MEMBERSHIP

The annual subscription for individual membership of **ISRS** is currently US$80, provided renewal payments are made by 1st March each year. Individual and Family Members receive the journal **Coral Reefs**, the magazine **Reef Encounter** and other periodic mailings. Family membership is US$90. Student membership costs US$25 and benefits include all of the above except the journal **Coral Reefs**.

The Category - Sustaining Member- is for those supporting the society with a subscription of $200. In addition to other benefits, sustaining members will see their names printed in each issue of **Reef Encounter**.

Renewals received between 1 March and 30 April will cost US$30 for a student member, US$90 for a full member and US$100 for a family membership. Those received after 1st May will cost US$32, US$100 and US$110 respectively. New members can join at the base rate of US$25, US$80 and US$90 at any time of the year. Financial assistance may be available to prospective members with legitimate needs. Please contact **ISRS** Corresponding Secretary Richard Aronson at raronson@jaguar1.usouthal.edu.

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

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

NOTES FOR CONTRIBUTORS

Reef Encounter is the International Society for Reef Studies' magazine-style newsletter. In addition to our main feature articles, we include news on all aspects of reef science, including meetings, expeditions, book reviews, and information on student opportunities. We encourage discussion and debate on issues concerning reefs or the **ISRS**, and we welcome letters to the Editor for our correspondence column (Upwellings). We aim to complement the Society's journal, **Coral Reefs**, by publishing brief reviews of recent trends and developments that bear on reef studies. Please note that **Reef Encounter** does not publish original scientific data. We do, however, have a section reporting on recent publications (Reef Briefs). To have a paper to be included, please send a copy (reprint or corrected proofs only) to the Editor. Articles should range between 200 and 2000 words. Except in exceptional circumstances, text should be sent by email to bprecht@pbsj.com

Reef Encounter has an informal and journalistic style, and while references are permitted, they should be kept to a minimum. Please number references in the text using superscript, and list them at the end of the article in the order in which they are cited, first through the text, and then through the table and figure legends. Each reference should have a unique number, and references should not be combined. Avoid the use of op.cit. or ibid, and use World List abbreviations. In all other aspects, references should follow the style prescribed for **Coral Reefs**.

We particularly welcome artwork and photographs to help us illustrate the magazine. Images can be sent as hard copy to the Editor. Electronic images should have a resolution of 350 dpi and must be a size appropriate for the magazine format. In particular, we cannot enlarge small electronic images and retain publishable quality. We prefer tiff format files. Where images are included in the article, please send legends and/or captions separately (not in the image file). Explain all symbols, abbreviations, shading patterns, etc. Maps should have a scale and indicate orientation. Please use either metric units or imperial with metric units. Please send with your article a short 'by-line' explaining who you are. Include your full address and email details which will be published with your article. We have no regular reprint system, but contributors who are not already members will receive a free copy of the relevant issue. Please consider joining the society if you are not already a member!

We acknowledge contributions by email. If you do not receive an acknowledgement within one week of submitting electronic material, please contact us to verify that it was received. We reserve the right to edit text to achieve a consistent style, and to minimize our changes you should use recent issues as style guides. We do not usually return articles for checking unless we consider our editorial changes may have altered your meaning. Articles are not refereed, and opinions expressed and errors of fact remain largely the author's responsibility. No published item should be taken as **ISRS** opinion unless indicated. Please note that **Reef Encounter** is an entirely voluntary effort. We do not have funds to pay contributors, and the editors are also unpaid.

We welcome contributions regardless of when they arrive. Issue 33 (expected out in June 2004) will have the updated yearly schedule of when you can expect **Reef Encounter** in the future. Submissions for issue 33 are due 1 April 2004. If you are planning a substantial contribution, it will help the Editor plan ahead by contacting him well in advance of the deadline. Thank you for your support.

DEADLINE FOR COPY FOR REEF ENCOUNTER 33 (DUE OUT JULY 2004) IS 1 MAY 2004

Please send correspondence and submissions to one of these addresses:
bprecht@pbsj.com

Editor, William F. Precht, PBS&J, 2001 NW 107th avenue, Miami, FL 33172. Email: bprecht@pbsj.com

Associate Editor, Martha L. Robbart, PBS&J, 2001 NW 107th avenue, Miami, FL 33172. Email: mrobbart@pbsj.com

Associate Editor, Beth Zimmer, PBS&J, 2001 NW 107th avenue, Miami, FL 33172. Email: bzimmer@pbsj.com

APPLICATION FORM FOR MEMBERSHIP

Name: .....
Address: .....
.....
.....
Title: .....
Fields of Interest: .....

Bank drafts and cheques to be made payable to: International Society for Reef Studies. If a receipt is required, please request it at the time of payment. Send completed application forms and payment to ISRS, P.O. Box 1897, Lawrence, Kansas 66044-8897, USA.

I/We enclose a cheque (in US$ ONLY please) of:
..... US$80 for FULL membership
..... US$90 for FAMILY membership
..... US$25 for STUDENT membership
..... US$200 for SUSTAINING membership

Credit Card Payment: VISA/Mastercard

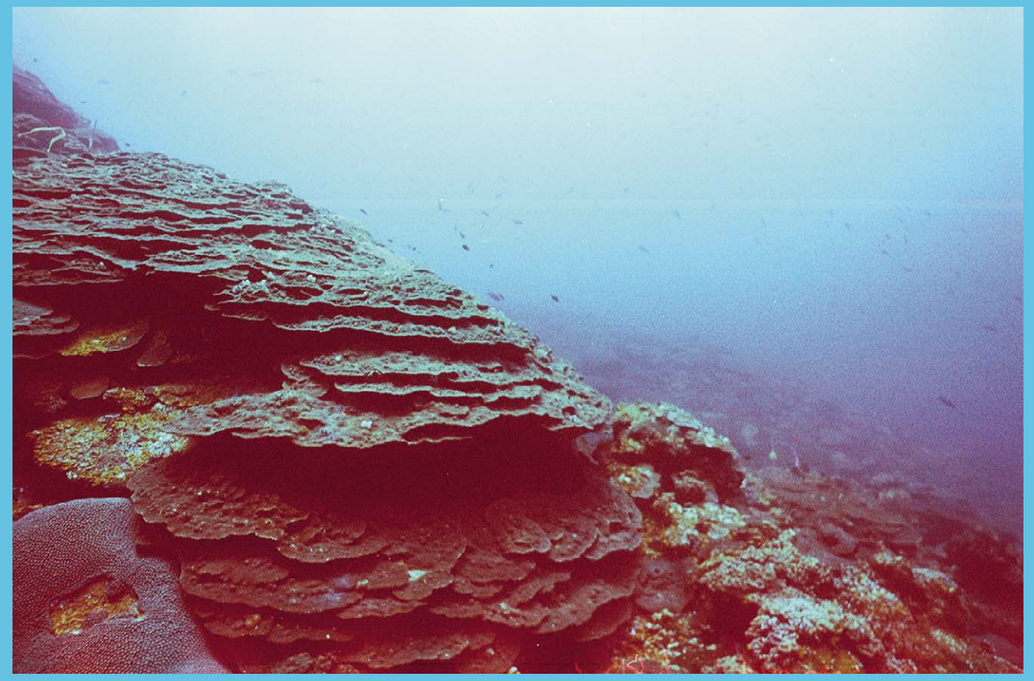
No. ..... Expir. Date .....

Signature .....

Number 32 April 2004

REEF ENCOUNTER

Magazine of the International Society for Reef Studies



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Reef Encounter No. 32, April 2004

Magazine of the International Society for Reef Studies

Editor William F Precht
Associate Editors Martha L Robbart and Beth Zimmer
Editors@ReefEncounter.org

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(Contents continued on inside back cover)

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Cover image: This photo of *Montastraea franksi* shingles was taken by WF Precht at the Flower Garden Banks National Marine Sanctuary in April 2003.

COPY DEADLINE FOR REEF ENCOUNTER 33
(due out JULY 2004) IS MAY 1 2004

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

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

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

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

ii. To print, publish and sell, lend and distribute any papers, treatise or communications relating to coral reefs, living and fossil, and any Reports of the Proceedings or the Accounts of the Society

iii. To raise funds and invite and receive contributions from any persons whatsoever by way of subscription, donation or otherwise providing that the Society shall not undertake any permanent trading activities in raising funds for its primary objects.

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

EDITORIAL

Welcome to the long overdue issue of **Reef Encounter**! We are your new editorial team and are excited about this opportunity to bring you interesting articles, papers, opinions, announcements and more from the coral reef scientific and conservation community. You will notice that this issue is substantially larger than previous issues. We will be returning to normal publication schedule and size, with a new look and format, so be sure to note the submission deadlines (see inside cover for details).

This issue has some important news from your Society, including information on the upcoming 10ICRS meeting in Okinawa Japan, as well subsidized travel for meritorious students or researchers, so be sure to read this section carefully. We have assembled a broad spectrum of articles (**Currents**) coming from the Pacific, Southeast Asia, East Africa and the Caribbean. From scleractinians in Vietnam to fisheries management in Jamaica, there is certainly something for everyone in this issue.

Following the sad news of Bob Johannes' and Terry Scoffin's death, two of the great champions of coral reef science and conservation, we have included full obituaries of both.

Thanks go out to all our contributors in this issue. Please keep the contributions coming, as this is a magazine-style newsletter where you can communicate your exciting news, thoughts, and ideas to colleagues around the world.

WF Precht, ML Robbart and B Zimmer

ISRS COMMENT

FROM THE OUTGOING PRESIDENT

This message marks the twenty-first birthday of **ISRS**. While twenty-one years is a good innings for the Society, it is just a blink of the eye in the existence of any coral reef, it is more than the life expectancy of many corals, and it is the entire window of observation that many of us as individuals can hope to have on coral reefs. Collectively, the Society both broadens that window and looks into detail of coral reef structure and process that could not have been contemplated twenty-one years ago. With all the pressures faced by coral reefs, and all the other organizations out there speaking and acting for coral reefs, it is more important than ever that we retain our distinctive role as the credible voice of the scientific research community.

The vision of founding President David Stoddart and his inaugural membership of a few dozen people was a society that would bring together people with diverse knowledge and skills to explore the paradoxes and questions that are coral reefs – the many faceted 'coral reef problem' of why and how coral reefs exist where and as they do. Now, with a much larger and more materially demanding humanity, and with the pressures on coral reefs and their resources multiplying and compounding, the questions of why, how and where have an unwelcome companion. What must be done to secure the future for coral reefs? The answer to this question will vary from place to place, and it will have many dimensions that are beyond the present scope of this Society. We currently embrace studies of biology, ecology, geology and environment with a reef focus. Actions for coral reef management and conservation involve people, and their dimensions are institutional, technological, political, social, economic and cultural. Our perennial challenge is to seek to be more effective in the communication of our diverse science and in our engagement with the broader community of intergovernmental, governmental, non-governmental and commercial users of coral reefs.

In recent years, we have complemented our technical journal **Coral Reefs** and our newsletter **Reef Encounter** with consensus statements on coral bleaching, coral reef diseases and sustainable fishing that were targeted to support the efforts of the newly formed International Coral Reef Initiative, our main conduit to coral reef policy globally. We have also been active in scientific capacity building. Through our association with The Ocean Conservancy and the generosity of donors, we are able to provide several valuable post-graduate fellowships, and we provide travel awards for students to attend our scientific meetings. In partnership with the Indonesian organizing committee, we were instrumental in running the Ninth International Coral Reef Symposium in Bali, October 2000 and in the distribution of the Proceedings, including donations of copies to laboratories in developing countries. Our growth in membership to over 1100 has enabled us to broaden our support to institutions in developing countries through donations of sets of back-issues of the journal Coral Reefs.

This is my eighth and last message to you as President of **ISRS**. Major coral bleaching episodes marked the start, middle, and end of my term, but I am assured that correlation is not evidence of causation. It is a great pleasure that one of my final duties will be the granting of Honorary Life Membership to our founding President, David Stoddart. David, a distinguished geographer at Cambridge University and then University of California, Berkeley, was a prime mover of the First International Coral Reef Symposium held in India in 1969. In the Proceedings of that meeting, he planted the seed of an idea for an **International Society for Reef Studies**, and in the subsequent decade, was instrumental in bringing it to life in September 1981. It has been a great privilege for me to serve as President in the four years up to our coming of age, and I thank all the officers, council members and members who have worked with me.

And to incoming President, Nick Polunin, officers and council – best of luck!

Terry Done

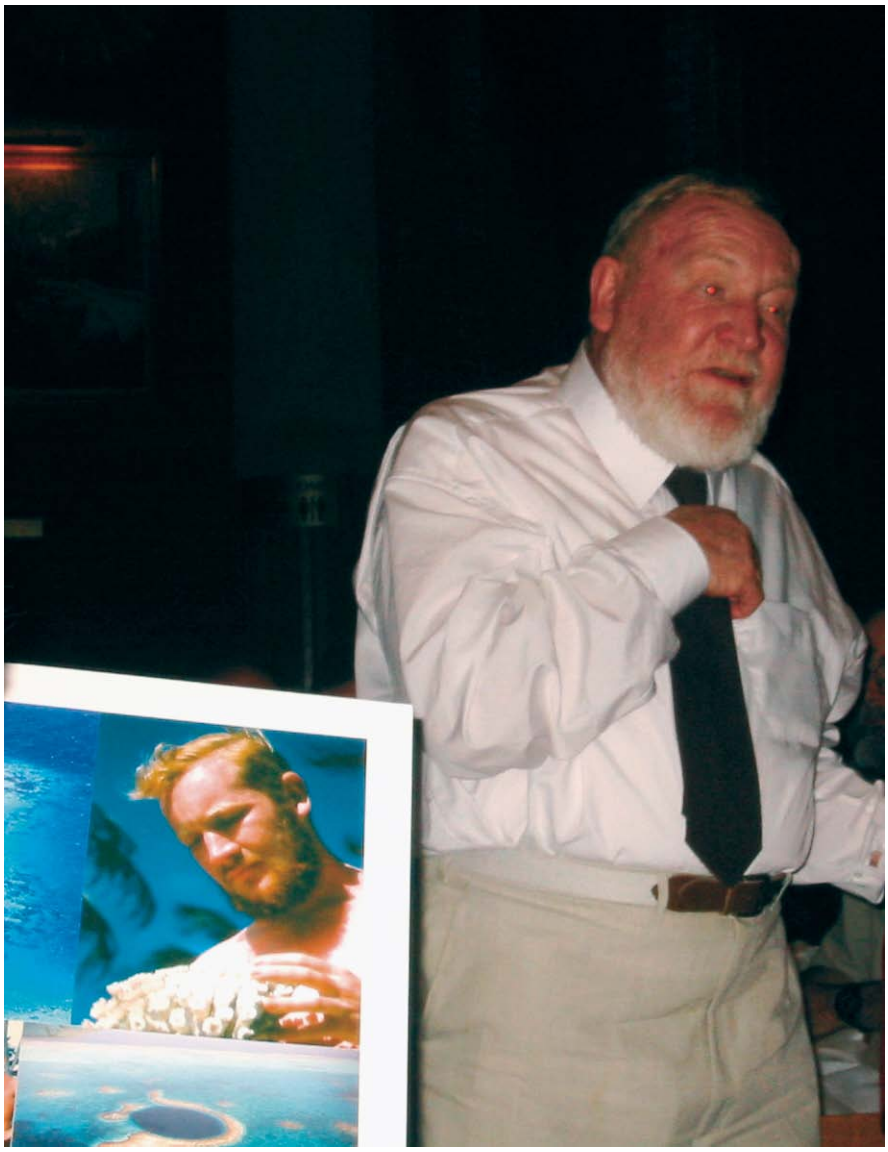
FROM THE INCOMING PRESIDENT

In days gone by, the younger generation might have preferred optimism to 'blimpish' views of its silver-haired mentors that everything had gone downhill since they started their careers. But within my 30 years' experience the face of many reefs has changed fundamentally. At this time I can appreciate the feeling of many that it has become harder to distinguish between apocalyptic views and the scientific tendency to refer to nothing as 'doom' until all the facts are known. The stakes seem steadily higher, but a vast space remains between environmental science and 'environmentalism.' Few working scientists really venture into the middle ground; the same is true for 'environmentalists' in the opposite direction. In the case of scientists, the criticism of 'fisheries science' and the hard-nosed nature and small packets of most research funding scarcely encourage the research most needed to reverse the sorry state of the fisheries. Analogous thoughts come to mind in relation to coral bleaching and other human-induced threats to the structural integrity of reefs. Yet, such venturing is important ground for the future. The application of rigorous experimental science in small manageable reef spaces to the large-scale issues of concern will remain contentious for the foreseeable future. As we try to forecast the likely states of reefs to come, both disciplined information and political decision making are going to be needed. Noting the emphasis on science in our constitution, where does that put our **International Society for Reef Studies**?

