US$ 1 billion live fish trade has brought 20,000 to 25,000 tons of live coral-reef fishes into Southeast Asia for restaurants in 1995 (Johannes and Riepen 1995).

One grouper was purchased in Hong Kong for US$ 10,256

When fishes are purchased primarily as a display of wealth, the high dollar-value of a rare species has a positive feedback with a negative consequence. The species becomes more valuable and intensely sought as it becomes more rare and in greater jeopardy. Asians often claim that wild-caught reef fish taste better than those raised in aquaculture (Johannes and Riepen 1995), but whether this is just attraction to the difficult-to-obtain or endangered species remains to be objectively tested. It has been suggested that for relatively simple marine systems, where a particular fishing apparatus catches mainly one species, that species can be protected when fishers are constrained by "economic overfishing". "Economic overfishing" occurs when a species becomes rare enough that it is no longer profitable to catch. Economics compels the fisherman to switch gear or location before the resource population nears local extinction. This does not happen with coral reef resources. High dollar values encourage fishing effort even after the targeted species is too rare to sustain a viable reproductive population. The coral reef is a diverse community, and even though a rare targeted species (e.g., *Cromileptes altivelis*) cannot support a fishery by itself, alternative nontargeted species (numerous species of a variety of families) can sustain a fishery and keep the fishers active in the area. Guam and American Samoa have marine resource agencies that keep good fisheries records, and have shown that before there is a strong decrease in total catch or in catch per unit effort, there is a change in relative abundances of fish species, with a strong decrease in the preferred species.

When interest rates on money are greater than return on natural capital, private enterprise liquidates resources, regardless of tradition, management policies, or law.

An additional force that buffers the effects of "economic overfishing" until after "biological overfishing" has occurred is subsidy from Asian countries to perpetuate fishing on coral reefs regardless of economic viability. In the early 1980s, Japan AID provided the small island of Kosrae in the Federated States of Micronesia (FSM) with 70 fishing boats with outboard motors, fuel tanks and fishing gear, indirectly in exchange for access by Japan to the Economic Exclusion Zone around the FSM for offshore fishing. The Marine Resources Division of the State of Kosrae advised against accepting boats and equipment because the small fringing reef could not sustain such fishing pressure. However, the conspicuous achievement of acquiring 70 boats and sets of fishing equipment was a vote-getting accomplishment for the executive branch of government as the elections were coming near, and so consideration of sustainability was overridden. The stocks of fishes were depleted within a few months when the additional 70 boats were put into use, and the reefs around Kosrae have still not recovered large fishes.

Depreciation

A high dollar value is especially dangerous for coral-reef resources such as large groupers, giant clams, spiny lobsters, and sea turtles which take many years to mature. This is because of the comparative long-term return accruing to individual fishers from investments compared to sustainable fisheries. Sea turtles take about 25 years to reproduce, whereas money will usually bring at least 8% growth per year. When interest rates on money are greater than return on natural capital, it is usually in the immediate interests of private enterprise to liquidate the resources, regardless of tradition, management policies, or law.

For example, sea turtles are protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), but this international regulation is often ignored. In Naha, Okinawa (Japan), small (30–45 cm carapace) sea turtles are publicly displayed for sale at up to US$ 2,571.43. The prices for the larger carapaces on display are

greater, but not publicly posted. If the interest rate on the money from the sale at US$ 2,571.43 is a modest 8%, then in the 25 years required for the first reproduction of the sea turtle, the money from the sale of the one small carapace would have grown to US$ 19,000. International regulations are difficult to justify to businessmen when the profit margin of the two alternatives is so different.

Illegal and dangerous risks

Analogous to the trade in illegal drugs with a high profit margin and a vast growing market, the profit margin on Pacific coral-reef resources is high enough to risk fine, arrest of crew, or forfeiture of ships. Up to 1977, 22 Taiwanese fishing boats were apprehended on the Great Barrier Reef for poaching *Tridacna* (Pearson 1977). The fishing boats were destroyed, but the value of adductor muscles from *Tridacna* was high enough (US$ 100 per kg) that the catch from successful trips was more than adequate to absorb the cost of losing ships and transporting the crew back to Taiwan. *Trochus niloticus* was harvested sustainably throughout eastern Indonesia for most of this century (Reid 1992), but when the price of *Trochus* shell increased, the stocks in Indonesia became severely overharvested. The fishermen then began taking long voyages from Sulawesi all the way into Australian waters, risking arrest, imprisonment, and destruction of their boats (Reid 1992).

When the commercial value is high for an endangered resource, confrontations may become violent. Fishermen in Ecuador claimed they could make only an average income of $71 per month until the Asian desire for sea cucumbers from the Galapagos for food and aphrodisiacs increased their potential income over 40-fold to an average of $100 per day. With a difference in income of this scale, it is unrealistic to consider arguing for the long-term benefits of sustainability. When scientists recommended closing the fishery until a sustainable management plan could be established, the fishermen took the scientists and their families hostage. Ecuadorian soldiers were called in to free the hostages (San Jose Mercury News, 2 April 1995).

When scientists recommended closing the fishery until a sustainable management plan could be established, the fishermen took the scientists and their families hostage.

Richards [(1993) in Johannes and Riepen 1995] tells of physical confrontation between clans of different villages caused by jealousy and arguments about the money involved in live reef fish export operations. The vice president of a sea watch program was shot and killed at his dinner table after apprehending illegal fishermen in the Philippines in 1994 (Johannes and Riepen 1995). International Marinelife Alliance personnel have received death threats. The disposable income of the rapidly growing economy in Asia endangers the society as well as the physical health of Pacific islanders.

People will risk their lives to harvest coral reef products when the price is high enough. The rapidly developing Asian restaurant trade has led to the death from the bends of up to 30 Pacific islanders while collecting holothuroids (Pacific Daily News, 25 March 1997, page 14). Sea cucumbers (trepang, beche-de-mer) can usually be collected in shallow waters, but the Asian restaurant demand and price was so great that the shallow-water stocks in Fiji and Tonga were depleted in six years and the collectors had to begin using compressed air to search for extensive periods of time at greater depths. The economic pressure from Asian restaurants is driving both the resource to local extinction and the collectors to risking death. With numerous examples of bends in local divers in the Philippines and Indonesia, Johannes and Riepen (1995) estimate by extrapolation that there have been thousands of serious cases of the bends and hundreds of deaths in the western Pacific because of fishing to meet the economic demand from the Asian restaurant business.

Effects of geography

The distances of Pacific islands from Asia make a one-time harvest of standing stocks of slow-growing, long-lived species more economical than a sustained fishery. For the Asian restaurant trade, ships are often modified for carrying live reef fish in a central section holding tank sealed off from the front and back of the ship and drilled full of holes for seawater exchange. These large ships cost money to run and the distances are long, so the investors are not interested in culling a moderate harvest for a sustainable yield on repeated trips.

The enforcement of regulations and protection of resources by islanders are also made difficult by distances among islands in the Pacific. Visits of Asian fishing vessels to uninhabited atolls are probably often undetected. A Taiwanese fishing boat cut adductor muscles from 15,000 giant clams on remote Helen's Reef (between Palau and Papua New Guinea), leaving the rest of the meat from the clams to rot on the reef (Wexler 1994).

A general conclusion of a "Colloquium and Forum on Global Aspects of Coral Reefs" held in Miami in 1993 was that coral reefs in the Pacific were being degraded near concentrations of humans, but in good condition away from urban areas (Ginsburg 1993). This is probably true for degradation by sedimentation, but overfishing of important species is

probably also frequently happening away from human populations because of high dollar values and the lack of effective policing.

Money as well as distance makes enforcement of regulations difficult. Bribes and gifts are a common business procedure in Asia, and large amounts of cash are compelling, especially if negotiations for access to local resources are made with higher government officials (Johannes and Riepen 1995). The amount of cash available from Asian entrepreneurs for valuable marine resources can overwhelm islanders and can make short-term deals irresistible at the expense of sustainability.

Long-term or permanent effects

Expense compels large ships from Asia to spend little time in port, and therefore expediency compels investors to focus on groupers in their spawning aggregations. Some of these spawning aggregations may have been important sustained sources of fish production for local villages for many years, perhaps centuries, prior to their extirpation (Johannes and Riepen 1995). When spawning aggregations are removed, the entire reproductive population is possibly taken and the population may not return for many years, if at all. A commercial live-fish operation in Palau in the late 1980s wiped out an aggregation of groupers (mostly *Plectropomus areolatus*) at Denges channel on the east side in the Rock Islands. This has not yet recovered (Noah Idechong and Tom Graham, pers. comm.). An offshore pinnacle was discovered near Guam in 1967 and harvested down within 6 months (Ikehara et al. 1970). The Government of Guam Division of Aquatic and Wildlife Resources has been monitoring the pinnacle since that time and the populations of the more valuable fish species still have not returned after 30 years. Populations of the sea cucumber *Holothuria nobilis* and other commercially valuable holothuroid species were heavily harvested and exported from Chuuk (Truk) in the late 1930s. These populations have still not recovered after 60 years (Richmond 1997).

In addition to coaxing a focus on spawning aggregations and a one-time, nonsustainable, harvesting strategy, economic expediency also tempts the live-fish trade to use effective collecting methods such as sodium cyanide. According to the International Marine Alliance (as reported by Rowley 1997), over 6,000 divers squirt about 150,000 kg of poison onto around 33 million coral heads in the Philippines alone each year. These methods are general and are effective in producing a large bykill, including corals as well as uncollected fishes.

Commendation of Palau and FSM

Our situation is not hopeless. Palau and the Federated States of Micronesia (FSM) have expelled the Ting Hong Corporation from their waters. An executive of Ting Hong Corporation was arrested for offering a bribe in Palau. Palau and FSM should be commended for having the strength to stand up to a corporation which has a larger economy (a net worth of about one billion US dollars) than their combined nations (combined GNP of US$ 242 million in 1994).

