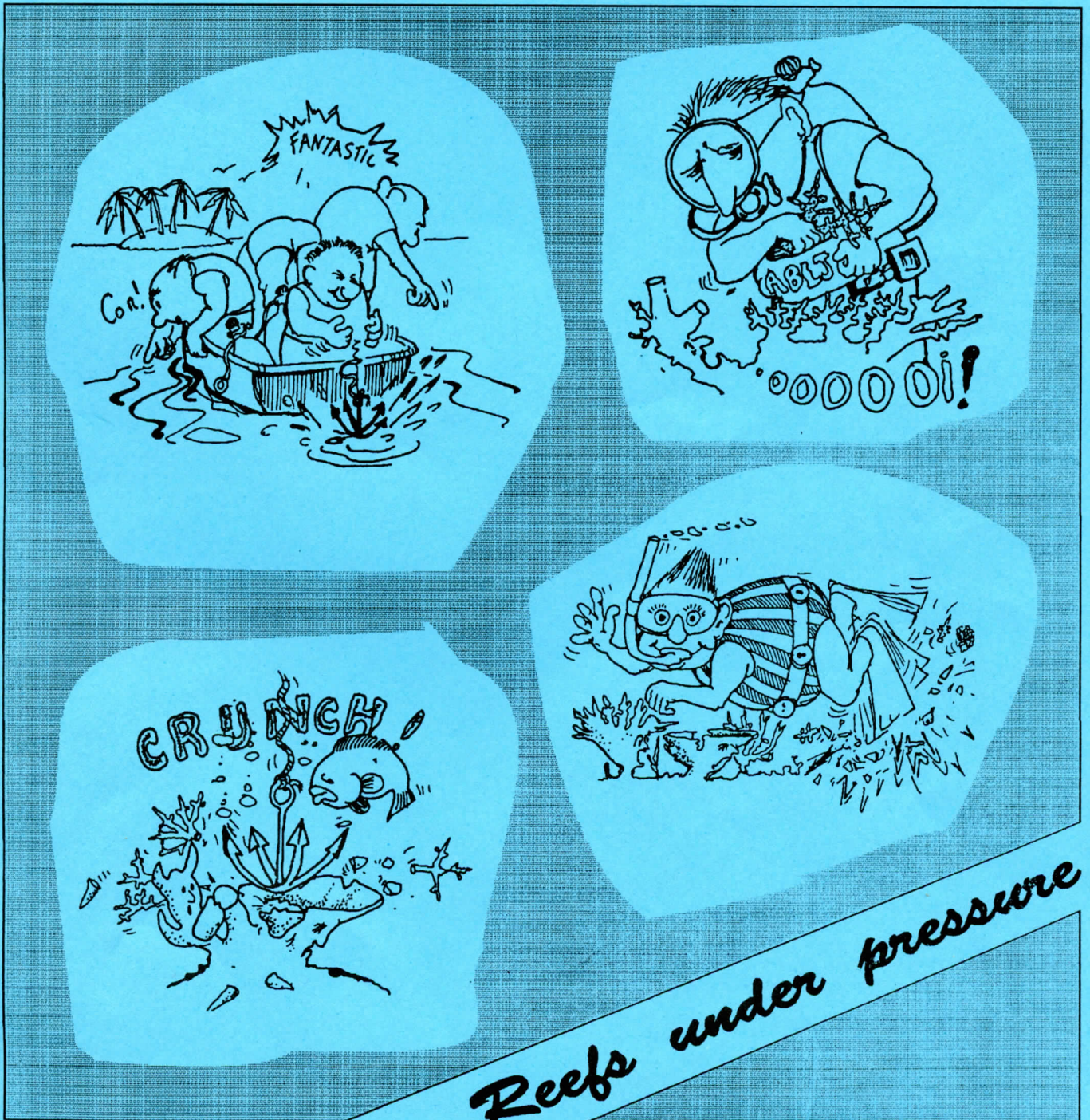


REEF ENCOUNTER

Newsletter of the International Society for Reef Studies

Number 5

August 1989



Reefs under pressure

REEF ENCOUNTER No. 5 August 1989

NEWSLETTER OF THE INTERNATIONAL SOCIETY FOR REEF STUDIES

Edited by Sue Wells assisted by Barbara Brown and Brian Rosen



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

Its aim under the constitution is to "promote for the benefit of the public, the production and dissemination of scientific knowledge and understanding concerning coral reefs, both living and fossil."

In order to achieve its aim, the Society has the following powers:

- To hold meetings, symposia, conferences and other gatherings to disseminate this scientific knowledge and understanding of coral reefs, both living and fossil.
- 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.
- 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.

Membership

The annual subscription for membership of ISRS is currently US\$50 or £35. Under the constitution, subscriptions are due by January 31st each year. Members receive the journal *Coral Reefs*, the newsletter *Reef Encounter*, abstracts of papers of Annual Meetings and other periodic mailings.

Student membership costs US\$8 or £6 and benefits include all of the above except the journal *Coral Reefs*.

Spouse membership costs US\$58 or £41 (i.e. one full + one student membership) and entitles the couple to one copy of each issue of the journal and other mailings.

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

Subscriptions to the Society should be addressed to the Membership and Development Officer.

Camera-ready copy produced by: The Nature Conservation Bureau, 122 Derwent Road, Thatcham, Newbury, Berkshire RG13 4UP, UK.

Printed by: Cambridge Free Press, Unit 6, 25 Gwydir St, Cambridge CB1 2LG, UK.

EDITORIAL

The new editors are wondering if it was too much Antipodean sun at the Townsville International Reef Symposium that drove them to volunteer so foolishly for this job. If *Reef Encounter* appeared somewhat erratically before, at least two members of ISRS now fully understand why! We have already discovered that it is extremely difficult to produce a regular, useful and informative newsletter on a shoe-string budget and as a 'spare-time' activity. So first of all, many thanks to Brian Rosen for starting the newsletter, establishing a format, producing the early (often substantial) issues and providing much help with this issue.

We are planning to produce two issues a year and want *Reef Encounter* to contain a lively mixture of debate, news, and information on current issues in reef science, conservation and other relevant topics. For the time being we intend to keep to the format developed by Brian, as this is relatively inexpensive to produce. Regular items will include the **ISRS News and Comment** pages, **Upwellings** (the correspondence column), **Currents** (trends in research etc), news, feature articles, the diary column and book reviews. Some new ideas have been put forward:-

* **Student's Voice** - a page for and by students; we were not able to find any contributions in time for this issue, but perhaps someone can produce something for the next.

* **Country Profile** - a page devoted to a country, giving news and information on research programmes and institutions, conservation issues, legislation etc., the material to be provided by scientists in the country concerned. We thought France might be topical for the next issue (due in December for the ISRS Annual Meeting); other countries suggested include the Maldives, Netherland, Philippines. Are there any potential contributors out there?

* **Who's Who?** - brief descriptions of organisations/institutions involved in reef work and of interest to ISRS members, the aim being to encourage contact and liaison between different groups. In this issue, we have described a few of the conservation groups involved with reefs. We could also cover national reef societies, geological and palaeontological societies and so on.

We would like to try and have a theme for each issue, as this gives a focus for seeking contributions and promotes discussion and debate about particular topics. This issue is devoted largely to conservation and books, as a result of excess material accumulated for *Reef Encounter* 4. We are very grateful to Chuck Birkeland, Vicki Harriott, John Ogden and Rick Grigg for producing conservation-related contributions at such short notice. This subject has become so topical in reef science that in future we will probably want to look at more specific aspects. Ideas for themes for the next issue include global warming and sea level rise, as a follow up to Bob Buddemeier's statement (see page 8), and reefs in the context of the conservation of biological diversity.

ISRS and *Reef Encounter* have been criticised for a lack of real international outlook. Whether this is true or not, we are determined to make *Reef Encounter* the

newsletter of the **INTERNATIONAL** Society for Reef Studies. The new editors are both British and biologists with a strong interest in conservation, which could lead to a bias and weak coverage of geological, palaeontological etc. issues. We will do all we can to avoid this, but we will need your help - we need contributors and contributions from all over the world, covering all issues related to reef science. Your help is essential - do send us your news and ideas.

Bob Buddemeier, in the **Upwellings** column, has opened discussion of the role of ISRS and *Reef Encounter*. What do you think? Is there room for another newsletter or are you all already swamped? The consensus of ISRS opinion has generally been that *Reef Encounter* could be a major membership incentive, particularly for students. How can we achieve this aim? If you think a newsletter is a good idea - whether for your work or as bedtime reading - what topics do you think we should be covering and how?

Finally, if ISRS wants a newsletter, it must be prepared to pay for it. We are happy to solicit and edit material, write copy and generally organise production. However, neither of us has the time nor the equipment to produce the camera-ready copy ourselves. We intend to use the small desk-top publishing company who produced this issue at very reasonable rates. To keep costs down, we have restricted the length of this issue, and have supplied the material on diskette which has meant many hours at the word-processor. The printers were the cheapest we could find, and we have managed to obtain free mailing. The cost has worked out at about £2.00 (US\$3.00) per copy. But we really need extra money to pay for typing and secretarial help, or additional reliable help from other ISRS members. It will certainly save time to have material supplied on diskette provided it comes in the right format; we hope eventually to be able to accept a variety of word-processing programmes. Does anyone have any ideas on fundraising? How about sponsorship? Does anyone have good contacts with a company, foundation, private individual, who might put up the money - say £2,000 a year?

Do send in your contributions for the next issue as soon as possible. The deadline is **October 7th**. And please send illustrations and cartoons - neither of us seem to be as good as Brian at finding these. Many thanks to Brian, Bob Foster-Smith and Agus Hartoko, an Indonesian student on the Tropical Coastal Management M.Sc. course in Newcastle, for providing cartoons for this issue. If we write to you for a contribution, please respond quickly - even if it's to say that you can't provide what we want; at least then we'll have time to find someone else - and if you can suggest an alternative contributor that is even better. We can both be contacted by fax, phone and telex.

ISRS still has a relatively small membership. Do help to increase this by making sure non-ISRS members see *Reef Encounter* and in particular by encouraging students to join.

Sue Wells
Barbara Brown

ISRS NEWS AND COMMENT

From the President:

TO CONSERVE THE DIVERSITY OF CORAL REEFS WE MUST FOCUS ON FINDING ALTERNATIVES FOR USERS

Chuck Birkeland

USAID, NSF (National Science Foundation) and NRCT co-sponsored a workshop in Bangkok last March to establish funding priorities for development of more effective management and conservation of biologically diverse ecosystems. Most of the participants were from south-east Asian countries, but there were a few scientists from developed countries, such as the USA. These came as advisors, with their concepts on how to do science with experiments, controls, replicates and long-term monitoring, and with the goals of demonstrating cause-and-effect explanations of the changes in reef systems over the past decades. As it turned out, the advisors spent most of their time learning rather than giving advice - and they came away with a better understanding of the perception of those living near the reefs in south-east Asia.

Long-term studies with adequate replication and controls can be perceived as a gentleman's science, a luxury. The need for immediate action, however, became imperative over a decade ago. To conserve biodiversity, we need to develop and demonstrate non-destructive alternative methods of resource management which will provide economic incentives for the residents.



B. Rosen

Cartoon by Brian Rosen, based on an idea by Terry Scoffin)

About 30% of the coral reefs of the world is in the south-east Asian - Indonesian - Philippine region (Smith, 1978). This is where biodiversity is by far the greatest, and where the reefs are possibly being degraded the fastest - although damage in some locations such as Haiti and the Ryukyus may have been greater. At the Bangkok meeting, it was generally accepted that about 70% (Yap and Gomez, 1985) or 60% (Sukarno *et al.*, 1986) of these reefs are degraded with only about 5% in excellent condition.