The growth of non-governmental organisations in the recent past addressing the need for conservation of coral reefs in the face of bleaching, fishing, eutrophication, tourism, invasions, outbreaks and other such events and impacts, has been tremendous. The **ISRS**, through its members and their vast expertise, has a pivotal role to play in the disciplined work that these subjects demand. We are the world body concerned with the science of coral reefs. Our scientific journal is currently the most highly ranked of those which regularly address the understanding of coral reefs, and thanks to successive local organising committees we manage the major international scientific conference series solely aimed at reef science.

It is time for the ISRS' vast collective experience and knowledge to be more widely recognised in the context of the **Society**. I would like to see us together exploring how we can build 'the scientific knowledge and understanding of coral reefs, both living and fossil.' One of the ways of doing this is by producing authoritative briefing papers on important topical issues, we expect to put four such papers to the members for feedback before the 10th ICRS. Many of you will have noticed that with your renewals we are seeking more information about members than we have previously. The goal of this is to call on the membership to help with tasks such as the briefing papers as new needs arise. Thanks to FIT and Rob van Woesik we are putting the Web to greater work and this is our big year. I am pleased to say we are offering more funds in 2004 for the ISRS/TOC Fellowships than we have ever done. But at present this money has to be raised on an annual basis and so we are working hard now to get recurring funds for this valuable support to young scientists. Here's looking at you Okinawa!

Nicholas Polunin



Honorary Life Membership to our founding President, David Stoddart

ISRS Officers and Council Members

The following are the results of elections for the **International Society for Reef Studies**, held in September 2002. New officers and council members will take up duties on January 1st 2003.

President: Nicholas V. C. Polunin
Vice President: Richard B. Aronson
Corresponding Secretary: Peter J. Mumby

Councillors:
Richard Dodge
Katharina Fabricius
Ove Hoegh-Guldberg
Tim McClanahan
Michel Pichon
William Precht
Helmut Schuhmacher
Makoto Tsuchiya

Continuing officers and council members
(until Dec 31 2004)

Treasurer - John Ware
Recording Secretary - Peter Edmunds

Jaime Garzon-Ferreira
Hajime Kayanne
Lucien Montaggioni
Kathleen Sullivan-Sealey
Helge Peter Vogt
Robert Van Woesik

2004 Election of Officers and Councillors - Call for Nominations

The International Society for Reef Studies will be holding elections in September 2004 to replace outgoing officers and members of the ISRS Council. We will be electing a new Treasurer (currently John Ware) and recording secretary (currently Pete Edmunds). In addition, we will be replacing six retiring members of the ISRS Council: Robert van Woesik, Lucien Montaggioni, Kathleen Sullivan-Sealey, Helge P. Vogt, Jaime Garzón-Ferreira and Hajime Kayanne. The tenure of each elected position is 4 years, and new officers and councillors will take over beginning 1 January 2005. These positions are open only to members of ISRS.

Nominations should be submitted to Corresponding Secretary Peter Mumby *by post* (Marine Spatial Ecology Lab, School of Biological & Chemical Sciences, Prince of Wales Road, University of Exeter, EX4 4PS, UK), *by fax* (44-1392-263798), or *as an email attachment* (p.j.mumby@ex.ac.uk). Because of constitutional requirements, a nomination submitted as text of an email message cannot be accepted unless it is also submitted by one of the above methods. Each nomination should consist of the person's name, institution and country, and the post for which s/he is running. Each candidate should provide a one-paragraph statement about his/her qualifications for the position (a brief history of his/her involvement in coral reef work) and objectives while in that position (how s/he envisions working to the benefit of ISRS). Also required by the Society's bylaws is a statement of disclosure of any financial arrangements the candidate may have with any publisher of scientific literature. Self-nominations are welcome. If you wish to nominate someone other than yourself, please ask that person to mail, fax or email Peter Mumby a confirmation of his/her willingness to run for the office.

DEADLINE: The deadline for nominations is 7 June 2004. Ballots and biographical sketches will be mailed to all members of ISRS, to be returned to the Recording Secretary in September (exact date to be announced). The biographical sketches of the candidates will also be posted on the ISRS web site, http//www.fit.edu/isrs/ until the day ballots are due. The results of the election will be announced once the ballots have been counted.

This is your chance to participate in running your Society. We look forward to hearing from you!

10TH INTERNATIONAL CORAL REEF SYMPOSIUM

STABILITY AND DEGRADATION OF CORAL REEF ECOSYSTEMS
28 June to 2 July 2004, Okinawa Convention Center, Okinawa, Japan

The 10th International Coral Reef Symposium, Okinawa, Japan, is being organized and coordinated by the Japanese Coral Reef Society in collaboration with the **ISRS**.

The Organizing Committee has selected *Stability and Degradation of Coral Reef Ecosystems* as the main theme of the 10th Symposium, and has identified four concurrent sub-themes for further discussion and elaboration:

1) The evolution of coral reef ecosystems
2) Environmental factors controlling coral reef formation in time and space
3) The relationship between ecosystem stability and biogeochemical cycles
4) Towards a system where humans and coral reefs coexist

The Organizing Committee invites the submission of mini-symposium titles based on these themes. Please refer to the first circular and 10th ICRS homepage www.plando.co.jp/icrs2004 for the further details.

The first circular has been distributed to all ISRS members (July 2002) and those who attended the previous symposium in Bali, Indonesia. Those who have not received the first circular and are interested in participating in the next symposium in Okinawa are encouraged to contact the organizing committee.

International Organizing Committee

Kiyoshi Yamazato (Japan), Makoto Tsuchiya (Japan), Terry Done (Australia), Hajime Kayanne (Japan), Yoshimi Suzuki (Japan), Toru Nakamori (Japan), Makoto Omori (Japan), Kenji Konishi (Japan), Masashi Chikamori (Japan), Richard Kenchington (Australia), Barbara Brown (UK), Michel Pichon (France), Edgardo Gomez (Philippines), Anugerah Nontji (Indonesia), Don Potts (USA), Robert van Woesik (USA).

Local Organizing Committee

President: Kiyoshi Yamazato (Meio Univ.)
Committee Chair: Makoto Tshuchiya (Univ. Ryukyus)
Secretariat General: Hajime Kayanne (Univ. Tokyo);
Scientific Program: Yoshimi Suzuki (Shizuoka Univ.), Toru Nakamori (Tohoku Univ.), Michio Hidaka (Univ. Ryukyus), Tamotsu Oomori (Univ. Ryukyus), Hironobu Kan (Okayama Univ,), Beatriz Casareto E. (Lab. Aquatic Science Consultant);
Finance: Kimiaki Kudo (Global Ocean Development Inc.), Tatsuo Nakai (Nature Conservation Society of Japan), Yutaka Tateda (Central Res. Inst. Electric Power Industry), Koichi Sakai (WCCS);
Venue: Yuji Arakaki (Meio Univ.), Shinya Matsuda (Univ. Ryukyus), Hideyuki Yamashiro (Meio Univ.)
Public Relations: Kazuo Nadaoka (Tokyo Inst. Techonology), Saki Harii (Tokyo Inst. Techonology), Hiroya Yamano (National Inst. Environmental Studies)

Supporting Institutions (as in June 2002): Okinawa Prefecture, Ministry of the Environment, Japan

For more information on the 10th ICRS please contact:
Plando Japan, e-mail <icrs@plando.co.jp>, Fax 81-3-5470-4410 or www.plando.co.jp/icrs2004

TRAVEL AWARDS FOR 10th ICRS

The International Society for Reef Studies recently received grants from The David and Lucille Packard Foundation and The Henry Foundation to support travel to the 10th International Coral Reef Symposium, to be held in Okinawa, Japan from June 28 to July 2, 2004. The awards, which will be administered by the Florida Institute of Oceanography, are intended for students and researchers at the beginning of their careers who have legitimate financial needs. For the approximately 50 Packard awards, special attention will be given to applicants from developing countries of the Pacific Rim, but others in developed and developing countries may apply as well. A maximum of 4-6 Henry awards are for applicants from the Caribbean region. Most of the awards will be made in increments of US$500 to a maximum of $1500, but larger awards will be considered in cases of extraordinary need. The Local Organizing Committee of 10th ICRS will waive registration fees for the awardees, and those awardees who have already registered will be reimbursed. Each recipient will be required to submit a one-page report by September 2004 detailing her/his activities at the Symposium and the personal significance of the support.

Awards will be made by direct bank transfer, not as reimbursements. Applicants should submit the following information, preferably by email, to the address below.

(1) Full name, date of birth, citizenship, institution, address, telephone and fax numbers, and email address.
(2) A two-page essay (double-spaced, on A4 or letter-size paper) that briefly describes the research in which the applicant is engaged and the reasons for wishing to attend the 10ICRS. Also, please include a paragraph describing the reasons for requesting financial assistance.
(3) The cost of the least expensive economy round-trip airfare between the applicants institution and Okinawa, quoted in US dollars.
(4) Name, position and email contact of one individual who can serve as a reference.
(5) Details for bank transfer:
    Bank name
    Country
    Account holder
    Account number
    Routing code

Deadline for applications is **March 15, 2004**. Please send materials to Dr. Peter Mumby, Corresponding Secretary, ISRS at P.J.Mumby@exeter.ac.uk. Because of the short time available, applications can only be accepted via e-mail.

Eleventh International Coral Reef Symposium

Call for expression of Interest and Guidelines for Application and Selection

The International Society for Reef Studies (ISRS) invites expressions of interest for the hosting of the 11th International Coral Reef Symposium ('Symposium'). ISRS will coordinate the selection process by way of an international selection committee from among its membership and other respected individuals previously involved with selection and/or running of an International Coral Reef Symposium.

Schedule

1 October 2003	Call for expressions of interest.
1 March 2004	Closing date for receipt of initial expressions of interest (see item 6 below).
1 March 2004	Closing date for receipt of expressions of interest.
May/June 2004	Selection committee will review applications and draw up a short list of three who will be invited to present their bid in Okinawa before the 10th ICRS.
29 June 2004	The short-listed applicants will make a presentation to the selection committee assembled at the 10th ICRS in Okinawa. It is envisaged that each of these presentations will last 1 hour including a short formal presentation and discussion.
2 July 2004	Announcement of successful bid at the closing ceremony of the 10th ICRS.

Expressions of interest must arrive at the following address before 1 March 2004:

11ICRS International Selection Committee
c/o Prof. M Pichon
Laboratoire de Biologie Marine
EPHE
Université de Perpignan
Perpignan cedex 66860
FRANCE

Tel : +33 4 68 66 20 55
Fax : +33 4 68 50 36 86

Guidelines for Application and Selection

1. The International Society for Reef Studies (ISRS)

The **International Society for Reef Studies** (**ISRS**) is an international, voluntary, organisation with ~900 members from ~50 countries and a council of 17 individuals who work for the Society in their own time. The Society uses annual subscriptions to produce two publications and accepts donations to allow it to award student prizes. It does not earn a profit, and its income and expenditures each year are closely matched. The Society does not have the capability for a major role in the organization, program development and running of International Coral Reef Symposia (ICRSs), and it requires the host country and local organizing committee to take that role.`

2. Coordination and selection committee

ISRS will coordinate the selection process by way of an International Selection Committee from among its membership and other respected individuals previously involved with selection and/or running of an ICRS.

3. Responsibilities of the host country and local organizing committee

The host country will be required to:

1. Provide a safe venue (1 main plenary room, 10-12 additional working session rooms, offices for secretariat, exhibition area for paying exhibitors, boards for contributed posters), logistical support (including where possible transport, adjacent banking, postal, telephone, medical and photocopying services to be used on a commercial basis) and ensure adequate accommodation (see 4 below).
2. Meet all costs including those of the venue, printing of brochures, printing and distribution of proceedings, logistics (see 1 above), professional organizer, work delegated to other individuals or organizations including **ISRS** if applicable.
3. Take leadership in raising of additional funds to meet financial targets (see below), and take responsibility for underwriting the Symposium.
4. Form a local organizing committee (LOC) with the following responsibilities: Development of a budget and business plan agreed with the Selection Committee

4. Overall control and coordination of the event

- Provision of a range of accommodations, from budget to luxury, and airport-hotel-venue transfers to be included within the Symposium fee.
- Development of the Symposium program of ceremonies and presentations.
- Provision of a program of scientific field trips to living and, if available, fossil coral reefs.
- Provision of an accompanying persons program.
- Initiate fundraising to ensure the widest possible attendance.
- Development and maintenance of a Symposium website.
- Printing and distribution of announcements, programs and abstracts.
- Editing, production and distribution of Proceedings of the Symposium, with editorial assistance from organizers of mini-symposia and others.

