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REEF ENCOUNTER

Newsletter of the International Society for Reef Studies

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NEWSLETTER OF THE INTERNATIONAL SOCIETY FOR REEF STUDIES

Editor Sue Wells
Associate Editor Callum Roberts

CONTENTS

Cover illustration by Margaret Roberts

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

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

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

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

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

Membership

The annual subscription for full membership of ISRS is currently US$60, provided renewal payments are made by 1st March each year. Full Members receive the journal *Coral Reefs*, the newsletter *Reef Encounter*, and other periodic mailings.

Spouse membership is US$70.

Student membership costs US$10 and benefits include all of the above except the journal *Coral Reefs*.

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

Subscriptions to the Society should be addressed to the Treasurer (address given above).

EDITORIAL

The last few months has been a busy time for ISRS with several important meetings and a steady growth in membership. The President and Treasurer have done an enormous amount recently in publicising the Society and improving its financial base. Unfortunately, this does not mean we can all sit back and relax – at least, not just yet. There are still new members out there to bring into the fold; with this issue, you will receive a copy of the membership list which will enable you to see at a glance which of your colleagues have still not made their contribution. Please persuade them to join us, to take part in our activities (such as writing for *Reef Encounter*), and to make the reef science community the strong body that it needs to be in the coming years.

We go to press as many ISRS members meet in Miami at the 50th anniversary celebrations of the Rosenstiel School of Marine and Atmospheric Science, to discuss the global status of coral reefs. We will report fully on this in the next issue of *Reef Encounter*, but this issue also carries several articles relevant to the ongoing debate about the role of reef scientists and ISRS itself in environmental advocacy and management. If you attended the Miami meeting, please send us a contribution with your views on the debate and its outcome.

Spurred on by the July meeting on the history of reefs, we thought we might start a new series in *Reef Encounter*: 'Makers of Reef Science'. Some of the younger ISRS members are probably fairly ignorant about the early history of reef science. Reef history buffs are requested to send in short contributions (about a column) on people who have played key roles in any aspect of reef science. We think we should restrict the column to profiles of reef scientists who are no longer with us; we could run into trouble publishing the lives of the current makers of reef science, and ISRS can ill afford a libel case just now!

The next gathering of ISRS members will be in Vienna in December, for the European meeting, where we expect a good number of geologists to participate. If you are attending this meeting, do try and drum up some geological contributions for *Reef Encounter* – making the newsletter a multi-disciplinary publication is still proving difficult.

As the proposed new Constitution has to be circulated to all members of ISRS, there will be a few changes in the next two issues of *Reef Encounter*. Number 14 will be distributed in October with the draft Constitution. Number 15 will come out in March 1994. Thereafter we plan to return to the normal July and December issues. Please note that the copy deadline for the next issue is August 31, 1993.

Sue Wells
Callum Roberts

COPY DEADLINE FOR REEF ENCOUNTER 14 (due out October 1993) IS AUGUST 31ST 1993
Please send copy to Callum Roberts – see back page

ISRS NEWS

ISRS CO-SPONSORED MEETINGS

INTERNATIONAL SYMPOSIUM ON BIODIVERSITY AND ADAPTIVE STRATEGIES OF REEF ORGANISMS

Dr K. Yamazato has sent further information on this meeting which was organized by the Sesoko Marine Science Center (SMSC) at the University of the Ryukyus, Okinawa, Japan in November 1992 to celebrate its 20th anniversary. The majority of papers were presented by former visiting research fellows at the SMSC or by individuals planning to work there. As a result, many were concerned with reef organisms found in Japanese waters. Charlie Veron spoke on the biogeography of Japanese hermatypic corals, describing how species diversity progressively attenuates from a maximum of 359 at the Yaeyama Islands to 34 at Tateyama, near Tokyo. Peter Glynn compared the 1980 bleaching event that took place at Sesoko with the one he observed himself in 1991 in various parts of Okinawa. The 1980 event appeared to have affected corals much more strongly, and the question was raised as to whether typhoon induced sea surface cooling could mitigate bleaching.

Other papers ensured that the entire Indo-Pacific, from Tahiti to the Red Sea, was covered. The 31 papers were presented in six sessions:

- Faunistic and floristic diversity in Okinawan coral reefs
- Adaptive strategies of coral reef organisms
- Reproductive biology and sex change in coral reef fish
- Reproduction and adaptive strategies in corals
- Mechanisms of promoting multispecies coexistence in coral reef communities
- Coral reef communities in changing environments.

These will be published in *Galaxea*, the publication of the SMSC. ISRS was formally represented by the President Bernard Salvat, and council member Yossi Loya.

Further information from: *Dr Kiyoshi Yamazato, Sesoko Marine Science Center, University of the Ryukyus, Nishihara-cho, Okinawa, 903-01 Japan. Fax: (81)-98-895-5376.*

FIFTH INTERNATIONAL CONGRESS ON THE HISTORY OF OCEANOGRAPHY

This was held at the Scripps Institution of Oceanography, San Diego, in the USA in July 1993. One of the plenary sessions, entitled 'Beyond Darwin: Coral Reef Research in the 20th Century' and organised by Daphne Fautin, had extensive ISRS input. David Stoddart, founder of ISRS, former editor of *Coral Reefs*, and ISRS Darwin medallist, spoke on early explorations of coral reefs. Papers by Siro Kawaguti and Joshua Tracey, both Honorary Members of ISRS, respectively covered pre-war research on reef corals in Japan and the drilling studies at Bikini and Enewetak. Caribbean

contributions to reef research were outlined by Robert Kinzie III, and Patricia Mather, organiser of the Second International Coral Reef Congress tackled the topic 'Coral reef biological science comes of age'. The current ISRS president and organiser of the Fifth International Coral Reef Congress outlined two centuries of science and reefs in France, providing a case study of the links between politics and reef research.

Information about the proceedings can be obtained from: *Dr Philip F. Rehbock, Dept of History, University of Hawaii, 2530 Dole St., Honolulu, Hawaii 96822, USA.*

FUTURE ISRS MEETINGS

16–20 December 1993
FIRST EUROPEAN REGIONAL MEETING OF ISRS
This will be held in the Biozentrum, University of Vienna, is open to all, and will cover all aspects of recent and fossil reefs; special topics will be announced later if proposed. The meeting will be opened on the afternoon of 16 December. Presentations will be made 17–19 December. The meeting will be closed on 20 December, when there will also be opportunities for sightseeing around Vienna. The first circular has been mailed and those responding will receive the second.

Further information from: *Prof. Dr Werner E. Piller, Institut fur Palaontologie, Universitat Wien, Universitatsstr. 7/2, A-1010 Vienna, Austria. Tel. (43)-1-40103-2498; Fax. (43)-1-40205-33.*

9–11 July 1994
1994 ANNUAL ISRS MEETING
This will be held jointly with the Australian Coral Reef Society at James Cook University, Townsville, Queensland. The theme of the meeting will be 'Reef Science, Management and Sustainability of Reefal Habitats in the 21st Century'. The meeting will follow the format of the regular annual ACRS meetings. On the first day there will be a couple of keynote addresses, followed by papers on the theme of the conference. The next two days will be available for papers either on the theme or on other aspects of reef science. Informal gatherings will be arranged in the evenings to maximise discussion time.

A large number of marine scientists will be in Townsville over this period. Prior to the meeting, the Pacific Congress on Marine Science and Technology (PACON) will be held from 4–8 July, and the Australian Marine Sciences Association will be meeting from 8–10 July. Overseas scientists wishing to participate in the ACRS/ISRS meeting should contact ACRS who will try to arrange billets, although a wide range of accomodation is available in Townsville.

Further information available from: *Dr Terry Done, Hon. Sec. ACRS, Australian Institute of Marine Science, PMB No 3, Townsville MSO, Qld 4810, Australia. Fax (077)-725-852.*

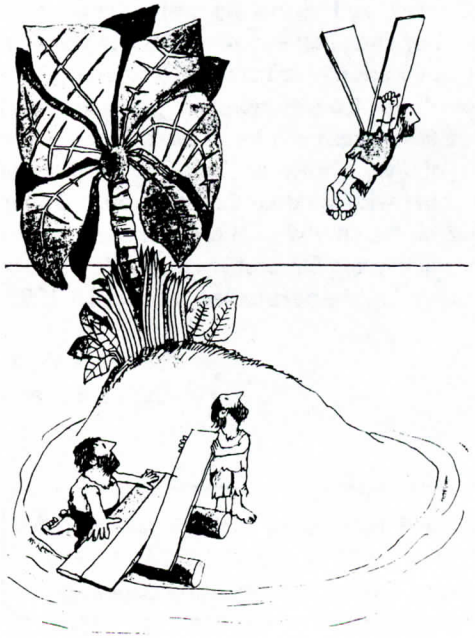
30 August-2 September 1994
SECOND EUROPEAN REGIONAL MEETING OF ISRS
This will be held in the new buildings of the Centre Universitaire in the Grand-Duchy of Luxembourg. The meeting is being jointly organised by Jorn Geister (Universitat Bern, Switzerland), Bernard Lathuilière (Université de Nancy 1, France), Alain Faber (Musée d'Histoire Naturelle, Luxembourg) and Robert Maquil (Service Géologique, Luxembourg). The first circular will be distributed **to those requesting it** in January 1994, after the regional meeting in Vienna.

There will be a two day field trip before the meeting to the spectacular outcrops of Middle and Upper Jurassic coral reefs in Lorraine and southern Luxembourg. If there is sufficient interest (minimimum of 15 people), an additional field trip may be organised to the recent and Pleistocene coral reefs of the Sinai Peninsula (Egypt). Depending on flight schedules, this would probably take place after the meeting, starting from an airport in Germany or France.

For further information contact: *Jorn Geister, Geologisches Institut der Universitat Bern, Baltzerstr. 1, CH 3012 Bern, Switzerland. Tel. (41) 31 65 45 07; Fax (41) 31 65 48 43.*

PROCEEDINGS OF THE 7th INTERNATIONAL CORAL REEF SYMPOSIUM

The proceedings of the 7ICRS, held in Guam last year, are well on the way to being released. Senior authors of each paper should by now have received (and returned!) the proofs of their typeset papers. If there have been no undue delays in getting corrected proofs back to the printers then the Proceedings should be out this summer (northern hemisphere). Bob Richmond, the editor, says that cooperation at all levels has been very good and we can look forward to a high quality Proceedings.



CURRENTS

FIVE CANONS OF ENVIRONMENTAL ADVOCACY

Jamie Oliver

In recent issues of *Reef Encounter* there have been several articles dealing with important philosophical questions such as: what is a healthy reef? (Thomason and Roberts 1992); why monitor? (Hughes 1992), and when do we have enough data to justify specific conclusions and management action? (Risk 1992, Eakin 1992 a,b). A recurrent theme in these articles is that there is a conflict between the need for clear and conclusive scientific results with which to justify conservation and management action, and the creed of scientists that no hypothesis is ever absolutely proven.

The authors cited above express justifiable concerns that, on the one hand, environmental managers and conservation-orientated scientists risk their own reputations, and that of their professions, by advocating and initiating action based on insufficient scientific evidence. On the other hand there is concern that, due to the cautious nature of the scientific method, most reefs will be long gone by the time rigorous proof of degradation has been obtained.

The job of an environmental manager can be divided into three components: advocacy, design and implementation. While design and implementation of conservation management programmes are recognised fields, carried out in a logical (if not purely scientific) manner, the field of **environmental advocacy**, in which the need for action is first identified and advocated, receives much less official status and is not governed by any standard set of operating procedures. Yet this is the most critical phase in any campaign since it is required before either of the other two phases can be initiated. It is also the phase about which much of the dilemma mentioned above is concerned.

The solution to the conflict between science and management, I believe, is to recognise that environmental advocacy is not just a scientific discipline but a field in which social, political, economic and emotional factors must be blended with scientific information to ensure the preservation of our natural heritage. This conservation ethic is a uniquely human attribute which springs from emotional and aesthetic roots more than from the cold body of scientific research. To be a successful advocate in any field requires an ability to marshal facts, opinions and relationships into a coherent and convincing argument. It is noteworthy that facts and opinions are both of importance here.

While all environmental managers must be effective environmental advocates to convince governments, corporations and the general population of the need for various policies and programmes, I do not necessarily believe that all scientists must be active environmental advocates (although it would certainly help). The important point is that it is not necessary to provide unequivocal scientific evidence as the sole justification for specific actions or advice. While such evidence is certainly sufficient if it is indeed unequivocal, other evidence and arguments should also be considered, if necessary, in order to justify action. To borrow an analogy from a recent review by Steven J. Gould (Gould 1992), there are two different approaches one can take in arguing for the preservation of nature. The Galilean approach stresses the need for carefully collected empirical evidence to support any argument (as Galileo used to prove that the Earth was not the centre of the universe), while the Franciscan approach (after St Francis of Assisi, who was one of the first Christian saints to regard all of God's creatures and creations as being sacred) highlights the importance of our aesthetic and emotional attraction to a pristine environment and our duty to preserve nature for its own sake. Both approaches are valid and essential if we are to convince others of the need for conservation and management.