There are numerous marine parks and reserves in south-east Asia on paper (White, 1988) - 70 in Indonesia alone - but government regulations are of no use if the people are not affluent enough to respect the aesthetic value of reefs, their potential importance in the future, or their importance in relation to the country as a whole. The Great Barrier Reef Marine Park Authority has been most successful in managing the Great Barrier Reef, but they have the backing of an affluent society. If a park is to function in a developing country where police enforcement is negligible, the local people must 1) understand the immediate value of the park to their livelihoods and 2) play a major role in its management.

Angel Alcalá, Alan White, John McManus, Gail Savina and others in the Philippines have been successful in organizing village-based management systems. The communities of fishermen on three islands have endorsed management plans which include marine reserves/ sanctuaries. The fishermen themselves participated in delineating the boundaries, sizes and locations of these areas. Dramatic increases in numbers and species of fishes within two years were documented, demonstrating immediate economic benefits. This is the most promising approach I have seen to improving biodiversity of coral reefs in the "continental" south-western Pacific. Government regulations for parks and reserves and the scientific determination of the causes of reef degradation may be affective in wealthy societies, but in developing countries an increased understanding by the people of the benefits of resource management systems is most urgently needed.

Some of the reefs seriously degraded by coral mining in south-west Sri Lanka lie within a park at Hikkaduwa, even though coral mining has been officially prohibited. A protected area regulated at the national level belongs to all the people, and thus control is weakened by a tragedy of the commons. Those living from day to day may well feel that only the affluent nations can afford to preserve biodiversity. Delicate reefs may appear obstructive to those mining corals, or to fishermen who might imagine that fishing on a level bottom with trawls or large nets would be more efficient. The diversity of fish life on a coral reef automatically reduces the efficiency of harvest in comparison to a monoculture. And although coral reefs are among the most productive ecosystems with an especially high standing stock of fishes, coral reefs appear to be more vulnerable to over-exploitation than some less productive systems.

The provision of immediate economic incentives is one approach to such reactions. In developing countries, predicted economic returns are often more important

than the conclusions of environmental impact assessments. Hodgson and Dixon (1988), in a study in Bacuit Bay (El Nido), Palawan, in the Philippines, have produced some striking economic predictions. The study looked at the impact of clear-cut logging in the adjacent watershed through rates of sedimentation, its effects on the reefs and fishes and the impact that this would have on tourism and fisheries. If logging is continued, it is calculated that the overall gross revenue to the community would be reduced by more than US\$40 million over the next ten years, notwithstanding the cash from forest products, as a result of losses in tourism and fisheries through the increased siltation on the reefs. While a 10-year time period may not mean much to local villages, it may be significant to governments when major industries such as tourism and fisheries are weighed up against logging. This approach may also be appropriate in developed countries where government regulations on land use may be more powerful (Muzik, 1985).

Few of us are in a position to set up management systems in local villages of developing countries. But I believe we can put more thought into alternatives to destructive practices and justifications for coral reefs. One article with practical suggestions for increasing the yield from coral reefs has appeared in our Society's journal.

In *Coral Reefs*, Grigg, Polovina and Atkinson (1984) suggested that reefs should be harvested at a level low on the food chain and the top predators should be cropped to release predator-pressure on selected prey. But can the system be maintained over the long-term by exporting a higher yield of materials lower in the food chain? Coral reefs appear particularly vulnerable to over-exploitation despite their high productivity. A diverse system based on recycling may be more sustainable over the long term in oligotrophic environments. An alternative way to increase yield might be to concentrate on high value resources on the reef. The export of cultured pearls from the Tuamotu atolls brought in \$A5.2 million in the first three months of 1985 alone; I daresay exporting CaCO_3 as pearls will not exhaust the atoll's supply. And of course tourism is a potentially non-destructive source of revenue from coral reefs. However, although I am not sure that increasing yield is the best way to protect reef diversity, I feel that Grigg, Polovina and Atkinson have made an important original contribution in promoting the potential value of reefs.

We have been taking comfortable but ineffective paths in reef conservation. Scientists have generally considered it their job to demonstrate the causes of reef degradation (i.e. to rigorously examine whether coral mining, dredging, dynamite-fishing etc. really harm reefs) and to tell each other and government officials how important coral reefs are in coastal ecosystems. This is similar to people at IUCN meetings agreeing that conservation is important, or Audubon Society members agreeing that wildlife is in danger and something needs to be done. We feel gratified that the audience and our colleagues are convinced by our point of view - but they probably agreed

before they came to the meeting, or they would not have come.

We must now get to the nitty-gritty of the situation. While we are patting each other on the back, people are trying to make a living out of coastal resources in the face of growing populations, degrading and unproductive habitats and increasingly difficult economic situations. We need to be producing workable solutions for these people. We talk among ourselves and to government representatives in terms of biodiversity preservation, unique and endangered species and national heritages. These are all very important, but they are abstract concepts to the fisherman obtaining food for his children's next meal using dynamite, muro-ami or small-meshed nets. The problem is lack of wealth, not education. The fisherman will easily understand that if he waits a few months for the fish to grow and uses a wider mesh, his yield will improve. But he cannot wait to feed his family. We need to provide alternatives with immediate benefits to him, if we are to preserve marine biodiversity.

Ed Gomez, Angel Alcala, Hansa Chansang, Alan White, John McManus, Gregor Hodgson, Rick Grigg and their respective colleagues, including others I should have mentioned, are doing a great job at what is needed, but there are too few of them. Perhaps ISRS could be used to draw attention to this problem. If you have any ideas on what we should do, please send a note or bring your thoughts to the next ISRS annual meeting.

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EFFECTS OF RECREATIONAL DIVERS ON CORAL REEFS

For the last twelve months we have been working at the Marine Research Centre in Sharm el Sheikh, at the southern tip of the Sinai peninsula in Egypt. During this time there has been very rapid development of tourism in the area with the number of hotels doubling and set to double again in the coming two years. All this development is unregulated as is use of the reefs. In only a year we have noticed considerable degradation of the most popular dive sites, and so have initiated a study to look at the effects of recreational diving on these reefs. Since little work appears to have been published on this subject, we would be very interested to hear from anyone who is currently studying this problem, or has worked on it in the past.

Please write to: Julie Hawkins and Dr Callum Roberts, Marine Research Centre, Environmental Institute, Sharm el Sheikh, Egypt.

ISRS NEWS

SYMPOSIUM PROCEEDINGS

The Proceedings of the 6th International International Coral Reef Symposium held in Townsville in August 1988 are now with the printers. They will be published and posted to all paid-up participants of the symposium in the next few months.

BEST PAPER AWARD

This award is given once a year at the Annual General Meeting of the ISRS, for the best paper in each volume of *Coral Reefs*. The first award was given in 1988 for the best paper in Volume 6, to Terence J. Done for "Simulation of the effects of *Acanthaster planci* on the population structure of massive corals in the genus *Porites*: evidence of population resilience?"

SPECIAL OFFER TO ISRS MEMBERS

The Northern Great Barrier Reef - A Royal Society discussion organised by D.R. Stoddart and Sir Maurice Yonge, F.R.S. and published (hardback) by the Royal Society of London in 1978. 366 pp., maps, diagrams, plates, indexes.

Available to ISRS members for only US\$25 (£15 sterling) incl. p&p. Send cheques/bank drafts made payable to INTERNATIONAL SOCIETY FOR REEF STUDIES to:

International Society for Reef Studies,
Downing Place,
Cambridge CB2 3EN,
England.

Do buy this; any sales will go direct to ISRS and we urgently need the money (particularly for production of this newsletter!).

THE COMPLEAT REEF ENCOUNTER - No. 5

And now for the MOST COMPLEAT reef encounter of all.....

CORAL REEFS OF THE WORLD

".....an indispensable new three volume reference book on the status and conservation of coral reefs....."

Ed's note: This *Compleat Reef Encounter* was kindly submitted by Brian Rosen. For anyone not satiated with information on this book, full details are given in the book list! Do send in any *Compleat Reef Encounters* that you come across.

DARWIN AWARD

This is an award presented by the ISRS every four years at the International Coral Reef Symposium to a member of the society who has made a highly significant contribution to coral reef studies.

The first award was given at the 1988 Symposium to David R. Stoddart, currently Professor and Chairman of the Department of Geography, University of California at Berkeley, in appreciation of the tremendous role he has played in advancing coral reef studies. In particular, he convened the first International Coral Reef Symposium, proposed the continuation of such symposia on a regular basis, and founded ISRS and its journal *Coral Reefs*.

1989 ANNUAL MEETING OF ISRS

Dec. 14-16, 1989 Marseilles, France

Biology and geology of modern and tertiary coral reefs

The meeting is being held as part of the centenary celebrations of the Station Marine d'Endoume of Aix-Marseilles University. It will be held in collaboration with C.N.R.S (National Center for Scientific Research) and the Marseilles Group of C.N.R.S. Laboratories, I.N.S.U. (National Institute for Earth Sciences), and with the participation of the Centre for Sedimentology and Palaeontology of Provence University, Marseilles. The main topics for the meeting will be:

1. Space-time dynamics in coral reefs
2. Fluxes in coral reefs and lagoons and influences from adjacent systems
3. Are modern reefal and lagoonal ecosystems good models for ancient reef formations?
4. Coral reefs as recorders of climatic variations (including sea-level change) and tectonic movements.

Proposed programme:

- Dec.14:- Evening reception at the Station Marine d'Endoume
 Dec.15:- Oral presentations (15-20 mins)
 - Posters
 - Exhibition of scientific material, video films etc at the C.N.R.S. Laboratory group.
 Registration: 350 FF (reduced rate for students)
 Proposed post-meeting one day field trips:
 Dec.17:- Excursion A. Coral reefs and coastal formations of the Aquitanian of the Nerthe coast (western Marseilles area)
 Dec.18:- Excursion B. Coral formations in carbonate platform context (Provence Baremian, Lower Cretaceous/SE France)
 Dec.18 or 19:- Excursion C. Coral and rudist bioconstructions of the Upper Cretaceous of Provence.
 A 5-day trip to the Miocene coral and lagoonal formations of SE Corsica may be arranged if there is enough interest.

For further information contact:

Dr. B. Thomassin, Station Marine d'Endoume, Rue Batterie des Lions, Marseilles 13007, France.

UPWELLINGS

This column is for contributors who want to take issue with facts and views expressed in recent publications, including *Reef Encounter*, or to give vent to any other views on the subject of reefs, including ISRS.

Dear Editors,

I'd like to suggest that the resurrected *Reef Encounter* provoke some discussion of just what the re-incarnation is all about - and for that matter, what ISRS is about.

I finally joined ISRS because *Coral Reefs* turned out to be a reasonably interesting and useful journal. As a traditional professional society, ISRS probably doesn't have much to offer; most of us have identities and affiliations in our "primary" disciplines, and organisations like AGU (American Geologists' Union), ASLO (American Society of Limnologists and Oceanographers), GSA (Geological Society of America)*, etc., operate on a completely different scale of programs and benefits. Putting out a decent and reasonably interesting journal is no mean feat, however, and I think it's one that deserves support.