5. Financial targets of the LOC

- The host country should take primary responsibility to:
- Cover any costs incurred in presenting the Symposium, including costs incurred in preparation of the scientific program and creation and maintenance of the website if applicable.
- Raise funds to support plenary speakers.
- Raise funds to support key people in various mini-symposia.
- Raise funds to support attendance of students and others from developing countries.

- Raise funds for printing and distribution of Symposium Proceedings.
- Generate a surplus to pass on to the organizers of the 12th ICRS.

6. Expressions of interest

- The bidding group should make an initial expression of interest, in which key people and institutions which will make up the organizing committee are identified, including government department(s) or other organisation(s) who will underwrite the venture. An agreement in principle will be made to conform to the requirements above. This expression of interest should include the following (in order listed):
- Suggested location and dates (taking into account worldwide university schedules and local weather phenomena which might interrupt field excursions).
- Details of the Symposium venue and its facilities.
- The availability of a range of hotels and alternative accommodation.
- A concept budget itemizing major expenditure and income, including possible sources of sponsorship such as government and private enterprise, a policy for underwriting the expense of the Symposium and allowance for a Student Travel Awards Programme (STAP).
- Suggested registration fees covering ISRS members, non-members, students and accompanying members.
- Nomination of a Professional Conference Organiser, with a list of events they have organised over the last 3 years, or alternatively, some form of guarantee of professional organisation of the symposium if a professional organiser is not available.
- Nomination of LOC members such as (i) Chairman, (ii) Treasurer, (iii) Scientific program organizer, (iv) Publications editor, and (v) Scientific field trips organizer.
- Social events and accompanying members program organizer.
- A timetable of organisational goals, including a schedule, procedures and targeted media for publication of the proceedings.
- A range of pre and post symposium of scientific field trips directed at a variety of disciplines (e.g. biology, ecology, geography, management and conservation) to locations within the region of the host country or adjacent to it.
- An accompanying persons program.
- Any special features such as civic receptions.

Nicholas Polunin

Dr. Charlie Veron Wins 2004 Darwin Medal

The Darwin Medal, the most prestigious award given by the International Society for Reef Studies, is presented every four years at the International Coral Reef Symposium. It is awarded to a senior ISRS member who is recognized worldwide for major contributions throughout his/her career. The previous recipients have been Drs. David Stoddart, Peter Glynn, Ian Macintyre and Yossi Loya. The next occasion at which the medal will be presented is the Tenth International Coral Reef Symposium, to be held in Okinawa, Japan from 28 June to 2 July 2004.

ISRS is pleased to announce that Dr. J. E. N. (Charlie) Veron has been elected to receive the 2004 Darwin Medal. Dr. Veron is Leading Scientist at the Australian Institute of Marine Science in Townsville, Queensland. ISRS President Dr. Nick Polunin will present the medal and Dr. Veron will deliver a plenary address at a ceremony in Okinawa scheduled for Tuesday 29 June.

For more information on the International Coral Reef Symposium, please see www.plando.co.jp/icrs2004.

International Society for Reef Studies: Financial Report 2002

Total cash assets as of December 31, 2002 were $174,991.48 all of which are in interest checking accounts. At the beginning of the year cash assets were $157,263.25, representing a net increase of $17,728.23. Income and expenses were as follows (all values represented in US dollars):

Income	
Memberships	63,873.00
Interest	3,324.29
Editorial Subsidies (from Springer-Verlag)	7,561.21
Sales (back issues of ISRS publications)	30.00
Editorial Consulting Fees	2,260.00
Total Income	77,048.49
Less Expenses	
Editorial Subsidies Paid	7,557.6
Travel Expenses	612.69
Postal Permit & Fees	8,233.47
Bank Charges	180.85
Credit Card Charges	1,266.93
Management Fees - Allen Marketing & Management	10,734.51
Marketing Fees - Allen Marketing & Management	1,433.95
Coral Reefs - Springer-Verlag	11,963.02
"Reef Encounter" - Allen Press	9,510.55
Student Travel Award Program	1,478.00
Miscellaneous[1]	6,181.70
Total Expenses	59,153.27
NET INCOME[2]	$17,895.222

Note 1: Miscellaneous expenses include books purchased by ISRS for distribution to marine labs in under-developed nations, fees for tax preparation, publications of membership directory, warehouse storage fees for back issues of publications, and Cambridge Meeting expenses.

Note 2: The difference between this figure and the “net increase” referred to in the first paragraph is due to checks written in one year and not cashed until the next year.

The **ISRS** continues to have good financial success and we expect this success to continue in the future to the extent that the Society meets its members needs. The Officers and Council of the ISRS are actively pursuing programs to best utilize the accumulating funds.

John R. Ware
Treasurer

2002 International Society for Reef Studies/The Ocean Conservancy Fellowship Winners

The **International Society for Reef Studies** (www.uncwil.edu/isrs) and The Ocean Conservancy (formerly the Center for Marine Conservation, www.oceanconservancy.org) awarded four fellowships this year. Many thanks to all of the students who submitted proposals and thanks to the reviewers for giving their time to this important job. All of the applications were of the highest quality, and the selection process was very competitive. The **ISRS** and The Ocean Conservancy congratulate the winners and wish them well with their research endeavors over the next year.

For information about the Fellowship contact: Dr. Peter Edmunds (Recording Secretary, ISRS), Department of Biology, California State University, 18111 Nordhoff Street, Northridge, CA 91330-8303, USA. E-mail: peter.edmunds@csun.edu

SPATIAL ECOLOGY OF INTENSIVELY HARVESTED REEF-TOP INVERTEBRATES IN THE COOK ISLANDS: RESPONSE TO TRADITIONAL MARINE RESERVES

Throughout the Pacific, many echinoderms and molluscs (e.g. sea cucumbers, sea urchins, trochus and giant clams) have cultural value and are harvested extensively in the subsistence fisheries. They often provide a substantial protein component to the traditional diet. Despite their importance, many of these species are either presently over fished or are vulnerable to overexploitation. This project applies spatial approaches to the study of invertebrates to aid in the management of vulnerable reef-top resources on Rarotonga in the Cook Islands. I will use remote sensing techniques and a Geographic Information System (GIS) to accurately map the position and extent of different reef top habitats. The information in the GIS provides the basis for designing a rigorous sampling program to assess the distribution and abundance of the invertebrate reef top resources in different habitats, and evaluate the effectiveness of existing marine reserves in conserving the fauna. The data will be analysed using multivariate statistics, ANOVA, and regression analyses along with machine learning techniques (e.g. artificial neural network's and regression trees) to investigate the distribution and abundance of the reef-top invertebrates, their relationship to habitat type, and response to the recent establishment of marine protected areas (ra'ui). This research project will establish an important GIS for reef tops and their resources on Rarotonga, Cook Islands, and increase our understanding of the spatial relationship between the marine invertebrate communities and habitats. It will therefore provide management agencies with excellent information for better monitoring the status of these resources and evaluating the effectiveness of current and potential marine reserves. The integration of marine ecology, remote sensing and GIS provides a new and exciting approach to understanding tropical marine ecosystems. This study will provide the tools and methods for the Cook Island Ministry of Marine Resources to develop a simple, repeatable monitoring program that would be applicable to other small island nations.

This project applies spatial approaches to the study of invertebrates to aid in the management of vulnerable reef-top resources on Rarotonga in the Cook Islands.

Darrin J. Drumm, Department of Marine Science, University of Otago New Zealand
Email <druda019@student.otago.ac.nz>

THE EFFECTS OF INCREASED SEA SURFACE TEMPERATURE (SST) AND DISEASE ON GORGONIAN CORALS IN THE CARIBBEAN

My dissertation research examines the effects of increased sea surface temperature (SST) and disease on gorgonian corals in the Caribbean. I will address two hypotheses: 1) temperature-induced bleaching increases gorgonian susceptibility to aspergillosis, and 2) aspergillosis negatively impacts gorgonian biodiversity. Temperature-induced coral bleaching and prevalence and severity of disease are associated with above average SSTs. While reports of coral bleaching and disease are increasing, many pathogens have not been identified or are not culturable in the laboratory. A gorgonian coral patho-gen was discovered and isolated in 1995. The pathogen, *Aspergillus sydowii*, is a fungus of terrestrial origin that infects at least five species of gorgonian corals, including sea fan corals, *Gorgonia ventalina* and *G. flabel-lum*, throughout the Caribbean and Florida Keys, USA.

My dissertation research examines the effects of increased sea surface temperature (SST) and disease on gorgonian corals in the Caribbean

The optimum temperature for *A. sydowii* growth is 30˚C and SSTs can reach 32˚C in the Florida Keys, USA. Monitoring of sea fans in the Caribbean suggests the disease is temperature dependent with increased disease prevalence and

severity during summer. The isolation of *A. sydowii* provides a unique opportunity to explore the relationship between temperature, bleaching, and disease. Temperature-controlled laboratory experiments and *in situ* studies will be conducted at Mote Marine Laboratory Center for Tropical Research in the Florida Keys, USA. Permanent transects in the Florida Keys, USA and Akumal, Mexico will be surveyed for gorgonian diversity and disease.

Jessica R. Ward, Department of Ecology & Evolutionary Biology, Cornell University
Email <jrw37@cornell.edu>

THE EFFECTS OF A MARINE PROTECTED AREA AND HABITAT ON THE STRUCTURE OF FISH ASSEMBLAGES OF ITACOLOMIS REEFS, MARINE EXTRACTIVE RESERVE OF CORUMBAU, BRAZIL

The Abrolhos reef complex is located in the northeastern coast of Brazil and it is the largest and richest reef of the south Atlantic[1]. Reef fisheries are the most important subsistence or commercial activity for thousands of people in the Abrolhos region and the increasing pressure of fisheries is leading to the first signs of overexploitation[2]. In a recent effort to integrate biodiversity conservation and sustainable fisheries in the Abrolhos region, the Brazilian Government, in partnership with a non-governmental organization and representatives of the local population, created the Marine Extractive Reserve of Corumbau (MERC). Inside the MERC, exploitation of marine resources is allowed only for local traditional fishers, most of who are descendents of Pataxós Indians. A preliminary fishery management plan includes the establishment of a MPA on the Itacolomis Reefs (the main reef complex) inside the MERC.

Itacolomis Reefs (16° 55'S, 039° 03'W) have an approximate area of 15 km^2. Reef structures are circular or elongate, attaining sizes that vary from a few meters to almost a kilometre wide[3]. The MPA extends from the central portion of the reefs to the eastern boundary of the MERC (about 4.5 km^2, Figure 1). In my Ph.D. research I will focus on the effects of the protection from fishing and habitat characteristics on the structure of fish assemblages (species biomass, abundance, richness and diversity/dominance), both inside the MPA and in adjacent unprotected sites at Itacolomis Reefs, during a three year time period (2002-2004). Twenty-one sites were selected for the sampling program: three sites inside the MPA and 18 sites in non-protected reefs located in different distance categories, to the northern and southern boundaries of the MPA (0-500, 500-1000, 1000-1500 m). Fish counts will be made by using a stationary visual censuses method and the following habitat characteristics will be measured in each site: reef area, volume, connectivity [measured by the proximity of a given site to nearby reefs and the availability of suitable reef habitat between that site and the marine protected area boundary (the later case applicable only to non-protected reefs)], substrate complexity and benthic organisms cover. Reef connectivity will be calculated by using field measurements and aerial photographs.

The present study would help in understanding the role of MPAs and the influence of habitat, particularly reef connectivity, in the conservation of biodiversity and recovery of fish assemblages on coral reefs in the short term.

The present study would help in understanding the role of MPAs and the influence of habitat, particularly reef connectivity, in the conservation of biodiversity and recovery of fish assemblages on coral reefs in the short term. The **ISRS**/OC 2002 fellowship will allow the acquisition of essential equipment for field data collections and cover part of travel and office expenses. My project is also financially and logistically supported by the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) and Conservation International Brazil. I am very thankful for this great support.

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Ronaldo B. Francini-Filho, Museu de Zoologia da Universidade de São Paulo, Caixa Postal 42594, 04299-970, São Paulo, São Paulo, Brazil. E-mail: rofilho@yahoo.com

DESIGNING MARINE PROTECTED AREAS FOR CORAL REEF MANAGEMENT IN AMERICAN SAMOA: LINKING MULTIPLE SCALES OF ENVIRONMENTAL STRESSORS

It is estimated that 11% of the world's reefs have already been lost, a further 15% are at a critical state[1], and nearly 60% are currently threatened by human activities[2]. Natural and anthropogenic disturbances are increasing, and a bet-

ter understanding needed. There is across multiple linkages will then tive approach to A primary and fun- (MPAs). Although

address several of these shortcomings and draw explicit connections to coral reef MPA design, function, and local management within the archipelago of American Samoa (AS)

of how these disturbances affect coral reefs is greatly need for integrated studies that link ecological processes spatial and temporal scales. Studies building on these form a solid foundation on which a more holistic and effec- coral reef management and conservation can be built [3,4]. damental tool in this effort is the use of marine protected areas much has been done in MPA management, little has been done to quantify the hierarchical linkages and cumulative effects of environmental stressors with the ecological connectivity between protected sites[5].

The goal of the proposed research is to address several of these shortcomings and draw explicit connections to coral reef MPA design, function, and local management within the archipelago of American Samoa (AS). In particular, the goals are to: 1) Analyze the hierarchical scaling and combinatorial affects of environmental stressors on coral reef community structure in AS, 2) Investigate the ecological connectivity between reef systems within the AS archipelago, 3) Address the influence of the arrangement and size of potential marine protected areas with regards to the ecological connectivity and scaling of environmental stressors, 4) Bring the implications from this research to the local marine protected area community as recommendations for use in the decision making process.

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Eric Treml, Landscape Ecology Lab, Nicholas School of the Environment and Earth Sciences
Duke University Email <eat4@duke.edu>

ISRS Library Awards for 2003

While many of us can take access to books and journals for granted, that's not the case in many places where important contributions are being made to coral reef studies. In 2002, **ISRS** came up with a new initiative to recognize these contributions, and to support future efforts in developing countries. Through the generosity of a number of authors and publishers, and a modest contribution of funds from **ISRS**, we were able to offer ten sets of books and three-year subscriptions to **Coral Reefs** and **Reef Encounter**. We received twenty-seven applications, and a committee of Council made their choice of ten successful applicants based on criteria of relevance of the applicant's mission to coral reef studies, the number of people who would make use of the materials, the quality of arrangements for access, and the track record of contributions made by the institution so far. All of the applicants would have made worthy recipients, but due to a limited quantity of books, we had to narrow our selection down to the following institutions.