I would like to add a further, complementary approach to the foregoing, namely the precautionary approach. Although the utility of the precautionary principle has been debated recently (Gray 1990, Earll 1992, Peterman and M'Gonigle 1992, Stebbing 1992), there is widespread support for the concept in its most general form. This states that action should be taken if there is strong evidence for an impact, even if this evidence does not permit conclusions based on standard statistical tests using $\alpha = 0.05$.

It is all very well to say that we need to take into account factors other than scientific evidence in deciding whether to initiate or advocate action. But how should we weight the different factors and when should we decide that the non-scientific evidence is strong enough to warrant action? In this respect it is clear that we must act as both judge and advocate, weighing up the various bits of information and arguments and then forming an opinion based on this evidence and our own experience and wisdom. In order to maintain credibility during such a process it is essential that we are seen to be qualified to make such decisions. My own feelings on this issue are that scientific evidence should always be the first, and most important source of supporting evidence, and that scientific training is therefore essential in order to verify the validity of the available scientific evidence. But in order to take all the other factors into consideration, it is necessary to have an appreciation and understanding of other social issues and how they should be weighed against the scientific evidence (which may itself be of variable quality and utility).

As a first step towards the development of a 'creed' for environmental advocates, I would like to propose five 'canons' of environmental advocacy which attempt to incorporate the needs of both science and management in dealing with

THE COMPLEAT REEF ENCOUNTER

No. 13

"It's not called the Crown-of-Thorns for nothing; could have been called the Ball-and-Chain I guess!".

A Townsville scientist (who will remain nameless) laments the dominance of Crown-of-Thorns starfish research in Australia over the past few years as the programme begins to wind down.

environmental issues. I am aware that I am sticking my neck out here but am prepared to risk it if it at least generates a response from others who may have thought more carefully about this problem than I have.

1. Never pretend you know more than you do, but don't underestimate the value of what you do know.

If we as environmental advocates are to maintain credibility, it is essential that we are not seen to stretch the truth or to overstate our case. If there are weaknesses in the available data, they should be pointed out and targeted for further work. On the other hand qualitative or semi-quantitative data can still provide a strong indication of some effect, which (in the absence of any quantitative data to the contrary) should be used to argue for action if required.

2. Never apologise for what is not known.

To apologise for something that cannot be helped only weakens your position in any debate. If a decision needs to be made, then it must be made using whatever information is available. The decision, if based on sound logic and a correct interpretation of the data, should be the best that could be arrived at under the circumstances, and can be vigorously defended as such.

3. Professional opinion is highly valued, gut feeling based on experience is OK, and anecdotal evidence is admissible but none are substitutes for hard data.

Given the above considerations, it is depressingly easy to fall into the trap of carrying out a 'quick and dirty' survey because it is easier, cheaper and ought to provide convincing evidence. If time and resources are **truly** limited then one gets what one can, but even here it is important to strive to carry out the most comprehensive and quantitative study possible. In many cases it is worth arguing for a bit more time and/or money at the beginning of a survey to ensure that the design is correct so that one can be sure of getting maximum value for money from the resulting data.

We are, I believe, in a period of rapid change in our appreciation of how surveys should be designed and carried out, and there is a paucity of adequately trained personnel. It is critical that training programmes are developed in all countries so that we can design smart but simple and effective programmes to assess and monitor reefs. In the meantime it is worth attempting to bring in expertise at the planning phase if it can possibly be afforded. To neglect this is to risk wasting what precious money is available.

4. Always adhere to the precautionary principle.

The precautionary principle can take many forms. In one form it advocates the use of much more 'conservative' criteria for action. This might be the lowering of thresholds for effluents, the lowering of the critical level for acceptable discharge, or the relaxing of statistical decision making criteria (e.g. $\alpha = 0.05$ to $\alpha = 0.1$ or 0.2).

In many respects it is similar to the standard engineering practice of over-design, or health standards for permissible levels of toxic substances which incorporate a large safety margin. A similarly cautious approach is readily defensible in environmental conservation given our lack of understanding of ecological relationships and critical levels.

5. Don't just stand there, do something!

If, having weighed all the evidence (both quanititive and qualitative) you think that there is a real problem, then don't wait for more data. Act immediately to alleviate the suspected problem while attempting to gather more data if quantitative proof is lacking. Once a decision is made to act you must be able to justify it by presenting all the evidence (even if some is a bit shaky), as well as the logic employed to arrive at your conclusions. This justification step is critical since it prevents others who disagree from accusing you of whimsy or irrational over-reaction. Detractors are also more likely to target specific evidence or logic that they disagree with. This will enable you to focus subsequent efforts at bolstering the weakest part of your argument. It is not acceptable, as some people have done, to say "the degradation of this reef is perfectly obvious to anyone, and an assessment or monitoring programme would simply waste resources which would be better spent on management or rehabilitation". Such a statement must be backed up with cogent reasoning and clearly presented evidence (no matter how qualitative).

A role for everyone

As in any major campaign, a wide variety of activities must be pursued to win the battle to preserve our environment. At the front line we must act quickly, often with minimum funds and knowledge, using whatever information and resources are available to save those habitats that are clearly going down hill. However, behind the lines it is essential that we continue to carry out research to determine how best to conserve endangered habitats, how to obtain more rigorous proof of environmental degradation and how to detect such degradation at an early stage. I do not think it is constructive to argue that we should only spend time and money at the front line, although I acknowledge that the ratio of effort allocated between the two may be less than optimal at present. While it is lunacy to suggest that research and monitoring are not an essential component of any long-term environmental campaign I agree that it is suicidal to devote all of one's resources to these areas if the environment is in imminent danger of collapse and requires urgent protection and rehabilitation. I hope that, in his article, Mike Risk was indicating a need to redress this imbalance rather than suggesting that monitoring, and research into better management tools, are a total waste of time.

Above all, I feel that we must keep these types of discussion going through further contributions to this and other journals, so that we may continue to refine our thoughts and policies on this important topic.

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The opinions expressed in this article are not necessarily those of the Great Barrier Reef Marine Park Authority.

CORAL REEFS: WHAT HAPPENED TO MANAGEMENT SCIENCE?

John W. McManus

A quick glance at *Coral Reefs* 11(3) had me sighing with relief. At last! An environmental editor and a preface calling for interdisciplinary papers. Now we can start submitting papers dealing with management issues such as determining how much fishing effort should be redirected toward harvesting seaweed to ease pressure on overharvested fish, or on combining knowledge of user rights, gear and economic strata with data on ecological community structure to design an optimal reserve.... Wait a minute! That was **environmental**, not **environmental management**. What did the introduction say? "Population dynamics... responses... paleoceanography." No management. And that second preface? "...earth, atmospheric and biological sciences." No management.

Of course, there is nothing saying specifically that management papers will not be accepted. Many people will feel that "reef response to natural and anthropogenic stress" allows for management papers. It does call for papers that will help to identify problems, but not for those which present potential solutions. The bulk of the papers that a scientist concerned with the conservation or harvesting of reef populations would write are not being actively solicited.

Management science is a combination of natural and social sciences. The new *Coral Reefs* retains the previous version's call for the former and omission of the latter. However, human societies are integral parts of the ecology of the average fringing reef and habitable atoll. The scientific study of the human component of a reef is in the realm of social science, with its diverse approaches that include sociology, anthropology, social psychology, economics, and a myriad of other disciplines. Some specifically bridge the natural-social science categories, including ethnobotany, conservation science, human ecology, resource ecology, fisheries, and coastal zone management science. These sciences are particularly important in determining the future of coral reef environments, and account for the primary work of many coral reef scientists. More significantly, a large proportion, if not **most** of the funding now being used to pay for coral reef studies has been justified in terms of these management-oriented sciences.

Part of the problem seems to be that there is a widespread feeling that the **quality** of *Coral Reefs* will suffer if papers are published which deal with sociological or economic issues. Some social science papers are obviously based more on opinion than fact, but others are so statistically sophisticated that they are difficult to comprehend. Equally, some ecology papers are so strongly opinionated that they provoke published condemnation, while others involve statistics or mathematics that restrict their readership to a select few. The same may be said for many other disciplines.

Secondly, there is the problem of unfamiliarity. Most natural scientists feel that they have no time to peruse social science journals. Many academic biologists have little idea of what occurs in fisheries science, a situation that has deep historical roots (McIntosh 1985). This problem is typified by a comment I received on a fishery manuscript submitted to an ICRS Proceedings some years ago, suggesting that I remove the word 'effort'. That would, of course, be like removing the word 'gene' from a genetics paper. The rewards for those who cross the line between basic and applied science can be very great, as can be attested to by those who use length-based modal progression analysis from fisheries science to determine turnover rates in zooplankton communities.

Whether attributable to unfamiliarity or paradigmatic elitism, the problem clearly exists. Many potential *Coral Reefs* authors have been asked to remove valid discussions of sociological or economic issues with direct bearing on reef management. It is one thing to make an unsupported statement that coral reefs will die without radical social change. It is another thing entirely to state that destructive

fishing is often a symptom of specific sociological and economic circumstances and to cite formally reviewed sociological and fisheries papers in support. The former approach is akin to some early statements about global warming, and perhaps belongs in a letter of concern. The latter approach is as valid as a discussion of genetic clines, and should not be flagged as a personal opinion. An experimental paper on crinoids should cite previous relevant work on crinoids. Similarly, a paper involving the management of a reef should cite previous relevant work on the problem, regardless of whether the citations involved geological, ecological, sociological, economic or any other scientific aspects of the problem. In particular, the term 'perspectives paper' should not be used to arbitrarily distinguish social from natural science papers. The criteria for what is or is not a 'perspective' should involve evidence versus opinion, regardless of the discipline.

There is a need for a place to publish coral reef management papers so that they will be available to scientists with limited access to library collections. Currently, most coral reef fishery papers are scattered through various fishery journals. The *Bulletin of Marine Science*, *Atoll Research Bulletin*, and even *Coral Reefs* have published a few quantitative fishery papers. The *Atoll Research Bulletin* has published several anthropological and ethnobotanical papers. Some other journals (*Micronesica*, *Pacific Science*) occasionally carry natural-social science studies involving reefs. Economic studies of reef use tend to go to economic journals. Conservation science studies tend to go to conservation science journals. Most of the relevant coastal zone management papers end up in symposia or gray literature of extremely localized distribution. This broad dispersion makes it difficult for researchers to perceive the reef as a human-ecological system. The vast majority of reef scientists in developing countries deal with the management of reefs, and most have access to only a handful of journals at best – and most coral reefs are in developing countries.

In 1988, at the 6th ICRS, a request was made for management papers to be published in *Coral Reefs*. Since that time, the journal has changed little. While the management orientation of the ICRS has grown rapidly since 1980, that of *Coral Reefs* has not. A substantial proportion of the ICRS membership specializes in research relevant to the management of coral reefs. Perhaps it is time to evaluate the objectives of the journal in light of the objectives of the scientific community that it represents.

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John McManus, University of Rhode Island and Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines.

UPWELLINGS

CORAL REEF SCIENCE OR CORAL REEF ENGINEERING

In his article in *Reef Encounter* 12 (Musings on monitoring), Michael Risk, speaking from his acknowledged 'geological perspective', makes several valid points concerning coral reef science. In particular he concludes that much research on coral reefs is of little relevance to the people who obtain their livelihoods from reefs or depend on them for a substantial portion of their protein. In the same issue Sue Wells and Callum Roberts call for a more multi-disciplinary outlook on coral reefs. The purpose of this note is to provide a view of coral reefs from an engineering perspective, thereby partially satisfying Sue Wells' and Callum Roberts' desires while extending Michael Risk's comments.

Those few reef scientists who know me also know that I recently became interested in coral reef research after upwards of 30 years of honest (more or less) engineering work. What Michael Risk seems to be suggesting is an engineering approach to reef research. At the risk of starting endless arguments, I wish to discuss the three primary characteristics that I feel separate engineering from reef science: engineering projects have goals, are organised and use a team approach.

First, real engineers (not academics) are product-oriented and work on well defined projects. Each has a specific goal which is most often a real physical object: a submarine, a bridge or a better mousetrap. The product of reef science is most often paper. In addition, there are no identified goals, the field is made up of large numbers of individuals whose projects are determined by their personal interests or the perceived probability of obtaining financial support.