The fascinating thing to me about reef research is its obligate multi-disciplinary nature. One simply cannot get very far with a narrow or specialised view, and I think that suggests one of the directions in which ISRS might move to expand membership and readership. If we consider reefs as representatives and important components of larger systems, then the subject should have appeal to anyone working in shallow tropical or subtropical marine systems, or on any of the classes of reef-dwelling organisms. Can the organisation broaden its appeal without losing its grasp on what is a fairly precarious identity to start with? I'm not sure, but I think it's an idea worth discussing. One example of an approach might be redefinition of the editorial areas of *Coral Reefs*, followed by systematic solicitation of relevant papers and subscribers. On a reef, categories like Process and Structure, or Micro, Meso and Macro, make at least as much sense as Biology and Geology. Prizes may or may not be awarded for the most outrageous suggestions.

On to the newsletter - if it can achieve prompt and regular publication, there are many things it could be (and by the way haven't we reached the point where desktop publishing can put out something cheaper, faster and almost as attractive as the present typeset version?). Possibilities include the traditional newsletter functions of listing publications, projects, meetings etc., but I think we have to ask whether there is a sufficiently unique and valuable function there to be worth the effort, especially since a well-established Pacific-oriented newsletter is already put out by the PSA. *Coral Reefs* lacks a correspondence section and I miss it - both for discussion of specific papers and for general reef science communication. Another possibility is that of a junior journal, where very brief self-reviewed notes on interesting subjects could be brought to the attention of the research community. I tend to favour the idea of trying to develop it into a medium for the exchange of ideas and information on a time scale considerably faster than can be provided by journal review and publication, or by quad-

rennial symposia. Shall we try, or does someone have a better idea?

Bob Buddemeier

Lawrence Livermore National Laboratory, University of California, PO Box 808 Livermore, California 94550, USA. P.S. I suggest an absolute moratorium on *Acanthaster* debates.

The following is an extract from a letter, dated 24 Feb 1989, to Chuck Birkeland, as President of ISRS, which we thought worth printing to fuel the debate initiated by Bob Buddemeier on the role of ISRS. See also earlier issues of *Reef Encounter*.

"I read with interest the last correspondence from ISRS, noting especially (page 1) the comments on recruiting new members.

As long ago as the Miami meeting (1984) I commented that I felt the Society needed to offer more to members if it were to attract greater numbers. I expressed the view that it needed to shift its emphasis towards the layman, rather than primarily being a vehicle for the specialist.

Although I am the author of *The Coral Seas of Muscat* and was for many years a carbonate sedimentologist, I consider myself an informed LAYMAN. I thoroughly enjoy reading and learning from *Reef Encounter* (when it appears....) while I find much of *Coral Reefs* incomprehensible.

For myself, I should like to be a member of a Society which provides a 'voice' for reefs. We all appreciate the immense value of our seas. Collectively, I feel that we could do much to promote research and conservation of reefs throughout the world."

Frances Green, Project Co-ordinator, 'The Natural Wealth of the Gulf', DBA Television, 21, Ormeau Avenue, Belfast BT2 8HD, Northern Ireland.

*** Plea from the editors: Please give acronyms in full; we did some guesswork on these - apologies if we have got them wrong but we have not had time to check them.**

Ellis & Solander's *Zoophytes*: six unpublished plates and other aspects.

P.F.S. Cornelius and J.W. Wells.

Bull. BMNH (Historical Series) 1988 16(1): 17-87.

Six previously unpublished plates intended for Ellis and Solander's *Zoophytes* (1786) are reproduced for the first time and taxonomic assessment of the animals depicted is given. The illustrations correspond to parts of the published text and show 15 scleractinians, including many reef-contributing species, three hydroids, two bryozoans and two red algae. Some 20 further species depicted on the originally-issued plates of the book but which lacked captions are identified where possible - eight scleractinians, again including reef forms, three sea fans, one hydroid, four bryozoans and three sponges. Also discussed are the fate of Ellis' collections and MSS and various aspects of the preparation and authorship of the book and of Ellis' life's work. Essential for any library holding the Ellis and Solander book, and for scleractinian systematists.

Available from Publications Dept, British Museum (Natural History), London SW7 5BD, UK. £16.20 plus postage.

CURRENTS

REEFS IN THE GREENHOUSE?

Climatic change, global warming and the greenhouse effect are now in the forefront of world concern. Bob Buddemeier, with Graham Baines, Roger McLean and David Hopley, raised the issue in relation to coral reefs at the 1988 AGM of ISRS and presented the following statement, which was endorsed by the Society:

Coral Reefs and the Greenhouse Effect

In the course of the Sixth International Coral Reef Symposium, held in Townsville, Australia, in August 1988, a special meeting was convened to consider the linkages between climatic change and coral reefs and to specifically assess the impact and management of the projected 'Greenhouse Effect' on reef ecosystems and adjacent coasts and islands, and to discuss the role of reef research in contributing to an understanding of global change. It was recognised that:

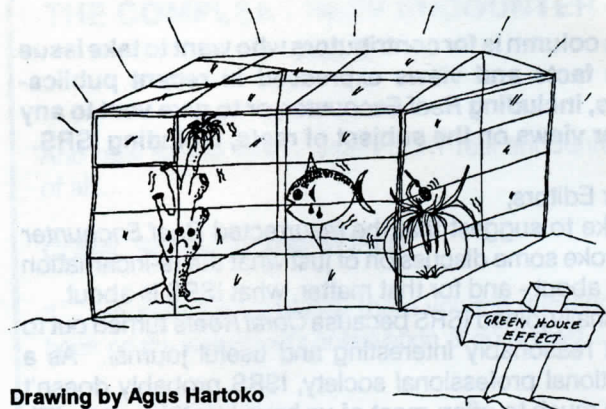
1. The predicted changes in climate and sea level rise present both challenges and opportunities to the diverse fields of reef research and reef management, but that
2. At the present time reef research has not, on the whole, been directed towards this aspect in any comprehensive way, even though there are many studies that could be utilized to address the problem.

It was also noted that:

1. Coral reefs are vitally important physical and biological resources for many tropical island and coastal nations.
2. Coral reefs and associated systems may play an important role in the global carbon budget.
3. Corals and reefs are uniquely sensitive to changes in climate and sea level.
4. Corals and reefs are effective recorders of important information on past environments and environmental changes.
5. Data from coral reefs can be used to test and modify global climatic and ocean models dealing with the 'Greenhouse Effect'.

In view of the intrinsic and extrinsic values of reefs, several research questions need to be addressed with some urgency, for instance:

1. How will reefs adjust to the projected increases in temperature, CO₂, and the rise in sea level, and to local and regional changes in marine climate?
2. What will be the consequences of this adjustment for adjacent coasts and for island states, for which reefs are especially important ecological and physical resources?
3. What are the potential contributions of basic and ap-



Drawing by Agus Hartoko

plied reef research to environmental management and societal responses to changing climate?

These discussions have led to the suggestion that the scientific community involved in coral reef studies develop an organisational structure to address climate related issues on a comprehensive and integrated basis, and that they do this with a view to ready applications of the results to the planning and management needs of island and other tropical coastal nations.

At the AGM, it was agreed that Council should consider the suggestion made in the statement for "an organizational structure to address climate related issues on a comprehensive and integrated basis". In November 1988, Bob Buddemeier produced an informal newsletter *Reefs in the Greenhouse* to discuss the issue further, and raised the question of how to circulate 'greenhouse' information. Bob planned to put out one more informal newsletter to incorporate everyone's ideas. We wondered if *Reef Encounter* would be a suitable vehicle for distribution of information relating to this topic but Bob has reservations about this at the moment. The number of meetings, publications and initiatives on the subject has really snowballed since last year. What role should ISRS be playing?

Contact: Bob Buddemeier, Lawrence Livermore National Laboratory, University of California, P.O. Box 808 Livermore, California 94550, USA.

CORAL REEFS ARE ROBUST ECOSYSTEMS

Rick Grigg

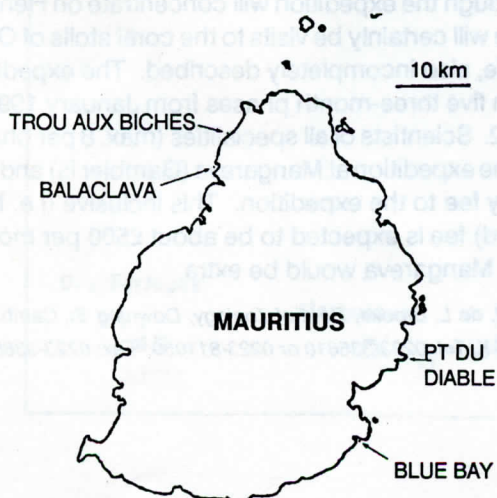
Over the last 18,000 years, coral reefs have endured one of the most rapid transgressions in all of earth's history. During this period, sea level has risen by at least 130 metres according to most estimates. Between 10 and 15 thousand years ago it was rising at rates of between 10 and 20 mm/year which is considerably faster than most coral reefs are able to grow. Why more coral reefs did not drown is probably because their foundations were in many cases elevated above sea level during this period of history. On high islands and continental shelves, rising

sea level simply created new habitat as elevated shelves were flooded by the advancing sea. Today, in the open oceans of the world, there are 261 atolls and 116 drowned banks. The fact that only 1/3 of this total of 377 potential sites for atolls actually drowned is grand testimony to the power of reefs to overcome adversity. This conclusion is reinforced by the fact that coral reefs persist over time despite other great forces of destruction, such as storm waves, freshwater run-off and sedimentation, epidemics of disease, outbreaks of *Acanthaster*, earthquakes and rapid subsistence.

These observations dispel the notion that coral reefs are fragile systems delicately balanced with nature. Rather, they demonstrate that reefs are remarkably robust ecosystems.

Nevertheless, there are obvious and serious problems ahead. In third world countries, where impoverished people may depend upon coral reef resources for their survival, reefs are particularly threatened. Widespread pollution and overfishing have devastated huge areas in Indonesia and the Philippines. More localized abuse is unfortunately a commonplace problem throughout much of tropical Oceania. And now looming on the horizon is a new threat - the greenhouse effect - bringing with it the renewed problem of rapid sea-level rise. Many estimates suggest that during the next century sea level will rise on the order of one metre. While some reefs may be able to keep pace with this, widespread erosion, property damage and contamination of ground water will almost surely create major problems for many island and coastal communities. Perhaps the only good news in this scenario is that coral reefs are remarkably robust. Given a hand by man, armed with sound principles of resource management and the will to protect and conserve coral reefs, these ecosystems may once again weather the storm. As coral reef scientists, we all have an important role to play. We must monitor and further our research efforts and we must manage resources wisely. There has never been a time of greater need for coral reef science to stem the tide.

Rick Grigg, Dept of Oceanography, Division of Marine Sciences, University of Hawaii at Manoa, 1000 Pope Road, Honolulu, Hawaii 96822.



NEWS

CLASSIFICATION AND ASSESSMENT OF SOME CORAL REEFS IN MAURITIUS

A Regional Field Training Workshop on Coral Taxonomy and Studies and Management of Coral Reefs was held in Mauritius in October 1988 under the auspices of COMARAF - the Regional Project for Training and Research on African Coastal Systems*.