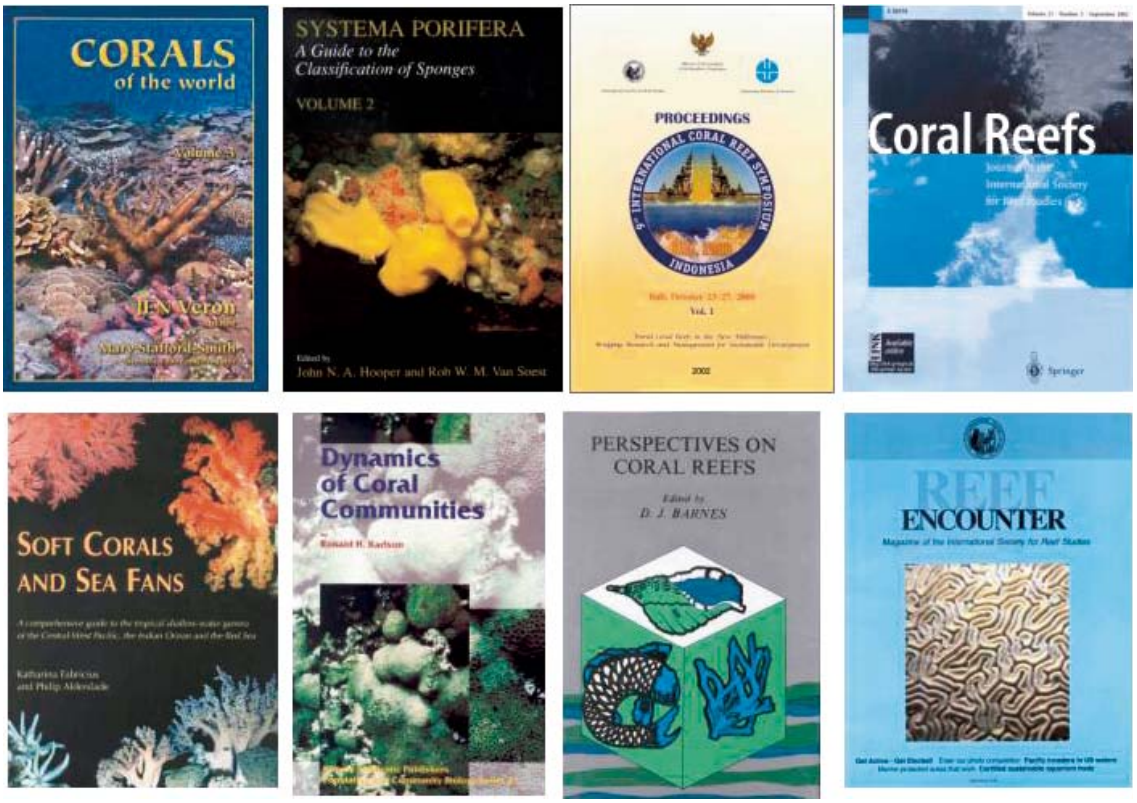
- Phuket Marine Biological Centre, Thailand
- Discovery Bay Marine Laboratory, Jamaica
- Marine Biological Station, Zoological Survey of India, Chennai, India
- Silliman University Marine Laboratory, Dumaguete City, Philippines
- The Institute of Marine and Coastal Research of Colombia –INVEMAR, Santa Marta, Colombia
- Institute of Marine Sciences, Zanzibar, Tanzania
- CORALINA, Corporation for the sustainable development of the archipelago of San Andres, Old Providence and Santa Catalina, Colombia
- Unidad Académica - Sistemas Arrecifales, Universidad Nacional Autónoma de México Puerto Morelos, Mexico
- University of Southeastern Philippines, Davao City, Philippines
- University of Asmara, Eritrea

Researchers and students in these labs will now be able to refer to the stellar works of John Hooper and Rob van Soest, Katharina Fabricius and Phil Alderslade, and Charlie Veron and Mary Stafford Smith for rich sources of biological

information and as the basis for the identification of sponges, soft corals and hard corals. Ron Karlson's book provides an excellent ecological framework for researchers trying to understand the ecological world in which these benthic groups operate. The Proceedings from the 9th International Coral Reef Symposium will provide readers access to the diversity of over 200 papers that were presented at Bali, and the subscriptions to Coral Reefs and Reef Encounter will further enhance access to recent papers and issues in coral reef studies. Dave Barnes' book – a key milestone from the early 1980s, is a convenient connection to earlier literature and to some enduring ideas just waiting to be rediscovered.

The Society thanks all these authors, the publishers Springer-Verlag and Kluwer, the Local Organizing Committee of the Bali Symposium, and AIMS, without whose generosity and support, this Award would not have been possible. Thank you all.

Terry Done, Chair, Library Awards Committee, 2003



Corals of the world (3 volumes)
By J.E.N. Veron and Mary Stafford-Smith.
One of the most comprehensive, authoritative and spectacular productions ever given to a group of marine organisms.

Soft Corals and Sea Fans
By K. Fabricius and P. Alderslade. A comprehensive guide to the tropical shallow-water genera of the Central-West Pacific, the Indian Ocean and the Red Sea.

Systema Porifera
Edited by John Hooper and Rob van Soest. This book provides a tool for biologists to document the rich biodiversity of the Porifera, and a unified classification for the phylum.

Dynamics of Coral Communities
By Ronald H. Karlson. This book focuses on the dynamical processes influencing the structure of coral communities, some of the most biologically diverse communities on earth.

Proceedings of the 9th International Coral Reef Symposium, Bali, Indonesia, 2000
These Proceedings are provided through the generosity of the Indonesian Ministry of State for the Environment and the Indonesian Institute of Science.

Three-year subscription to Coral Reefs (2003-5 incl.)
The publisher Springer-Verlag and the International Society for Reef Studies will provide a three-year subscription to the Society's journal Coral Reefs, that appears four times per year.

Three-year subscription to Reef Encounters (2003-5 incl.)
The International Society for Reef Studies will provide a three-year subscription to the Society's twice yearly newsletter Reef Encounter.

Perspectives on Coral Reefs
By David Barnes (Editor). A 1983 classic containing a series of reviews that were important in their time and are still useful today.

New ISRS logo

The ISRS is organizing a competition open to all ISRS members to redesign its logo. The contest commences February 1 and closes on April 30, 2004. The best logo submitted will be selected by an ISRS Council sub-committee and announced in Okinawa at the 10th International Coral Reef Symposium. The prize for the best logo will be 1 year's free full ISRS membership.

Entries should be emailed as attachments (pdf, jpg or tiff files, no larger than 500 kb) to Helmut Schuhmacher (h.schuhmacher@uni-essen.de) or Robert van Woesik (rvw@fit.edu) by 30 April 2004.

VAUGHAN'S RULER

Thomas Wayland Vaughan was a geologist and coral taxonomist who worked at the Smithsonian Institution in Washington DC in the early decades of the 20th Century. The Society's second president, Ian Macintyre, discovered the ruler with 'Vaughan' written in ink on the back. He donated it to the Society during his term as President, and it has been passed on to his successors. The plaque is inscribed with their names: David Stoddart (UK 1980-2), Ian Macintyre (US 1983-6), Peter Sale (Australia 1987-90), Charles Birkeland (US 1990-93), Bernard Salvat (France 1993-5), John Ogden (1996-1998), Terence Done (1996-2002) and Nicholas Polunin (2003-6).

Terry Done (President 1999-2002) holding Vaughan's Ruler, the symbol of office for Presidents of ISRS.

Love On The Rocks - Coral Spawning Takes Two

When it's springtime, love abounds for most creatures, but not for corals. Corals prefer a steamy August night. Only one night each year, they burst forth in an underwater reproductive display that rivals most spectacles in nature.

Coral spawning was recently discovered in the western hemisphere in 1990 when sport divers observed star corals 'smoking' - emitting a milky sperm into the warm Gulf of Mexico waters. Organized teams of volunteers and scientists only began studying the phenomenon eight years ago.

There are so many questions left unanswered. That's what Project Reef Spawn hopes to remedy. Teams of volunteers from all over the country are coordinated each year through Oceanographic Expeditions, a New Orleans agency that pairs divers with scientists to help with underwater research. The diver teams spread out over five locations during the spawning period, which occurs about a week after the eighth full moon of the year: Key Largo, Walker's Cay (Bahamas), Cayos Cochinos (Honduras), Flower Garden Banks (off Texas), and Belize.

They dive primarily at night - taking turns sometimes until early morning - waiting and watching for the corals to erupt. During the day, they can study videos of past spawning and learn about coral reproduction by experienced expedition leaders.

The data each team collects is accessed by researchers at Texas A&M, the Universities of Miami and Honduras, the Flower Garden Banks and Florida Keys National Marine Sanctuaries, Walker's Cay and coral researchers. So far, results have shown corals are fairly predictable.

Some corals release sperm and eggs separately from male and female colonies. Others produce egg and sperm within each polyp. The two are combined into BB-sized packets that are released wave-after-wave in a domino effect. The eggs drift like Alka Seltzer bubbles to the surface where they pop and form a thick slick. The larvae created float with the current until some environmental trigger makes them drop to the sea bottom.

Last year in the Keys for instance, divers made note that schools of barracuda and many other predators hovered over the corals during the spawn and that other fish seemed to lie in wait to consume the eggs.

One of the volunteer divers, Mary Casey, an ABC Network Correspondent, said: "Being able to watch the reef creatures well into the night enabled me to see things I have never seen on a night dive before."

In 2001, the August full moon occurred early in the month. Scientists felt the water temperature would not be warm enough, nor would the gametes be mature. They predicted a split spawn between August and September. True to predictions, the spawning was equally split between the two nights in August and September. Throughout the Atlantic, Caribbean, and Gulf of Mexico, divers were treated to the rare sight of millions of eggs, egg bundles, and sperm being released by star coral, brain corals, and a variety of invertebrates.

Divers helping the Audubon Aquarium of the Americas, collected egg bundles and planulae (coral larvae) to be grown in the Aquarium laboratories. These juvenile corals will help establish reef seeding procedures and preserve future reefs. Researchers hope the studies will improve the future of coral reefs. If coral spawning can be predicted and corals can be induced to spawn in captivity, we can reseed damaged reefs with new corals.

The role of volunteers is invaluable. "The value of simultaneous coordinated observations by volunteer divers can't be overemphasized," said Jim Hart, an oceanographer who often leads project teams at the Flower Gardens. "It is the dedication of volunteers that has made this particularly difficult search for information n our underwater world possible. Their efforts will be useful to marine scientists for years to come."

For more information on Project Reef Spawn, to interview researchers or to locate divers from your area, call Jim Hart, executive director, Oceanographic Expeditions, at +1 (504) 488-1573, or contact him via e-mail at Seascience@aol.com or visit their website soon at: seascience.com.

Canada designates Coral Conservation Area off Georges Bank

Last month, the Canadian Department of Fisheries and Oceans (DFO) designated a 424 square kilometer area of the Northeast Channel between Georges Bank and Browns Bank as a no bottom trawling/no gillnetting zone to protect extensive stands of deep sea corals there. Hookfishing is still allowed in a limited portion of the area.

The area was protected by the Canadian Department of Fisheries and Oceans through the issuance of a Canada Fisheries Act "variation order." DFO seems to have negotiated primarily with the commercial fishing industry in making its decision to protection the corals of the area.

Gene Shinn Wins 2002 Shoemaker Award for Distinguished Achievement in Communications

The 2002 Shoemaker Award for Distinguished Achievement in Communications has been awarded to U.S. Geological Survey (USGS) scientist Gene Shinn (St. Petersburg, FL). Below is the text of the message in which USGS Director Chip Groat informed Dr. Shinn that he had won the award:

"Congratulations, Gene Shinn! You have been selected to receive the 2002 Eugene M. Shoemaker Award for Distinguished Achievement in Communications. This award is given periodically to honor a U.S. Geological Survey (USGS) employee or private citizen who combines outstanding scientific ability with great skill in presenting complex scientific concepts to many different audiences. This lifetime-achievement award honors your standing in your professional field and your skill and enthusiasm for conveying science in multiple media. The first winner of this award was Gene Shoemaker in 1998 for his landmark contributions to the geology of the Earth, its Moon, and the Solar System, and his enthusiasm in educating the public and inspiring young students to enter the science field. You are the fourth recipient of this award since its inception.

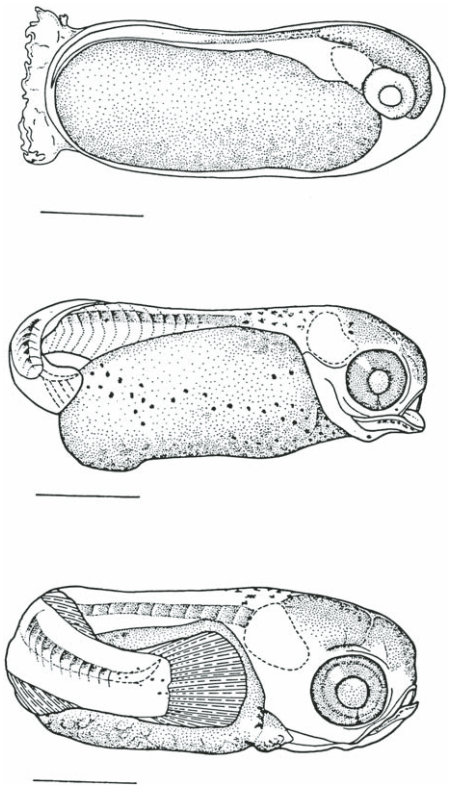
I know you are recognized nationally and internationally for your outstanding career in the field of carbonate geology, particularly your work on the effects of African dust on reef ecosystem and organizational health. But you are known as well for your skills as a communicator in presenting scientific results in words and graphics that captivate audiences of all types. Your keen sense of audience needs is key to effectively communicating complex and revolutionary scientific theories to a wide audience, ranging from scientific to nontechnical groups, including Federal agencies, private-sector groups, and the media. You have repeatedly been recognized by the scientific community for your work, appeared in the media as the USGS expert in your field, produced numerous videos and training films for use worldwide, and provided endless research and studies on an array of scientific topics. You epitomize the spirit of the Shoemaker Award for Distinguished Achievement.

I join with all employees in commending you for your efforts in communicating USGS science and its impact on a changing world. Thank you for a job well done! Formal presentation of this year's award will be held at the annual awards convocation in each regional center in spring 2003."

Reprinted from the Soundwaves Newsletter (Feb. / Mar. 2003) providing Coastal Science & Research News from Across the USGS (http://soundwaves.usgs.gov/)

Damselfish Eggs

A coral reef fish, the spiny damselfish, *Acanthochromis polyacanthus*, has huge eggs! The well-developed hatchlings measure over 5 mm and, remarkably, they are guarded for months by both of their parents. This highly unusual life history lacks a dispersive larval stage and consequently strong genetic differences have arisen between separated populations. Kathryn Kavanagh is studying the evolution of this unusual early life history and needs samples of eggs and new hatchlings from populations throughout the Indo-West Pacific. If you can help Kathryn, please contact her at kkavanagh@oeb.harvard.edu.