Australia gave Palau and FSM intimidating patrol boats which have been activiely arresting and confiscating vessels of poachers in their waters. The U.S. Coast Guard chased and captured an unmarked, unregistered vessel with 21 crew members from mainland China and 3 from Taiwan for illegal fishing. (An unregistered, unidentified boat that plunders resources illegally is technically a "pirate".) The Coast Guard was able to catch another Asian vessel that was illegally fishing by lassoing its props in a rope and towing it back to Guam.

In Conclusion

Just as the proportionately few Chinese with disposable income have changed China within one year from a net exporter of grain to the second largest net importer of grain (a 24 million ton change as a result of a desire for meat), the disposable income provided by a record economic rate of growth in Asia produces a qualitatively different and powerful force with attributes that work against development of long-term resource management for Pacific islanders. Sustainable export of marine resources is not considered an option for markets based on disposable income from Asia, and the geographic distances involved have a synergistic effect. Nevertheless, Palau and the Federated States of Micronesia have demonstrated the ability to stand up for their own interests against the influence of a corporation economically more than four times larger than their combined nations.

Palau and FSM should be commended for standing up to Ting Hong corporation which has a larger economy than their combined nations.

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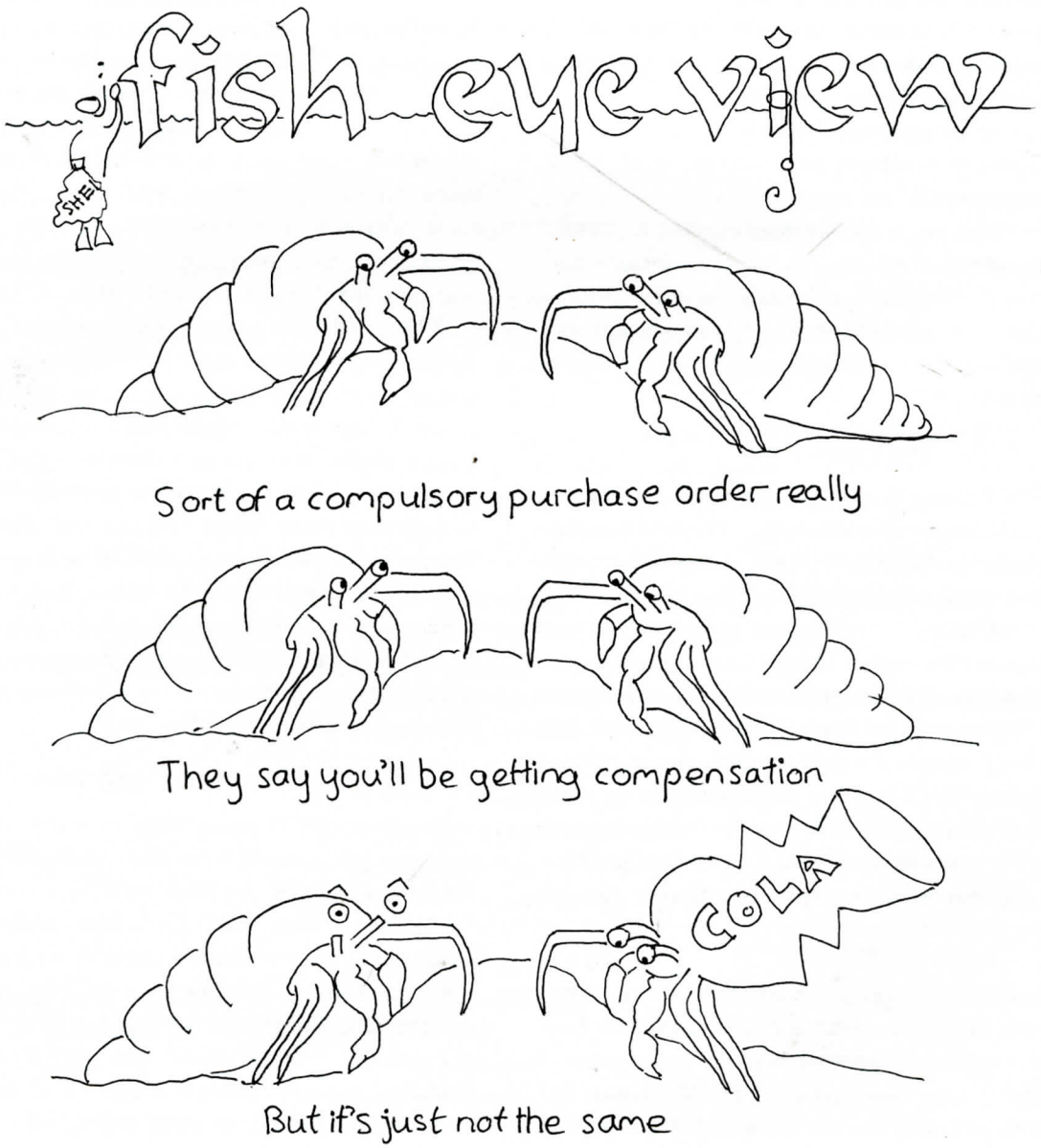

CURRENTS

WHITE BAND DISEASE IN THE FLORIDA KEYS— A CONTINUING CONCERN

W.F. Precht and R.B. Aronson

Throughout the Caribbean and western Atlantic coral reefs are in crisis. This is especially true along the Florida Reef Tract. Coral cover has declined and the cover of non-calcareous, fleshy macroalgae has increased. Many authors have argued that the loss of herbivores has been the primary culprit in this community shift towards macroalgal dominance, while others have cited reef nutrification. However, the most important precursor to macroalgal dominance, irrespective of herbivory and nutrient levels, is the mortality of stony corals. This mortality has been especially pronounced for the two major *Acropora* species, *A. palmata* and *A. cervicornis*. Sources of *Acropora* mortality include hurricanes and storms, predation by mobile invertebrates, nutrient loading, sedimentation, hyper-and hypothermic stress, prolonged bleaching, direct and indirect anthropogenic impacts, and disease.

the current regional decline of *Acropora* dominated communities is unprecedented

The Pattern

In the 1950's Thomas F. Goreau and colleagues recognized that typical Caribbean/western Atlantic coral zonation consists of *A. palmata* dominance at the shallowest depths, and *A. cervicornis* dominance at intermediate depths. Similar zonation has been found in Pleistocene and Holocene reef deposits throughout the region. These patterns attest to the importance of *Acropora spp.* in time and space. However, a review of the reef survey data from CARICOMP shows that *Acropora spp.* are presently dominant at only one of 14 sites (Smith and Ogden, 1994). *Acropora* dominated communities are dynamic at the scale of the individual reef and have come and gone over the past century on the Florida Reef Tract but their current regional decline is unprecedented.

The Role of Disease

Although quantitative data are generally lacking, it is becoming apparent that for the past two decades White-Band Disease (WBD) epizootics have been the primary cause of *Acropora* mortality over wide areas of the Caribbean and western Atlantic, including Florida. Wells and Hanna (1992), noted that acroporids from the Florida Reef Tract had up to 96% of reef cover in places in 1981. By 1986 these corals had succumbed to disease and were reduced to only 3% of the total reef cover. Before-and-after photographs in Shinn (1989) and Ward (1990), emphasize the dramatic and devastating effects of this coral killer in the Florida Keys (continuing photo documentation from 1989 to the present shows an almost complete loss of *Acropora spp.* and subsequent overgrowth by macroalgae; Shinn, oral presentation, University of Miami, 1997) . Even after 20 years, the etiology of the disease remains a mystery, and recent reports reveal that there may be multiple varieties of WBD with differing characteristics (Ritchie and Smith, 1995; Holden, 1996). WBD can generally be recognized as areas of bare skeleton, sometimes bordered by narrow bands of disintegrating, necrotic coral tissue, on otherwise healthy-looking, golden-brown *Acropora* branches. The disease spreads rapidly along the branches, usually from base to tip. The branches initially turn white and soon are covered with a microalgal turf. These rapidly killed colonies are often left standing "frozen" in growth position. With time they are broken and reduced to coral rubble by both physical and biological processes. Dead stands of *Acropora* are especially susceptible to breakage and transport during major storms. The resulting fields of *Acropora* rubble are then overgrown by replacement species, usually macroalgae.

Sounding the Alarm

Sheppard (1993) asked "Why were the warnings of mass mortality (of *Acropora*) from this cause ignored? ... Did people really think that the *Diadema* issue was more important than that of the main Caribbean shallow water reef builder?" To answer these questions, we surveyed over 90 scientists actively involved in coral reef research and/or management. The results (below), highlight the general lack of appreciation of the importance of WBD. A review of the literature indicates there is a paucity of data available on WBD and its effects on reefs throughout Florida, the Ba-

hamas and the Caribbean. This includes reefs with active, ongoing, long-term monitoring programs. We believe that in many cases the cause of *Acropora* mortality has been misdiagnosed, under-emphasized or ignored (see also Goreau, 1997). The literature is rife with examples (including photographs) of these errors, further complicating the problem. What does this portend for the future of reef science and management, and more importantly, the future of coral reefs in the region?

The recovery of these reefs will depend on the recurrence of disturbance and the recruitment and regeneration of the affected coral species. The recent, regional demise of *Acropora* may be a unique event on a millennial scale (Aronson & Precht, 1997), and it is presently unknown what the long-term effects on coral reef community structure will be. Even under the most favorable circumstances, the region will probably not reattain its pre-disease coral community structure for many decades and most likely we will be faced with a protracted trend toward macroalgal dominance.

in many cases the cause of *Acropora* mortality has been misdiagnosed, under-emphasized or ignored

Where Do We Go From Here?