Field exercises at the workshop showed that there has been a great deal of recent coral mortality at all the west coast locations visited, viz. Flic en Flac, Albion, Trou aux Biches and BalACLAVA. Some coral mortality is known to have been caused by feeding by Crown of thorns starfish *Acanthaster planci*, but the extent of this impact, or any other has not been determined. The very high densities of the burrowing sea urchin *Echinometra mathaei* was also striking. The reefs were highly eroded by recent *E. mathaei* burrowing, and though there was some recolonisation by hard corals, and quite a significant population of surviving adult corals, it appears that reef erosion is presently occurring at a faster rate than reef construction. Considering the vital role of the reefs in protecting the adjacent shoreline, and the great economic significance of that shoreline to the Mauritian economy, a detailed study of reef construction and erosion rates is called for.

The reef system on the west coast of Mauritius consists of narrow intertidal reef flats, where little living coral is normally found. The flat separates the reef slope to seaward, and a shallow sand flat and/or boat channel to landward (Montaggioni and Faure 1980). In some locations, such as BalACLAVA, a section of reef slope is directly adjacent to the shore.

Large amounts of dead coral are found both on the reef slopes, and on the shallow sand flats. Large populations of sea urchins in the shallow sand flats probably have little significance in terms of reef erosion, because this part of the reef is unconsolidated at any time. However, their erosion of the shallow reef slope, the barrier on which all the wave energy is dissipated, is of potential significance, and their high abundance in the shallow sand flats may be symptomatic of their high abundance on the reef slope i.e. their present high abundance may be a response to the same factors causing high abundance on the outer slope. As planktonic larvae will be dispersed throughout the reef system, they may be contributing juveniles to the outer slope population, and *vice versa*.

A three-pronged research programme is recommended, each part to be conducted by independent teams, but each sharing the common goal of documenting coral reef condition, and understanding its dynamics.

1. Make quantitative line transect surveys at a large number of shallow reef sites around the country to assess the spatial pattern of coral death and urchin populations (and any other significant phenomena which may be observed) in relation to rivers, centres of population, reef type, distance from shore etc. This is

a large project and would require a two year commitment of manpower full time for field work, analysis and report preparation. This work will better clarify the location and extent of problem areas.

2. Set up a programme to regularly monitor water quality in rivers, wells and reef areas around the country, at sites chosen in conjunction with areas surveyed for coral death. Look for evidence of excessive nutrient load, pesticides or other pollutants entering the reef system.
3. Set up time series studies using random and marked, permanent study areas to determine net limestone accretion through time. Sampling design to be such that experimental results may be confidently extrapolated to larger reef areas. This could be approached on several levels:
 - i Volumetric and gravimetric determinations of coral growth, and surface bio-erosion.
 - ii Studies of internal erosion using shallow cores and porosity measurements.
 - iii Studies of carbonate ingestion by urchins in conjunction with estimates of population densities, by reef zone, in populations of urchins.

These are ambitious programmes which would require a high level of commitment but which depend on relatively simple techniques. Though based on relatively few observations made during the workshop, these recommendations do address what appears to be the major ecological issue on Mauritian reefs at present.

Further information on the workshop and its results is available in:

Done, T.J. (1989). Classification and Assessment of Some Coral Reefs in Mauritius. *COMARAF Series Documentaire 2*. Regional Project RAF/87/038.

* COMARAF is an integral part of the major inter-regional research and training UNESCO project for the integrated management of coastal ecosystems (COMAR). It was conceived as an inter-disciplinary and inter-regional project which would contribute to defining the scientific bases necessary to understand the specific features of African coastal systems. This in-depth knowledge and understanding of African coastal systems will also help promote an integrated management of the coastal zone and reinforce the capacities of the countries involved to use, develop and protect their respective coastal zones through appropriate training and the dissemination of data and information collected through research activities. Finally, the project plans to set up an active regional network for an efficient and permanent exchange of skills and knowledge among the institutions and countries of the region.

For more information on COMARAF, contact COMARAF/COMAR Major Project, Division of Marine Sciences, UNESCO, 1 rue Miollis, Paris, France.

Henderson Expedition 1991-1992

Since Fletcher Christian and the Bounty mutineers arrived on Pitcairn Island in 1790, it has remained the only inhabited member of the Pitcairn group. The other, uninhabited members of the group are the atolls of Ducie and Oeno and the elevated limestone island of Henderson. The group is exceptionally remote, over 450 km east of the Gambier Islands, and over 1,000 km west of Easter Island.

All our information on the Pitcairn Islands, which are U.K. Dependent Territories, derives from brief visits, often many years ago. Longer visits have hitherto been precluded by the formidable costs of boat charter. Now a suitable research vessel is available on a running-costs-only basis to support a more sustained Pitcairn expedition. The proposed expedition will seize this exceptional opportunity to mount the first year-round study of a unique archipelago. It will concentrate on Henderson Island, recently listed under the World Heritage Convention.

Henderson is the world's only raised coral atoll with its ecology virtually intact. It is of immense, but unrealised value to science. The ecology of the island seems to have been little altered by a period of Polynesian settlement (12th-15th centuries) and so today's dense wooded vegetation supports a wealth of endemic plants, birds and invertebrates.

Physically Henderson is an elevated limestone island atop a volcanic base which rises from a depth of about 3.5 km. When volcanic activity ceased some 13 million years ago, the island subsided and coral reefs developed. Subsequently, in the last million years, crustal loading at Pitcairn has caused the uplift of Henderson at a rate of 1 mm per 25 years.

The contemporary reef is limited to a narrow reef platform surrounding the northern three-quarters of the island and a steep fore reef. The reef platform is continually awash as it slopes seaward and lacks a reef crest; it supports little coral growth. Nevertheless the coral biota of this island at the extreme south-east of the Pacific distribution of coral has not been fully described and is likely to be of exceptional interest.

Although the expedition will concentrate on Henderson there will certainly be visits to the coral atolls of Oeno and Ducie, also incompletely described. The expedition will run in five three-month phases from January 1991 to April 1992. Scientists of all specialities (max. 8 per phase) will join the expedition at Mangareva (Gambier Is) and pay a monthly fee to the expedition. This inclusive (i.e. boat and board) fee is expected to be about £500 per month; reaching Mangareva would be extra.

Contact: M. de L. Brooke, Dept of Zoology, Downing St, Cambridge CB2 3EJ, U.K. Tel. 0223-336610 or 0223-811059. Fax: 0223-336676.

FEATURES

KEY TO CONSERVATION IN THE FLORIDA KEYS? - SUSTAINED ECOLOGICAL RESEARCH ON THE CORAL REEF TRACT

John C. Ogden

Introduction

South-east of the Florida Peninsula, stretching for 220 miles from Soldier Key to the Dry Tortugas, lies the only stretch of tropical coastline in the continental United States (Fig. 1). The Florida Keys 'seascape', a mosaic of interacting ecosystems including the coral reef tract, seagrass beds, mangrove forests, the expanse of Florida Bay, and the adjoining Everglades, is a unique national resource. In addition to providing habitat for important commercial and sport fisheries, the region, which includes numerous National and State parks and sanctuaries, is a significant element in tourism in South Florida, and brings in millions of dollars to regional commerce each year.

It is evident that the Keys seascape is suffering from a precipitous decline in environmental 'health'. Any research program addressing the decline must involve integrated, interdisciplinary studies of the seascape, particularly the influence of effluents from land. The coral reef tract occupies the extreme downstream position in the Keys seascape and may suffer from damage to the upstream elements which buffer the reef against impacts originating on land, including sedimentation, sewage, agrochemicals and other pollutants. The reefs of the Keys have suffered a dramatic and unexplained decrease in live coral coverage in the last 10 years (Dustan and Halas 1987, J.W. Porter and M White unpubl.). This program,

which originated at a workshop of coral reef scientists in the Keys in June 1988 (Miller 1988) centres on an understanding of this decline and on the generation of data suitable for management of the seascape.

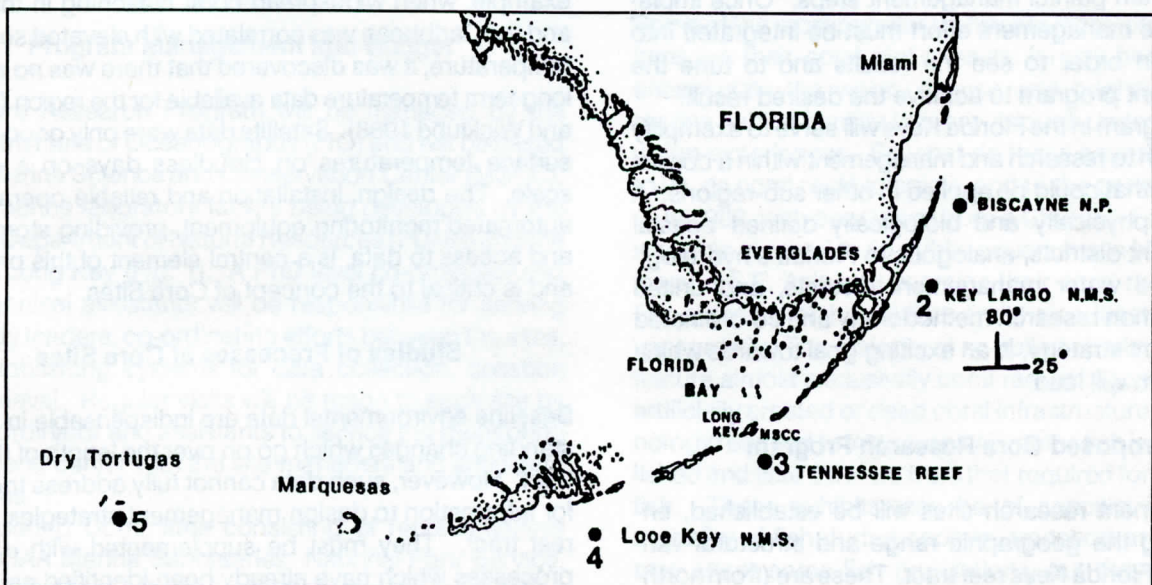
Hypotheses for Reef Decline

There are at least four hypotheses which have been advanced to explain the decline in coral reef health (Miller 1988). The nutrification hypothesis suggests that nutrients from sewage and agricultural run-off are fertilizing the normally clear, oligotrophic waters surrounding the reefs, poisoning the corals and favouring the growth of nutrient-tolerant algae. Another hypothesis places the blame on trace metals and pesticides from the same sources which induce lethal and sublethal stresses in coral reefs. Poor land use practices in the region may have caused increased loads of suspended sediment in the water, cutting light levels and stressing corals. Finally, the decline has been attributed to natural disturbances such as storms, disease and abnormally high or low water temperatures. Certainly some combination of all four of these factors may be involved.

Ecological Research Over the Long-term

Declines in environmental quality, while imperceptible on a day-to-day basis, are dramatic on a decade scale and can involve large geographic regions. In order to document and understand these changes, we must integrate the efforts of the appropriate disciplines and direct this effort over the geographic and temporal scales which encompass the natural processes, so easily disturbed by man, that we seek to understand.

A principal problem with marine ecosystem research related to human impacts is the difficulty in discriminating natural variation from changes caused by human impacts



that may be managed, such as waste disposal, human visitation, boat groundings and over-fishing. As natural processes vary on a time-scale different from research funding cycles, only rarely have studies encompassed the time course of: 1) phenomena such as storms, diseases and oceanographic-atmospheric events such as the ENSO (Glynn 1988, Porter *et al.*, 1982); or (2) processes, such as productivity, larval dispersal, recruitment, global warming trends, and sea level rise. We now have enough experience to know that when a crisis occurs, long-term data sets for the impacted areas are essential to assess the crisis and initiate potential management.