Damselfish Eggs

Comment on the Article '*Condylactis gigantea* – A Giant Comes Under Pressure from the Aquarium Trade in Florida'

A colleague recently sent me an issue of **Reef Encounter** (RE30), and asked me to comment on the *Condylactis* article, "*Condylactis gigantea* – A Giant Comes Under Pressure from the Aquarium Trade in Florida," because he could not reconcile the survey numbers with the harvest numbers. I analyzed the article's information, and have reached the following conclusions.

The article states, "Recruitment of sexually produced planula into natural populations is probably rare. *C. gigantea* is a gonochoric (separate sexed) broadcast spawner, has a 1:1 sex ratio of males to females, spawns at least during the summer, and the larvae are planktonic . . . There is the possibility that the distribution patterns we observed offer dismal prospects for population recovery . . . "

Central to any unbiased and representative estimate of a population of organisms, and the conclusions derived from it, is a series of survey areas placed in appropriate habitats that fairly represent the population distribution of an organism. The *Condylactis* article does not clearly state the reasons why particular survey areas were chosen for this study.

Conclusions drawn by the *Condylactis* article were based on the authors' analysis of their survey results, which were conducted on hard bottom and reef habitats and compared to commercial catch data. The commercial catch data cited in their article (11,800,000 per year) versus a transect count (15 in a survey length of 250 kilometers) suggests that *Condylactis* populations are in demise.

Surveys conducted on reef and hard-bottom areas are not appropriate to estimate *Condylactis* populations. *Condylactis* is found on inshore turtle grass soft-bottom habitats, on the top of grass flats in very shallow water (almost intertidal). Deeper turtle grass areas seldom hold *Condylactis* populations. In addition, even on shallow grass flats, *Condylactis* populations are very spotty, occurring at one end of a grass flat but not on the other. Where individuals do occur, they occur in high density.

As a consequence of this population distribution variability, a population survey method that fairly estimates the *Condylactis* population has been hard to establish. A better estimate of stock could be obtained by analyzing the landings in terms of overall increase or decline. However, as the *Condylactis* fishery is demand-driven (orders by aquarium customers) rather than catch-driven (food fishery), a companion study of the aquarium industry demand for *Condylactis* would properly assess any changes in catch.

The authors stated that "appropriate sampling can provide fishery-independent density and total abundance estimates." I would have hoped that the authors had applied this very valid statement to their own sampling methods.

Henry Feddern, PhD,
Florida Marine Life Association

Mask, Fins, Camera!!

I am no photographer, underwater or otherwise. I don't have expert knowledge regarding the latest camera gear available, and profess only the usual admiration for those who can take beautiful pictures. However, I do know what an excellent research tool an underwater camera is. Photographic images can be extremely rich in information and, if you haven't already done so, their potential for encapsulating data is well worth investigating.

Although photography as an aide to research really comes into its own if some sort of time series is established, a set of images from any day's underwater fieldwork can still be a great asset, especially when you are writing-up and trying to remember what happened on a certain afternoon months previously. What were the conditions like? Who was I diving with? Exactly how far off the seabed were those sediment traps? What did I fix that baseline to? How big were those coral heads? What species were spawning? What was that strange bubble-like slime? Now, a photographic record might not make up for poor note taking (or storing!), and it helps if you have something of known size included in your shots, but such information can be tremendously helpful if you have nothing else to go on other than your dive-addled memory. Don't forget that, when identifying tricky corals, although a photograph may be of limited use without an accompanying piece of cleaned skeleton; classification from skeletal samples can be a lot easier with a color image at hand (for us mortals at least).

Anyone who is conducting long-term monitoring, or has a field experiment in place (especially a transplant experiment), and who isn't using any form of photography is forfeiting a real opportunity. Now this may seem disingenuous, as underwater photography and video are well-documented research tools, but if the research does not necessitate it, then many will just not bother with the hassle of lugging a camera along with their regular kit. Too often, perfectly decent camera equipment is left gathering dust while researchers are preparing for their fieldwork. But so many unexpected things can happen! I took some pictures at the beginning, middle, and end of a transplantation experiment, primarily because I was interested in the morphometric information extractable from the images. My efforts were rewarded, not only with the measurement data, but also with rich findings on changes in pigmentation, variation in tissue loss and mortality, and differential levels of budding. Other researchers have successfully recorded coral growth, colony morphology, lesion regeneration, feeding activity, polyp bailout, sweeper tentacles in action, the list goes on . . .

Some people might feel that underwater photography is some kind of black art, and rightly so - if you want your pictures in National Geographic. But useful images can be accomplished with the minimum of training. My own experience has been with 35 mm underwater cameras made by Nikonos, or Sea & Sea. When used with a close-up frame (a mechanical device that protrudes from the camera), these complex machines metamorphose into point-and-shoot fun-things. All you need to do is read the instructions, and maybe find a friend to show you how to grease the O-rings. With the introduction of underwater housings for some digital cameras life is even easier – no close-up frames required, no separate strobe and cables, and no need to change film while all soggy and wet.

Not only do images provide us with memory-jogs or additional data, they can illustrate a finding in a truly wonderful and exciting way. And, as coral reef scientists, we are fortunate to have a journal (and a magazine) that provides us the opportunity to disseminate our images in their full splendor. This is not a plug - I presently have color photographs of non-reef organisms that I wished I had a similar outlet for. So, if you are about to conduct some coral reef fieldwork seriously consider investing in an underwater camera or housing. And if you have one stuffed on a shelf somewhere, take it down, dust it off, and pop it in your dive bag.

Peter Todd,School of Life Sciences, Napier University, 10 Colinton Road, Edinburgh EH10 5DT

R.E. (Bob) Johannes (1936 - 2002)

I first met Bob in 1977 drinking beer on the lawn in front of the Ratskeller at the University of Miami during the 3rd International Coral Reef Symposium. Bob and other heroes like Len Muscatine and David Stoddart were happy to talk about science to a recent PhD graduate who had just cited their names in a thesis. That started a 25 year friendship in science, a love of bushwalking, trout fishing and life; that for Bob ended on Wednesday, 4 September 2002.

He was known for starting many fields in our coral reef science. Since his nurturing, many of these fields have gone on to develop further, as he moved onto the next area that interested him. His interests were wide as he read voraciously across disciplines. Many of Bob's papers are first cited e.g. nutrient transfer and exchange across reefs and corals (remember the Eniwetok experiments), the role of zooplankton on reefs etc. He was probably one of the first microbial ecologists to work on reefs. These are just two examples of his many areas of expertise.

Bob was never afraid to attempt something different. He was criticised by the science establishment as 'going troppo' when he packed up his wife Chris and infant son Greg and lived for a year in a fishing village in Palau. Bob gained the confidence of the local fishers through his patience, knowledge and the fact that he was a competent fisherman and could hold his own with them in spear fishing competitions. The scientific community gained an order of magnitude leap in knowledge of coral reef fishes and he spawned two very popular themes of current coral reef inquiry – ethnobiology and the study and conservation of mass spawning aggregations of coral reef fishes. When he first proposed that many of the larger target species of fishes (serranids, lutjanids etc.) would assemble in thousands on specific days around the new moon to spawn, many fisheries biologists disbelieved him because studies at the time were on small, site-specific species. The fishers in Palau knew about the aggregations and Bob was able to confirm these via direct observations. I recommend that you read 'Words of the Lagoon' published in 1981[1].

Bob tried to move on from ethnobiology, but this field developed rapidly, especially as a valuable tool to assist management through the use of Traditional Ecological Knowledge and Management systems (TEKMS). He was regularly invited to conferences as the keynote speaker in this discipline. He also became a leader in creating a sustainable reef food-fish trade in the Pacific by working with local fishermen and businessmen in Hong Kong.

Bob was frustrated at the reluctance of scientists to promote the necessary urgent management action until they had sufficient data. I also suggest that you read the case for data-less management – which is another way of expressing the precautionary principle[2].

Bob was particularly calm in a crisis and the master of understatement. One anecdote concerns shifting a piano upstairs; his companions paused and put it down, then Bob quietly asked could they please lift it off his foot. Another occurred during experiments to assess nutrient exchange across the flats of the Abrolhos reefs in Western Australia. I looked over to see Bob bent double in water up to his knees with one hand under water. He quietly called "Steve (S.V. Smith) – I think I have a problem." Bob had been searching for a meal of octopus and had his hand firmly stuck in the mouth of a moray eel. He then continued to work with a shredded hand.

Many people around the world like me regarded Bob as a very good friend, somebody who was always willing to listen and assist. He was a real hero of the coral reef world and to reef peoples, especially those in the Pacific, whose lives are enmeshed in reef resources and are asking for assistance in their management. It is up to the rest of us to continue this work – a job made harder without one of the truly great personalities of our coral reef world. Thanks Bob – we will miss you.

Clive Wilkinson

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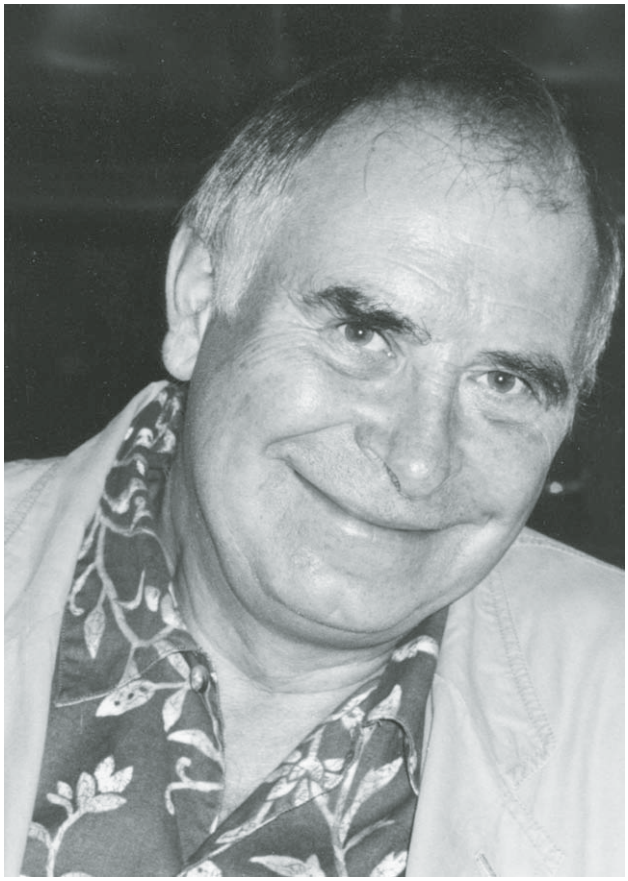
Terry Scoffin (1941–2002)

Terry Scoffin died on 23rd November 2002, age 61, after a fight against cancer. With his passing, the **International Society for Reef Studies** has lost one of its founding members, the Journal **Coral Reefs** has lost one of its most dedicated reviewers and editors, and reef science has lost one of the most innovative reef geologists of our times. For many reef scientists around the world, it also means the loss of a great friend and colleague.

Terry was born in Selby, England, on 6th January 1941. After a sport-filled youth, he went to Swansea in 1959 to study for his BSc in geology. His long career of reef research started when he stayed on at Swansea for his PhD, investigating the Silurian reefs of the Much Wenlock limestone in England. He moved to Liverpool in 1965 on a post-doctoral fellowship, where he started his investigations of modern carbonate sediments in the Bahamas, focussing on observing and quantifying organism-sediment relationships. It was around this time that he got his nickname, "Black Dog," after the character in Robert Louis Stevenson's Treasure Island . . . apt because of his love of adventurous expeditions to tropical islands, rather than because of any striking similarity to the character in the book!



In 1967 he accepted a Lectureship in the Geology Department of Edinburgh University in Scotland where he remained until his (early) retirement in 1995. At Edinburgh he continued his study of ancient limestones in Europe, but most of his research became directed towards the study of modern carbonate environments, predominately modern coral reefs, but including deep water corals and temperate carbonates in the N. Atlantic. His research took him to the Great Barrier Reef on a 5-month Royal Society expedition in 1973 and on five subsequent occasions, to the Cook Islands in the central Pacific, to Thailand, Indonesia, the Maldives, Barbados, Bermuda, St Vincent, Jamaica, and Papua New Guinea. This resulted in 80 research papers, including first authored works in the journals *Science* and *Nature*, and an undergraduate level textbook on carbonate sediments and rocks. He was supervisor to 17 PhD students, as well as playing a very active role in the teaching, fieldwork and social life of the Department of Geology at Edinburgh. As a founding member of **ISRS**, he was on the Council from 1981 to 1986, and he was an Advisory Editor for **Coral Reefs** until 1992.

Terry's academic achievements were recognised through his winning of two best-paper-of-the-year-awards, the first, in 1970, towards the start of his research career for work on the effects of algal mats on sediment trapping and binding, and the second, in 1992, for his insightful review of the taphonomy of coral reefs in the journal **Coral Reefs**. He was elected a Fellow of the Royal Society of Edinburgh, and held visiting Professorships in Calgary, Bergen, and University of the West Indies. He was promoted to Reader at Edinburgh University in 1982.

The bare factual summary of some of Terry's achievements only goes part-way to conveying the essence of what made him so special as a reef scientist. Terry was always hugely enthusiastic, energetic and creative. He particularly enjoyed fieldwork, and it was perhaps in this sphere that he excelled the most. He possessed a tremendous gift for using field observations to identify key processes that mould the development and growth of corals and coral reefs. Once Terry pointed these connections out to you in the field, it was 'obvious' . . . why hadn't we thought of that before? The answer lay in Terry's creative and lateral-thinking approach that allowed him to quickly see what mattered. Examples of this talent are evident in his work on the nature and significance of coral microatolls, his work on the significance of marine vegetation for determining sediment transport and accumulation, his contribution to the seminal carbonate budget studies conducted on reefs in Barbados, and the insights that he summarised in his review on the taphonomy of coral reefs.