Second, engineering projects tend to be large with tens, hundreds or even thousands of engineers engaged in the task. Management and organisational skills are therefore extremely important in obtaining successful outcomes. Most reef scientists work in very small groups, typically as individuals with a few graduate students. Organisational skills are not required and are often lacking.

Third, and by far the most important difference, is that engineers work as a **team**. Each large project is divided into sub-projects, every one of which is **essential** for successful completion of the common goal. For example, in the construction of a submarine the design of the hull is extremely important. Nevertheless, the engineer whose task it is to specify the bolts which hold down the deck plates **must** do his job before the ship can go to sea. On the other hand, much coral reef science is composed of individual projects whose relationship to others, even in very similar areas, is tenuous at best. A glance at a recent issue of *Coral Reefs* makes this abundantly clear. Should studies of fulvic acid in coral growth bands fail, work on predation by coral trout can continue to its logical conclusion.

I can now hear the objections of reef scientists reading the above somewhat idealized and selective view. Everyone can find some way to defend their vitally important research. Nevertheless, I think my characterisations have a significant

degree of validity ($p < 0.05$)!

Do we need coral reef engineering? No! Not if our interests remain centred on our own research niches without some consideration of how that research fits into some big picture. Reef scientists are unlikely to organise into large-scale projects in a manner that even remotely resembles the way engineering projects are run. Certainly fiscal considerations preclude the full use of an engineering approach. Not only would its application require subjugation of individual projects and egos for the common goals, but I feel it is extremely doubtful that reef researchers can agree on what the common goals of reef science should be.

However, if some common goals could be agreed upon, this would be a very useful first step in making reef science a constructive endeavour. Goals can serve as standards by which to evaluate the relevance of one's efforts and they may be of great benefit to young scientists starting out. They also provide a measure of the utility of available tools and the possible need for development of additional ones. How many papers do we see that address various methodologies for measuring reefs and their inhabitants which do not specifically address the purpose for which the measurements are made? The recent controversy over manta tow counts for *Acanthaster* comes to mind.

The 'mega-monitoring' programs that Michael Risk criticises are not goals. Monitoring can and should only be a **tool**. To establish useful monitoring systems, an overall goal or goals must be identified (see Monitoring of coral reefs: a bandwagon? by Terry Hughes, *Reef Encounter* 11). This goal cannot be simply to measure pH, temperature and salinity once a week. However, monitoring can be important, indeed essential, if one's goals are to determine the state of current systems, to identify rates of change, to attempt to separate 'signal' from 'noise', to help distinguish causes for change and to isolate areas on which effort should be concentrated. If such goals have been identified then mega-monitoring makes sense and should be continued.

I disagree with Michael Risk that enough work has been done on the tolerance limits of reefs. Lord Rayleigh stated that one truly understands a system only when one can describe it in mathematical terms. For those of us who have attempted to understand reefs from this perspective, I guarantee that not enough has been done in certain fundamental areas. For example, what do we really know about the temeprature tolerances of reefs and how they acclimate to variations in climate? Will our present day reefs survive a continued warming trend of 2–4°C over the next century or two? What would be the effect of a 2% increase in UV-B? I submit that no one can answer these crucial questions with any accuracy and that very little reef science has contributed much to an understanding of how reefs respond to changes in most environmental variables.

As long as we (and let me include myself as a 'reef scientist') have no specific long-term goals other than getting the next publication out and obtaining the next grant, coral reef research may never contribute much to making the world a better place in which to live.

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PROBLEMS WITH PERCENT COMPOSITION ANALYSES

In our efforts to analyze changes on coral reefs, we must be cognizant of a difficulty which has slowly crept into a number of seminars and publications. Suppose there are two species of coral growing on a reef slope. We measure the area of substrate covered by these corals over a ten-year period using quadrats. One coral remains constant throughout the period. The other coral undergoes an increase, followed by a decrease in area covered (Table 1, Fig. 1).

Table 1: Coral cover (cm^2 coral per $1 m^2$ quadrat).

Year	Species		Sum
	A	B	
1	20	10	30
2	20	10	30
3	20	20	40
4	20	30	50
5	20	40	60
6	20	30	50
7	20	20	40
8	20	10	30
9	20	10	30
10	20	10	30

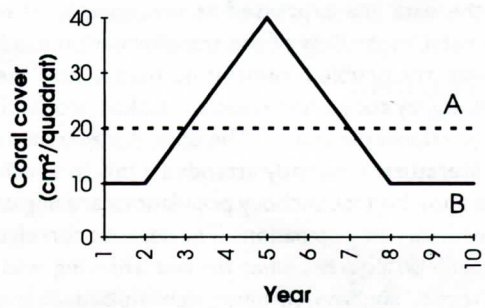

Fig. 1: Changes in coral cover expressed in cm^2.

However, following the lead of several papers in recent symposia, we decide to convert the data to "percent of total coral". Lo and behold, suddenly species A is *strongly negatively correlated* with species B (Table 2, Fig. 2).

Table 2: Percentage of coral cover by species.

Year	Species		Sum
	A	B	
1	67%	33%	100%
2	67%	33%	100%
3	50%	50%	100%
4	40%	60%	100%
5	33%	67%	100%
6	40%	60%	100%
7	50%	50%	100%
8	67%	33%	100%
9	67%	33%	100%
10	67%	33%	100%

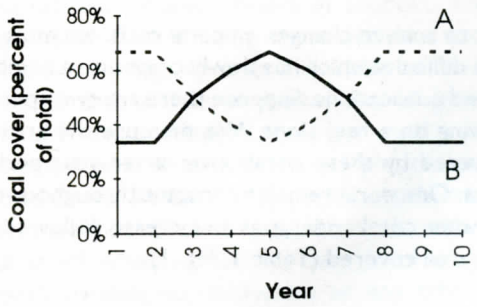

Fig. 2: Changes in coral cover expressed by percentage.

The problem arises whenever abundance, density or cover data is converted such that the total is set to a constant. In the case of percentages, the total is 100%. Obviously, the problem affects correlation coefficients, ANOVA tests, and most other inferential statistical tests. Including more species only reduces the apparent correlations, while at the same time reducing the apparent amount of change in the changing population. Incorporating sand, algae, or bare substrate into the proportions is similar to including more species, and is not a cure. It is possible to apply certain inferential statistical tests to questions about the change in *proportion* that a species made up, generally after an appropriate data transformation. However, it is difficult to show whether the *abundance* of the species has changed if the data are expressed as percentages of some unspecified total, regardless of the transformation used.

By the way, the problem remains no matter how we try to disguise it, e.g. by comparing areas on stacked proportional bars or proportional pie charts. The difficulty also pervades the fishery literature. I recently attended a talk in which the speaker was showing that anchovy populations are negatively correlated with sardine populations. The negative correlations were beautiful! Of course, what he was showing was the *percent* of the total anchovy-sardine catch which each species comprised. We really have no idea if the abundances really were negatively correlated, or if one population rose or fell, causing the percent abundance of the other to fall or rise accordingly.

The moral is: use abundances (densities, covers) whenever changes of abundance (density, cover) are the point. If you must use percentages, do so cautiously and with appropriate warnings to the reader.

John McManus, University of Rhode Island and Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines.

CARLOS GOENAGA

We regret to announce the death of Carlos Goenaga, who was killed by a freak wave at Isabella Beach, Puerto Rico, on 10 March 1993 while in the field with two students. He will be greatly missed by his colleagues at the University of Puerto Rico and by his many friends within the coral reef research and conservation community throughout the world.

FEATURES

THE NASSAU GROUPER, ENDANGERED OR JUST UNLUCKY?

Yvonne Sadovy

For decades, at about the time of the full moon each December and January, a small fleet of sloops and dories would set sail from fishing villages of western Puerto Rico (Fig. 1) well before dawn. Eagerly, the fishermen headed for the traditional spawning grounds of the Nassau grouper, *Epinephelus striatus*, located on the southwestern corner of the island's insular platform. These trips promised a bounty in fish. The aggregations concentrated many thousands of individuals in a brief annual spawning extravaganza which lasted at most a few weeks each year. With their wicker fish pots and their hooks-and-lines, the fishermen easily took as much as they could possibly need. The catches were spectactular. Thousands of pounds of fish were landed and placed in large 'live wells' that kept the fish in good condition for the long journey home. The fish were eaten fresh or salted for future use and represented an important source of food and income for local communities. It is now more than 20 years since the last sloops brought back such abundance to their homes and villages.

The Nassau has been, at least historically, one of the most valuable grouper species taken commercially not only in Puerto Rico but also in much of the Caribbean and tropical western Atlantic. It is still important in the Bahamas, Mexico and in Belize where a high proportion of annual landings come from aggregation fishing. Indeed, these concentrations have been fished in many areas since at least the beginning of this century. It was not until 1972, however, that the first was described in any detail from direct observation. C. Lavett Smith wrote of an aggregation which formed off Cat Cay in the Bahamas and contained possibly as many as 100,000 individuals (Smith, 1972). Such a spectacular natural phenomenon as these massive concentrations of fish has, not surprisingly, attracted considerable public interest.

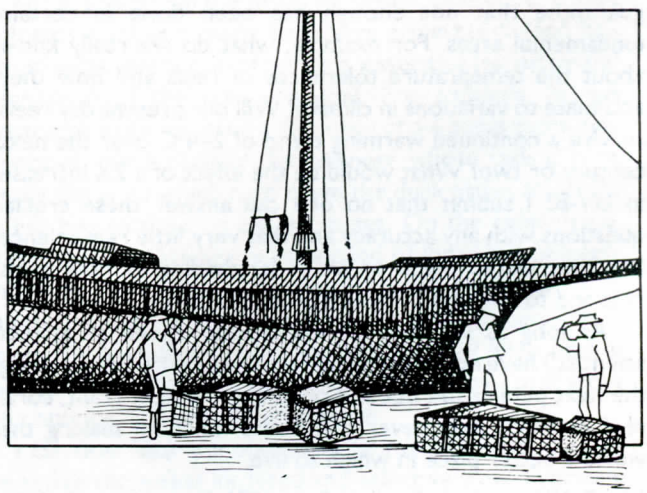

Fig. 1: Fishing schooner in Puerto Rico, 1900 (illustration by B. Bower-Dennis)

The Nassau grouper is probably the most distinct and readily recognized grouper in the region and has featured in documentary specials by Jacques Cousteau, has appeared in many popular articles, and has even been used to sell Budweiser beer!

Given the importance of this species in the region, it is particularly alarming that, over the last two decades, its landings have plummeted so drastically that in many areas it is now considered no more than incidental catch. In Puerto Rico before 1900, for example, this species was "a common and very important food fish, reaching a weight of 50 lbs (22.7 kg) or more" (Evermann, 1900) and in 1970, it was the fourth most commonly taken species overall (Suárez-Caabro, 1970). Now it is rare in the fishery and only juveniles are landed. Stocks have likewise declined in the US Virgin Islands (Olsen and LaPlace, 1979). In Bermuda, landings have diminished for all grouper species since 1975 and most of all for the Nassau grouper (a striking 15-fold drop in 14 years) which is currently being considered for protected species status as a result (Bannerot *et al.*, 1987). In Cuba, annual landings have fallen almost four-fold since 1960, despite (or perhaps because of) an increase in fishing effort over this period and, again, most individuals that are landed are juveniles and stocks are now considered to be seriously overfished (Claro *et al.*, 1990). The list goes on with similar trends noted in the Dominican Republic, Jamaica, Florida and the Netherlands Antilles (Sadovy, in press). These declines have almost invariably been preceded by intensified exploitation or the introduction of fish traps and/or spears into the fishery.

Of even greater significance, perhaps, is that almost one third of the better documented traditional spawning aggregations could not even be located in recent years; they have, either temporarily or permanently, disappeared (Fig. 2) (Sadovy, in press) and many others yield increasingly reduced landings. One of the more extreme examples is an aggregation off the Bay Islands in Honduras. This was discovered in 1988, was heavily fished and had dwindled to a mere few hundred individuals by 1991 (Fine, 1992). In Belize, one aggregation has apparently disappeared completely in the last few years while others, particularly where traps have recently been introduced to supplement hook-and-line fishing, have suffered reduced production (Carter, 1986, 1989). Even in cases where management measures exist to protect aggregations, declines have been noted. In the Cayman Islands, although fishermen can no longer use traps and fishing is restricted to Cayman Island residents, catches have, nonetheless, been lower in recent years (Bush and Ebanks-Petrie, in press). These various examples clearly suggest that while aggregations and associated stocks can withstand light levels of fishing for extended periods, as soon as efforts intensify aggregations suffer and local stocks decline.