As Bob Ginsburg has repeatedly emphasized during this International Year of the Reef, "The problems of the coral reef crisis need to be identified before remedies can be prescribed." If WBD is indeed the main problem, there may be little that reef managers can do, especially in the short term. Clearly, we need to redouble our efforts with regard to understanding the effects of catastrophic coral mortality in general and the impact of WBD epizootics in particular. The future of sustainable reef management in the Caribbean and western Atlantic will depend on our ability to predict the response of these communities to large-scale disturbance

SURVEY QUESTIONNAIRE
94 Respondents

Question 1 What are the three most important threats facing the reefs of the Caribbean and western Atlantic?	1. Loss of herbivores (esp. *Diadema* and fish)	[88]
	2. Water quality (esp. nutrification and sedimentation)	[59]
	3. Physical disturbances (esp. hurricanes)	[48]
	4. Coral bleaching	[36]
	5. Global change (esp. CO2, changing sea level, increased SST)	[20]
	6. Anthrópogenic impacts (both direct and indirect)	[20]
	7. Coral diseases (esp. BBD, WBD, others)	[6]
	8. Other	[5]
Question 2 What are the most important scientific questions and funding priorities in reef research?	1. Global change (esp. bleaching, greenhouse, El Niño)	[62]
	2. Causes of nutrification	[61]
	3. Impacts of hurricanes	[38]
	4. Use of corals as paleoclimatic proxies and indicators of reef health	[28]
	5. Coral reproduction and physiology	[19]
	6. Long-term monitoring studies (reef ecology)	[18]
	7. Reef restoration and management	[16]
	8. Etiology of coral diseases	[10]
	9. Coral taxonomy and systematics (and evolution)	[9]
	10. Others, mostly various anthropogenic influences	[21]
Question 3 Qualify the importance and impact of White Band Disease on *Acropora spp.* throughout the region?	1. Devastating	[6]
	2. Moderate/Widespread	[29]
	3. Minor/Local	[48]
	4. Little or None	[5]
	5. Don't Know	[6]

events and our political will to control the exacerbating influence of human activity.

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FAST SPREADING NEW CARIBBEAN CORAL DISEASE

J. Cervino, T. Goreau, G. Smith, K. DeMeyer, I. Nagelkerken, R. Hayes

A new coral pathology, which we call Rapid Wasting Disease (RWD), is attacking tissues and skeletons of two of the most important Caribbean reef corals. The new disease has a clumped distribution, characteristic of spreading infection and spreads rapidly across affected colonies, peaking at a depth of around 15 metres. RWD is most intense in the south central Caribbean, where it proliferated from the start of 1997. By mid year incipient infections were also found in the northwest, southeast, and northeast Caribbean. At current rates it is likely to become a major source of coral mortality in the region within the next year.

RWD is likely to become a major source of coral mortality in the Caribbean within the next year

RWD attacks both tissue and skeleton. An infected coral has a sharp boundary between normal tissue and areas in which the upper layers of the skeletons are missing. These are crumbling to the touch, and appear as if concentrated acid has been poured on the coral. RWD affects all morphotypes of *Montastrea annularis*, but is most common on large multilobate heads. The lesions affect the upper several millimeters of skeleton on the top surfaces and spread at the rate of several polyps per day, stopping after reaching a size typically between 5 and 50 centimeters across. These patches are then overgrown by either filamentous green algae or by red cyanobacteria, while new centers of infection arise on nearby corals. On sheet-like morphotypes of *Montastrea annularis* the disease normally attacks lower edges and proceeds horizontally. On *Colpoyhllia natans* the disease progresses as a sharp front until the entire colony is killed and several centimeters of skeleton are missing.

At our study sites, algal turf quickly overgrew the exposed white skeleton of both RWD-infected species in approximately one week. The spreading rate was found to be rapid and extensive, expanding by approximately four to five cm per day. Pathogens that might cause this affliction are not grossly visible.

RWD is often confused with severe parrotfish bites or anchor damage, but differs characteristically from either when examined closely. This epizootic can be differentiated by the patterns of ridges and valleys which on *C. natans* are depressed and eroded, while fish would leave scraping bite

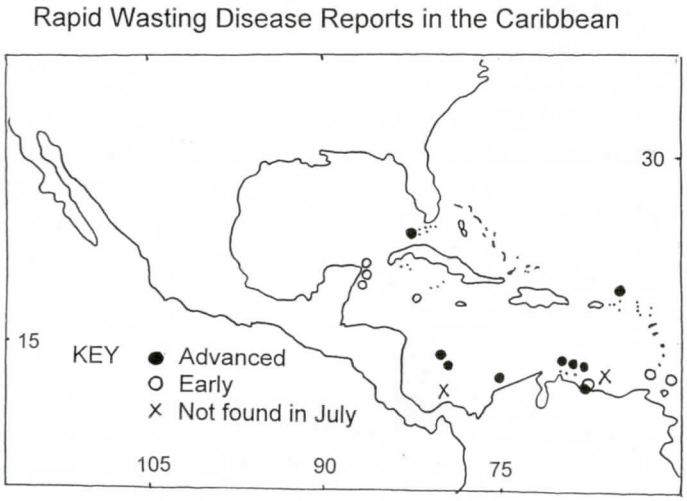

Figure 1. Map of the known distribution of Rapid Wasting Disease (RWD) in the Caribbean in July 1997. Sites with severe infestation are indicated by black dots. Heavy rimmed circles indicate presence of RWD only on a few corals, and overwhelmingly as small or incipient lesions. Light rimmed circles indicate reports of white areas on corals which may be RWD but have not yet been confirmed from photographs or specimens, and x marks sites where it has been searched for and not been found.

marks, disrupting the normal pattern of the valley and ridge direction. This can best seen microscopically. On *M. annularis* the direction of the septa and caylex are not disrupted, just eroded and depressed. It is not likely that fish would do such damage to miles and miles of coral heads and not be observed.

Jim Porter and Craig Quirolo recently observed RWD in Florida. They report that it was completely unlike anything they had ever seen before, and that it had a distribution and appearance which could not have been due to parrotfish. When first reported in **Science** (Anonymous 1997) this epizootic had spread 600 km. Now the data show occurrences over 10,000 km. RWD has been observed in Aruba, Bonaire, Curacao, Colombia, Cayman, Mexico, Tobago, Granada, the US and British Virgin Islands and Florida. The spread is fast. Colonies of *M. annularis* and *C. natans* photographed in February showed the beginning stages of RWD which appeared on the tops, and swiftly worked its way downward towards the base. The sunken or depressed bright skeleton is visually evident when diving. RWD occurs at depths of 20 m or less, predominantly clumped between 15 to 20 meters, often in the company of extensive yellow-band disease.

Microscopy of RWD reveals filamentous fungal hyphae covering and invading epidermal cells. This has been observed independently in two of our laboratories, although the fungus appears somewhat fastidious. In addition, a bacterium unique to RWD samples has been isolated which may be capable of high rates of demineralization of skeletal tissue. Experiments are currently in progress. It would not be unusual for both organisms to be involved in the pathogenesis of the disease. Endolithic fungi that when under stress may become pathogenic have been reported in hard corals (Le Campion-Alsumard et al., 1995a,b). These fungi were not isolated nor identified, however, so their role as putative pathogens could not be confirmed. Fungi (*Aspergillus sp.*) are pathogens of gorgonians (Smith et al., 1996)

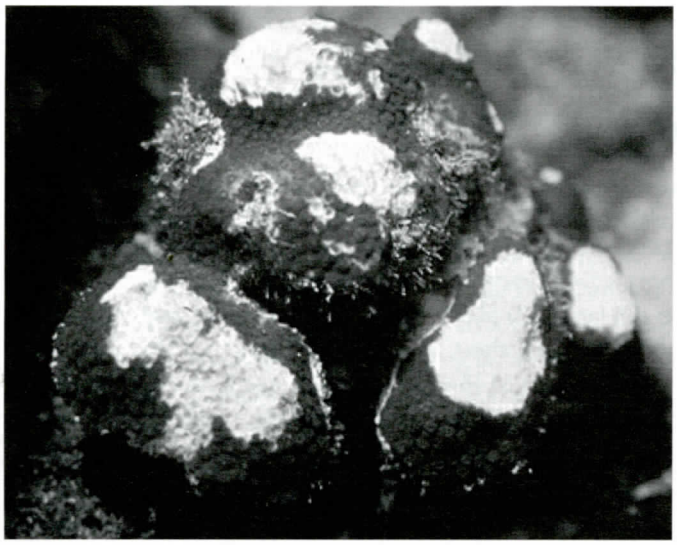

Figure 2. Whole head of RWD on Montastrea annularis, *showing typical appearance of afflicted colonies.*

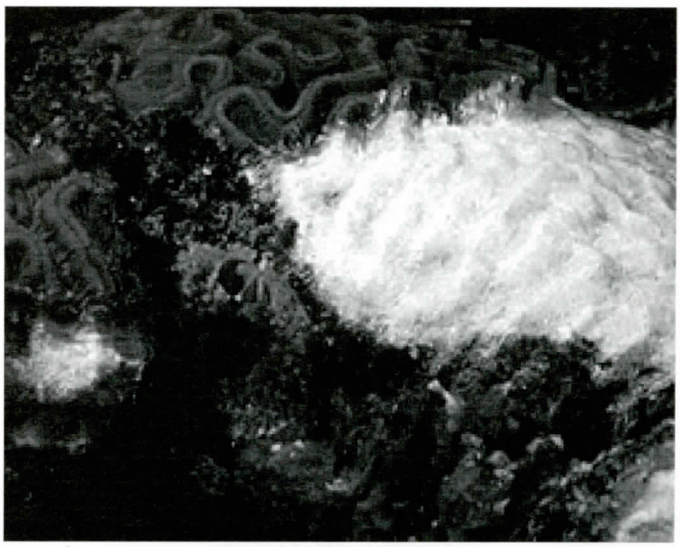

Figure 3. Colpophyllia natans *affected by Rapid Wasting Disease*

and this disease was found throughout the Caribbean (Nagelkerken et al., 1997). Much more work needs to be done to track the geographic spread of coral mortality caused by the new disease, verify the identity of potential pathogens, and understand their role in the pathogenesis of the disease.