Terry's creativity didn't stop at visual observation. He was always thinking about new ways to collect samples, take photographs, make films, or conduct experiments in the field. For example, he designed and built an underwater flume, made a film about the reefs and geology of Barbados, and

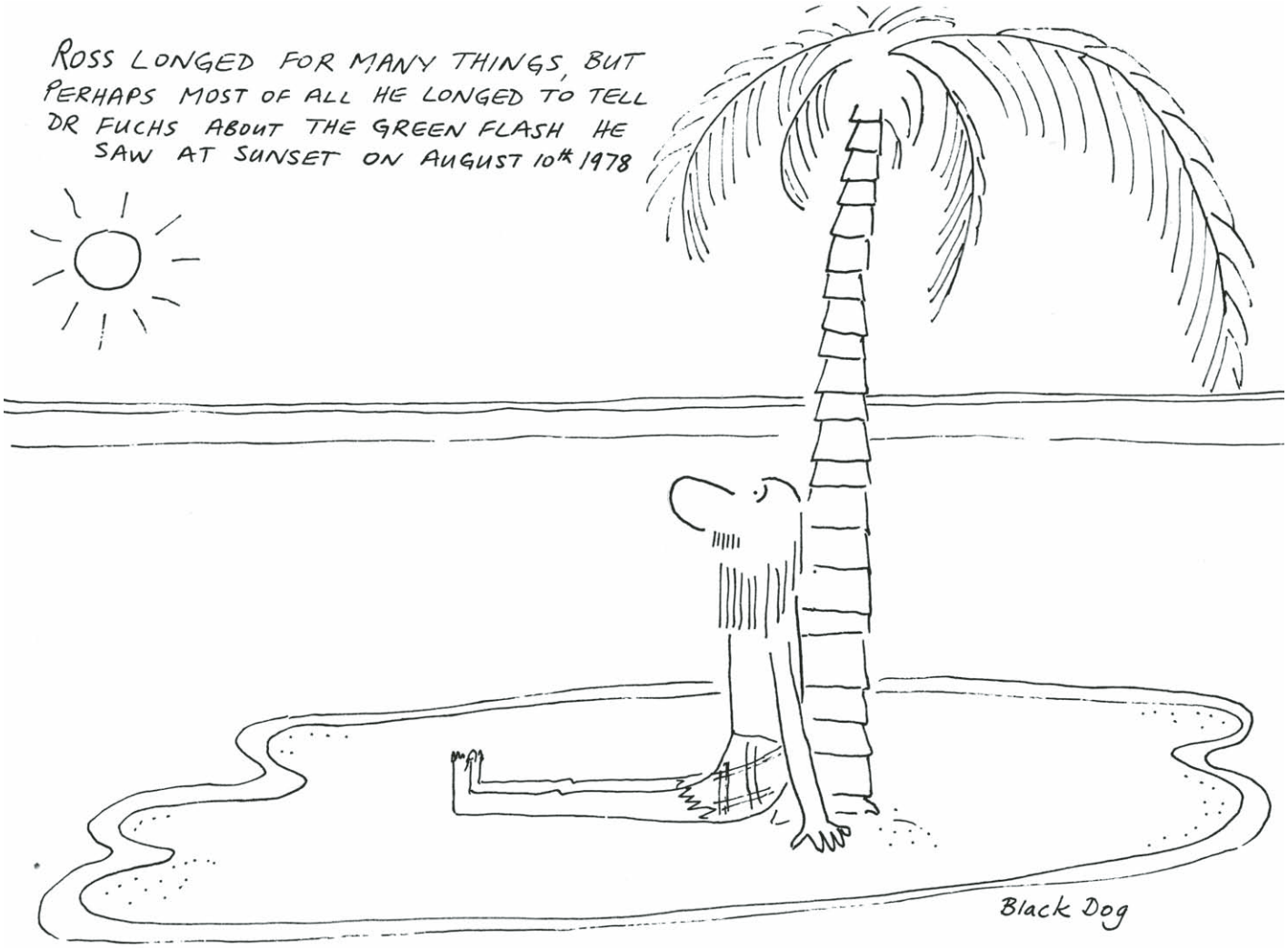
used underwater pneumatic drills and saws - all in the late1960s and early 1970s. Later on, he developed the use of kites and helium balloons for aerial surveys of reefs . . . extremely effective as well as fun to use . . . and designed devices for sampling and experimentation from manned submersibles.

Another essential aspect of Terry was his great sense of humour and incorrigible laugh; few people can tell a story or a joke quite like Terry could. This humour became invaluable to his colleagues in the field. When things were going badly wrong . . . it was excruciatingly hot, the rats had broken into your only food supply, the outboard engine had broken down and you were drifting off into the central Pacific, or you'd just found a live scorpion in your bed . . . it was then that you really appreciated having Terry with you . . . with his ability to see the funny side of the situation and to make some typically quick-witted quip to ease the tension. First he'd make the joke, then he'd bend his back to get the job done or the problem solved.

Terry has left us with a very significant legacy of progress in reef science, and in particular, in the connections between geology and active processes on reefs. He achieved all this whilst maintaining an extremely active and broad range of 'outside' interests. These included music (playing and composing), writing short stories, photography, playing a wide range of sports (many of which he excelled in), creating a series of cartoons (about a man shipwrecked on a desert island), re-building an old barn in the south of France, and organising elaborate social events. But above all, Terry always made time for his family and friends. He is survived by his son, Patrick, and by his partner, Pauline.

Sandy Tudhope
School of GeoSciences, Grant Institute, Edinburgh University, West Mains Road, Edinburgh EH9 3JW, Scotland, U.K. Email <Sandy.Tudhope@ed.ac.uk>

Editor: Terry contributed many cartoons to **Reef Encounter** *over the years under the name of Black Dog and we have reprinted one here.*



A preliminary assessment of the coral reefs of Europa (Mozambique channel)

Figure 1. Aerial view of Europa (30 km^2

Europa (22°21'S-40°21'E), a small (30 km^2), French coralline island, is located in the southern Mozambique Channel, 300 km west of Madagascar. It is one of the few remote coral reef locations remaining unaffected by humans in the Western Indian Ocean region. The waters surrounding the island are known to support coral communities, but the biodiversity and species richness of these reefs has never been surveyed and studied in any detail.

Europa (also known as Iles Éparses Françaises) and the islands of Juan de Nova, Glorieuses, Bassas da India and Tromelin were declared an environmentally protected area by the French government in 1975 (**Reef Encounter 26: 33–36**) due to their great importance for turtle and seabird breeding. Since this declaration, there have been no permanent residents on Europa other than French meteorological and military personnel.

Early last year (15–19th April 2002), observations and reef surveys were conducted from the Quiksilver-sponsored vessel, *Indies Trader*, as part of the Reef Check monitoring program. The two marine biologists who participated in the monitoring program were from the Agence pour la Recherche et la VAlorisation Marines (ARVAM) and represented the Global Coral Reef Monitoring Network (GCRMN) and Coral Reef Degradation in the Indian Ocean (CORDIO) network. The objectives of this study were to:

- Map the shallow marine habitats,
- Establish a permanent system for the long term monitoring of invertebrates (including corals) and fish communities,
- Undertake the first inventory of corals and fish, and assess the diversity; and
- Identify natural and human threats, especially evidence and incidence of coral bleaching.

Surveys were performed in the lagoon, on the fringing reef and on the outer slopes, constituting a depth profile from 0 to 30 m. Snorkeling and scuba diving were used to describe habitats and to assess the reef diversity, with one permanent monitoring transect (PMT) having been installed at Anse Gabriel.

Marine Habitats

The island itself is the emergent part of a fossil atoll and is only 6-7m above actual sea level at its highest point. The older, eroded karst structure of this emergent atoll can be easily seen on the coast of the island where the shore is formed by a fossil ridge indicative of higher sea levels during the Pleistocene. Five sandy beaches can be found around the island, all of which are important turtle nesting sites. These beaches are particularly important given that Europa is one of the most important breeding sites in the world for the green turtle, *Chelonia mydas*, with 8,000 to 15,000 nests per year.

The intertidal zone is a reef flat that maintains low coral cover and is dominated by algal turf, most of which is composed of cyanobacteria (*Lyngbia* spp.). A fringing reef occurring along the north coast (Figure 1) was found to have the highest species richness and diversity of hard corals. At this same reef, significant coral recruitment was also observed with numerous 5-15 cm *Acropora* colonies, suggesting a coral settlement of 3-4 years ago.

The lagoon is very shallow (<1 m deep) with no significant connection to the open ocean during low tides (tidal range is up to 4 m), yet it supports numerous habitats. Coral communities are present, but there was evidence of recent mass mortality, especially in *Acropora* spp and *Fungia* spp where the majority were found to be dead. This high mortality may have been due to the 1998 coral bleaching event which was reported to have affected other reefs in the Mozambique Channel. *Porites* spp was the most abundant of corals encountered in the lagoon. Seagrass beds, while reported in literature, are not well developed (composed of three species, *Thalassia* sp, *Halodule universis*, *Halophila ovalis*) and are not suspected to feed the resident turtle population. Mangroves are found in the channels of the lagoon and are regularly inundated through karstic holes connected directly to the ocean.

> Considering the geographical position of Europa, it may have been one of the first coral systems affected by warm waters in the region.

The outer reef slopes have good live coral cover nearest to the crest. The width of the slope is usually very narrow reaching a maximum depth of

6-7m before becoming a vertical drop. There is one exception on the north side of the island where a 12 m plateau occurs, dominated by *Millepora* colonies. The detailed results of the Reef Check survey (not included in the present document) have been sent to the coordination unit for incorporation into the world report (see **Bookshelf**). Data will also be entered into the COREMO (ARMDES adapted) database and will contribute to the regional GCRMN status report. According to the GCRMN protocol, live coral cover (hard and soft species) at the PMT was estimated at 58% (36% for hard coral and 22% for soft coral).

Mapping the shallow marine biotopes of Europa is one of the goals of the programme and the biotope map (Figure 1) will be regularly updated with information from aerial photos and future ground truthing.

Coral Bleaching

Recent coral bleaching was not observed, but algal cover on dead coral colonies was significant in both lagoon and outer slopes. This suggests that Europa, similar to those observations made in East Africa, Madagascar, Mayotte, Comoros and Seychelles, was affected by the 1998 coral bleaching event and subsequent mortality resulted. Considering the geographical position of Europa, it may have been one of the first coral systems affected by warm waters in the region. The coral appears to have been most affected on the upper part of the outer slope and in some sites of the lagoon (a great number of dead *Fungia* spp. and large stands of dead *Acropora* cf *muricata*). Recovery (3-4 year old colonies) appears to have been slow and suggests that, as a source and/or sink, Europa is sub-optimal when compared to Mayotte, where coral cover is actively increasing.

Europa may be considered a strategic location for a coral beaching alert system for the Indian Ocean as part of the CORDIO network. For this purpose, a temperature data logger was installed at the PMT.

one of the few reefs which remain unaffected by humans in the Western Indian Ocean

Assessment of Marine Diversity

During this survey, specific attention was given to the fish and hard coral communities at 14 stations, from the surface to 30 m depth. The survey identified 33 hard coral species (22 on the outer slopes and 17 in the lagoon) and 150 fish species. Soft corals, algae and other benthic species were not assessed. Significant development of soft coral was, however, observed on the majority of the outer slopes that were surveyed.

Fish fauna is benefiting from 25 years of conservation as Europa is a *Réserve Naturelle* (since 1975), with an amazing abundance of carnivorous species (e.g. groupers such as *Variola louti* and *Epinephelus tukula* and snapper such as *Lutjanus bohar*).

Samples of coral, algae, plankton and shells were collected for future identification. This included the collection of potentially harmful dinoflagellates that were isolated from algal turfs for further culture in Réunion, as part of AlgoBank project.

The general information collected on Europa's marine ecosystems, coral and fish species richness and diversity will be used as a baseline for further studies as part of the IFRECOR (French coral reef initiative) action plan.

Threats

Coral bleaching and related mortality is clearly a major threat to the reefs of Europa. However, other threats are minimal as there appears to be no harmful human use of Europa's marine resources. There were no indications of oil spills or contamination during the exploration of the shoreline, nor has this been noticed in the past by military personnel stationed there. Fish poaching is not known in these waters and fish communities were considered to be pristine, with numerous carnivorous species (e.g. groupers, snappers, jacks) present. Crown-of-horn starfish may also be seriously affecting the corals with a significant aggregation (more than 130 individuals) observed at the PMT site.

Figure 2. Evidence of the recent mass recruitment of branching corals on the fringing reef.

Islands such as Europa are particularly vulnerable to human pressure and global threats, and it is therefore of great importance to have a better understanding on the patterns of recruitment, resistance and resilience of these remote coral ecosystems.

The Future

A *Shallow Marine Ecosystem Programme* has been set up this year to highlight these scattered, remote islands of the Mozambique Channel. This strategy is promoted by France under the umbrella of IFRECOR and represents an important contribution to networks such as Reef Check, GCRMN and CORDIO. From 2002 to 2006, monitoring and research activities will be developed at Europa, Juan de Nova, Bassas da India and Glorieuses (Tromelin, which is located in the "open" ocean side, will not be monitored).

These unique islands are invaluable and integral components of the marine ecosystems in the Western

Figure 3. Map of Europa.

Indian Ocean, and their conservation value needs to be recognised at both the regional and international level. This island will be proposed as a UNESCO World Heritage and/or Ramsar Convention site in the near future. This proposal for World Heritage sit status was made at last year's workshop held in Hanoi, Vietnam. As with this and other opportunities that recognise conservation value and imporatance, these should include both terrestrial and marine biodiversity and endangered species. To achieve these goals in the region, there is an urgent need to strengthen marine programmes on these remote islands of the Mozambique Channel.

Jean-Pascal Quod and Rémi Garnier
ARVAM, 14, rue du stade de l'Est,
97490, Sainte Clotilde,
France Réunion
Email jpquod.arvam@wanadoo.fr or
rgarnier.arvam@wanadoo.fr

Acanthaster planci on La Réunion Reefs (Western Indian Ocean)

Acanthaster planci, the crown-of-thorns starfish, is the subject of numerous studies and extensive debate in the tropical Indo-Pacific[1,2,3,4]. It is present on the fringing reefs of La Réunion, but has never been the subject of a census there. Following observations by divers and a survey of several diving clubs on the damage to coral by the individuals encountered, a study was undertaken in 1998 by the Ecomar Laboratory (Université de La Réunion). A survey form was prepared and distributed to both volunteers and individuals involved in the local marine environment (i.e. Marine Park Association, diving clubs, students and scientists). The form asked the surveyor to note general observations (date, hour, site, depth, type of environment), whether the observations were made via a scuba diving or snorkeling, the duration of the observation and precise data on the number and diameter of the *Acanthaster* observed.

> the general occurrence of Acanthaster on La Réunion reefs has declined since 2000

Among the 352 forms returned from 1998 to the end of 2000, 130 reported *Acanthaster*. However, several observers only filled in the form when the starfish was present, resulting in an over estimation of the presence of crown-of-thorns starfish.

From the observations collected, data have been analyzed to illustrate: 1) the distribution of *Acanthaster* on the different reef complexes and the population densities; 2) the distribution of *Acanthaster* with the depth, type of environment and night/day presence; and 3) the size structure of the populations.