To understand the reasons for, and ponder the possible consequences of, these trends, it is important to know something of the biology and fishery characteristics of this species. The Nassau grouper is distributed throughout the

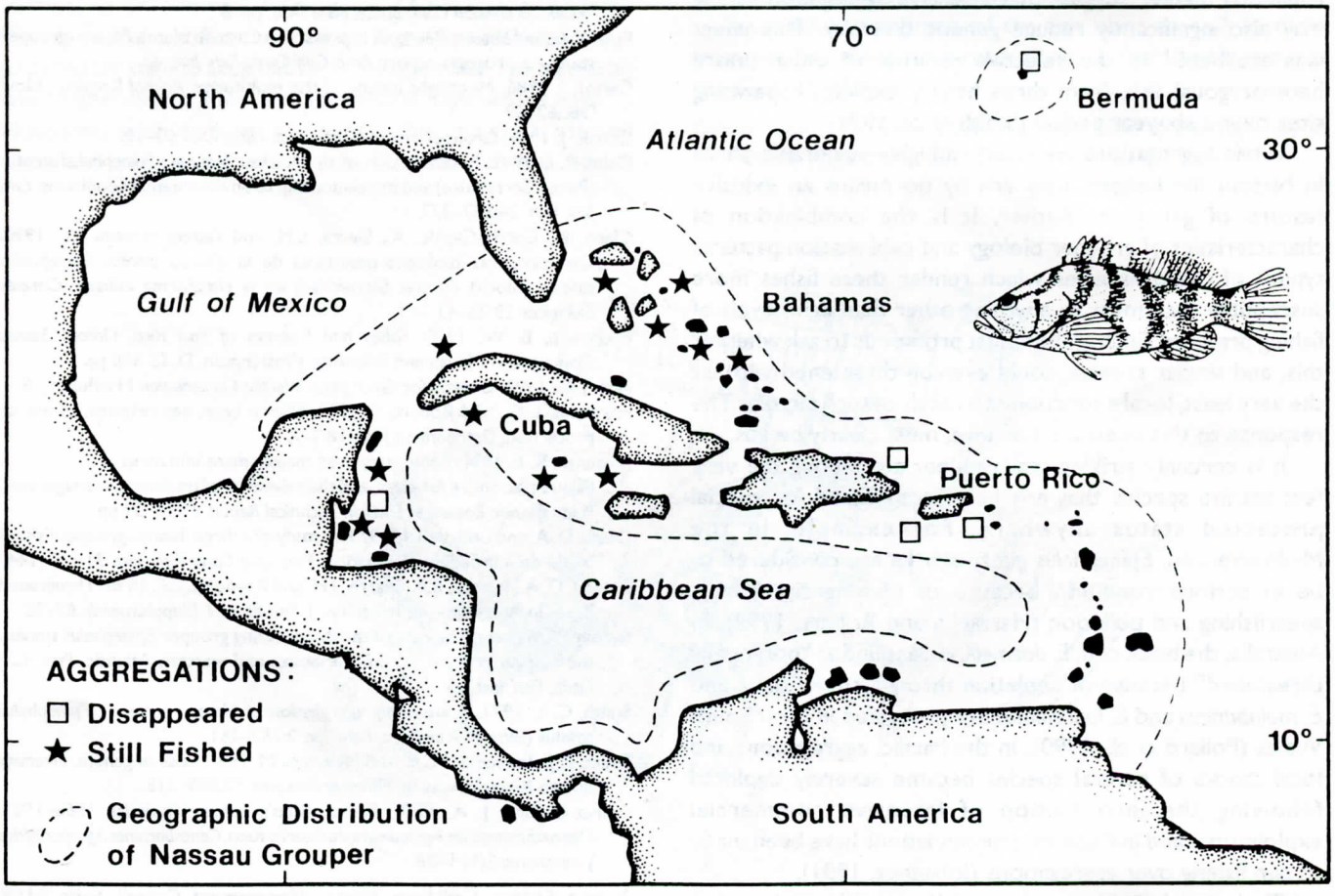

Fig. 2: Geographic distribution of Nassau grouper and locations of spawning aggregations that are still fished (star) and which are believed to have disappeared (square). Some symbols represent more than one aggregation in the area indicated (illustration by B. Bower-Dennis)

islands of the Caribbean and along the coast of much of northern and central South America. Its range extends to southern Florida and to Bermuda (Fig. 2). It is long-lived and slow-growing, attaining a total length of more than 80cm and an age of at least 20 years. It reaches sexual maturity at about 50cm long, a large size relative to many other species in multi-species fisheries in the region. This is noteworthy in as much as the most commonly used fishing gears, such as small meshed traps, tend to target species that are, on average, substantially smaller than mature Nassau grouper. In Puerto Rico, for example, the average weight of fish currently taken in the commercial fishery is 0.3 kg, well below the 1.9kg of a 50cm Nassau. Hence this species, and others like it in the typical fisheries of the region, are particularly liable to overexploitation both because of their relative size and susceptibility (especially of juveniles) to fishing gears such as traps and spears.

More than any other factor, however, it seems that its aggregating habit makes this species so vulnerable. As far as we know, all spawning activity occurs during the course of these highly localized, and often widely dispersed, aggregations; the observation that individuals will travel more than 100km to reach these traditional sites only serves to emphasise their importance (Colin, 1992). Heavy fishing over such short-term concentrations undoubtedly impacts reproductive potential and compromises spawning activity in remaining individuals (Bohnsack, 1989). Moreover, the results of a recent study on the orange roughy (*Hoplostethus atlanticus*) further suggest that intensive aggregation fishing may also significantly reduce genetic diversity. This effect was attributed to the selective removal of older (more heterozygous) fish, from three heavily exploited spawning sites over a six-year period (Smith *et al.*, 1991).

While aggregations are clearly a highly vulnerable phase in Nassau life history, they are by no means an exlusive feature of groupers. Rather, it is the combination of characteristics of grouper biology and exploitation patterns typical of island fisheries which render these fishes more susceptible than most to anything other than light levels of fishing pressure. Such trends must prompt us to ask whether this, and similar species, could ever be threatened with, at the very least, local extinction as a result of such factors. The response to this question, I believe, must clearly be yes.

It is certainly striking that grouper are among the very few marine species that are being considered for special protected status anywhere. For example, in the Mediterranean, *Epinephelus guaza* stocks are considered to be in serious condition because of commercial fishing, spearfishing and pollution (Harmelin and Robert, 1992). In Australia, the black cod, *E. daemelii*, is classified as "potentially threatened" because of depletion through spearfishing and *E. malabaricus* and *E. lanceolatus* are protected in New South Wales (Pollard *et al.*, 1990). In the Pacific, aggregations and local stocks of several species became severely depleted following the introduction of intensive commercial exploitation, and in Palau recommendations have been made to ban fishing over aggregations (Johannes, 1991).

There is a belief by many, even by many biologists, that marine fish species, particularly those of commercial importance, could not possibly become extinct, because of their abundance, wide distribution and larval dispersal. This view was aptly summarized by Lamarck who contended that "Animals living in the waters, especially the sea waters... are protected from the destruction of their species by man. Their multiplication is so rapid and their means of evading pursuit or traps are so great, that there is no likelihood of his being able to destroy the entire species of any of these animals" (*Philosophie Zoologique*, chapter 3). The Nassau grouper is unlucky in that neither of these advantages apply. What is the likelihood that it could become extinct, even if only locally? While such a possibility has yet to receive serious consideration from scientists, it is noteworthy that this species is currently one of two fully marine species of commercial importance which have been named as candidates for the Endangered Species List in the United States (the other is, interestingly, another grouper, the huge jewfish *Epinephelus itajara*). Whether or not the assessments of status currently underway will ultimately result in a classification of 'endangered' for either species, we now know better than to accept Lamarck's contention without more critical reflection – after all, he has been wrong before!

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EXPERIMENTAL RESTOCKING OF NASSAU GROUPER UNDERWAY IN US VIRGIN ISLANDS

Apart from being an endearing and biologically intriguing animal, the Nassau grouper makes great eating! Declining stocks throughout the Caribbean led to attempts by the Harbor Branch Oceanographic Institution to grow them from eggs in their aquaculture facility in Florida. Following the success of these efforts, the possibility was raised of using hatchery-reared fish to help restock areas where populations had fallen drastically.

An ideal location to test the feasibility of reintroducing the Nassau was found in the US Virgin Islands. Once a common sight in local waters, they are now virtually extinct commercially and only rarely encountered by divers. The project was picked up by the Eastern Caribbean Center of the University of the Virgin Islands (UVI). With financial support from Sea Grant and Harbor Branch, twenty nine fish weighing 1–3lbs and measuring 12–15 inches were flown from Florida to St Thomas in September 1992 for release at Saba Island, about 4km from the Marine Science Center of UVI.

To prepare fish for the transition from captivity to the wild, they were put through a 'training program' for the previous six months, moving from a diet of pelleted food to live fish, shrimp and crabs. Their reflexes had been sharpened by being chased around their tank by people splashing the surface! In St Thomas, following a 17-hour journey from Florida (with no buffet service), we transferred the fish to an underwater cage to acclimatise to the open sea. The intention was to give them a good feed for several days before release. However, with striking perversity, the groupers refused succulent chunks of fresh dolphin fish, tuna, shrimp, squid, brittle stars and even the tempting pellets of *Science Diet* dog food didn't help. A few long-distance telephone calls later the fish were happily eating.... live goldfish, a favourite food from Florida days!! Two weeks after arrival, under the eye of television cameras, 27 tagged groupers were released from the cage to begin life in the wild (two had died).

Within hours of release the fish had all found shelter under rocks or ledges and were being cleaned by cleaning gobies. What was most remarkable was that they had never encountered these gobies before but were allowing them into their mouths and gills just like wild fish would. Over the following week the fish were watched closely as they learned to live on the open reef. One fish was even seen following an octopus while the latter was hunting, a behaviour common in wild groupers which takes advantage of prey being disturbed by the octopus.

Five months later, at least five fish remain on the part of the reef in which they were released and appear to be doing well and two others have been spotted on reefs up to 11km away. Since only the immediate vicinity of the release point has been monitored systematically it is likely that others also survive. Whilst the initial success of this project suggests that large-scale releases of hatchery-reared fish might have some chance of revitalising local populations, many questions remain. Among the most important are what proportion of hatchery fish would survive until sexually mature and would they find their way to spawning sites? Perhaps the best chance for Nassau groupers will come from more traditional management initiatives presently underway. In the meantime, rumour has it that some of the fish want to cash in their frequent flier miles for a return trip to their home reefs in the Cayman Islands!

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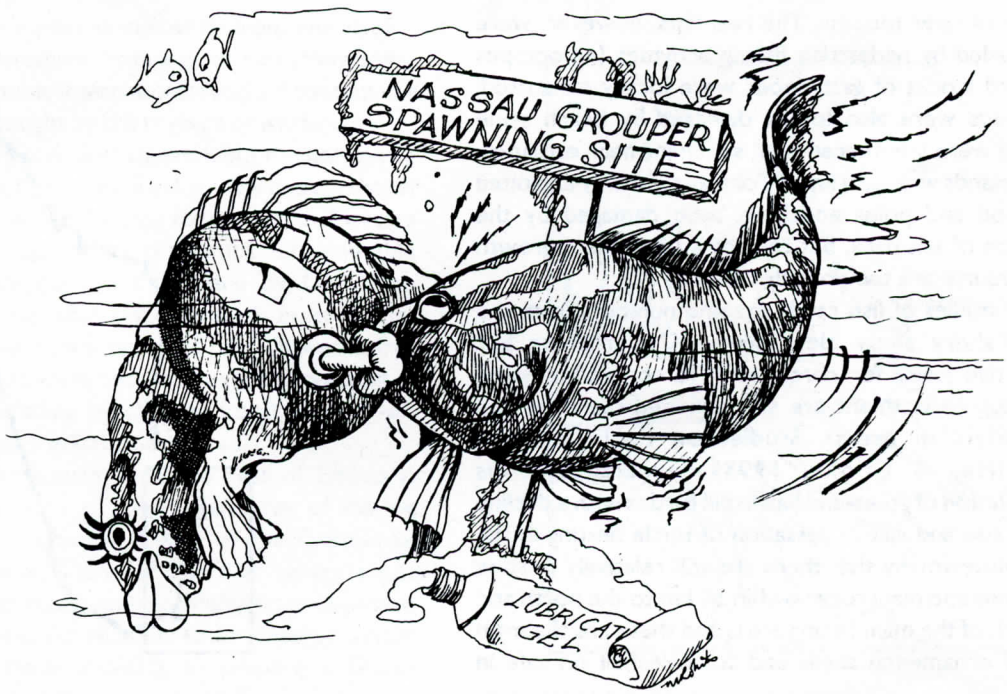


The last Nassau grouper in the Virgin Islands gathers to spawn...