A second problem is that marine ecosystem research is too often confined to single sites which may, for example, be the 'best reefs' or the easiest to get to, but are not representative of the region. It is critical that comparative methods be employed at multiple sites which encompass the range of development and variation of the ecosystems being studied.

Rationale for Monitoring

Evaluation of the various hypotheses which have been advanced to explain the environmental decline in the Keys will require long-term effort over an expanded geographic scale. We are convinced that this is the only way to effectively approach research which must be applied to management. We are confident that the Core Research Program will attract other sources of funding so that the long-term financial burden may be shared by Federal, State and private sources.

This does not mean that effective management must wait for future research results. In many cases, cause and effect are known, for example, the direct impact of human visitation and boat groundings on coral reefs, or the impact of over-fishing. In other cases, however, assignment of cause is much more complex and requires documentation to convince managers and lawmakers of the need for often painful management steps. Once implemented, the management effort must be integrated into the study in order to see the results and to tune the management program to achieve the desired result.

This program in the Florida Keys will serve to exemplify an approach to research and management within a coastal sub-region that could be applied in other sub-regions. A system of physically and biologically defined coastal management districts, analogous to Florida's hydrologically-defined water management districts, and united with a common research methodology and co-ordinated management strategy, is an exciting goal towards which this program will lead.

Proposed Core Research Program

Five permanent research sites will be established, encompassing the geographic range and structural variation of the Florida Keys reef tract. These are (from north-east to south-west): (1) Biscayne National Park; (2) Key Largo National Marine Sanctuary; (3) Tennessee Reef; (4) Looe Key National Marine Sanctuary and (5) Fort Jeffer-

son National Monument (*Fig. 1*). The establishment of most of the Core Sites at National Parks and Sanctuaries provides numerous benefits. Park and Sanctuary personnel will provide protection for the study sites and equipment, assist with logistic support, and provide scientific and management expertise to guide the program. Additionally, the Parks and Sanctuaries have been the focus of a great deal of background work which will be integrated into the Core Program.

The Core Sites are located on the reef tract as it is the downstream element of the seascape and the one most endangered. They are not, however, the only places where research should be done. This program will interface with existing programs dealing with other parts of the Keys and Florida Bay. For example, close cooperation with the NPS program dealing with the recent massive seagrass die-back in Florida Bay is essential (J.C. Zieman and M. Robblee *pers. comm.*).

Baseline Environmental Data for Core Sites

An automated environmental monitor, recording seven air and water parameters, will be placed at each Core Site to collect meteorological and water quality data (wind speed and direction, air temperature, rainfall, solar radiation, salinity, water temperature and turbidity). Other parameters such as wave and tide height, pH, dissolved oxygen, and chlorophyll *a* may be added at a later date. The data will be broadcast to a base station at the Core Site headquarters and logged into a computer. Computers at the Core Sites will be linked by modem to each other and to the Program headquarters at Long Key. Installations of monitoring equipment by NOAA at Alligator Reef and by the Australian Institute of Marine Science (AIMS) on the Great Barrier Reef will guide this effort.

While seeming routine, the collection of such weather and water quality data over the long-term and over the scale of the Florida Keys reef tract is unprecedented. For example, when widespread coral bleaching in the Keys and the Caribbean was correlated with elevated seawater temperature, it was discovered that there was *no* reliable long-term temperature data available for the region (Ogden and Wicklund 1988). Satellite data were only good for sea surface temperatures on cloudless days on a course scale. The design, installation and reliable operation of automated monitoring equipment, providing storage for and access to data, is a central element of this program and is critical to the concept of Core Sites.

Studies of Processes at Core Sites

Baseline environmental data are indispensable in understanding changes which go on over the length of the reef tract. However, such data cannot fully address the need for information to design management strategies for the reef tract. They must be supplemented with data on processes which have already been identified as important to the growth and health of coral reefs. Therefore, we propose four areas of special study which take into account what is already known about the Core Sites and the

information which is currently lacking. These specific studies are grouped under the following headings and the leaders are identified:

1. **Water Circulation and Transport:** Dr Ned Smith, Harbor Branch Oceanographic Institution.
2. **Coral Reef Dynamics:** Dr James W. Porter, University of Georgia; Mr Walter Jaap, Florida Department of Natural Resources.
3. **Ecological and Physiological Indicators:** Dr Alina Szmant, University of Miami; Dr James W. Porter, University of Georgia.
4. **Nutrient Dynamics:** Dr Alina Szmant, University of Miami.

Coral Reef Management and Public Education

A long-term research and management effort on the Florida Keys seascape must be accompanied by an appropriate public educational effort. While it is likely that the proposed Core Research program will lead directly to innovative management strategies, there is no assurance that the public will accept these management measures without a parallel effort in public relations and education. We have arrived at a point of considerable public sophistication in science just when the management solutions we are likely to propose will be most painful to individual freedom and the public purse. We can no longer simply cry "wolf" without selling our case to the public with adequate documentation and education.

Our initial effort to develop this public consensus turns on a television film and accompanying text materials that describe the holistic approach to the understanding and management of the Florida Keys seascape that is the goal of this program. This film will be designed for a general audience and will also serve, with the text, as the core of study units on coral reefs to be used in schools and by community action groups.

Program Management and Budget

The Core Research Program will be managed by the Florida Institute of Oceanography (FIO) and will be based at the Marine Science and Conservation Center (MSCC), a new marine laboratory facility being developed by the Florida Department of Natural Resources (FDNR) and the FIO on Long Key (Fig. 1). A PhD level co-ordinator and two technical assistants will be responsible for serving the study leaders, co-ordinating efforts between the sites, and establishing systems for data collection, collation and retrieval. Regular visits will be made to each site by the co-ordinator and assistants to service the monitoring equipment, confer with the site managers and anticipate problems.

A Steering Committee consisting of representatives from NOAA Marine Sanctuaries, National Park Service, FDNR, FIO, Marine Resources Development Foundation (MRDF) as well as marine scientists from the major universities of the region including the State Universities and the

University of Miami, will meet at frequent intervals to guide the Program, review and initiate co-funding proposals and review progress.

The estimated budget, including equipment, personnel, and film production is US\$1.8 million for three years. These funds are presently being sought from private sources. Following this initial period it is expected that the monitoring program could be sustained at a cost of about US \$200,000 per year. These maintenance funds may be an appropriate use for new revenues expected from a proposed Salt Water Fishing License in Florida which will be considered by the Legislature in 1989.

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- John C. Ogden, Florida Institute of Oceanography, 830 First St., South, St Petersburg, Florida 33701, USA.*

CAPTIVE CORAL REEFS

Vicki J. Harriott

Some of the most popular features in many public aquariums are their coral reef exhibits, largely because they encapsulate the warm, diverse and brightly coloured marine habitat familiar to many through underwater television experiences. So what do these aquariums mean to us, as coral reef biologists, and to the general public?

In 1988, with assistance from a Churchill Fellowship, I was able to travel to 20 public aquariums in North America and S.E. Asia and examine their coral reef exhibits. The standard of the exhibits and their educational value vary greatly. The majority of so-called coral reef exhibits feature almost exclusively coral reef fish, generally in an artificially created or dead coral infrastructure. The technology required to keep tropical marine fish is well established and little different from that required for temperate fish. These exhibits may be of concern in that the mortality of fish during capture, transport and captivity may affect some fish populations, but they are not of exceptional interest biologically (though this may reflect my personal bias!).

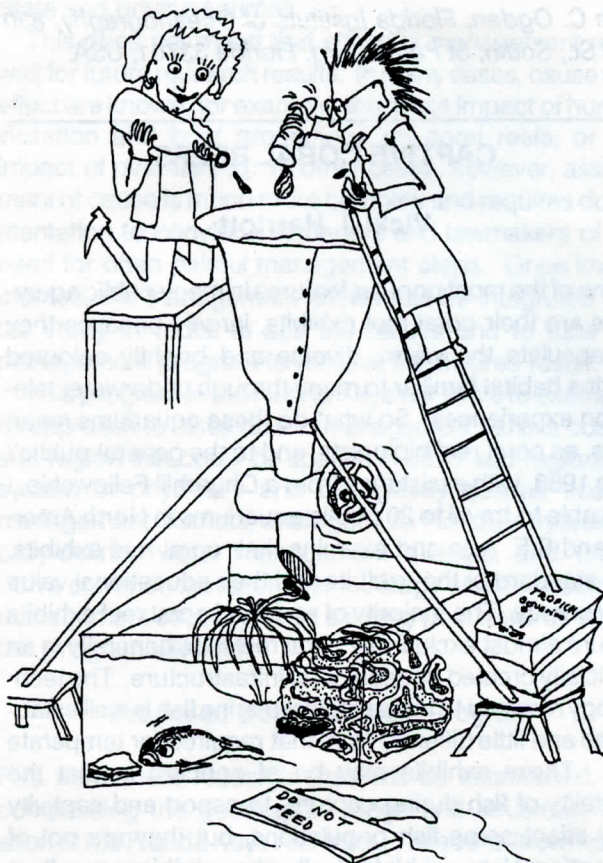
The real frontline in aquarium technology in both

public and private aquariums is the maintenance of invertebrates, particularly corals.

Keeping Corals Comfortable

Many of us know the basic requirements for coral life, but meeting them in an aquarium is another matter entirely.

1. **Light:** It is difficult to simulate daylight indoors, but sunlight or an approximation of it is vital for many corals.
2. **Food:** Many corals require plankton which is usually rare in the artificial environment.
3. **Temperature:** Corals require water between about 15°C and 29°C. The lower limit is significant in temperate regions, particularly in aquaria with flow-through water. In the tropics in tanks exposed to air, water temperature can frequently climb above tolerable levels.
4. **Water movement:** Corals require significant water movement and this is not generally supplied in conventional aquarium designs.
5. **Nutrients:** Although it has long been known that corals are difficult to keep in conventional aquaria, the major detrimental effects of elevated nutrient levels have only relatively recently been elucidated. Some coral species are intolerant of nitrate concentrations above 1 micromole per litre - well below the level detectable by aquarium test kits, and thousands of times lower than concentrations tolerated by fish.



Drawing by Agus Hartoko

Life support systems

Corals can be maintained using several systems or combinations of systems. The simplest is a flow-through system whereby good quality water is rapidly cycled through the aquarium eliminating virtually all water quality problems. This system is used successfully in several Hawaiian aquaria, but there are few other sites with enough sufficiently good quality water.

The second system is the use of algae for filtration. This was used by Dr Walter Adey in an exhibit tank at the Smithsonian Institution, Washington D.C. and scaled up for the 2 million litre Great Barrier Reef Aquarium in Townsville, Australia. Here we have been able to keep nitrate concentrations consistently below 0.5 micromolar and have had good success with long term survival of the hardier corals, although some other species have proved to be very sensitive to aquarium conditions. Some corals in the reef tank spawned at the same time as the mass spawning of corals on the Great Barrier Reef in each of the last two years.

Other recent coral reef exhibits, such as those of Baltimore Aquarium and Steinhardt Aquarium use combinations of filtration systems, including particulate filtration, activated carbon or ozone, bacterial filtration and algal filters with apparently good success. This also reflects to some extent the trend in serious home aquaria towards the "mini-reef" life support systems recommended for maintenance of corals and invertebrates, which focus on high light levels, the use of algae, and bacterial trickle filtration, coupled with relatively low stocking density.

Conservation and Public Education

Most large aquaria place much emphasis on education, through signs accompanying exhibits and programmes encouraging active community participation. Programmes at major public aquaria probably play a real role in informing people about marine life and in increasing appreciation of the need to conserve natural resources.