1. *Distribution of Acanthaster on the different reef complexes and the population density*: La Réunion island has reefs located on the western coast (Figure 1) where the zones of study were demarcated (1 to 24). In each of the zones, the number of *Acanthaster* observations and the density were evaluated per 30 minutes. It appears that most observations are located on the western coast, and specifically zones 2 to 5 and 12 to 14 *Acanthaster* have been observed regularly. The variations of density observed from 1998 to 2000 show that there is a slight decline in these zones. The overall density, except in zone 3 rarely exceeds 4 individuals per 30 minutes.
2. *Characteristics of the Acanthaster distribution*: The distribution of the *Acanthaster* according to the type of environment was observed (Figure 2). *Acanthaster* was primarily found on coral reef substrates, but had also been noted to be present on rocky substrates. The difference in distribution of *Acanthaster* between the reef habitats is very clear with 83% found on the outer slope and 17% on the reef flats (although a bias could come from the unrecord-

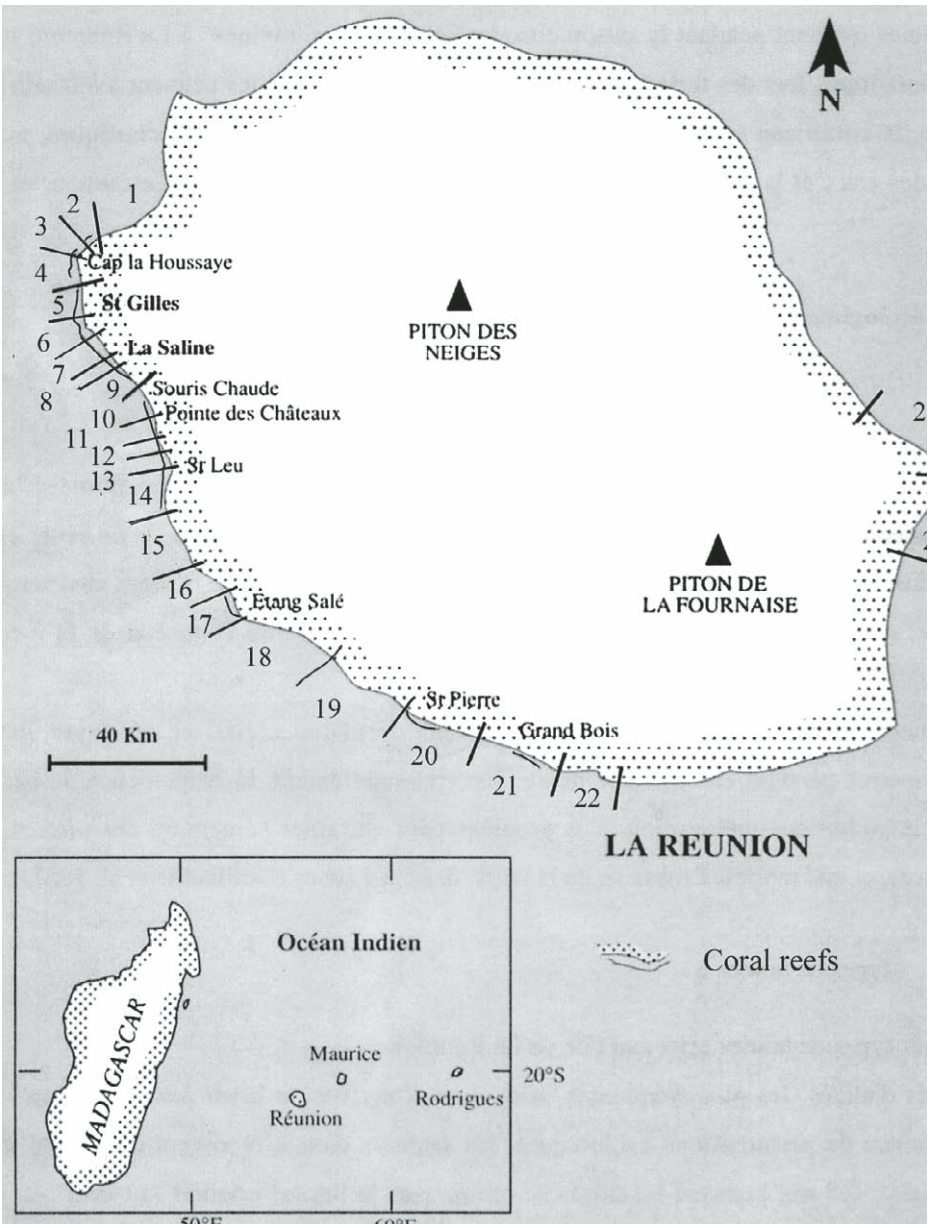


Figure 1 La Réunion and the 24 zones of the study

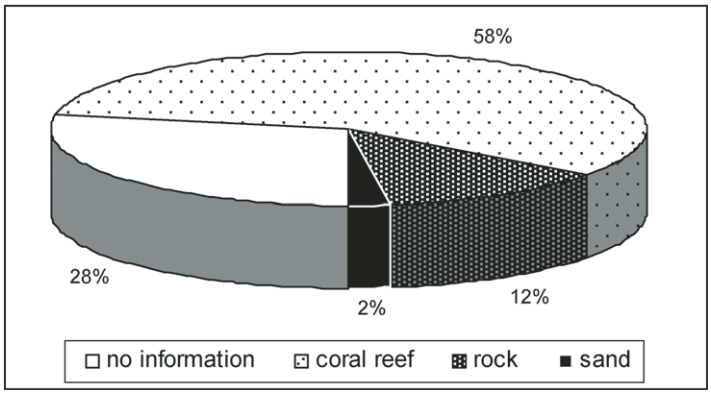


Figure 2 Occurrence of *Acanthaster* according to the habitats (% dives).

ed absence of *Acanthaster* during snorkel observations). Most of the *Acanthaster* are found around 6 meters and were very rarely deeper then 20 meters. The night versus day observations revealed there was no difference in the percentage of dives where *Acanthaster* had been observed (36%).

3. *Size structure of the populations*: Figure 3 shows the size distribution of *Acanthaster*, both on reef flat and outer slope, as percentages of the overall observations in these habitats. For both habitats, the distribution is roughly the same. The average size is large at 40 cm, with individuals under 30 cm very rare. These results show that the populations observed are not outbreaks and that the individuals are mostly adults[5].

In conclusion, this was the first study to describe the main characteristics of *Acanthaster* in La Réunion, where the starfish was found to be present in many sites, but with low densities and populations that were mostly composed of large individuals (35-45 cm diameter). Although the reefs suffered from the bleaching event[6,7] of 1998, no increase in the population, nor occurrence of juveniles, has been observed. Nevertheless, the general occurrence of *Acanthaster* on La Réunion reefs has declined since 2000.

Further work is being undertaken on the genetics of the species[8], with work still in progress on the variation in mtDNA derived from RFLP (Restriction Fragment Length Polymorphism) analysis of five samples of *A. planci* from La Reunion. This work has shown that these genotypes cluster closely with those from South Africa and Mauritius in a "Southern Indian Ocean group". This group is distinct from a "Northern Indian Ocean group" composed of samples from Thailand and the Maldives, and more distantly from the Red Sea. All the Indian Ocean animals form a distinct group relative to those of Pacific Ocean or Southeast Asian origin9.

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J Emeras, M-P Falquet and C. Conand
Laboratoire d'Ecologie Marine, Université de La Reunion, 97 715 Saint Denis

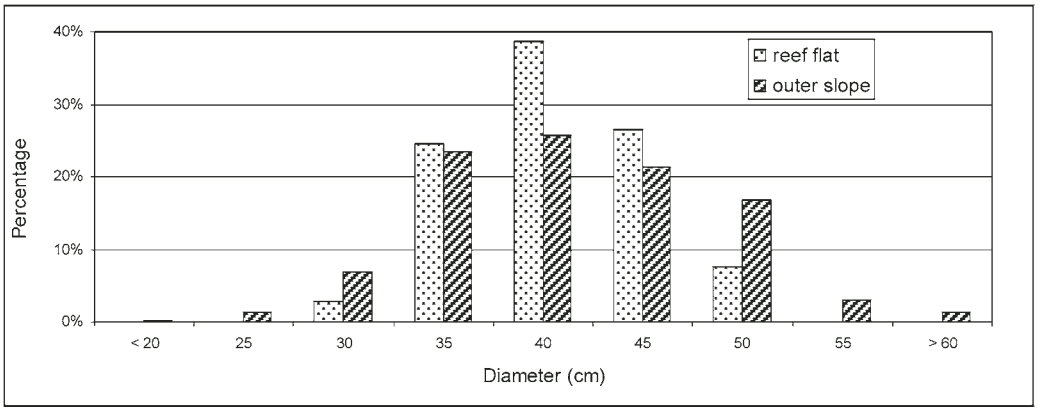

Figure 3 Size distribution of *Acanthaster* on the reef flats and outer slopes of La Réunion.

Species Composition And Distribution Of The Scleractinia Of Vietnam

356 species of scleractinians are known for Vietnam

To date, little information has been available on the coral reefs of Vietnam. The first record of Vietnamese scleractinians appeared in 1937 in a paper by Serene[1] which was devoted to the results of his expedition aboard the De Lanessan. In this paper, Serene mentioned 64 species of scleractinians belonging to 33 genera. A more comprehensive list of scleractinians, mainly of Southern Vietnam, was presented 15 years later by the well-known Russian naturalist Dawydoff[2]. This list included about 230 species of scleractinians belonging to 51 genera (though 5 to 12 species are considered synonyms of each other).

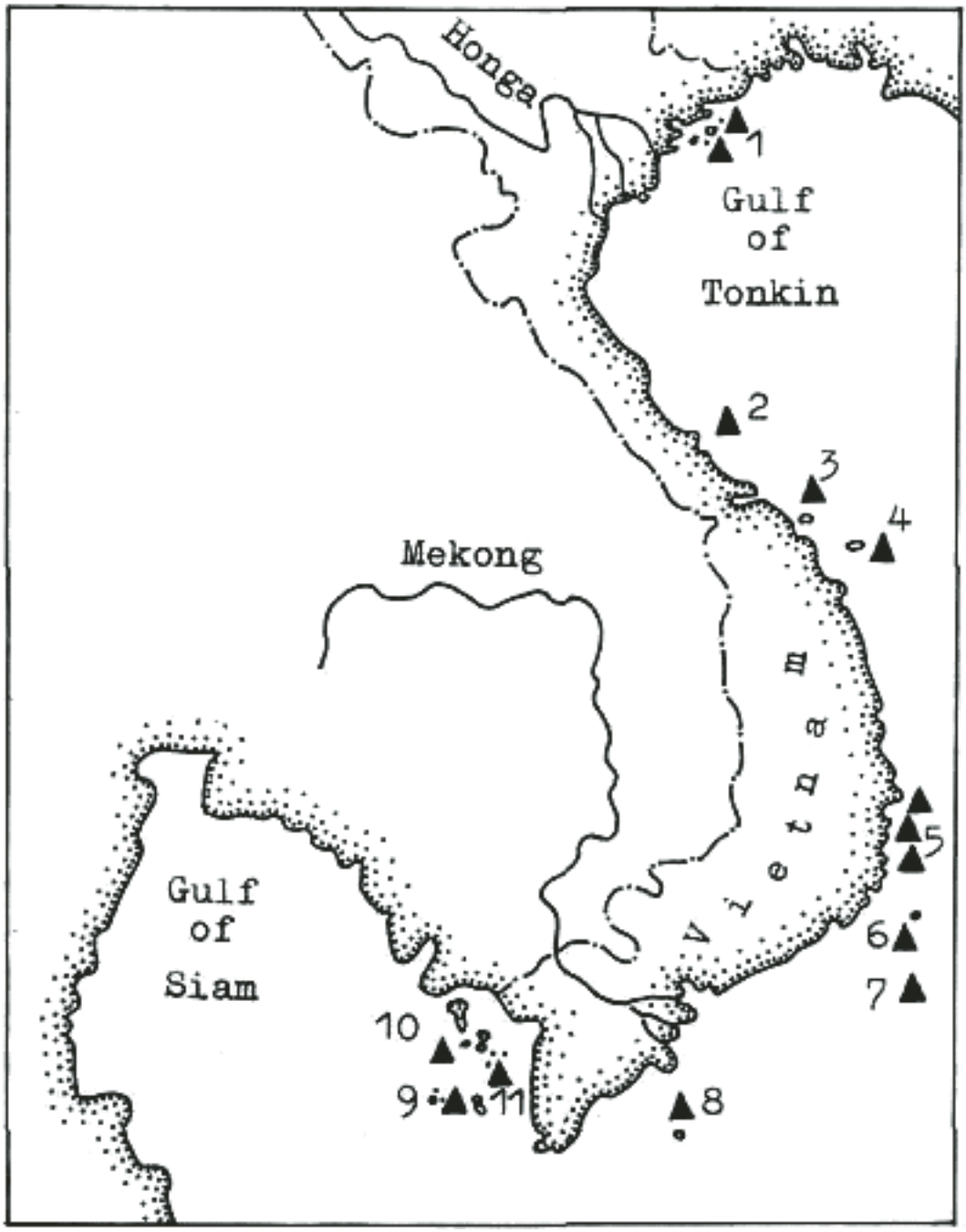

Figure 1. Location of study areas. -1-Baitylong Archipelago, 2-Island Ze, 3-Cape of Danang and Island Thyam, 4-Island He, 5-Phuknan Province, 6-Island Tchu, 7-Katuik Islands, 8-Kondao Islands, 9-Island Tchotyu, 10-Antchoy Islands, 11-Namsu Islands.

Since 1980, regular expeditions to survey and study Vietnamese coral reefs have been carried out through the collaborative efforts of The Institute of Marine Biology (Far East Branch, Russian Academy of Sciences), the Institute of Oceanography (Nha Trang) and The Haiphong Institute of Oceanology (Haiphong). Altogether, ten marine and land-based expeditions from the northern part of the Gulf of Tonkin to the South Kon Dao Islands, including the reefs of the Bay of Thailand, have been undertaken, amounting to studies of 56 reefs in 11 different areas (Figure 1). Descriptions of the reefs themselves and the analysis of coral distribution and some associated plants and animals in certain areas have been presented in several papers elsewhere[3,4,5,6,7].

At present, 356 species of scleractinians, belonging to 71 genera, are known to be found in Vietnam. Of these 356 species, 111 species and 23 genera were previously unknown for this region, while ten species of five genera appeared as new ones. The majority of species are represented by five genera, *Acropora* (59 species), *Montipora* (26), *Porites* (17), *Favia* (13), and *Fungia* (12), which is a similar composition to that found on most Indo-West-Pacific

reefs. These five genera represent as much as 35% of the entire species composition of Vietnamese scleractinians and one third of the total species are found in 75% of the habitats. Two thirds of the scleractinians are distributed in more than half of the areas, and only about 15% of the species are rare and are found in one or two areas. Almost the same ratios in the distributional structure of species composition of scleractinians have been observed in the reefs of Japan, Indonesia, and the Great Barrier Reef[8,9].