Further information or help with identification of RWD from James M. Cervino, Global Coral Reef Alliance, 124-19 9th Ave, College Point NY 11356 tel/fax 718-539-8155 e-mail <cnidaria@earthlink.net.>

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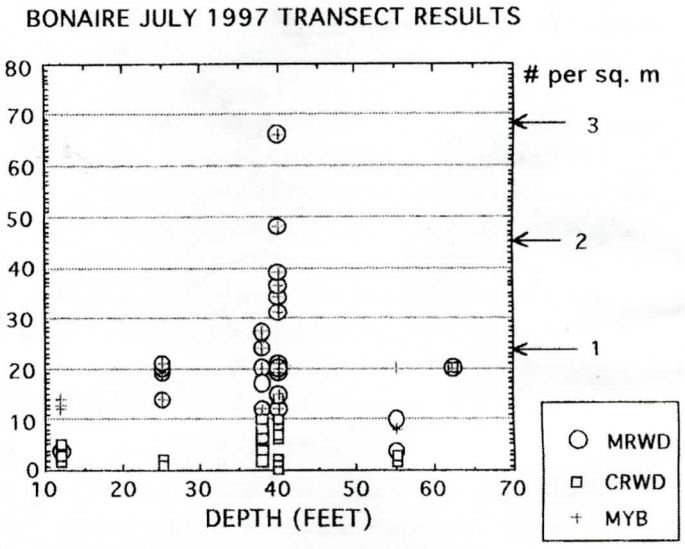


Figure 4. Distribution of RWD on Montastrea annularis, *RWD on* Colpophyllia natans, *and Yellow Band (YB) on* Montastrea annularis *with depth based on transects at four sites in Bonaire, July 1997 (by JC). This figure shows a peak in abundance at a depth of around 40 feet. The highly clumped nature of the disease in each transect is shown by the wide range of density values found in different transects at the same depth. RWD was much more common on M. annularis than C. natans due to the greater abundance of that species, but mortality of corals from RWD, as indicated by the fraction of the colony killed, was observed to be far more complete on the latter species. In most transects* M. annularis *colonies were affected by both RWD and YB, but at a few shallow sites YB was more common than RWD, and up to 10% of colonies were unaffected by either disease.*

CORAL REEFS IN THE NORTH ATLANTIC!

M. Roberts

At 64 degrees north, off the fjordic coastline in the Norwegian Sea, you might not expect to find a coral reef. You might be even more surprised to find that it is more than five kilometres in length and in some areas rises over 30 metres above the sea bed. This reef has developed on the Sula Ridge, a submarine structure in about 250 metres of water, created by the cold water coral *Lophelia pertusa*. After years in obscurity this reclusive coral has recently been thrown into the limelight as industrial and environmental heavyweights square up for a fight over its future at the Atlantic Frontier.

Lophelia is a colonial, asymbiotic scleractinian coral. Despite the lack of zooxanthellae, *Lophelia* polyps secrete a calcium carbonate skeleton just like their tropical counterparts and in the right conditions can produce reefs or bioherms that reach impressive sizes. The reef on the Sula Ridge is the largest *Lophelia* bioherm found so far and dramatically demonstrates their reef-building capacity. Most records of this coral are of ahermatypic colonies in the north east Atlantic, but it has also been recorded in the Mediterranean Sea, along the coasts of Eastern North America, Brazil, West Africa and on the mid-Atlantic Ridge.

Lophelia reefs provide a habitat for many other species and the biodiversity (eg. of sponges, polychaetes, echinoderms and bryozoans) associated with these deep water

coral banks can approach that found in the tropics. Unlike its tropical counterparts, *Lophelia* flourishes in water temperatures of between 4 and 12°C. It seems to require oceanic waters and is usually found in areas where there are fast currents. For instance, coral banks in fjords are often found in narrow stretches or on sills where water flow is high, which may help supply more particulate food and limit the impact of sedimentation on the polyps. Recently it has been suggested that coral banks could be fuelled by a chemosynthetic food chain that is based on hydrocarbons seeping out of the seafloor, but at the moment this theory remains controversial. As with other corals, *Lophelia* requires a hard substrate to settle onto. Once settled, the coral polyps divide and grow, and as the colony expands it is believed to spread out across the seafloor by breaking and so creating new areas of hard substrate that can be colonised.

Industrial and environmental heavyweights square up for a fight

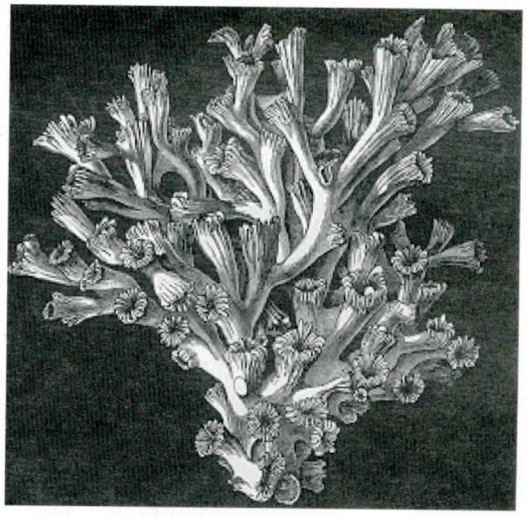
Lophelia remains a mysterious animal. It has only been seen alive by a handful of adventurous scientists who have taken submersibles to the 200 or so metres depth where *Lophelia* is usually found. Many aspects of its basic biology are still unclear. There is little known about what the polyps feed on, or how the coral reproduces sexually. Its distribution remains poorly understood and gathering new information is hampered by the technical difficulties and expense of working at these depths.

At the Atlantic Frontier, to the west of the Shetland Islands, *Lophelia* has been thrust into the spotlight by oil and gas exploration and deep water fish trawling. Coral colonies are known to exist along the edge of the Scottish continental shelf within areas that have been licensed for oil exploration. The *Lophelia* colonies found here are small (up to a few meters in diameter), very different from the large reefs found on the Sula Ridge. Information available at the moment suggests that there are no large coral colonies in areas that were licensed for oil exploration before April 1997, though the extent of coral colonies in the most recently licensed areas is uncertain. Later this year oil will flow from some of these new wells for the first time. Whether these coral colonies and other large benthic organisms such as the fields of large sponges which are often found in this environment are at risk from oil drilling or fish trawling is not known. Many are concerned that drilling is taking place too rapidly before its impact on the coral colonies has been assessed. Greenpeace are campaigning to stop all oil and gas exploration in this area, arguing that it is time to 'put the lid on fossil fuels' and seek alternatives to oil and gas that will not contribute to global warming. They also argue that the drilling activity is illegal since it was licensed before the environmental impact on the *Lophelia* 'coral reefs' of the Atlantic Frontier had been assessed. Unfortunately until more is known about the basic biology of *Lophelia* it is impossible to predict how sensitive it may be.

At the Scottish Association for Marine Science we have just begun a project to address some basic questions about the biology of *Lophelia* and then to assess its sensitivity to developments at the Atlantic Frontier. Our first objective is to map the distribution of coral colonies and sponge fields. We will also examine the coral's geochemistry to help determine colony age, growth rate and to provide clues about past environmental conditions. This analysis should show whether heavy metals have appeared in the skeleton over the twenty years which have elapsed since drilling began at the Atlantic Frontier. DNA fingerprinting techniques will show how colonies reproduce and their capacity to recover from damage. We intend to monitor colonies visually and will analyse the hydrodynamic regime and suspended particle load around corals to understand the impact of any sediment produced by drilling.

We are working in association with industry while preserving our independence, and intend to make full use of industry's technical expertise to find and then sample coral colonies. This independent study is part of the Managing Impacts on the Marine Environment (MIME) programme in collaboration with the oil and gas industry with additional research undertaken by the British Geological Survey, the University of Southampton and the University of Strathclyde.

further information from Murray Roberts, Dunstaffnage Marine Laboratory, P.O. Box 3, Oban, Argyll, Scotland PA34 4AD, tel. +44 1631 652244 fax +44 1631 5685518 e-mail <m.roberts@dml.ac.uk> *web page* http://www.nerc-oban.ac.uk/dml/



Lophelia pertusa

NEWS

JAPAN FORMS A CORAL REEF SOCIETY

In response to the increasing concern for coral reefs, scientists founded the Coral Reef Society of Japan in November 1997. A preparation committee investigated the merits and feasibility of founding such a society, which would aim to promote coral reef awareness and coral reef sciences, spread scientific knowledge to the public and enhance interdisciplinary and international communication. Questionnaires gauged support for a society and positive responses and commitments were obtained from more than two hundred scientists from disciplines including bioscience, geoscience, oceanography, fisheries, social sciences as well as from both government and non government organizations. The general meeting which founded the society was held on 2nd November, 1997 at the University of Ryukyus in Okinawa, Japan. Once the constitution, officers and action plan have been decided, Reef Encounter hopes to bring you a full 'who's who'.

But in the meantime further information can be obtained from Dr. Hajime Kayanne, Executive secretary, preparation committee of the Coral Reef Society of Japan, Department of Geography, University of Tokyo, Tokyo 113 Japan. fax: 81-3-3814-6358 e-mail: <kayanne@geogr.s.u-tokyo.ac.jp>

COZUMEL SUCCUMBS TO ALGAL OVERGROWTH

Once world renowned dive sites off the island of Cozumel, Quintana Roo, Mexico have succumbed to algal overgrowth. During dives at Palancar Caves and Gardens, Columbia Deep and Santa Rosa Wall in 1995, 1996 and 1997, full 50 minute drift dives were spent at depths of 18–22 meters viewing reef tracts virtually blanketed by algae. By contrast, in 1989, only Palancar Caverns and Gardens exhibited early signs of algal succession. At least eight species of algae (*Halimeda goreavi, H. tuna, Rhipocephalus phoenix, Udotea cyathiformis, Penecillus dumetosus, Microdictyon boergesenii, Wrangelia penicillata* and *Dictyota sp.*) are involved. Anecdotal reports gathered in 1997 also suggest that Yucab Reef, Chankanabb 'Deep', and Cedral Pass, all formerly internationally celebrated dive spots, have suffered the same fate.