On the negative side, all aquaria suffer some loss of animals and this has to be kept to a minimum in any responsible establishment, if only for the economics of the costs of replacing animals.

Overall, I believe that coral reef aquaria are a valuable means of educating the public about the diversity, beauty, and conservation value of coral reefs, particularly when coupled with effective public education programmes, reaching interested adults and children. In some cases they may also have the potential to allow us to learn more about the physiology and behaviour of some organisms in an accessible environment.

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- Vicki J. Harriott, G.B.R.M.P.A., P.O. Box 1379, Townsville, M.S.O. Australia.

WHO'S WHO?

In this issue we are listing a very small selection of the many groups, societies and organisations concerned in reef conservation. With so many people involved, there is potential for overlap in activities - perhaps we can avoid some of this by using *Reef Encounter* to put groups in touch with each other.

IUCN Commission on Ecology Coral Reef Group

This is a small group of reef experts brought together by IUCN with the aim of applying the best scientific knowledge available to the conservation of coral reefs. Operating on a voluntary basis, the group published four issues of a newsletter between 1978 and 1982, and initiated an inventory of coral reef parks and reserves. This formed the basis for the recently published IUCN/UNEP directory of coral reefs of international importance *Coral Reefs of the World* (see book list). In 1987, the group produced *Human Impacts on Coral Reefs: facts and recommendations*, edited by Bernard Salvat and published by the Antenne Museum EPHE, Tahiti (see book list).

In 1988 a new group was set up under the chairmanship of Bernard Salvat; its activities for the period up to 1992 are currently being developed and members recruited. There are three principle objectives:

1. To produce a summary, mainly in the form of maps, of the directory of coral reefs of international importance, in order to provide a comprehensive overview of the global status of reefs for broad distribution throughout the world.
2. To produce a small, concise and synoptic brochure for decision makers on how to avoid and limit human impacts on coral reefs, as a follow-up to the 1987 book on this subject which was aimed mainly at scientific advisors.
3. To promote knowledge and research on rehabilitation and restoration of damaged coral reefs, initially as a data-gathering exercise, and with the subsequent aim of convening a symposium on this topic and publication and dissemination of the results.

Chairman and contact: *Dr. B. Salvat, Ecole Pratique des Hautes Etudes, Lab. biologie marine et malacologie, Centre biologie Ecologie Trop. et Med., Universite de Perpignan, Ave de Villeneuve, 66025 Perpignan, France.* Sue Wells, Bernard Salvat and Harold Hudson have responsibility for Objectives 1, 2 and 3 respectively.

IUCN Species Survival Commission Coral Reef Fish Specialist Group

This is a group of experts drawn together by IUCN to take responsibility, on a voluntary basis, for all aspects of coral reef fish conservation. Aims and objectives of this group are currently being defined and will focus on determining whether particular species are under threat from habitat destruction, trade, etc. The group will work in close collaboration with the IUCN Coral Reef Group and the IUCN Fisheries Management Group, a group recently established under the chairmanship of Gary Bernacsek.

Chairman and contact: *Don McAllister, 2883 Otterson Drive, Ottawa, Ontario K1V 7B2, Canada.*

Marine Conservation Society Coral Reef Team

This is a small group of reef scientists and conservationists set up in 1988 by the UK-based Marine Conservation Society to launch a campaign in Britain entitled 'Let Coral Reefs Live'. The main objectives of the team are to increase public awareness of reef conservation issues in Britain; persuade people not to buy coral reef curios; campaign for better controls and more effective monitoring of the trade in reef corals; press for improved management of the marine aquarium trade; and stimulate conservation action particularly in the UK Dependent Territories, through practical reef projects and provision of educational materials.

Contact: *Dr Elizabeth Wood, Hollybush, Chequers Lane, Eversley, Basingstoke, Hants RG27 0NY, UK*

International Marinelife Alliance Canada (IMAC)

Established as a non-profit organization in 1985, IMAC aims to conserve the diversity of marine life, protect marine environments and promote sustainable use of marine resources, particularly coral reefs. It produces a quarterly bulletin *Seawind* with semi-popular articles on a variety of subjects relating to marine conservation principally in developing countries. Most of its work has been carried out in the Philippines in connection with the aquarium fish trade, publicising the damage caused by the use of sodium cyanide to catch fish. Funding has been obtained for a programme to train collectors in the use of nets - the Netsman Project - which will be implemented by the Haribon Foundation, starting in August 1988. IMAC has also been involved in efforts to protect Shiraho reef in Japan and has carried out two surveys of the reef in 1988 on behalf of IUCN and WWF. A new project will involve the production of a manual on coral reef habitat restoration for use in developing countries.

Contact: *Don McAllister, IMAC, 2883 Otterson Drive, Ottawa, Ontario K1V 7B2, Canada.*

ASEAN/USAID Coastal Resources Management Project

This is a project implemented by ICLARM from Manila and established in 1986, which aims to assist the six ASEAN nations (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand) to increase existing capabilities to manage their renewable coastal resources on a sustainable basis. Site-specific projects have been developed in each of the participating countries; coastal resource management plans are being finalized for each of these sites and implementation of some of these will start in 1990. A newsletter *Tropical Coastal Area Management* is produced and distributed free of charge to individuals and institutions involved in coastal resources research and management. A number of publications have been produced concerning the projects, including *Coral reefs: valuable resources of Southeast Asia* by Alan White (see book list).

Contact: *ASEAN/USAID Coastal Resources Management Project, ICLARM, MC P.O. Box 1501, Makati, Metro Manila, Philippines.*

BOOK REVIEW

The Growth and Form of Modular Organisms

Edited by J.L. Harper, B.B. Rosen and J. White.

The Royal Society, London 1986. 250 pp. 4 pls.
£43 (UK addresses), £46 (overseas addresses).

This collection of papers, originally published as volume 313 in series B of the *Philosophical Transactions of the Royal Society*, arose from a meeting held at the Royal Society during June 1985. A complementary volume (*Proceedings of the Royal Society, Series B, Vol. 228*) consists of papers which were presented as posters at the same meeting. As is customary with publications of the Royal Society, this book has been produced to a generally high standard with respect to both scientific content and presentation. It is certainly a very timely publication - interest in modular organisms from ecologists and evolutionary biologists has never been greater. The work of John Harper, one of the book's editors, has been particularly influential. Harper's ideas on the population biology of plants have been grasped with enthusiasm by zoologists working on colonial invertebrates including reef corals.

But what is a 'modular organism'? Modular organisms are those in which the genetic individual (genet) grows by repeated iteration of multicellular parts (modules). A diverse range of organisms fall within this definition, including fungi, some higher plants, and colonial marine invertebrates such as bryozoans and many cnidarians. As the editors point out in their informative preface, modular organisms share some or all of the following characteristics: they are typically sessile (or are moved passively); their growth commonly involves branching, and sometimes fragmentation into numerous clonal ramets; modules may senesce (and may accumulate as dead 'necromass' which remains attached to the living parts of the organism), whereas the genet appears potentially to be immortal; and the germ plasm is not segregated from the soma during early development. Through these attributes modular organisms challenge some of the conventional wisdom of population biology which has been formulated largely for unitary organisms like ourselves.

Several of the themes introduced by the editors are tackled in detail with reference to particular groups of modular organisms in the 15 papers that follow. Contributions by Jackson and Coates, Ryland and Warner, Rosen, Dyrinda, and Mackie are likely to be the most interesting for marine scientists. Jackson and Coates discuss the greater complexity of the life cycle in clonal and aclonal animals. In addition, there is evidence of selection for inbreeding in some clonal species. However, these differences appear not to be reflected by differences in evolutionary rates between clonal and aclonal groups; species longevities are approximately equal in clonal and aclonal scleractinian corals.

Ryland and Warner examine the relationship between module size and colonial integration. There are theoretical grounds for supposing that the two should be inversely correlated. However, integration is a rather nebulous concept which is difficult to quantify in a meaningful way, and surveys of ascidians, hydroids and bryozoans

fail to provide strong support for the predicted correlation.

In a thoughtful paper, Rosen devises a conceptual framework for the description and interpretation of modularity in corals. The morphology of coral colonies can be described in terms of differing hierarchies of modularity, ranging from the fundamental module or zooid (= polyp + corallite) through second level modules (e.g. polystomatous groupings of meandroid corals) to higher level modules (e.g. branching or platey systems of meandroid corals). Some useful new terminology is introduced, including clonoteny (cloning in which the clones remain attached to one another to form a colony) and clonopary (cloning in which the clones become completely detached).

Dyrinda reviews the defences possessed by sessile colonies and other sessile animals to handle competitors, predators, epibionts and endobionts. 'Flight' as a defence is usually precluded, and a range of physical reinforcements and chemical defences are employed instead. The secondary metabolites utilized by many sponges, soft corals and bryozoans have attracted considerable attention recently because of their possible pharmaceutical value.

While most of the contributors focus on sessile modular organisms, Mackie's contribution on physiological aspects of modularity in colonial animals concentrates on planktonic colonies such as salps and siphonophores. Many aspects (e.g. symmetry) of planktonic colonies contrast greatly with sessile colonies, and neural co-ordination between modules can be highly developed in association with swimming behaviour.

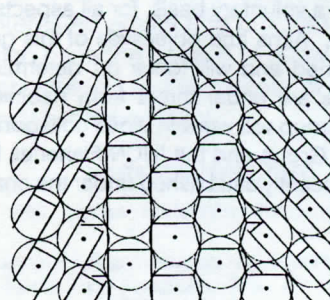
In summary, this valuable collection of papers is a stimulating epitome of the diverse areas of current interest concerning modular organisms, and sets the scene for the further empirical and conceptual advances which must surely happen in the next few years. With respect to animal colonies, it is instructive to chart the changing emphasis in research by comparing this book with the multi-authored volumes edited by Boardman, Cheetham and Oliver (1973), Larwood and Rosen (1979) and Jackson, Buss and Cook (1985).

Boardman, R.S., Cheetham, A.H. and Oliver, W.J. 1973. *Animal colonies*. Dowden, Hutchinson and Ross, Stroudsburg.

Larwood, G. and Rosen, B.R. 1979. *Biology and systematics of colonial organisms*. Academic Press, London.

Jackson, J.B.C., Buss, L.W. and Cook, R.E. 1985. *Population biology and evolution of clonal organisms*. Yale University Press, New Haven.

Paul Taylor, Dept of Palaeontology, British Museum (Natural History), London SW7 5BD U.K.



Possible zooid shapes in Bryozoa; Fig. 4 in paper by Ryland and Warner

BOOK SHELF

A SELECTION OF (RELATIVELY) RECENT BOOKS ON REEFS AND REEF-RELATED TOPICS

Compiled by Jill Darrell with additions by Sue Wells and Barbara Brown

N.B. This is very definitely only a **selection**. Please keep the editors informed of new publications relevant to *Reef Encounter* readers. We apologise that full details of publication, cost, availability etc. are not always given, but we have not had the time to research this; further apologies for the lack of accents - we hope to sort this out soon.

ATLAS OF LIVING REEFS OF CURACAO AND BONAIRE (NETHERLANDS ANTILLES)

Fleur C. van Duyl

Natuurwetenschappelijke Studiekring voor Suriname en de Nederlandse Antillen, Utrecht, 1985. No. 117, 38 pp., 63 figs, 14 tables and 41 maps. ISBN 0300-5534.