NEWS

MADAGASCAR'S GREAT BARRIER REEF – RECENT DEVELOPMENTS

The barrier reefs of south west Madagascar are the most extensive in the Indian Ocean and rank among the largest in the world. In all there are some 200 km of true barrier, 200 km of fringing reef and a number of offshore coral islands scattered along the coast. These reefs support Madagascar's largest artisanal fishery. Parts of the reefs near the provincial capital, Toliara, were studied by scientists from the University of Marseille in the 1960s and 1970s. Apart from a survey in 1987 (Vasseur *et al.*, 1988) the reef ecosystems have received little fresh scientific attention in the last 15 years.

In establishing its marine conservation programme for Madagascar, WWF chose to focus initially on the reefs and coastal zone of Toliara because of the economic and conservation importance of the reefs and nearby terrestrial habitats and the potential in the area for developing 'eco-tourism', an integral part of Madagascar's Environmental Action Plan of 1988.

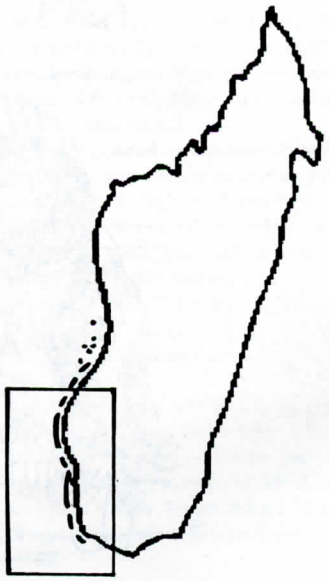
In the first half of 1992, WWF commissioned a locally based team of scientists, officials and others to conduct a series of studies of the area covering key environments and natural resources as well as social and economic issues and the tourist industry. All participants were asked to make recommendations for action in subsequent project phases. The findings and recommendations were written up (WWF, 1993) and presented at Madagascar's national seminar on eco-tourism in February, 1993.

The study covering coastal ecosystems found that the external reef slopes appeared in good condition, with excellent coral growth and little physical human impact. Lagoon reefs for the most part appeared to be fairly healthy despite some anchor damage and evident sedimentation in the vicinity of river mouths. The reef flats, however, were badly degraded by pedestrian fishing activities (eg octopus hunting) and stocks of gastropods were locally exhausted. Seagrass beds were also locally damaged by beach seine netting and were smothered with sediment near estuaries. Mangrove stands within 30 km of Toliara are heavily exploited for firewood and poles and have been damaged by the construction of salt pans, but can show vigorous regrowth where pressures are temporarily relaxed.

Recent studies of fish catch size and numbers from the artisanal fishery show clear signs of overfishing but representative yields for coral reefs (12 tonnes/km^2/year) and vigorous recruitment are still obtained (Laroche and Ramananarivo, in press). Studies on turtle fisheries (Rakotonirina & Cooke, 1993) revealed serious overexploitation of green and hawksbill turtles with a decline in average size and virtual cessation of turtle nesting in the area. It is noteworthy that there are still relatively pristine reefs, lagoons and mangroves within 50 km to the north and to the south of the main fishing areas and these are the main sources of ornamental shells and tortoiseshell on sale in Toliara.

Marine research at Toliara is conducted through the newly formed 'Institute Halieutique et des Sciences Marines' (IHSM), staffed by personnel from the now defunct 'Station Marine' and 'Unité de Formation Supérieure Halieutique' (UFSH). The IHSM maintains links with Toliara University and will have teaching as well as training and research functions. The emphasis will be on the development of fisheries and aquaculture, with FAO/UNDP being the main source of funding as was the case with UFSH. Areas of work include developing artisanal fisheries (pelagic fish aggregation devices, fish curing and refrigeration), aquaculture (mangrove crabs, *Artemia* shrimp, seaweed farming, oyster beds), socio-economic studies, conservation and fundamental ecological research. IHSM has 15 permanent research staff, 5 resident research fellows, about 10 regularly serving consultants and 8 technical and administrative staff. Facilities include about 15 offices, two laboratories, a library, three laptop computers and two Land Rovers. Five fish aggregation devices (DCP = 'dispositives de concentration de poissons') have recently been installed at distances between 2 and 5km outside the barrier by the Tuna Association of the Indian Ocean Commission (COI) and the results are eagerly awaited. One of the problems will be enabling and persuading local fishermen to fish far out to sea rather than in the lagoons. A new design of boat may be needed.

Special activities planned in the near future include a collaborative project with a British marine research team (which includes three marine biologists from the University of Swansea) and local interests (villages, hotels) to conduct baseline ecological surveys of two sites which have been proposed as marine protected areas for biodiversity conservation and eco-tourism. IHSM would welcome further research partnerships with foreign organisations or institutions in a compatible field of interest.



Reefs along south-west coast of Madagascar

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REEF SURVEY WORK TO BE INITIATED IN ERITREA

The new African nation of Eritrea came into being in May 1993 following a referendum held amongst its peoples. Eritrea occupies a corner of the Horn of Africa, stretching from the Sudanese border in the north to the Djibouti border in the south. It is bounded along its southern edge by Ethiopia, and on the east by the Red Sea. A relatively arid and rocky countryside characterises much of the highland spine and the coastal plain of the country and its numerous islands in the Red Sea. A preliminary scanning of the international navigation maps reveals a coastline length of approximately 1062km and at least 262 islands and islets, of which 159 bear a name on various maps.

Eritrea's meagre support is currently from the land – hard won crops and livestock from a poor and stony soil – together with considerable international food aid consequent on the destruction wrought by thirty years of warfare. In the past, the sea has been a source of support, but the harvesting infrastructure has all but vanished, leaving a few basic artisanal fishermen. The nation is now looking to its coast and waters as a major source of support for the future. Considerable assistance has already been put in place by UNDP to rehabilitate the fisheries that once existed, in particular assisting monitoring and marketing. In the past whole cultures on the islands and coast were based upon the harvesting of marine resources, including pearls, red coral, mother-of-pearl, beche-de-mer, and gastropod opercula.

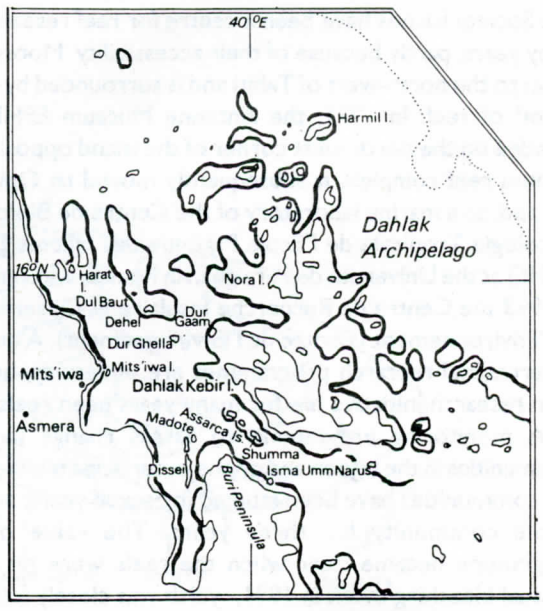
Management of the coastal area and seas of Eritrea is currently the responsibility of the Department of Marine Resources and Inland Fisheries (MRIF) of the Provisional Government of Eritrea. Two UNDP/FAO projects are overseeing fisheries management and rehabilitation, based at Massawa in the north and Asseb in the south. Further UNDP assistance has been made available to prepare a Global Environment Facility project, entitles the Eritrean Coastal Conservation Project, which it is hoped may be implemented later this year. This is intended to inventory resources, determine priorities and enable Eritreans to monitor, manage and plan the utilisation of their marine resources.

MRIF is concerned about how little is known about the status of the resource base being harvested. They recognise the significance of the numerous areas of coral reefs, seagrass beds and mangrove habitat in maintaining stocks of marine resources and are particularly determined to protect the reefs of the Eritrean coast and Dahlak Archipelago, given their importance for fisheries and as a potential tourist resource. However, the mechanism to be used has yet to be determine. MRIF is determined to learn from the mistakes of others, and to regulate harvesting before offtake is allowed to cause irreparable damage. While the various archipelagos and coastal sites may seem tailor-made for a tourist industry, the pitfalls that could be involved are also recognised.

A cautious approach has been adopted to all exploitation possibilities, to ensure that first and foremost the people of Eritrea benefit from an improved food supply, a sustained marine resource base, and the chance to decide for themselves how they wish their culture to be effected by outside influences. They are also determined that local people should remain a part of the resource management and harvesting process, allowing and encouraging artisanal harvesting to continue.

The first major task will be an inventory of habitats and resources, making use of all possible sources of information and assistance. It will then be possible to develop a management policy and implement plans as assistance becomes available. Particular emphasis is to be placed on incorporating the island and coastal peoples into the management process. On a wider scale, it is hoped to dovetail this project with the related GEF projects already underway in Egypt and the Yemen.

Jesse C. Hillman, Ethiopian Wildlife Conservation Organisation, P.O. Box 386, Addis Ababa, Ethiopia; 2 Southside Cottages, Netherton, Morpeth NE65 7E2, UK.



Map of Dahlak Archipelago. From UNEP/IUCN (1988/89), Coral Reefs of the World, *Vol. 2. (Reefs = thick black lines).*

COUNTRY PROFILE

FRENCH POLYNESIA: A FOCUS FOR REEF RESEARCH IN THE SOUTH PACIFIC

B. Salvat, W. Loher, R. Galzin and F.J. Murphy

Tahiti has long been a magnet for reef scientists. Darwin, Dana and others made their mark there (see *Reef Encounter* 3, 1986), and in 1985 the island saw the largest invasion of reef scientists that it is ever likely to experience, when several hundred descended for the 5th International Coral Reef Congress. Such itinerants have made many useful scientific contributions as a result of their brief visits, but the real body of work on the reefs of French Polynesia has been put together by those based at and working with the institutions on the islands (for a summary to 1985, see Gabrié and Salvat (1985) and Richard (1985)). Early work in the 1960s was largely expedition-based, much of it carried out as an interdisciplinary collaboration between the Muséum National d'Histoire Naturelle in Paris and the Direction des Centres d'Experimentation Nucléaires (DIRCEN) to look at island ecosystems (Salvat, 1976).

French Polynesia is made up of five archipelagoes, four of which (Society, Australs, Gambier and Marquesas) are predominantly high islands, and one (Tuamotus) that comprises atolls only. The 118 islands cover only 4000km^2, despite the fact that the territory of French Polynesia is about the size of Europe, with nearly 40,000km^2 of water. Research and the environment are the responsibilities of the autonomous government (French Polynesia is an overseas territory of France), but a number of metropolitan research institutes are based in the islands as well.

MOOREA

The Society Islands have been a centre for reef research for many years, partly because of their accessibility. Moorea lies 25km to the north-west of Tahiti and is surrounded by about 50km^2 of reef. In 1971, the Antenne Museum EPHE was founded on the north-west corner of the island opposite the Tiahura reef complex. It subsequently moved to Opunohu Bay and, as a marine laboratory of the Centre de Biologie et d'Ecologie Tropicale de l'Ecole Pratique des Hautes Etudes (EPHE) at the Université de Perpignan in France, was renamed in 1993 the Centre de Recherche Insulaire et Observatoire de l'Environnement (Centre de l'Environnement). A number of terrestrial research programmes are underway, but the main research initiative has for many years been reefs.

A monitoring programme to assess change in coral communities in the lagoon and on the outer slope is underway, fish communities have been studied for seven years, and the whole community for three years. The value of this programme became clear when the reefs were hit by an unusual bleaching event in 1991, which was closely followed by a cyclone in the same year; the consequences of these events were reported on at the 7th International Coral Reef Symposium in Guam. The 'biodiversity' programme covers a range of studies relating species richness, community structure and submarine-seascape to environmental parameters and is being carried out around the island from the fringing reefs to the outer slopes. Other programmes cover fish recruitment and genetics, reef restoration through the transplantation of corals and studies on reproduction, the carbon dioxide cycle and the role of reef organisms in this, and the hydrodynamics of the reef and lagoon.

Several students, from universities in Paris, Montpellier, Perpignan and Tahiti are working on their doctorates at the station. Each September a two week course and field studies initiation is held for students from the Université Française du Pacifique, which is based on Tahiti.