A feature common to Palancar, Columbia and Santa Rosa reefs is heavy diving pressure. In 1997 six to eight 15-passenger and 10 to 12 six-passenger dive boats were counted on Palancar before noon. This suggests that about 150 to 200 divers are milling about this reef each morning, whilst more divers arrive for afternoon or evening excursions. On a more optimistic note, the less frequently dived, shallower coral reefs of Cozumel (including Tormentos, Paradise, La Francesa, and San Francisco reefs) have high coral cover and may still be considered 'coral' reefs. Ironically, fewer divers want to visit these sites because they are shallow, the coral is somewhat patchy, and they do not fit the classic image of 'Cozumel Wall Diving'. On the same days as counts of dive boats at Palancar, two to three six-passenger boats were seen at San Francisco reef before noon. Punta Sur, a 40m depth dive site featuring a passage through a 'blue hole' is similarly in good condition, perhaps because it has only recently become popular as other southwestern Cozumel reefs have declined.

Another worrying feature of Palancar and Columbia reefs in 1997 is the incidence of white band disease (at least four cases noted per 50 minute drift dive at 18–22m depth). Further scientific investigations are needed to confirm these findings. Cozumel presents a challenge to coral reef scientists because so many compounding factors, including hurricanes, excessive erosion (probably resulting from development sites for dive hotels and beach resorts on the southwestern side of the island) and intense diving pressure may have caused the deterioration. Moreover, the often swift currents make monitoring sites difficult to establish.

The transformation of Palancar, Columbia, and Santa Rosa reefs into algal covered reefs should be a major cause for concern to the diving as well as the scientific community. However, it is unfortunately apparent that little or none of the enormous financial income derived from recreational diving on Cozumel has been apportioned for valuable basic research or diver education.

John Lacson

INTERNATIONAL INITIATIVES

IYOR—A BEGINNING RATHER THAN AN END?

Sue Wells, Robert Ginsburg, Stephen Colwell

By the time this issue of Reef Encounter comes out, IYOR will be technically at an end, although we hope this will not be the case in spirit. Everyone involved in IYOR should be proud of its success in inspiring so many activities in public awareness, education and research. What is remarkable about these worldwide efforts is that they were developed entirely by local committees, groups or existing organizations - a truly grass-roots approach. All over the world, articles in the press, videos, radio reports and other media outputs have mentioned IYOR. Education has received much attention with new and imaginative teaching aids, travelling shows of underwater photographs, school competitions and the efforts of zoos and public aquaria.

On the research and monitoring front, Reef Check demonstrated that sports divers can play a key role in checking on the health of reefs (see report below). A major new assessment of the condition of Pacific reefs was published under the IYOR banner (see **Reef Encounter 21**, p. 23) and a comprehensive new evaluation of Atlantic and Gulf of Mexico Reefs is well underway. The number and range of IYOR activities is astonishing. Recent co-ordination efforts are largely due to input from the Coral Reef Alliance, with an impressive update put out in July and one in October. The IYOR web site (*http://www.coral.org/IYOR*) is being updated regularly, and the 'highlights' page has continued to grow. Taking into account Reef Check as well, it is certain that IYOR has made significant impacts in over 60 countries, and at the time of writing there are still three months to go.

these worldwide efforts were a truly grass-roots approach.

Several important events will be taking place while this issue of the newsletter is in production, including the release of the results of Reef Check (see below) and the 3-day conference that is being organized by the Environment Family of the World Bank, in cooperation with International Center for Living Aquatic Resources Management (ICLARM), the International Coral Reef Initiative (ICRI), the Smithsonian Institution, the World Conservation Union (IUCN), and the Great Barrier Reef Marine Park Authority (GBRMPA). The World Bank meeting will provide a framework for discussion of follow-up actions in areas such as sustainable marine enterprise, consumer education and marketing, policy and regulatory frameworks, and will examine regional and local strategies to combat coral reef degradation.

IYOR has made significant impacts in over 60 countries

Equally importantly, some decisions will have been taken about where IYOR itself can go from here, both at the national level and in relation to international initiatives such as ICRI, GCMRN and Reef Check. At the VIII Pacific Science Inter-Congress in Suva in July, a resolution was passed requesting the Pacific Science Association to endorse and support a program to continue IYOR for another year, as part of the International Year of the Ocean. This program would have the express purpose of establishing an International Decade of Reef Conservation and soliciting support for such a program from member countries of the PSA and stakeholder countries in which reefs are major and significant resources (see **Meeting Reports**). If the PSA takes the lead regionally, it may be that equivalent bodies could initiate similar programs in other regions, and that the proposed Decade could become a truly international initiative. Many conservation organizations and NGOs can be expected to continue their IYOR efforts throughout 1998 under the umbrella of the International Year of the Ocean. The exact form for future IYOR activities is under consideration, but there is every indication that the initiative launched at Panama in July 1996 will continue. We hope to have an assessment of the impact that IYOR has had by early 1998. Jeremy Saxton is collecting information about IYOR activities around the world, including press coverage, and opinions of the success of it all, as part of his Master's thesis. If you have not responded, but are interested in doing so, please send information in the following format to Jeremy <jms5@acpub.duke.edu>:

Your name:

The organization that you represent:

The country or region in which IYOR activities are taking place:

What IYOR activities/events have been most successful and why?

What IYOR activities/events have been least successful and why?

Have you noticed a change in public support towards reef conservation issues in your area?

If so, has this support resulted in any new developments regarding the marine environment in your area? These might include policy recommendations, a change in people's behavior, new funding for conservation projects, etc.

What do you think is the best way to continue the message of IYOR?

Do you have any other comments or suggestions regarding IYOR and its impact in your area?

For further information, see the Web page (address above) or contact: The Coral Reef Alliance, 64 Shattuck Square, Suite 220, Berkeley, CA 94704, USA. tel: (510) 848-0110; fax: (510) 848-3720; e-mail: <IYOR1997@aol.com>

LESSONS FROM REEF CHECK 97

Gregor Hodgson

Reef Check 97 is drawing to a close. Although the results are, at the time of writing, still flowing into the university computer, it is worthwhile to pause to examine this shared adventure and to try to extract some lessons.

Clearly Reef Check struck a positive nerve with many disparate people around the world - as many as 1,000 people including 150 scientists volunteered to help. We have been overwhelmed at the huge positive response. Why did this happen? What does the future hold?

To briefly review, Reef Check has two goals of equal importance:

1) To carry out a global scientific survey of human impacts on coral reefs.

2) To disseminate to the general public the idea that coral reefs are valuable, that they are threatened by human activities and that there are solutions to these problems.

We received much advice on Reef Check and it is worth considering what lessons can be drawn from some examples.

"You can't get scientists to agree on anything."

Reef Check has proven that it is fairly easy to get scientists to acquiesce, if not out-right agree with a protocol. Most coral reef scientists seem to sensibly realize that there is more than one way to skin a cat, and the end result is about the same. The bottom line is that out of about 150 teams, only a couple used a different protocol, and that apparently was because of English comprehension problems rather than a disagreement over methods. Most established groups such as Earthwatch realized that it was a simple matter of adjusting existing methods slightly to incorporate the relatively simple Reef Check parameters – and then they were able to participate in the first global survey of coral reefs.

Most coral reef scientists seem to sensibly realize that there is more than one way to skin a cat

"You know about volunteer programs, nothing ever happens."

Not only was this wrong, but it was very wrong. There was unprecedented support for the independent Reef Check teams from small and big sponsors, dive clubs, resorts, airlines that together with the volunteer manpower, allowed Reef Check to move mountains. Large groups from Europe traveled to far-away Red Sea, Maldives, etc. All told, we estimate that a program of this size would have cost about US$2 million in time, labor, transport, and dive support.

"But it's not hard science."

A resounding "so-what" is still echoing through the halls of academia. We are all in favor of hard science, and we believe that counting key species, and interpreting those numbers in relation to natural and anthropogenic effects, is just as "hard" as any other scientific endeavor. But more important than a debate over definition is that it appears that many "hard scientists" are seeking to put their data to more meaningful use than publication in a journal that perhaps a dozen people may read over the next 100 years. The quiet and humble volunteerism demonstrated by dozens of "hard-core" scientists to help lead Reef Check teams was proof of this shared desire to put science to use to solve real world problems and to spread the word about threats to our favorite workplace. And when curious "outsiders" such as US Biodiversity Survey scientists have taken the time to examine our industrial strength

quality control procedures, they have found that they exceed the typical academic standard.

"You will never get international media coverage."

We gave our first CNNI (covering Asia and Europe) interview two-weeks after we were given this helpful advice from the group responsible for promoting our work. The media are interested in coral reefs and dozens of our teams have had excellent TV, newspaper and magazine coverage. Our long-term goal is to get reefs out of the "environmental gutter" and up onto the front page.

The media have proven valuable in helping to disseminate the activities of Reef Check, however, they can also make a mess. The media exist to create controversy and sometimes when they get bored, they get creative. When this happened regarding a freelance news article and misleading photo (chosen by the art department) in a leading science journal that seemed to indicate that Reef Check was all about detecting coral reef diseases, some scientists got worried and wrote letters to the editor. The responsible journal editors responded sensibly to our request for printed clarification and stated among other things,

"We see no reason for a clarification - we make too many errors to correct them all."

During field surveys, no doubt there have been many exciting individual adventures that we are not yet aware of. Some interesting tales should surface from Steve Oakley et al., who effectively surveyed most of the pirate-infested east coast of Borneo for the first time, working for several weeks at a go, out of an open 20 ft boat. We haven't heard all the details yet, but our European/Red Sea co-coordinator, Moshira Hassan's interaction with the Egyptian military also deserves mention. After doing a tremendous job with Gert Woerheide in organizing travel and resort sponsorship, full-on network TV coverage and in-depth training for several large groups of Euro-divers, Moshira's request for a final authorization permit was denied by the military for "security" reasons. Only some last minute diplomacy and redefinition of the phrase "data collection" into "data collection training" saved the day. The resulting data and high quality video are an invaluable testament to all the hard work.