Obtainable from: Foundation for Scientific Research in Surinam and the Netherlands Antilles, c/o Zoology Laboratory, Plompetorengracht 9, 3512 CA Utrecht, Netherlands; and the Atlantic Reef Committee, Fisher Island Station, Miami Beach, Florida 33139, USA.

THE NATURAL HISTORY OF ENEWETAK ATOLL

Edited by D.M. Devaney, E.S. Reese, B. Burch and P. Helfrich

U.S. Dept of Energy, N.T.I.S. Energy Distribution Centre, P.O. Box 1300, Oak Ridge, Tennessee 37831, USA.

Vol.1: The ecosystem: environments, biotas and processes. Vol. 2: Biogeography and systematics. If ordering, request: DE87006110 (DOE/EV/0073-T1-Vol.1) and DE87006111 (DOE/EV/0073-T1-Vol.2). US\$62.90.

CORAL REEF GEOMORPHOLOGY

A. Guilcher

John Wiley & Sons, Brisbane. 1988. 248pp.

Available from: John Wiley and Sons, G.P.O. Box 859, Brisbane, Qld 4001. \$106.20. Contents include distribution and ecology, surface features of coral reefs, types of reefs, reef and man.

LIVING CORAL REEFS OF THE WORLD

Deitrich Kuhlmann

Arco Publ. Inc., New York, 1985. 185 pp, 151 colour photographs, 50 figs.

This book is the authorized translation of the German version *Das Lebende Riff*, published by Verlag Edition Leipzig. \$24.95.

ANCIENT REEF ECOSYSTEMS

Edited by G.D. Stanley and J.A. Fagerstrom

Palaos Vols 2 & 3 1988.

The proceedings of a symposium at the Fourth North American Paleontological Convention, August 1986, Boulder, Colorado. Contributions in the first part describe evolutionary steps in the development of reefs and provide glimpses of the composition, structure and changes in a succession of reef communities from the Early Cambrian to the Late Cretaceous. The second part deals with major ecologic themes which cross time boundaries to apply to reefs of all ages. For further information, contact: G.D. Stanley, Geology Dept, University of Montana, Missoula, MT 59812, USA.

NEOGENE OF THE MEDITERRANEAN TETHYS AND PARATETHYS. STRATIGRAPHIC CORRELATION TABLES AND SEDIMENT DISTRIBUTION MAPS

Edited by F.F. Steininger, J. Senes, K.Kleemann and F. Rogl

Institute of Paleontology Vienna Press. 1985. Vol. 1: xiv + 189 pp, 80 figs, 10 colour maps; Vol. 2: xxv + 524 correlation tables. ISBN 3-900545-00-6. Austrian Schillings 2100.

A LIST OF SCLERACTINIAN AND SUBGENERIC TAXA

J.W. Wells

Fossil Cnidaria 15(11): 1-69. 1986.

A GEOLOGICAL GUIDE TO THE NORTHERN GREAT BARRIER REEF

P.G. Flood

Australian Sedimentologists Group Field Guide Series, No.1. 100 pp.

Available from: A.P. Belperio, S. Aust. Dept Mines and Energy, P.O. Box 151, Eastwood, South Australia 5063. Aus \$15. Price includes surface postage (please add extra for overseas airmail). Cheques payable to "Australasian Sedimentologists Group".

MIXED TERRIGENOUS CARBONATE SEDIMENTATION IN THE CENTRAL GREAT BARRIER REEF PROVINCE

D.P. Johnson, A.P. Belperio, and D. Hopley.

Australian Sedimentologists Group Field Guide Series No. 3, 173 pp, Aus \$30. Available from: A.P. Belperio (as above).

PALAEOALGOLOGY

Edited by D.F. Toomey and M.H. Nitecki

Springer-verlag, 1985. 376 pp. ISBN 3-540-15312-18. DM 160. Proceedings of 3rd International Symposium on Fossil Algae at Colorado School of Mines, USA, August 1983.

Includes section on 'Reefs, buildups and other frameworks'.

SEA-FLOOR OBSERVATIONS AND SUBBOTTOM SEISMIC CHARACTERISTICS OF OAK AND KOA CRATERS, ENEWETAK ATOLL, MARSHALL ISLANDS

Edited by D.W. Folger

Bull. U.S. geol. Surv. 1678. 1986.

ISLANDS

H.W. Menard

Scientific American Books, Inc. New York. 1986.

Distributed by W.H. Freeman & Co., 41 Madison Avenue, New York, NY 10010, USA; and 20 Beaumont St, Oxford OX1 2NQ, England. £15.95.

ANTIGUA: REEFS, ROCKS AND HIGHROADS OF HISTORY

G. Multer, D. Nicholson and M. Weiss

116 pp.

This book is profusely illustrated, contains both an antique and modern location map and is accompanied by a separate map with tables of information helpful to tourists. A key to the common species of reef-forming corals and algae is accompanied by photographs that facilitate identification. Available from: Mac Weiss, Geology Dept, Northern Illinois University, DeKalb, Illinois 60115, USA. US\$10 (+\$2 for overseas postage).

CARBONATE CEMENTS

Edited by N. Schneidermann and P.M. Harris

Society of Economic Palaeontologists and Mineralogists, Spec. Pub. 36. 379 pp. 1985. ISBN 0-918985-37-4.

Second section on submarine cementation includes four reef cement papers by I. Macintyre, G. Friedman, R. Lighty and Pierson & Shinn; other reef papers by Walls & Burrowes. US\$36 (\$29 to members of SEPM and AAPG).

HERMATYPIC CORALS OF WESTERN AUSTRALIA

J.E.N. Veron and L.M. Marsh

Records of the Western Australian Museum, Supplement No. 29. 1988. 136 pp.

Available from: Western Australian Museum, Francis St, Perth, Western Australia 6000.

HUMAN IMPACTS ON CORAL REEFS: FACTS AND RECOMMENDATIONS

Edited by B. Salvat

Antenne Museum E.P.H.E., French Polynesia. 1987. 253 pp.

A compilation of 18 papers covering all the main human-induced threats to coral reefs, produced by the Coral Reef Group of the IUCN Commission on Ecology. Contact: B. Salvat, Centre de Biologie et d'Ecologie Tropicale et Méditerranéenne, Université de Perpignan, Ave de Villeneuve, 66025 Perpignan, France.

AN INTRODUCTION TO CARBONATE SEDIMENTS AND ROCKS

T.P. Scoffin
Blackie & Son Ltd, Glasgow and London. 1987. ISBN 0-2161-91789-1.

REEF DIAGENESIS

Edited by J.H. Schroeder and B.H. Purser
Springer-verlag, Berlin. 1986. 450 pp, 187 figs. ISBN 3-540-16594-0.
A survey demonstrating the importance of diagenesis in a series of case histories ranging from the Cambrian to the present. Diagenetic models derived from these data will help elucidate similar processes going on in other types of carbonate rocks. In view of the petroleum reservoir of reefs, these models have direct application to the worldwide search for oil. DM148.

THE CROWN OF THORNS STORY

Video and Booklet. Great Barrier Reef Marine Park Authority.
Booklet Aus \$3; Video Aus \$35. Available from: GBRMPA, P.O. Box 1379, Townsville, Queensland 4810, Australia.

THE BMW TROPICAL BEACH HANDBOOK

Nick Hanna
Fourth Estate. 1989. 320 pp, full colour throughout. ISBN 0-947795-13-8.
A guide to tropical beaches, diving and snorkelling in 19 countries, with information on accommodation for every pocket. Available from: Fourth Estate, 113 Westbourne Grove, London W2 4UP. £12.95 p&p inc., UK only; US\$22.50 + \$3.50 p&p, outside U.K.

CORAL REEFS OF THE WORLD

Edited by S.M. Wells, C. Sheppard and M.D. Jenkins
UNEP/IUCN, 1988/89. UNEP Regional Seas Directories and Bibliographies. UNEP, Nairobi Kenya and IUCN, Cambridge U.K. Vol. 1: Atlantic and Eastern Pacific. 373 pp, 38 maps; Vol. 2: Indian Ocean, Red Sea and Gulf. 389 pp, 36 maps; Vol. 3: Central and Western Pacific. 329 pp, 30 maps.
Available from IUCN Publications Services, 219c Huntingdon Road, Cambridge CB3 0DL, UK. £25/US\$45 each volume or £60/US\$100 for the complete set of three. Add £4/US\$8 each or £10/US\$20 per set for surface mail; £12.50/US\$25 each or £25/US\$50 for airmail.

CORAL REEFS: VALUABLE RESOURCES OF SOUTHEAST ASIA

A.T. White
ICLARM Education Series 1, 36 pp. 1987.
Available from ASEAN/USAID Coastal Resources Management Project, ICLARM, MC P.O. Box 1501, Makati, Metro Manila, Philippines. US\$1.50 surface mail, US\$5 airmail.

A FUNCTIONAL BIOLOGY OF MARINE GASTROPODS

R.N. Hughes
Croom Helm, London & Sydney, 1986. 245 pp. ISBN 0-7099-3746-6. £22.50.

GIANT CLAMS IN ASIA AND IN THE PACIFIC

Edited by J.W. Copland and J.S. Lucas
ACIAR Monograph 9. 274 pp. 1988.
Papers resulting from a workshop held by the Australian Centre for International Agricultural Research at Townsville in April 1988; the publication brings together the literature and results of most of the world's research on Giant Clams and is "likely to be a benchmark on the knowledge and potential of giant clams for the restocking of tropical reefs, and farming clams both extensively and intensively, in the Indo-Pacific region." Available from ACIAR, G.P.O. Box 1571, Canberra, A.C.T. 2601, Australia.

A HISTORY OF SHELL COLLECTING

S. Peter Dance
E.J. Brill, Leiden. 1986. 280 pp, 32 plates. ISBN 90 04 08063 5.
Available from E.J. Brill, P.O. Box 9000, 2300 PA Leiden, Netherlands. £24.95.

RED SEA SHELLS

D. Sharabati and I.A. Sharabati
KPI Ltd, Routledge & Kegan Paul plc, London. 1984. ISBN 0-7103-01301-0.

THE MARINE CURIO TRADE: CONSERVATION ISSUES

E.M. Wood and S.M. Wells
Marine Conservation Society, U.K. 1988. 120 pp.

A review of international trade in ornamental corals and shells with trade statistics, conservation problems and suggestions for the future. Available from: Marine Conservation Society, 9 Gloucester Road, Ross-on-Wye, Herefordshire HR9 5BU. £7.50 (excl. p&p), UK only. For overseas buyers, please send order, and a pro-forma invoice will be mailed by return; once payment is received in sterling your order will be dispatched by return.

MARINE INVERTEBRATE FISHERIES: THEIR ASSESSMENT AND MANAGEMENT

Edited by J.F. Caddy
Wiley-Interscience, John Wiley and Sons Inc., N.Y. 1989. 752 pp.
Includes 14 chapters on crustacean fisheries, 11 on molluscan fisheries and 4 on other invertebrates, many reef-related.

THE LITTORINID MOLLUSCS OF MANGROVE FORESTS IN THE INDO-PACIFIC REGION: THE GENUS LITTORARIA.

D.G. Reid
British Museum (Natural History) Publications, London. 1986. 240 pp, 99 illus., 1 colour plate. ISBN 0-565-00978-8.
A comprehensive account of the taxonomy, biology and biogeography of the '*Littorina scabra*' species complex. Available from Publication Sales, British Museum (Natural History), Cromwell Road, London SW7, UK. £35.00. Add 10% to cover postage and packing.