OTHER ISLANDS

Since it was founded, the research station on Moorea has organised expeditions to many other islands, initially to develop an island classification. The atolls are now well documented from the largest with lagoons that communicate with the ocean to the smallest which are closed; a number of these will be familiar to those who took part in field trips during the 1985 Coral Reef Congress. The high volcanic islands are still being studied; monographs on the reefs and ecology of Mururoa, the Gambiers, the Marquesas and the Austral have been published in the journal *Cahiers du Pacifique*, with the collaboration of DIRCEN, and research is now focussing on the other Society Islands, with a reef monitoring programme underway on Tahiti.

The research station also collaborates with other institutions to carry out research on economically important reef species. ORSTOM (Institut français de Recherche Scientifique pour le Développement en Coopération) carries out many fishery-oriented programmes, and EVAAM (Etablissement pour la Valorisation des Activités Aquacoles et Maritimes) is largely responsible for work on pearl oysters.

US INVOLVEMENT

In 1985, the Richard B. Gump South Pacific Biological Research Station was inaugurated on Moorea. The 35-acre estate on the shore of Cook Bay was a gift from the late Richard B. Gump of San Francisco to the University of California, Berkeley (UCB).

Unlike the French station, the Gump does not have a specific programme of research, but rather serves as a base from which scientists can conduct their own studies. Terrestrial and marine research are equally important. Visiting scientists are too numerous to be listed here, but recent reef projects include the behavioural physiology of stomatopods, the evolutionary biology of Foraminifera in the Indo-Pacific, coral recovery following bleaching disturbances, monogamy in two species of goby, population regulation of damselfish, and behaviour and habitat utilisation of a local group of spinner dolphins. Geomorphological studies carried out through UCB include the development of bathymetric and sediment profiles of Cook and Oponohu Bays and studies of the late-Holocene evolution of *motus*. A

new project to look at the effect of local agriculture on the reefs of the two bays has just been initiated.

Graduate students from UCB and other universities account for a large proportion of the work carried out here. The station also hosts a 6-8 week undergraduate field course on the biology and geomorphology of tropical islands each Fall semester, following a 5-week lecture course at Berkeley. Reef-related projects carried out during the course have ranged from studies on the algal distribution and morphology of the algal ridge to the territorial behaviour of damsel fishes.

The US and French research stations work together closely under a co-operative research agreement which includes the exchange of facilities and reference materials as well as ideas. Monthly seminars, sponsored jointly by the two stations and given by visiting scientists, foster lively discussion. Annual meetings are held to develop co-operative projects, such as monitoring of the 1991 bleaching event and, for 1993, the sharing of data from the Gump station's new weather station, installed in June this year, with both on-site and remote sensors for recording a variety of environmental parameters.

With the rapid growth in urban development and tourism on the more heavily populated islands, there has been a growing need for applied research. The reefs of French Polynesia have suffered their share of damage from hurricanes and bleaching, some the result of El Niño, others with a less obvious cause. The potential impact of nutrient-enrichment, sedimentation and pollution raises additional questions about the health of these once remote and inaccessible ecosystems. Current research, as elsewhere in the world, is focusing on the response of reefs to changing environmental conditions and developing reefs as economic resources.

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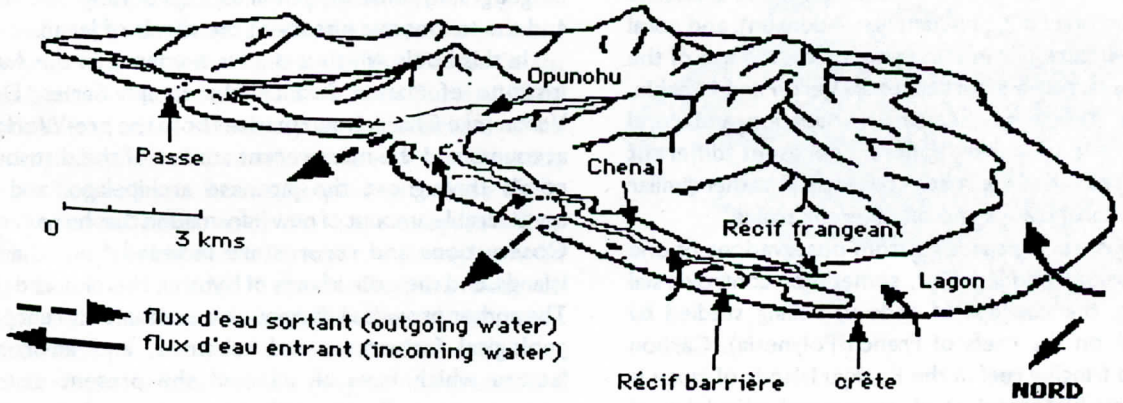
Richard, G. 1985. Faune et flore: premier abrégé des organismes marins de Polynésie française. *Proc. 5th Int. Coral Reef Cong., Tahiti* 1:379–518.

Salvat, B. 1976. Un programme interdisciplinaire sur les écosystèmes insulaires en Polynésie française. *Cah. Pacif.* 19:397–406.

Information for potential visitors

The Centre de l'Environnement, which can accomodate 12 scientists, is mainly equipped for field studies although there are some laboratory facilities and a good reference collections and a library. Full boat and diving facilities are available. Bench fees (US$35 a day; $30 for students) include lodging as well as laboratory and field work; food (cooked by resident and visiting researchers) costs an additional US$10–15. For further information contact: *Dr B. Salvat* or *Dr R. Galzin, E.P.H.E., Université de Perpignan, 66860 Perpignan, France, Fax 33.68.50.36.86; E.P.H.E. B.P., Papetoai, Moorea, French Polynesia, Fax 689.56.28.15.*

The Gump Station has a dormitory for up to 15 people, with shared kitchen and bathroom facilities, and a small guest house that can accomodate an additional three people. An air conditioned library/indoor lab is equipped with IBM and Macintosh computers, compound and dissecting microscopes and a modest collection of books, journals and maps. There is also an open-air, covered laboratory with an open sea-water seasystem comprising seawater tables with aquaria and small ponds, secure lockers for field equipment and a SCUBA facility with a compressor and diving equipment. The station has two small skiffs and an 18ft Boston Whaler. Bench fees are US$23–34 per night depending on the length of stay; additional nominal fees are charged for the use of station vehicles and SCUBA equipment. For further information contact: *Dr Werner Loher, College of Natural Resources, University of California, Berkeley, CA 94270, USA. Fax (510) 642-4612; E-mail: loher@insectberkeley.edu.* The address of the Gump Station is: *B.P. 244 Temae, Moorea, French Polynesia. Phone/fax: (689) 561374.*



Moorea

BOOK REVIEWS

CORAL REEF OCEANOGRAPHY

E. Wolanski and H. Choat, editors

Special Issue of *Continental Shelf Research*, Vol. 12(7/8). Available from Pergamon Press Ltd, Headington Hill Hall, Oxford OX3 0BW, UK. Fax: +44 865 743952. £40 sterling.

In its beginnings, 'oceanography' was the study of the physics of the ocean – largely confined to waves, currents and tides. Other aspects of ocean studies were mainly grouped under the rubric of 'natural history'. Perhaps the term 'ecology' could now be substituted for natural history. As the field of marine science has matured, the term 'oceanography' has taken on a broader meaning as the 'science of the ocean'. Sadly, the maturation of the field has increasingly tended to partition its practitioners into sub-disciplines which have often had less cross-disciplinary communication than the natural historians and oceanographers of old. The general move of modern science towards quantification has not necessarily improved the links between physics and ecology.

This journal issue is a happy demonstration that some coral reef scientists are communicating effectively across the sub-disciplines of modern oceanography. Indeed, the editors of this volume are each well-respected coral reef scientists in their own sub-disciplines: Eric Wolanski is a physical oceanographer with much experience working with ecologists on coral reefs, and Howard Choat is a coral reef ecologist. These editors have brought together a collection of twelve interesting papers on various aspects of interactions between physical oceanography and ecology (for those of you who feel left out, I suggest that reef geologists often have one foot in each of these disciplines, and sometimes, like the rest of us, a third foot in their mouth). Consider a brief and disorderly synopsis of the various papers.

Physical oceanographers use a 3-dimensional numerical model of circulation to offer interesting predictions about larval dispersal and local upwelling (Deleersnijder *et al.*). Ecologists and physical oceanographers work together to approach questions about physical circulation and larval dispersal (Oliver *et al.*, Lee *et al.*). Ecologists use physical principles and data to predict various aspects of water column biotic distribution (Williams and English, Delesalle and Sournia, Liston *et al.*), productivity (Atkinson), and coral community structure (Done). In some cases, the use of the physical data is largely a statistical tool (Veron and Minchin, examining sea surface temperature, circulation and coral distribution). All of these papers represent different disciplinary mixes and all approach conceptually rather similar problems in different ways and on different scales.

Broadly theoretical papers go from observations of one reef to conclusions about major, sometimes controversial processes (e.g. the concept of endo-upwelling studied by Rougerie *et al.* on the reefs of French Polynesia). Carbon budgeting on a fringing reef in the Ryukyu Islands of Japan is extrapolated by Nakamori *et al.* to general principles of carbon flux on coral reefs. Roberts *et al.* use observations on Caribbean-Atlantic reefs to discuss how physical processes shape coral reef structures geologically and biologically.

Is there a general take-home lesson from this volume? I think so, although I will admit that the lesson which I offer to some extent reflects my own prejudices cultivated over many years of working on coral reefs and other ecosystems. Coral reef properties, both in the water column and the sea floor, are horizontally, vertically and temporally extremely patchy. The reasons for the patchiness include physics, biology and geological history. The continuing development of coral reef oceanography as a science demands three intellectual elements: (1) small-scale experiments designed to understand and quantify the interactions among physical, chemical, biological and geological processes on coral reefs; (2) descriptions across entire reef systems, adequately quantifying spatial and temporal variations of the properties of interest and adequately addressing the connectivity between properties; and (3) increasingly sophisticated numerical models to link the observational and experimental results.

For the most part, the papers in this volume suggest that some researchers are indeed moving in the direction of coral reef oceanography as a quantitative discipline. Perhaps the next step in this development will be when we see a little more deliberate integration among the three elements I have outlined. The editors and authors are to be congratulated for producing a journal volume which should be widely used by coral reef oceanographers over the next decade.

S.V. Smith, Dept of Oceanography, University of Hawaii, Honolulu, Hawaii 96822, USA. Fax: +1 808 956 6751.

HERMATYPIC CORALS OF JAPAN

J.E.N. Veron

Australian Institute of Marine Science Monograph Series, Vol. 9. 1992. Available from : AIMS, PMB No. 3, Townsville MC, Queensland 4810, Australia. A$25 + postage A$17 (Australia), A$30 (overseas) for each item. ISBN 0-642-17083-5. Fax: +61 77 725852.

The *Hermatypic Corals of Japan* is not an identification guide for the sport diver or weekend naturalist. There are no photographs (except on the covers), no keys and no glossary of skeletal characteristics. The book is, however, an excellent reference for those interested in coral systematics, biogeography, environmental aspects of range distributions, and the taxonomic history of the corals of Japan.

In this book, which is the ninth volume in the Australian Institute of Marine Science Monograph Series, Dr J.E.N. Veron (*aka* Charlie), summarizes both the pre-World War II accounts and the most recent studies of the distribution of corals throughout the Japanese archipelago, and adds a considerable amount of new information that he has collected. Observations and records are included from the Ryukyu Islands, and the main islands of Kyushu, Shikoku, and Honshu. The author provides information on oceanic current patterns, geological formations and substrata, and environmental factors which have all affected the present distribution patterns, as well as specific discussions of the effects of anthropogenic factors and the crown-of-thorns starfish *Acanthaster planci*.

The format is well designed with discrete introductory chapters on historical records, currents and temperatures, spatial and temporal patterns, and information on the collecting stations. From there the chapters are organised by the 15 coral families found in the region. There are useful maps, tables, an index, and an extensive 'literature cited' section which includes over 250 references.

I feel this book represents an important landmark in the field of coral science, as one part of Dr Veron's critical work in the area of coral conservation biology. This monograph provides the database from which his paper on coral biodiversity is drawn (Conservation of biodiversity: a critical time for the hermatypic corals of Japan, *Coral Reefs* 11:13-21). While many scientists have observed the decline of coral reefs throughout the world, documentation is often limited. The coral taxonomy presented in this book is a valuable tool which can be used to prove that species, as well as local populations, are under threat of extinction.

I would highly recommend this book to anyone interested in coral taxonomy, biogeography, biodiversity and the application of this information to the areas of coral environmental studies. For those of us who still crave illustrated guides to help us through coral identification, the author promises such a book is being co-authored with Dr Nishihira based on the present publication.

Robert H. Richmond, University of Guam Marine Laboratory, Mangilao, Guam. Fax: +671 734 6767.