In another incident, Jim Maragos (who helped launch Reef Check in Kauai in June), was doing a reef survey unrelated to Reef Check in Bali in August, and bumped into a heavily encrusted reef marker. Thinking it must be from a survey years ago, Jim scraped off the tag, only to find it marked "Reef Check 97."

In general, some of the larger scientific groups already involved in heavy coral reef monitoring programs were slow to assume leadership roles in Reef Check. This is understandable from the standpoint of resources and time. However, they eventually joined in when it became obvious that Reef Check had succeeded in attracting a reasonable global network and that it was likely to be coming up with reliable, useful data that would help guide global efforts at policy-making on coral reef resources.

We have been most pleased when we have received comments from those such as Hungarian Emil Karath, who participated in the Indo-Pacific surveys, and stated that he was determined to "spread the word" about coral reefs back in his native country (despite the obvious distance from real reefs).

A program of this size would have cost about US$2 million in time, labor, transport, and dive support

Why Reef Check?

It seems obvious to almost everyone now that we need several types of activities if we are going to reverse the present trend of increasing damage and over-exploitation of coral reef resources. These are:

1) sufficient scientific monitoring to capture baseline data on remote reefs that have been least affected by humans, as well as on reefs that are exploited by humans. These data are needed to track changes in populations of reef organisms. Now these data can be used to show that the trend is negative, and in the future, we hope that these data will show that management works and recovery is possible.

2) sufficient public education such that the "person-in-the-street" including politicians and the business community are made aware that coral reefs exist and have great value, that they are threatened, but that there are cost-effective, sustainable solutions.

3) sufficient socio-economic monitoring to determine how humans interact with coral reefs around the world.

4) implementation of integrated coastal management programs in every coastal country.

Reef Check can successfully carry out the first two activities. But there is still a need for more detailed scientific and socio-economic investigations. Scientists don't understand how coral reefs work and how they respond to human impacts. Government-led programs such as GCRMN should be aiming to tackle these activities. This is because a global program of scientific and socio-economic monitoring is a realistic goal.

A third type of program is needed to design and implement national and regional integrated coastal management plans based on the interpretation of the monitoring data

from Reef Check, Aquanauts, GCRMN and others. In many parts of the world, such programs are already underway.

The Future of Reef Check

We believe that Reef Check will become an annual event. With over 250 sites reporting from 30-odd countries in 1997, we more than doubled our goal of 100 sites. Despite this initial level of success, the reef area surveyed represents but a tiny fraction of the world's reefs. To be representative, we need to expand the Reef Check network to include several thousand sites. We believe that this level of effort will be possible.

Over 100 years ago, weather reports were not common. Now many of us depend upon them to determine our daily activities. We would be upset if weather reports were cancelled. We need to educate the general public to understand that many citizens and the government need "reef reports," perhaps on a quarterly basis, to indicate what shape particular reefs are in and to enable us to plan how much human activity e.g. fishing, should be allowed.

Planning for Reef Check 98 is well underway. There will be an evaluation exercise for this year's methods and operations. Some modifications will be needed, and some additions will be made and the website adjusted. We are currently examining ways to increase participation and obtain funding to support surveys of remote areas. We take this opportunity to thank the participants, sponsors and supporters of Reef Check. If you are a coral reef scientist and you were not involved in Reef Check 97, you are welcome to join in this extremely rewarding program.

Gregor Hodgson, Institute for the Environment and Sustainable Development, Hong Kong University of Science and Technology, Clearwater Bay, Kowloon, HONG KONG e-mail: <rcgregor@usthk.ust.hk> *tel: (852) 2358-8568 fax: (852) 2358-1582 Reef Check:*

http://www.ust.hk/~webrc/ReefCheck/reef.html

UC-ICRI: A COMMITMENT BY THE UNIVERSITY OF CALIFORNIA

In 1996, the U.S. Under-Secretary of State, Mr. Timothy Wirth, acting on behalf of the Secretariat of the International Coral Reef Initiative (ICRI), invited the 9-campus University of California (UC) system to become the first research and educational partner in ICRI. This invitation was accepted in 1997 by UC President Richard Atkinson who subsequently designated the Santa Cruz campus (UCSC) as lead campus for ICRI activities within the university system. Donald Potts has now been asked to coordinate the new UC-ICRI programs.

Current priorities are to:

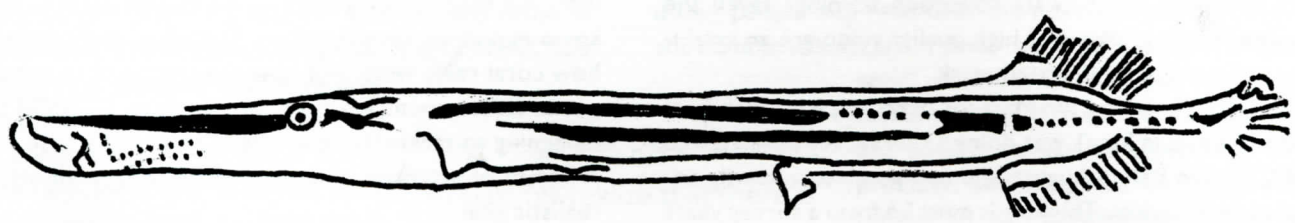
1) Establish a coordinating committee of experienced tropical researchers from the 9 campuses representing natural sciences, social sciences and applied disciplines.

2) Survey the 9 campuses to identify all University of California faculty, researchers and graduate students with research or other interests in the approximately 120 countries and major national territories having coral reefs, and to document the nature of those interests.

3) Establish formal communications with other ICRI partners and the ICRI Secretariat.

A workshop will be held within a few months to explore ways to integrate the University's own research, educational and outreach programs within the broader context of contributing to ICRI's goals.

For further information contact: Donald Potts, Institute of Marine Sciences, University of California, Santa Cruz, CA 95064, USA. fax 408-459-4882; tel. 408-459-4417; e-mail potts@biology.ucsc.edu



MEETING REPORTS

VIII PACIFIC SCIENCE ASSOCIATION INTER-CONGRESS, FIJI, 13–19 July 1997
Call for a Decade of Reef Conservation

A plea by Rick Grigg that we should not lose the momentum of IYOR led to the ratification of the following resolution at the PSA Inter-Congress in July 1997:

International Decade of Reef Conservation

- Whereas coral reefs are the most diverse marine ecosystem in the world and a most important source of natural resources both culturally and economically for tropical coastal societies, and
- Whereas coral reefs and their resources are under significantly increasing pressure from human population growth, urbanization, and economic development, and
- Whereas 1997 has been established and recognized as the International Year of the Reef;
- Be it resolved, therefore, that the Pacific Science Association endorse and support a program to continue the International Year of the Reef for another year as part of the International Year of the Ocean with the express purpose of establishing an International Decade of Reef Conservation and to solicit support for such a program from member countries of the Association and stakeholder countries in which reefs are major and significant resources.

Other developments at the meeting include a website for the PSA Coral Reef Newsletter. In addition to news and notes on research activities and announcements, the newsletter includes a bibliography of previous transects and surveys of coral reefs in the Pacific islands and is the most complete compilation of quantitative reef assessments in the past in both refereed journals and unpublished technical reports. In addition, there are bibliographies on coral reef survey handbooks and on effects of storms on coral reefs. The address of the website is: www.bishop.hawaii.org/bishop/psa/ The IX Pacific Science Inter-Congress "Sustainable Development in the Pacific" will be held in Taipei, Taiwan, November 15–21, 1998; the XIX Pacific Science Congress "Science for Pacific Posterity: Environments, Resources and Welfare of the Pacific People" will be held in Sydney, Australia, July 4–9, 1999. Coral reef activities are being planned for both of these future meetings.

Chuck Birkeland

BIODIVERSITY OF CORAL REEFS ASSOCIATION FOR TROPICAL BIOLOGY AND THE ORGANIZATION FOR TROPICAL STUDIES 25TH ANNUAL MEETING

Despite a quarter century of concerns with tropical biodiversity, there is no memory of the Association for Tropical Biology (ATB) or the Organization for Tropical Studies (OTS) focussing specifically on marine biodiversity. To rectify this omission, Jorge Cortes organized a special invitational symposium on "Biodiversity of Coral Reefs" on the first day of the 25th ATB/OTS Annual Meeting in San Jose, Costa Rica (15-17 June 1997). One major goal was to increase awareness of the nature and importance of marine systems among the predominantly terrestrial biologists and environmental managers working in Central America. When, unfortunately, illness prevented Jorge's participation, his student Carlos Jimenez very ably took up the slack, not only during the symposium but also in organizing other activities for the speakers.

The symposium was both stimulating and successful. The speakers (Carlos Jimenez - Costa Rica; John Pandolphi - STRI, Panama; Donald Potts - California, USA; Peter Sale - Windsor, Canada; Mireille Harmelin-Vivien - Marseille, France; Marjorie Reaka-Kudla Maryland, USA) presented aspects of reefal biodiversity on a variety of spatial and temporal scales to an overflow audience. In the following days, all participants were involved in numerous informal discussions suggesting that many ideas about spatial and temporal scales of disturbance and patterns of change that are now widely accepted among reef scientists, were relatively novel to biologists with experience mainly in neotropical wet forests. The exchanges were very positive, and undoubtedly contributed to the original goals of enhancing awareness and understanding of similarities and differences between tropical marine and terrestrial systems.

Donald Potts

BOOKSHELF

CORAL REEFS: CITIES UNDER THE SEA, Slide set and teacher's guide.