THE MALACOFUNA OF HONG KONG AND SOUTHERN CHINA

Edited by B. Morton and D. Dudgeon
Vols 1 and 2. Proceedings of the 2nd International Workshop on the Malacofauna of Hong Kong and Southern China, Hong Kong, 6-24 April 1983. Hong Kong University Press. 1985. ISBN 962-209-120-2.

COWRIES OF THE WORLD

C.M. Burgess
Gordon Verhoef Seacomber Publications, Orlando. 1985. 289 pp. ISBN 0-620-054183-2.
Available from: Seacomber Publications, P.O. Box 5683, Orlando, Florida 32855, USA. US\$95 + \$8 for postage.

MOLLUSKS. NOTES FOR A SHORT COURSE

Edited by T.W. Broadhead
Studies in Geology 13. 1985. Dept Geological Sciences, Univ. Tennessee. 308 pp, ISBN 0-910249-12-1.
Available from: Publications Editor, Dept Geological Sciences, Univ. Tennessee, Knoxville TN 37996-1410, USA.

SMITH'S SEA FISHES

Edited by M.M. Smith and P.C. Heemstra
Springer-Verlag, Berlin. 1986. ISBN 3-540-16851-6. DM 198.

EXPLOITATION OF CORAL REEF FISHES FOR THE AQUARIUM TRADE

E. Wood
Available from: Marine Conservation Society, 4, Gloucester Road, Ross-on-Wye HR9 5BU. £6.00 + £1.00 p&p.

GUIDE DES ETOILES DE MER, OURSINS ET AUTRE ECHINODERMES DU LAGON DE NOUVELLE-CALÉDONIE (HANDBOOK OF THE SEA-STARS, SEA URCHINS AND RELATED ECHINODERMS OF THE NEW CALEDONIA LAGOON)

A. Guille, P. Laboute and J.-L. Menou
ORSTOM, Paris. Collection Fauna Tropicale No. 25. 1986. (partly bilingual). ISBN 2-7099-0748-8.
This is a lavish, superbly illustrated taxonomic guide which will be useful for not just New Caledonia but also the Indo-Pacific generally. Available from: Editions de l'ORSTOM Publicite, 70, route d'Aulnay, 93140 Bondy, France. FF350.

RED SEA REEF FISHES

J.E. Randall
Immel, London. 1983. 192 pp, 446 colour photos. ISBN 0-907151-04-3. £33.50.

ANNOUNCEMENTS

S.O.S. TUBBATAHA

Tubbataha Reef is the communal fishing ground of fishermen from the municipality of Cagayancillo, Palawan and also attracts tourists from all over the world for diving. It is being destroyed by fishermen using dynamite, cyanide and other destructive fishing methods. It is now a national marine park and efforts are being made to mobilize the communities of Palawan to protect it.

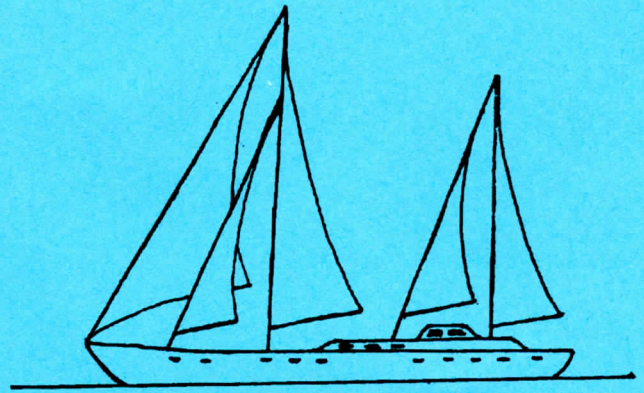
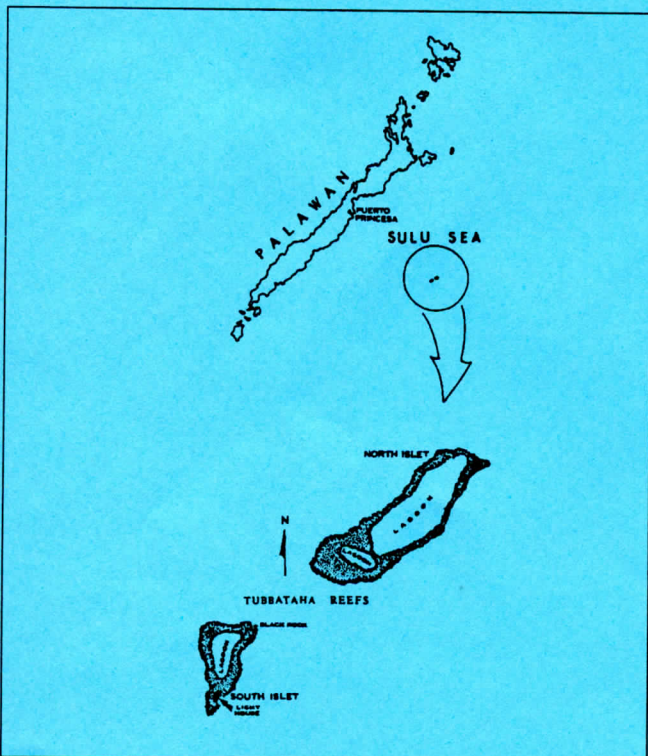
SAVE TUBBATAHA is a project developed by concerned members of the private sector and government to protect the reefs. You can help by becoming a member of the Tubbataha Foundation which has been established as an autonomous affiliated chapter of the Haribon Foundation and is registered as a non-stock, non-profit corporation with the Securities and Exchange Commission. Membership dues will be used to hire and train field workers, help the people of Cagayancillo improve their livelihood through marine-related income-generating activities and pay expenses for monitoring and research.

Annual membership fees are:

Student	P 50.00
Individual	300.00
Family	500.00
Organization	4,000.00
Patron	10,000.00

As a member, you will receive a membership card, an acknowledgement of your subscription and an opportunity to help save Tubbataha.

Further information from: *Tubbataha Foundation, 2172 Pasong Tamo St, Makati, Metro Manila, Philippines.*



NEED A DIVE BOAT?

EVOH is an 82 foot steel ketch, which can accommodate 20 people in 8 cabins and has a cruising range of over 4000 miles. There are two diving compressors, 24 dive bottles and three crew; trips have been run in the Caribbean and Pacific. The cost of chartering EVOHE is entirely negotiable. Undertaking interesting projects such as scientific research, filming expeditions or private charter to unusual places is the main objective and for such a project the charter fee would only cover the running costs (just over £50,000 in 1987). Given sufficient notice, EVOHE can be moved anywhere in the world. The boat can be contacted by radio.

Contact: *Steven Kafka, c/o Jane Cheriford, 35 Cornwall Road, Cheam, Surrey SM2 6DU, U.K. Tel: 01-642-5787.*

CONSERVATION EXPEDITION COMPETITION

Are you planning an expedition that will take place outside Europe and North America?

Are you a student?

Do your interests lie in the field of wildlife conservation?

Are you planning to involve local people in your work?

If the answers are 'yes', then you could be eligible for the conservation expedition competition organised by the Fauna and Flora Preservation Society (FFPS) and the International Council for Bird Preservation (ICBP). This was established to stimulate expedition groups to adopt a conservation objective for their work. There are separate categories for expeditions focusing on birds and for those on 'other wildlife and habitats'. First and second prizes in each category are £1000 and £800 respectively. The closing date for the 1990 competition is 31 January 1990.

Application details from: FFPS, 79-83 North Street, Brighton, East Sussex BN1 1ZA, U.K.

DIARY

We apologise that some of the following events will have happened before you receive this issue. They are included for general interest. Please send contributions for the **Diary** section as soon as possible for the next issue.

9 - 14 September, 1991, Munster, FRG FOSSIL CNIDARIA - 6TH INTERNATIONAL SYMPOSIUM ON FOSSIL CNIDARIA INCLUDING ARCHAEOCYATHA AND PORIFERA

Organised by the International Association for the Study of Fossil Cnidaria and Porifera, in collaboration with the Westfälische-Wilhelms-Universität, Münster. The planned scientific programme includes Evolution of Corals, Intraspecific Variability and Fossil Races, Diagenesis and Microstructure of Fossil Cnidaria and Porifera, Evolution of Reefs, Porifera, Coral Research History and Computer Supported Palaeontology. Further information from: *Fossil Vi Cnidaria, Westfälische-Wilhelms-Universität, Forschungsstelle für Korallenpaläozoologie, Pferdegasse 3, D-4400, Münster, FRG.*

15 June - 15 August, 1989, Hawaii Institute of Marine Biology, Coconut Island METABOLISM ON CORAL REEFS - THE 1989 EDWIN W. PAULEY ADVANCED RESEARCH TRAINING PROGRAM

Each year at HIMB, a summer course in a specialised area of marine research is made possible through the generous support of the Edwin W. Pauley Foundation. Graduate students will be given preference. The course provides opportunities for students to conduct research with guidance from experts in the field. Information about future courses from: *Dr Paul Jokiel, Hawaii Institute of Marine Biology, PO Box 1346, Kaneohe, HI 96744, USA.*

8 July - 18 August, 1989, Discovery Bay Marine Laboratory, Jamaica CORAL REEF FISH AND FISHERIES

A course organised through the University of the West Indies on the biology of reef fish and the special problems of their management, suitable for advanced undergraduates, graduate students or fishery officer who are certified SCUBA divers. For information contact: *Head, Discovery Bay Marine Laboratory, P.O. Box 35, Discovery Bay, St Ann, Jamaica, West Indies. Tel. (809) 973-2241.*

1990, University of Newcastle upon Tyne, U.K. M.SC IN TROPICAL COASTAL MANAGEMENT

A one year course held each year specifically for those within the developing nations who require an overview of tropical coastal zone management. The course consists of two ten-week teaching terms, followed by an examination and then either a two month research project (for the award of Diploma) or a four month research project (for the award of M.Sc). Prospective applicants should have already graduated with a first degree (B.Sc. or equivalent). A limited number of scholarships may be available. For further information contact: *Dr B.E. Brown, Centre for Tropical Coastal Management Studies, Dept of Biology, The University, Newcastle upon Tyne NE1 7RU, U.K.*

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 only, in that it provides an outlet for book reviews, discussion of papers in the journal 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* will continue to be 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 material will not normally be refereed or returned for corrections. Opinions expressed and errors of fact will have to remain largely the authors' responsibility. No published item should be taken as ISRS opinion unless indicated.

Please help by sending items of not more than 2,000 words in length and in double-spaced typescript, or on diskette using the Multimate word-processing package (we hope eventually to have other options available). 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 at present, although we hope eventually to be able to afford photographs. Diagrams should have legends and/or captions to explain all symbols, abbreviations and shading patterns etc. Maps should have a scale and indication of orientation. Use *World List* abbreviations in references. Please use metric, or imperial-with-metric units, but not imperial units on their own. Do not forget to give your name and full address, or any other contact address where applicable.

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

DEADLINE FOR COPY FOR REEF ENCOUNTER 6 (due out December 1989, for the Annual Meeting in Marseilles) IS OCTOBER 7th 1989.

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Phone: (0223) 350409*

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Address:.....

Title:.....

Fields of interest:.....

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-US\$ 8 or £ 6 for STUDENT membership
-US\$58 or £41 for SPOUSE membership

Cheques to be made payable to:

INTERNATIONAL SOCIETY FOR REEF STUDIES

Send completed application form and your cheque to:

Dr David H. Montgomery, Biological Sciences Dept, California Polytechnic State University, San Luis Obispo, California 93407, USA.