Note: a complementary publication, also by J.E.N. Veron is **New Scleractinia from Japan and other Indo-west Pacific countries**, in *Galaxea* 9:95-173, 1990; this has illustrations.

TRADITIONAL FISHING IN THE TORRES STRAIT ISLANDS

R.E. Johannes and J.W. MacFarlane

CSIRO Division of Fisheries, 1991. 228 pp. ISBN 0-643-05259-3. Available from CSIRO Division of Fisheries (Attn M. Bessell), GPO Box 1538, Hobart, Tasmania 7001, Australia. Fax: (61)-02-24-0530. Price A$40/US$40. Price includes postage by surface mail; please add US$10 for air mail outside Australia and New Zealand.

This book serves an important purpose in illustrating that island societies are not all the same. It describes the essential characteristics of traditional fisheries in the Torres Strait, which lies between Australia and Papua New Guinea. While a widespread traditional marine conservation ethic evolved among many islanders of Oceania, none was found among those of the Torres Strait. Readers expecting to find a 1990s version of Johannes' classic study *Words of the Lagoon* will be disappointed. The people of the Torres Strait, living between two large land masses, differ from the Palauans living on small isolated islands. Their different history and environment has affected their perception of the world and its resources.

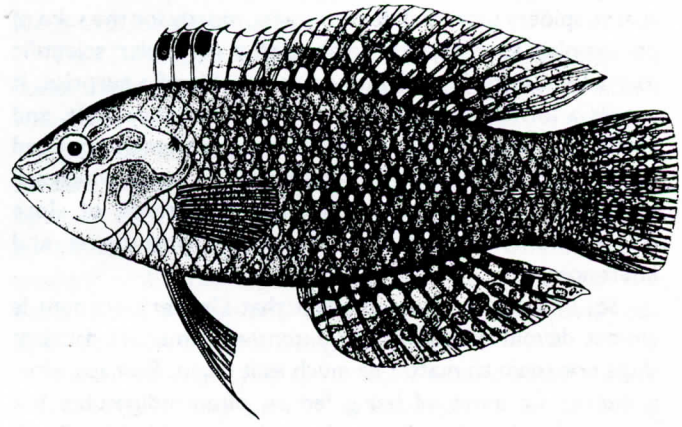
The first chapter establishes the geographical setting and historical context, reviews the islanders' participation in maritime industries and summarizes the historic Torres Strait treaty between Australia and Papua New Guinea. The next two chapters describe dugong and sea turtle fisheries, detailing their history, the fishing techniques, and animal behaviour. Unfortunately, the islanders' suspicions about the motives of the authors prevented critical data on dugong catches being made available.

Customary marine tenure is dealt with in Chapter 4, and problems relating to the renewed practice of extended marine tenure and its contribution to the conservation of Torres Strait seafood stocks are discussed. The next five chapters deal with fishing activities in each of the island groups. I.R. Poiner and A.N. Harris contribute a more statistical description of the fisheries of York Island and M. Fuari discusses the social implications of fishing on Yam Island. The final chapter provides recommendations for reducing the islanders' dependency on the Australian social welfare system. The authors suggest that, with appropriate education and training in the islands, the islanders ambitions to run commercial fisheries from catch to marketing without resource over-exploitation and complete loss of cultural identity could be achieved.

In the Preface, the authors beg tolerance in their use of the term 'fisherman' to refer to those of either sex who fish, particularly in a situation where almost all the fishing activities appear to be carried out by men. Except for historic references to female pearl divers and reef gleaners, women are not mentioned; it is not even clear if women participate in food preparation. I suspect that information regarding the women's role in the fishery was difficult to obtain by male scientists. This omission is rather unfortunate when the authors state that 'fisheries research should focus at least as much on fishermen (and women?) as on fish - especially in cultures to which the researchers do not belong.'

This aside, the book is well written, reasonably priced, with plenty of maps, and should be read by anyone interested in small-scale fisheries or the social impacts of technology on traditional societies.

Norman Quinn, Eastern Caribbean Center, Univ. of the Virgin Islands, St Thomas, US Virgin Islands, 00802, USA.



MODERN REEF DEVELOPMENT AND CENOZOIC EVOLUTION OF AN OCEANIC ISLAND/REEF COMPLEX: ISLA DE PROVIDENCIA (WESTERN CARIBBEAN SEA, COLOMBIA).

Jorn Geister

Facies, Erlangen, 1992, Vol 27:1-70. 17 pls, 4 tabs. ISSN 0172-9179. Available from: *GEOTECH Limitada, Apartado Aereo 51 846, Bogota, Colombia).*

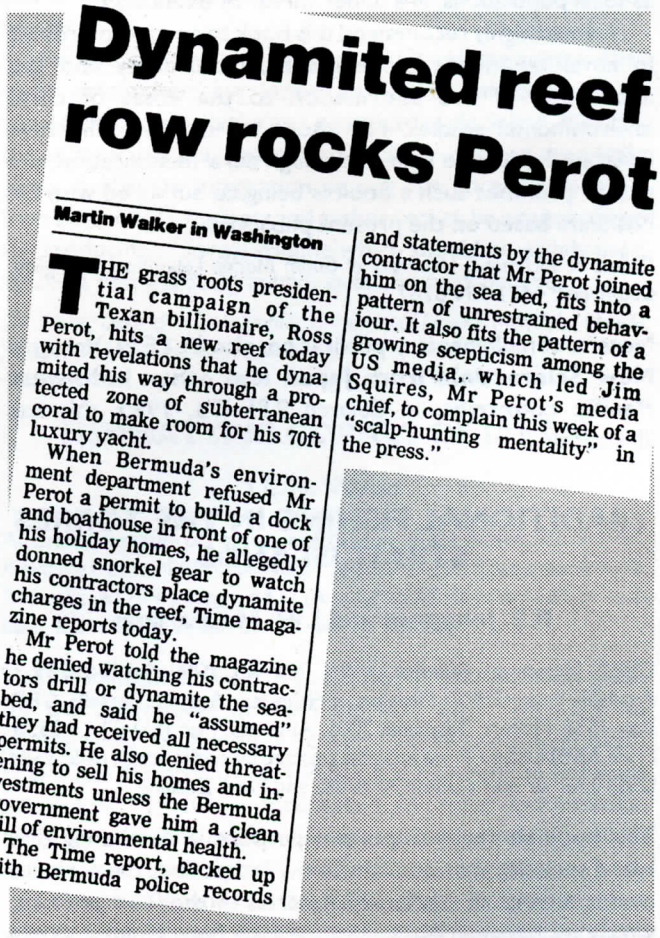
This is an excellently produced and well illustrated memoir (partly in colour) on a part of the Caribbean which is probably not well known to the reef-scientist community, though it is apparently an accessible place for wealthy tourists. Providencia is a small, largely volcanic island about 5 km across, about 200 km off the Nicaragua coastline, rising 2000 m above the Caribbean Sea floor. It belongs to Colombia, is English speaking and has extensive reef and coral developments, fossil and living, the latter including an impressive barrier reef system 32 km long, and said by Geister to be the second largest in the Caribbean (after that in Belize).

Geister's account, though emphasizing reefal and coral features, also deals at some length with the general geology and evolution of the island and many different structural and environmental aspects of Providencia's underwater features. Geister carried out much of the work over twenty years ago,but has also taken the trouble to catch up on more recent observations there like coral bleaching events in 1983/84 and 1987/88. The oldest exposed rocks are pre-Miocene, and the subsequent Miocene volcanic sequence also contains shallow-water carbonates. In keeping with what increasingly looks like a global pattern, these older carbonates, though coralliferous, contain no important *Acropora* component. The coral, though it's record goes back to the early Tertiary, does not seem to acquire its modern ecological pre-eminence anywhere until some time in the Plio-Pleistocene.

Conditioned as we are to worthy quantitative hypothetico-deductive analyses of a single phenomenon, tightly worked in terse telegraphese and illustrated with sparse spidery plots and dendrograms, mostly for the sake of conforming to the strict format of a particular scientific journal – Geister's account comes as a bit of a surprise. It recalls a former age in its broad and descriptive style, and reminds us that there is a continuing complementary need for detailed, descriptive, fully-illustrated accounts which are longer than ten pages, based on a wide range of close observations, knitted into interesting arguments and inferences.

So, in a curious way, the fact that Geister's account is almost devoid of analyses of extensive numerical datasets does not seem to matter as much as it might. Perhaps, after a decade or more of being fed an often indigestible but apparently objective diet such as that provided by fixed-format journals like *Corals Reefs*, it is refreshing to read this kind of personal account in the best of an older (Germanic?) nineteenth century tradition, readily recognisable to fans of Humboldt, Ehrenberg, Semper and (yes!) Darwin. This reflects well, not only on its author, but also on the flexible and imaginative editorial and format policy of the *Facies* editors, Erik and Erentraud Flugel. I haven't the least doubt that everyone who wants to know almost anything about the reefs, geology and general setting of this accessible and interesting island will find themselves consulting Jorn Geister's account for a long time to come. And if you're wondering where to send your longer coral reef papers, try *Facies*.

Brian Rosen, The Natural History Museum, Cromwell Road, London SW7 5BD, UK.



Dynamited reef row rocks Perot

Martin Walker in Washington

THE grass roots presidential campaign of the Texan billionaire, Ross Perot, hits a new reef today with revelations that he dynamited his way through a protected zone of subterranean coral to make room for his 70ft luxury yacht.

When Bermuda's environment department refused Mr Perot a permit to build a dock and boathouse in front of one of his holiday homes, he allegedly donned snorkel gear to watch his contractors place dynamite charges in the reef, Time magazine reports today.

Mr Perot told the magazine he denied watching his contractors drill or dynamite the seabed, and said he "assumed" they had received all necessary permits. He also denied threatening to sell his homes and investments unless the Bermuda government gave him a clean bill of environmental health.

The Time report, backed up with Bermuda police records and statements by the dynamite contractor that Mr Perot joined him on the sea bed, fits into a pattern of unrestrained behaviour. It also fits the pattern of a growing scepticism among the US media, which led Jim Squires, Mr Perot's media chief, to complain this week of a "scalp-hunting mentality" in the press."

Guardian (UK)
6 July 1992

USING MAPS TO SELL THE ENVIRONMENTAL ETHIC

Encouraging the public to adopt an appropriate coral reef management ethic involves a variety of 'hard sell' and/or 'soft sell' techniques. Success is often dependent on how well the presentation style and method of distribution is targeted. A brochure about the new Florida Keys National Marine Sanctuary may provide a good model that could be used elsewhere.

The brochure opens to form a 32 x 22-inch full colour map showing major living habitats (coral, seagrass, deep benthic, hard bottom, mangrove) in the Sanctuary, with a drawing of a cross-section illustrating the interdependence of mangrove, seagrass and reef habitats. Text and colour photos on the back describe:

— fossil (bedrock) habitats of Pleistocene age (a feature commonly found beneath living reefs around the world);
— modern habitats in the hardwood hammock, sand beach, mangrove, hardbottom, seagrass bed, coral reef and barebottom areas, showing human impact and potential management solutions;
— future challenges to the conservation and long-term survival of these habitats, and current research and management activities underway.

Additional sources of information, readily available in bookstores in the Keys, are listed.

Funded by the Mary Flagler Cary Trust, and produced by the Florida Institute of Oceanography in co-operation with the Coral Reef Coalition (representing over 100 local and national conservation organisations), the brochure is distributed free to local residents and school children. The aim is to provide local people with sufficient background information so that they can take part effectively in the deliberations leading up to finalisation of the rules and regulations of the Sanctuary.

The graphic picture of the delicate ecological balance that has survived **natural** stresses for over 100,000 years in the Florida Keys clearly emphasises the urgency with which **man-made** stresses must be reduced to an acceptable level.

Copies of the *Seakeys Habitat Guide* can be obtained from Florida Keys National Marine Sanctuary Planning Office, 9499 Overseas Highway, Marathon, FL 33050, USA.

Gray Multer, Multer and Associates, Environmental Consultants, 9655 Canaseraga Road, Arkport, N.Y. 14807, USA.

WHO'S WHO

SCHUTZGEMEINSCHAFT KORALLENRIFF — ASSOCIATION FOR THE PROTECTION OF CORAL REEFS

This organisation was founded in Germany in December 1992, and is dedicated to working for the preservation of coral reefs and associated ecosystems such as mangroves. The organisation will co-operate with other agencies involved in similar work and will play an active role in advocating better management practises for reefs. The initial focus is on the Philippines, where a project to develop artificial reefs is underway.