Like many others, I have found the functional analogies between coral reefs and cities an excellent way to introduce reefs to varied audiences. With help from colleagues, I have assembled 35 slides to illustrate these analogies: corals are like apartment houses; sponges are the reef's water purification system; bleaching is like a city fire etc. To simplify the visual comparisons, we combined two images on some 20 of the slides. In addition to the slides illustrating the comparisons, there are others to show the societal values of reefs and impacts, both natural and anthropogenic. For each of the slides, we prepared a written explanation with some background information to be used by presenters. For examples of these slides, see *http://www.rsmas.miami.edu/groups/rare/cities.*

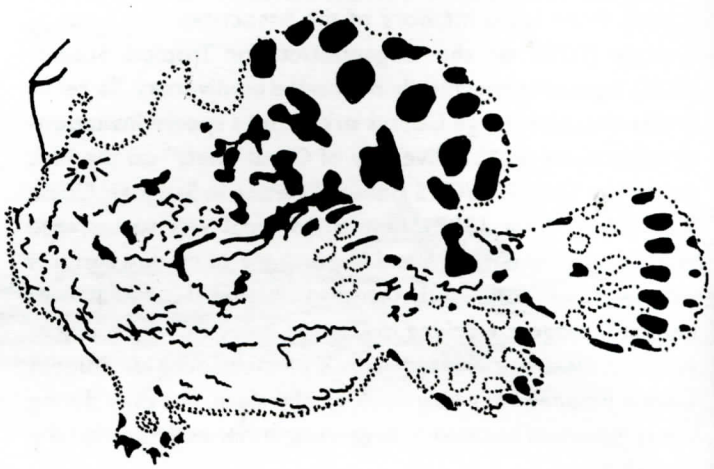
I wish we could provide these free to teachers, but we must cover our costs of production and duplication. The slide set and teacher's guide is available for $70.00, including first class postage and handling in the United States (Florida residents add $5.00 to cover sales tax). Please send a check or money order in US Dollars made payable to the University of Miami to Global Reefs, University of Miami, RSMAS, 4600 Rickenbacker Cswy., Miami, FL 33149. The cost of airmail postage outside the United States can be supplied on request.

Robert N. Ginsburg.

OCEANOGRAPHIC EDUCATIONAL MOVIE: SURFING OUR SEAS

This 20-minute educational video movie was developed by Eric Wolanski and produced by the Australian Institute of Marine Science (AIMS) with the support of IBM and UNESCO's IOC. The movie follows the life of a high school student in order to demonstrate the importance of the coastal ocean. In an innovative and highly entertaining way, the movie shows the student doing his homework on coastal seas. He interacts with his talking PC to surf a high tech Internet. While being entertained, he discovers the fascinating inner workings of coastal seas. The computer progressively challenges him to understand that his future depends on understanding the seas through science explained by computer animations. The animations are all based on actual study sites in estuaries, mangroves and coral reefs in Australia's Great Barrier Reef, Papua New Guinea, China, Thailand and Malaysia. In the computer these examples are merged in a virtual sea to show the inner workings of coastal seas. Examples include estuaries, mud dynamics, the effects of dams on the coast, harbors, oil slicks, mangroves and prawns, coral reefs and fish larvae. In this way the examples are applicable to all nations facing the ocean.

Marine scientists dealing with physics, chemistry and biology essentially speak their own technical jargon and each works in an isolated world. The movie demonstrates that computer visualization enables them to share information and readily pass their knowledge to the public, in this way helping to ensure wise use of the sea. It also provides a powerful tool for teaching marine science in schools and universities. For purchasing information, please contact Steve Clarke at e-mail address <S_Clarke@aims.gov.au>.



Book Reviews

ÖKOLOGIE UND SEDIMENTOLOGIE EINES REZENTEN RAMPENSYSTEMS AND DER KARIBIKKÜSTE VON PANAMA

(Ecology and Sedimentology of a recent ramp system on the Caribbean coast of Panama).

L. Greb, B. Saric, H. Seyfried, T. Broszonn, S. Brauch, G. Gugau, C. Wiltschko, R. Leinfelder

168pp. ISSN 0941-0414, 1996. Profil Band 10. Institut für Geologie und Paläontologie, Universität Stuttgart. Available from same institution, Herdweg 51, D-70174 Stuttgart, Germany, Fax: ++49-711-121 1341, DM 55,-

Comprehensive studies dealing with biological, sedimentological and geological phenomena of a certain area are rare and welcome to the scientist who wants to broaden his/her interdisciplinary knowledge. Only a few of the world's reef areas have the privileged of such detailed attention. The presently discussed publication is a detailed, well illustrated and expensively produced multidisciplinary study of the Bahia de Almirante in Panama. The paper is entirely written in German with only the abstract in English and Spanish, which unfortunately may greatly reduce the paper's circulation. It is one in a series of excellent publications produced by German research institutions. "Profil" is the home journal of Stuttgart's Geology and Paleontology Institute and has published a series of very interesting volumes, some in English, some in German - definitely worth checking out.

Interesting for those who worry about the disappearance of *Acropora* from many Caribbean reefs are the maps detailing the distribution of *Acropora cervicornis* and *Porites porites* monospecific stands

The present paper is a comprehensive study of the Bahia de Almirante. The introduction gives good, condensed background information on the area's geology and geological evolution, stratigraphy, climate, weather and oceanography. These sections will be very useful as a reference for anyone who works in Central America. The results section is well illustrated with color photographs of dominant taxa or aspects of each described facies. Color maps illustrate the lay of the land and bathymetry.

Interesting for those who worry about changes in reefs and especially the disappearance of *Acropora* from many Caribbean reefs are the maps detailing the distribution of *Acropora cervicornis* and *Porites porites* monospecific stands. It should be possible to use these maps some time in the future to check on the extent of these communities again. The detailed drawings of the test transects with the observed zonation of typical organismic groups came out very well and will also serve as good reference points for possible comparative studies. In any case, the bay's major benthic biota are adequately described and attractively illustrated. A list of encountered taxa is useful and detailed although certainly not complete, as also stated by the authors. Most quantitative work is restricted to sedimentological analysis, which gives interesting results concerning the bay's history, sediment production and transport mechanisms.

The discussion section offers thoughts and some data concerning organismic zonation, the development of the carbonate relief and reef development. Both tectonic and biotic mechanisms leading to the observed reef morphologies are discussed.

On the last few pages, the author's include a page (in German, English and Spanish) of recommendations to tourists how to avoid damage to the bay's biota. This follows a short description of the threats to the area's environment. Well done - a good example of scientist's concern for their study area. Moral of the story — a valuable contribution to Caribbean reef science and worth having.

Bernhard Riegl

I WAS AMELIA EARHART

A novel by Jane Mendelsohn. Published by Alfred A. Knopf, New York, 1996; 145 (small) pages. List price US$18.00.

The centenary of the birth of Amelia Earhart, arguably the most famous and certainly the most mythologized, aviatrix to have lived, has seen a spate of publications about her life. That life, of course, was (presumably) cut short in her 40th year as she attempted to be the first woman to fly around the world. She, in the company of Fred Noonan, a navigator

who had been fired by Pan American Airlines for drunkenness, took off from Lae, in eastern New Guinea, on 2 July 1937; their Lockheed Electra never arrived at that leg's destination, Howland Island.

The conceit of this slim volume is that they made a controlled landing on a reef flat of some small island ("Not even an island really, more of an atoll, four miles long and half a mile wide. It isn't much more than a sandbar. There's an outer ring of coral reef that extends from the beach about five hundred feet at low tide, and an inner ring of jungle encircling a peaceful lagoon"), where they lived for well over a year, first separately and in conflict, then amorously, before taking off again (the Electra with a broken windshield, after more than a year in the open on the reef flat of a tropical island), this time actually to run out of fuel and crash.

Part one of this fictive autobiography is a factual, credible, and entertaining account of Amelia's childhood, her learning to fly, and her marriage to the publisher George Putnam ("the husband who made her famous, who devoted himself to her"), and, it is clear from the fictional Amelia's comments, whose cultivation of her celebrity allowed her little time to maintain her flying skills. The author's imagination looms larger in the story as New Guinea is approached on the fabled round-the-world flight, setting the stage for part two.

As a pilot, I was engaged by the first part of the book passages that express some of the exhilaration of flying and recklessness of Amelia, as well as a chronicling of the fatal path Amelia chose to follow in order to be able to fly. Alas, the verisimilitude that contributed to my enjoyment of part one seemed largely absent in part two, except for punctuated reflections by Amelia on her past, fleshing out the factual and (imagined) psychological details of her life. As a coral reef scientist, I found so many gaffes I was unable to savor an interesting story concocted from the imagination of a seemingly talented writer.

Marginally credible assertions, such as Amelia's and Fred's living off the land ("fruits and berries," as well as coconut crabs and rats) and ocean (fish and "sea vegetables") are interspersed with the truly incredible. The first false note sounds on the fifth page of part two when "a seagull" lands atop the airplane. Three paragraphs later, the author's ignorance of biogeography (not to mention geomorphology) is revealed even more starkly: "after the rain she sits by the lagoon and watches the giant frogs relaxing on sun-baked stones . . . " The implication that the lagoon is fresh is confirmed many pages later when, during a heat wave, "the lagoon grows shallow and its waters stagnate into a cesspool on top of which winged bugs float belly up . . ." As jarring biogeographically as the fresh-water lagoon is geomorphologically, Fred and Amelia share their tiny island–which alternates between being a "desert island" and one characterized by "jungle" — with monkeys!

As jarring biogeographically as the fresh-water lagoon is geomorphologically, Fred and Amelia share their tiny island with monkeys!

Part three seems to be a truly post-mortem narrative — from a place even more idyllic than the tropical island of part two. In this book, being a work of fiction, I was able to accept such inventions from the author's imagination more easily than I was the author's rendering of the island. It seemed clear she had checked the facts of airplanes and Amelia's life; so how could she write episodes such as that in which Fred beachcombs for debris cast onto the beach by a storm, fighting over a fish with "a bird of paradise"? Is the scientific education we provide our children so poor that people, such as the author of this book, really believe that monkeys and frogs live on small tropical Pacific islands? Such misapprehension, it seems to me, is identical to the belief that dinosaurs and humans lived together, a conviction held by a astonishingly large fraction of Americans. Even more frightening is the apparent lack of knowledge on the part of the many people through whose hands the manuscript for this book had to pass before it was actually published. Or perhaps, most frightening of all, is the possibility that some or all of them knew full well — but cynically anticipated their readers would not. Why, after all, let facts get in the way of a good story?

Daphne Fautin

WHO'S WHO

REEFKEEPER INTERNATIONAL: to protect coral reefs and their marine life

ReefKeeper International, founded in 1989, is an international membership organization exclusively dedicated to the protection of coral reefs and their marine life. ReefKeeper International conducts an integrated program of reef assessment and monitoring, advocacy, policy analysis, grassroots organization, agency monitoring and public awareness. These activities work together to further coral reef protection and ecosystem management by targeting six Issue Areas: Offshore Oil & Marine Pollution, Coral Reef Initiatives, Coastal Zone Management, Living Resources Conservation, Physical Impacts, and Marine Protected Areas.

ReefKeeper has a staff of nine, a 21-member Scientific Advisory Panel and many other volunteers. Together, they conduct coral reef conservation programs in Florida, the U.S. Caribbean and Wider Caribbean, and Central America from facilities in Miami (Florida), Boqueron (Puerto Rico), and Cozumel (Mexico). In 1998, staff and facilities will be added in Hawaii and Guam to expand ReefKeeper activities to the U.S. Pacific and Micronesia.

Through its ReefKeeper Network, ReefKeeper facilitates and coordinates the pursuit of coral reef conservation advocacy by over 300 Network participant groups throughout the USA and several other countries. Technical assistance and campaign strategy consultation help are provided to local groups and activists worldwide through ReefTAP (Reef Technical Assistance Program).

ReefKeeper quarterly publications include the ReefKeeper Campaigner and the ReefMonitor Update. Book-length Conservation Action Guides and single-issue ReefAlert! kits are published periodically. Detailed issue information, status reports, news items, and downloadable reef monitoring data are available from ReefKeeper's web site at www.reefkeeper.org.

ReefKeeper Campaigns and Activities

ReefKeeper is involved in habitat protection efforts throughout Florida and the Caribbean and is pursuing the establishment of national or state-level Coral Reef Initiatives in Florida, Puerto Rico, the U.S.Virgin Islands, Mexico and the Netherlands Antilles. So far, this has produced government-sponsored efforts to develop such Initiatives in Puerto Rico and the Netherlands Antilles.

In 1997, ReefKeeper oversaw ReefCheck activities for the Florida Keys National Marine Sanctuary. Additionally, through its Cooperative Coral Reef Monitoring Program, ReefKeeper and 10 local ReefMonitor Affiliate groups are carrying out quarterly reef monitoring at 33 sites off Southeast Florida, the Florida Keys, Puerto Rico, Belize, Curacao, Cancun and Cozumel. The addition of another 20 or more sites to the program is expected in 1998.

ReefKeeper has had a hand in the creation of several marine protected areas. This includes the Flower Garden Banks National Marine Sanctuary, Florida Keys National Marine Sanctuary, Oculina Banks Habitat Area of Particular Concern, and Cozumel National Marine Park. Current ReefKeeper marine protected area creation efforts are targeting Mona Island and Desecheo Island (both off Puerto Rico), and Southeast St.Thomas (U.S.Virgin Islands). Current management plan efforts focus on the Cancun National Marine Park, Bonaire Marine Park, Curacao Underwater Park, Cozumel National Marine Park and Florida Keys National Marine Sanctuary.

Other ReefKeeper endeavors include the U.S. Living Reefs Initiative (reef fisheries conservation), and the ReefKeeper Rapid Response Initiative (field investigations, ecological assessments and technical assistance targeting Florida, the U.S. Caribbean, and the Wider Caribbean). Rapid Response reef assessments have been undertaken at the request of local groups to provide scientific documentation to protect Cozumel's Paraiso Reef from cruise ship pier construction impacts, to create a coastal development buffer zone along the eastern portion of the Curacao Underwater Park, and to prevent development of the island of Klein Bonaire in the Bonaire Marine Park. Under its U.S. Living Reefs Initiative, ReefKeeper pursues fishery management actions at the state level in Florida, Puerto Rico and the U.S. Virgin Islands, as well as through the federal regional fishery management councils for the Gulf of Mexico, U.S. Caribbean and South Atlantic. Previous work has resulted in the end of live rock collection in all targeted areas, the end of wire-mesh fish trapping in the South Atlantic, creation of a coral management plan for the U.S. Caribbean, and the establishment of a marine fishery reserve off Central Florida. Present work is targeting creation of additional marine fishery reserves in the South Atlantic and Gulf of Mexico, temporal protection for reef fish spawning aggregations, further cur-

tailment of fish trapping in the Gulf, and development of fishery management plans for tropical aquarium fish.

ReefKeeper Financial Supporters

Foundation grants, together with membership revenues and substantial in-kind contributions, fund ReefKeeper's annual $300,000 operations budget. ReefKeeper is partially supported as an affiliate of the American Littoral Society by grants from the Elizabeth Ordway Dunn Foundation, Jamee and Marshall Field Foundation, Bay Foundation, Phoebe W. Haas Charitable Trust, Henry Foundation, Homeland Foundation, Curtis and Edith Munson Foundation, Ohrbach Foundation, Orchard Foundation, Threshold Foundation , and Turner Foundation. Past funders have included the Beldon Fund, Conservation, Food & Health Foundation, W. Alton Jones Foundation, PADI Foundation, Pew Charitable Trusts, and Town Creek Foundation.

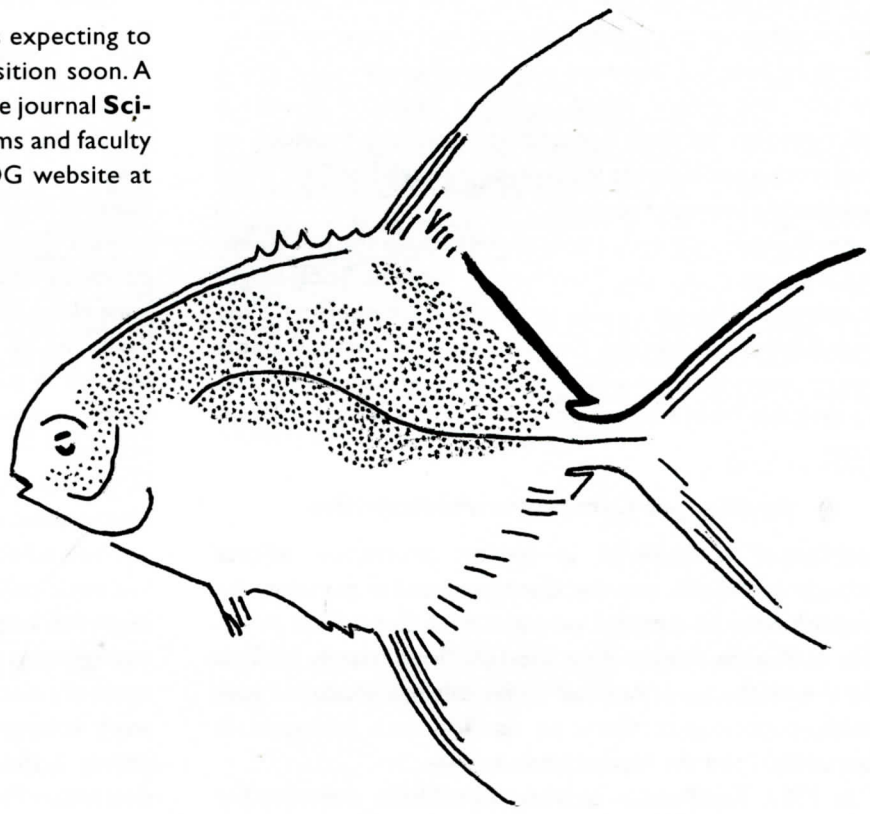
In-kind contributions of technical expertise, volunteer survey assistance, and boat use donations and other logistical support make ReefKeeper's reef monitoring program possible. Last but not least, membership donations starting at $25 per year make a significant contribution to ReefKeeper operations.

For further information contact Alexander Stone, e-mail <reefkeeper@reefkeeper.org>, fax (305) 358-3030, visit the website at www.reefkeeper.org, or write to 2809 Bird Avenue-Suite 162, Miami FL 33133.

ANNOUNCEMENTS

MARINE BIOLOGY POSITION IN GUAM

The University of Guam Marine Laboratory is expecting to hire a marine biologist for a tenure-track position soon. A call for applications is expected to appear in the journal **Science**. For information on the facilities, programs and faculty of the UOG Marine Laboratory, visit the UOG website at *http://www.uog2.uog.edu*



MEMBERSHIP

The annual subscription for individual membership of ISRS is currently US$70, 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$80. Student membership costs US$20 and benefits include all of the above except the journal *Coral Reefs*.

The category — Sustaining Member — is for those supporting the society with a subscription of $150. In addition to other benefits sustaining members will see their names printed in each issue of *Reef Encounter*.

Renewals received between 1 March and 30 April will cost US$30 for a student member, US$80 for a full member and US$90 for a family membership. Those received after 1 May will cost US$35, US$90 and US$100 respectively. New memberships will be at the base rate of US$20, US$70 and US$80 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, newspaper 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 the 2,000 words in length, preferably by e-mail or diskette using Word or ASCII 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 systems, but contributors will receive a free copy of the relevant issue.

DEADLINE FOR COPY FOR REEF ENCOUNTER 23 (DUE OUT JULY 1998) IS MAY 1st 1998; please send to one of these addresses:

Maggie Watson, ICLARM Caribbean Marine Protected Areas Project, c/o Conservation and Fisheries Department, P.O. Box 3323, Road Town, Tortola, British Virgin Islands. Fax: (1-284) 494 2670 Phone: (1-284) 494 5681 e-mail: iclarm@caribsurf.com

David Obura, The Wildlife Conservation Society, Coral Reef Conservation Project, P.O. Box 99470, Mombasa, Kenya. Fax: 254-11-472215 Phone: 254-11-485750 e-mail: dobura@users.africaonline.co.ke

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