Further information from: *Prof. G. Hillmer, Geologisch-Palaontologisches Institut und Museum, Universitat Hamburg, Bundesstrasse 55, 2000 Hamburg 13, Germany; Fax (040) 4123 5270.*

THE FRIENDS OF THE CHAGOS

A new organisation has just been formed for all those concerned with the conservation of the Chagos Archipelago (British Indian Ocean Territory). Its objectives are to:

— promote interest in the Chagos Archipelago
— encourage conservation, scientific and historic research and education
— provide a focal point for information about the Chagos Archipelago
— inform members of the past, present and future of the islands and their waters.

A newsletter will be produced, and meetings will be held as appropriate. The annual subscription is £5 ($10). Further information from: *Commander John Topp, Friends of the Chagos, c/o The Conservation Foundation, 1 Kensington Gore, London SW7 2AR. Tel. 071-823-8842.*

ATTENTION! INTERNATIONAL DIRECTORY OF NGOs WORKING ON CORAL REEF ISSUES

Greenpeace is compiling a *Coral Reef Network Directory* which will have information on non-governmental organisations (NGOs) worldwide working to protect and manage coral reefs. The directory will contain comprehensive profiles of NGOs working on the whole range of coral reef issues, describing their objectives, current activities and areas of expertise. Organisations that may have a only single coral reef-oriented project will be included as well as those that focus exclusively on reefs.

The Directory will help to promote co-operation, collaboration and support about NGOs worldwide concerned with coral reef ecosystems and the livelihoods they sustain. The growing number of NGOs working on reefs have much to learn from each other and the Directory will be a way of opening more lines of communication. It will also provide an invaluable reference work for reef scientists and managers working with other agencies and institutions at both the national and international level, and will help to foster co-operation between these organisations.

If you are employed by or work with any such NGO, please help by filling out the questionnaire on the following page using additional pages if necessary.

Jeanne Kirby, Project Co-ordinator, Greenpeace Pacific Campaign, 139 Townsend St, San Francisco, CA 94107, USA.

CORAL REEF NETWORK DIRECTORY QUESTIONNAIRE

Please complete and return to **Greenpeace Pacific Campaign, Coral Reef Network Directory, 139 Townsend St, San Francisco, CA 94107, USA** by October 1st 1993

Organisation's name _____

Contact person(s) _____

Address _____

_____

Telephone _____ Fax _____ Telex _____ Electronic mail _____

1. When was your organisation formed? 19_____

2. Are you a membership organisation? ❒ Yes ❒ No

3. What is your current membership? _____

4. How do you become a member?

5. For how long has your organisation devoted attention to issues related to coral reefs? _____ years

6. Briefly describe the goal(s) and/or philosophy of your organisation's coral reef-related programme(s).

_____

_____

7. Where is your organisation's coral reef work currently conducted:

a) Name specific locality: _____ and/or _____

b) Name country _____ and/or _____

c) Check off which regions:

❒ Red Sea ❒ Gulf ❒ Central and Western Pacific

❒ Atlantic ❒ Indian Ocean ❒ Eastern Pacific

8a. Check off and/or list your current coral reef-related initiatives and activities and describe these. Please be as specific as possible.

- ❒ community-based management
- ❒ marine protected areas/sanctuaries
- ❒ monitoring
- ❒ resource development and management
- ❒ marine curio and/or aquarium fish trade
- ❒ tourism/dive industries
- ❒ other (please specify)

8b. Please highlight the skills and strategies that you employ (e.g. community organising, education, demonstration projects, media, policy development, etc). Please be specific.

_____

_____

_____

_____

9. Check off and describe further the resources your organisation makes available to the public and/or other NGOs. If appropriate, give prices.

- ❒ newsletters
- ❒ reports
- ❒ books
- ❒ videos
- ❒ films
- ❒ educational materials
- ❒ training courses
- ❒ internships
- ❒ grant funding
- ❒ other (please specify) _____

10. Please list other NGOs that you work with who should be profiled in the directory. Include address, contact name(s), telephone and fax numbers if possible.

_____

_____

11. If possible, send copies of publications, logos or other graphics produced by the NGO that you would like used in the directory.

ANNOUNCEMENTS

AKAJIMA MARINE SCIENCE LABORATORY — AVAILABILITY OF FELLOWSHIPS

Fellowships are available for young scientists (up to 35) for coral reef-related research at the Akajima Marine Science Laboratory on Akajima in the Kerama Islands, Japan. The fellowships will be awarded under the Science and Technology Agency (STA) Program of the Government of Japan and tenure will be from six months to two years. Fellowships cover travel to and from Japan, monthly allowance, family allowance, accommodation and medical insurance.

The Akajima Marine Science Lab provides an excellent place for basic research on corals reefs, aquaculture, conservation and the effective use of marine resources. It can accommodate up to 16 guests and consists of a four-storey building approximately 300m from the harbour and seashore. There are dry and wet labs, abundant fresh and seawater and the labs are well equipped with standard equipment. The lab has six complete sets of scuba gear, 40 cylinders, a 50hp fibreglass boat and two zodiac inflatables with 15hp engines. A global positioning system, plankton nets, u/w video and Nikonos cameras are also available.

For applications for the above fellowships and further information about the lab please write to: *M. Omori, Akajima Marine Science Laboratory, 179, Aka, Zamami-son, Shimajiri-gun, Okinawa 901-33, Japan. Fax: +81 98-987-2875.*

WORK EXPERIENCE WANTED

Matthew Mortillo, a 23 year old graduate with BA in biology from the University of Kansas, would like to participate in volunteer work or internships specifically in Costa Rica or the Caribbean. Available from August/September for one year. Write to him at 305 Ridge Trail Drive, Chesterfield, Missouri 63107, USA.

Nigel Brett, also a 23 year old graduate in Environmental Sciences from the University of East Anglia and with interests covering aquatic, marine and coastal ecology, ecosystem management and conservation, would like to gain work experience before undertaking further studies. Available from June 1993 for voluntary work which provides board, lodging and subsistence allowance. He can be contacted at 49, Almoners Avenue, Cambridge CB1 4NZ, UK.

NEW RESEARCH FACILITY IN THE FEDERATED STATES OF MICRONESIA

The Coral Reef Research Foundation (CRRF) is pleased to announce the establishment of the Chuuk Atoll Research Laboratory on Chuuk (Truk) Atoll, Chuuk State, FSM. Chuuk Atoll is a huge 'almost atoll' located about 1000km southeast of Guam in the central Caroline Islands. The atoll is almost 50km in diameter, enclosing a group of about 10 large and numerous smaller basaltic islands, rising to 450m height, in the central area of the lagoon which reaches a maximum depth of nearly 90m. A barrier reef, almost 200km long, encircles the lagoon and is best developed in the north and east. The combination of high islands, barrier reef, dense mangroves and seagrasses results in the presence of nearly every type of shallow water marine habitat within the lagoon. A nearly pristing true atoll, Kuop, lies only 3km south of Chuuk and has contrasting environments and conditions.

Diversity is high on Chuuk reefs, but with nearly 30,000 people living on the main islands within the lagoon, anthropogenic problems, from sewage and litter (largely diapers) to dynamite fishing, are evident near population centres. Further away, environments are less disturbed and in many areas approach pristine. Many reefs however still have visible effects from *Acanthaster* infestations in the 1970s, and many still have relatively high populations of the starfish as evidenced by number of individuals and recently digested corals.

CRRF, a non-profit public benefit corporation incorporated in the state of California, is already working on a number of research projects. Marine invertebrates and plants have been collected from Chuuk since March 1992 under a contract with the U.S. National Cancer Institute 'Collection and taxonomy of shallow water marine organisms'; about 1000 species have been collected elsewhere in the FSM and Indo-Pacific for screening tests for tumors and the aids virus. The 'Chuuk Marine Biodiversity Survey' involves more comprehensive collecting and identification of all marine taxa and is aimed at the compilation of checklists for all groups. Monitoring of lagoon and outer reef water temperature with recording thermographs has been undertaken since June 1991. The atoll has been comprehensively mapped using colour aerial phots, the first such coverage since the 1970s and the first ever using colour film. A reef research and education programme is being developed with Xavier High School in Chuuk, which draws students from throughout Micronesia, and the science curriculum, previously based on US course materials, is to have local marine science materials and experience incorporated as much as possible.

The research laboratory is designed mainly to support the work of the CRRF with the National Cancer Institute. However, it is also available to qualified researchers conducting basic or applied research projects. The facility is located on the the southwestern portion of Weno, near the Truk Continental Hotel, and is on the water on the site of a WWII Japanese seaplane base. A 10m x 12m reinforced concrete building, leased from the Chuuk State Government, has been converted into a fully airconditioned facility with offices, library, workshops and general laboratory space. The station has two boats (a 21-ft Boston Whaler and a 23-ft Yamaha skiff), diving tanks, microscopes and other general laboratory equipment. A small sea water system has been installed. Standard laboratory fees have not yet been established and fees are at present negotiable. Principals within CRRF include Patrick Colin, Lori Colin and Charles Anson.

Anyone interested in using the laboratory should write to: *The Director, Chuuk Atoll Research Laboratory, P.O. Box 70, Weno, Chuuk, Federated States of Micronesia, 96942.*

Conferences

4-8 July 1994, James Cook University, Townsville, Australia.
PACON '94. 6TH PACIFIC CONGRESS ON MARINE SCIENCE AND TECHNOLOGY

The 1994 meeting will be held under the auspices of the Australian Marine Sciences Association and other organisations. Technical papers will be presented on a number of themes, and there will be workshops on topics such as global positioning systems, mapping and Pacific Basin Marine Science Organisations. The registration circular will be mailed in mid 1993 to those completing a pre-registration form. Further details are available from: *PACON '94 Organising Committee, c/o Sir George Fisher Centre for Tropical Marine Studies, James Cook University, Townsville, Qld 4811, Australia. Fax: 61 77 755429.*

5-12 June 1995, International Convention Center, Beijing, China
XVIII PACIFIC SCIENCE CONGRESS

Sponsored by a number of Chinese scientific institutions, this will have 'Population, Resources and Environment: Prospects and Initiatives' as its central theme. There will be six general symposia as well as scientific sessions organized by the Scientific Committee of the Pacific Science Association, including one on coral reefs. The first circular is available from: *XVIII Pacific Science Congress Secretariat, c/o Institute of Atmospheric Physics, Chinese Academy of Sciences, P.O. Box 2718, Beijing 100080, P.R. China; Fax: 86-1-2562458.*

Courses

24 Oct - 6 Nov 1993, Silliman University, Dumaguete City, Philippines
SPECIAL AREA MANAGEMENT FOR COASTAL ENVIRONMENTS

This international training programme, to be organised by the Coastal Resources Center of the University of Rhode Island and Silliman University, will have a special emphasis on coral reefs. It is aimed at individuals from Asia and the Pacific region interested in coastal resources management. Special Area Management (SAM) is an ecosystem-based, integrated approach for addressing coastal resources management problems in specific locations and uses participatory community-based techniques. The course is built around examples of coastal SAM plans for island and coral reef environments.

Course fees are US$1,900 and cover meals, housing, field trips and reading materials. Further information from: *The Training Co-ordinator, Coastal Resources Center, The University of Rhode Island, Narragansett Bay Campus, Narragansett, RI 02882, USA. Fax: (401) 789-4670.*

30 May - 24 June 1994, Coastal Resources Center and Department of Marine Affairs, The University of Rhode Island
SUMMER INSTITUTE IN COASTAL MANAGEMENT

The Summer Institute is for professionals responsible for planning or managing coastal management programmes for the whole range of agencies and institutions that work in this field. The aim is to provide participants with the practical skills required to design and implement coastal management programmes, particularly in developing nations. Instructors include faculty and staff at the University of Rhode Island and practitioners in coastal management with experience from around the world.

Course fees are US$3,900 and cover meals, housing, field trips and reading materials. Further information from: *The Training Co-ordinator, Coastal Resources Center, The University of Rhode Island, Narragansett Bay Campus, Narragansett, RI 02882, USA. Fax: (401) 789-4670.*

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* is cheerfully illustrated, with cartoons, newpaper cuttings and other entertaining material.

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

To save time and postage, we shall not normally acknowledge submitted material and 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, Wordperfect or Wordstar packages, or as ASCII text files. 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 14 (due out October 1993) IS AUGUST 31ST 1993; Please send to Sue Wells at:

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APPLICATION FORM FOR MEMBERSHIP

Name: .....

Address: .....

.....

.....

Title: .....

Fields of interest: .....

.....

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

..... US$60 for FULL membership

..... US$10 for STUDENT membership

..... US$70 for SPOUSE membership

Cheques to be made payable to:
INTERNATIONAL SOCIETY FOR REEF STUDIES

Send completed application form and your cheque to:
Dr Daphne Fautin, Treasurer, Dept of Systematics and Ecology University of Kansas, Lawrence, Kansas 66045-2106, USA.