Homogenous conditions for reefs occur along the entire Vietnamese coast leading to the creation of a uniform species composition of reef-building corals in the region. Varying little in their species abundance, the reefs of all areas have no less than 60% of species in common. The homogeneity of Vietnamese coral fauna can be further illustrated as there were no distinct groupings of species, genera, or other taxa of scleractinians found, and they were not clearly geographically restricted in range, nor did they show any other significant features in their distribution. Even in the Gulf of Tonkin, distinguished for its rather extreme conditions for coral growth, more than one third of the entire species composition of Pacific coral fauna occur, while 28% of these species are known from almost all reefs of the tropical Indo-West-Pacific. Only some restructuring of the community occurs here. The species with massive, encrusting, and funnel form colonies (*Porites lobata, Goniopora stokesi, Echinopora lamellosa, Turbinaria peltata, and Pachyseris rugosa*) are more widely distributed, whereas in typical Indo-West-Pacific reefs they settle in the depths exceeding 20 m, where the intensity of illumination is decreased.

Specific hydrological conditions influence the development of coral composition in Gulf of Tonkin and the Bay of Thailand. The shallow nature of both bays, the great eutrophication and turbidity of water, and the prevalence of clay deposits create similar conditions for reefs and thus similar compositions of coral communities. Representatives of the genera *Palauastrea* and *Caulastrea* have yet to be found in both bays, along with *Acropora palifera*, a species typically found on most reefs. The corals of the genera *Plerogyra* and *Physogyra* are not found in Gulf of Tonkin, while the genera *Pachyseris*, *Micedium*, and *Pectinia* have not been found (to date) in the innermost and coastal parts of the Bay of Thailand. However, some species of the three latter genera and the rare *Physogyra* and *Plerogyra* are known on Hai Nan and Tho Chu Islands and in the open parts of both bays. A wide distribution of massive colonies of *Porites* genus, which form not only vast monospecific settlements, but also communities with high species diversity (no less than 10 species), is characteristic of both bays. Conversely, representatives of *Pocillopora* genus, usually common on most Indo-West-Pacific reefs (5-7 species), are rare in the Bay of Thailand and Gulf of Tonkin (no more than 2 species), whereas they are common on the reefs of islands in the open parts of bays (Tho Chu and Hai Nan Islands). On the whole, species compositions of scleractinians of Gulf of Tonkin Bay and the Bay of Thailand, comprising 72% of common species, are comparable in both quantitative and qualitative respects.

species diversity of scleractians on Vietnamese reefs is one of the greatest throughout the Indo-West-Pacific

However, according to the most recent information, the most comprehensively studied reefs of Indonesia, the Philippines, and the Great Barrier Reef have no less than 350 species of reef-building scleractinians belonging to 70 genera[10,11,12]. This region of the Southwestern Pacific is considered a faunistic center of the origin of tropical corals where the greatest species diversity of scleractinians is found in the so-called "fertile triangle"[13] with vertices at the Philippines, Malacca Peninsula, and New Guinea. The scleractinian fauna of Vietnam is comprised of 356 species (70 genera) and should also be considered as part of this fertile center.

The Malayan-Polynesian nature of Vietnamese coral fauna is corroborated by a high degree of similarity between the latter and the fauna of other regions. The Vietnamese fauna has 75% species common with Thailand, 77% species common with Indonesia, and 71% species common with the Philippines. Among Vietnamese scleractinians, 77% of the species are common with Japanese fauna and 85% are common with Australian fauna, illustrating the uniformity of the coral fauna in the Western and Southwestern Pacific.

On the whole, the Vietnamese scleractinian species complex, as well as those alcyonarians and gorgonarians, belongs to tropical fauna because it comprises almost all species that are characteristic of the equatorial zone of reef development in the Indo-West-Pacific. Within this region, about 90% of the species diversity of Pacific scleractinians are already found and the species diversity of alcyonarians on Vietnamese reefs is one of the greatest throughout the Indo-West-Pacific[14]. The entire coast of Vietnam from the Bay of Thailand to Tonkin Bay represents a biogeographical unit, which is incorporated into the Indo-Polynesian Province of the Indo-Pacific Region.

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Yu. Ya. Latypov, Institute of Marine Biology, Far East Branch, Russian Academy of Science, Vladivostok, 690041 Russia Email tpv@stl.ru

Archipiélago Jardines De La Reina, Cuba

Thirty years later, species richness of scleractinian corals remains high

Three decades ago, Cuban reefs were found to be a biodiversity "hot spot" for scleractinian corals in the Atlantic region[1], making them an ideal candidate for the study of long-term changes in coral species richness, especially in light of present-day reef degradation. An Atlantic and Gulf Rapid Reef Assessment (AGRRA) expedition in August 2001 provided an opportunity to re-survey Scleractinia in the Archipiélago Jardines de la Reina in southeastern Cuba. This note compares the observations from the recent expedition with the information obtained in the same area thirty years ago. Data on Scleractinia in this area of Cuba were collected in 1971 by V. Zlatarski, and were published in detail in 1980 (in Russian) and in 1982 (in French)1. A full report of the results of the AGRRA expedition may be obtained separately[2].

The underwater observations in the present study were obtained (August 21-28) at 24 AGRRA sites (Figure 1). Eight of these sites were shallow (0.5-5.0 m) and included the reef crest, rear zone and reef front zones. The remaining 16 sites were deep (5.0-23.0 m) and in the fore-reef zone, representing reef terrace, fore-reef escarpment and coral heads. The objectives were to identify all present Scleractinia, without limitation on corallum or skeletal size, as well as to make observations on their condition and the presence of recruits and dead corals.

The new information was compared with that obtained in the earlier study in seven sites of the Archipiélago Jardines de la Reina area. These sites consisted of stations 69, Cayo Bretón (3.0-5.0 m); 70, Cayo Bretón (0.5-1.5 m); 71, Cayo Bretón (30.0-50.0 m); 67, Cayo Grande (4.5-7.0 m); 68, Cayo Grande (20.0 m); 66, Canal de Caballones (3.5-5.0 m) and 65, Cayo Cachiboca (18.0-23.0 m). These stations do not coincide exactly with the sites examined in August 2001, but are interspersed amongst them (Figure 1). In contrast to this survey, the coral identification performed in the earlier study was conducted in the laboratory on collected coral samples. These specimens remain on deposit in the Biological Collection of the Instituto de Oceanología in Havana.

Species richness

Forty-one taxa of specific and intraspecific categories were identified. In three cases, identification was not possible past the species level (*Montastraea annularis f. indet., Scolymia lacera* complex and *Mycetophyllia lamarckiana f. indet*.). The average number of taxa for shallow sites was 15.1, which represented 36.9% of all taxa. The average number for deep sites was 25.1, which represented 61.3% of all taxa. Both indices demonstrate high coral species richness for their respective zones of Western Atlantic reefs.

All coral taxa present 30 years ago were observed during the August 2001 expedition at one or more sites. In addition, four more species were identified. These new species included *Dendrogyra cylindrus*, which was found in seven of the deep sites, often with more than one colony. This species was not identified in southeastern Cuba in the earlier study. In addition, several colonies of *Solenastrea bournoni* were found in the two most eastern sites (sites 50 and 51). In the previous survey, this species had been reported in Cuba only in the Golfo de Batabanó and the Golfo de Guacanayabo. *Colpophyllia natans*, a species not frequently observed in southern Cuba 30 years ago, was identified in 16 sites. Finally, *Acropora prolifera* was found in one site. This rare and questionable species was identified three decades ago in Cuban waters in only one site, in south western Cuba.

The presence of *Tubastraea coccinea* was not confirmed in the study area. This species is considered to have been introduced to the Caribbean in the late 1930s or early 1940s from the Indo-Pacific on a ship's hull[3]. From Curaçao it spread westward

to Panama (1972), and northward to Jamaica (1955). In 1972 it was found in southeastern Cuba in the area of Santiago de Cuba[1]. *Porites colonensis* was also not observed, and has not been reported in Cuban waters to date.

The small increase between 1971 and 2001 in the number of scleractinian taxa does not appear to be significant. The earlier study was based on the laboratory identification of collected specimens, a method that may result in more limited results than underwater identification. Nonetheless, the recent survey clearly demonstrates that, after 30 years, the species richness of scleractinian corals in this area has remained high, at virtually the same level.

Coral diseases and epizoism

During the 1971 survey, some incidences of abnormalities — the appearance of colonies as hyperplasms[4], partial discoloration and damselfish chimneys—were observed, but not the existence of epizoism. Coral diseases were not yet described at that time, nor were they observed in the Cuban survey.

In August 2001, epizootic phenomena were also not found, but seemingly unprecedented moderate to high percentages of old mortality indicated a possible cumulative effect of mortality produced by coral diseases. This time, in addition to hyperplasms and damselfish chimneys (each case observed in the same frequency as in the earlier survey), low incidences of active coral diseases were registered. White-band disease was found on *Acropora cervicornis* (one case in four sites and two cases in a fifth site). Black-band disease was established on *Montastraea annularis f. faveolata* (two cases in one site) and also on *Dichocoenia stockesi* (one case in another site). Yellow-blotch was diagnosed on *Montastraea annularis f. faveolata* (one case in one site) and

species richness of corals
in the Jardines de la Reina remains
as high as it was 30 years ago

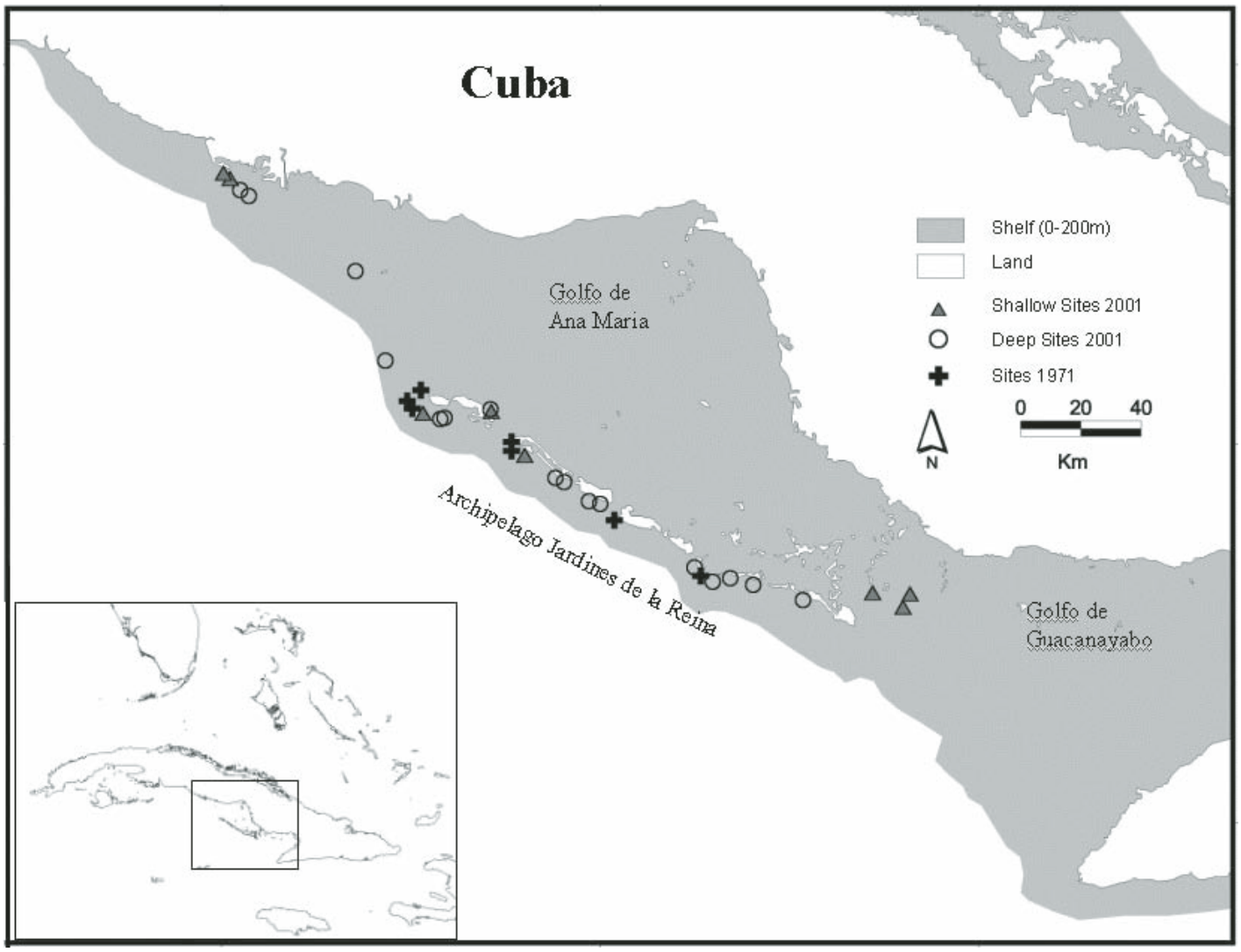

Figure 1. Location of Survey sites

on *Siderastrea radians f. siderea* (one case in another site). A low degree of bleaching (partial bleaching exhibited by pale bluish and pinkish coloration) was observed only on *Siderastrea radians f. siderea* (various cases in 13 sites). No clear case of neoplasm[5] was found.

Reef zonation, dead corals and recruits

In 1971, the composition of Scleractinia in reef zonation in Jardines de la Reina followed the general ecological scheme of Cuban reefs. The damage in shallow parts of the reefs, evidenced by broken and dead stony corals, was attributed to the destruction caused by hurricane Flora (1963) and the considerable input of fresh water and siltation in the area.

In August 2001, shifts of scleractinian zones were not noted, but a very poor presence of live stony corals in shallow zones, which were dominated by standing dead colonies (old mortality), was observed. The AGRRA survey established[6] that 95% of the studied reef crests had more than 40% dead surface of *Acropora palmata* and found only one reef crest in very good condition during a qualitative visit northeast of Cayo Caballones (inner side of the key). In the deep sites, the AGRRA survey found 52% dead surface of the colonies of *Montastraea annularis* complex. The presence of dead scleractinians diminished with depth, and after 8.0 - 12.0 m, their dominance faded away, giving way to live corals with the mentioned abnormalities, as well as the presence of numerous coral recruits.

Anthropogenic role

Neither survey noted significant reef damage caused by human activity. The anthropogenic impact in fact appeared to have recently played a beneficial role, as evidenced by the establishment of a special protected diving zone in the surveyed area. This protected zone serves to balance the interests of tourism, fisheries and preservation.

Other observations

The over-sheeting growth of *Acropora palmata* is a positive sign. Other encouraging signs of reef survival include the considerable width of the Cuban shelf, the presence of a variety of coral reef types, and the enormous size and central Caribbean position of the Cuban coral reef system, which is the largest in Atlantic Region.

Conclusions

Despite the significant decline of coral reef shallow zones and, to a lesser extent, deep zones, the species richness of scleractinian corals in the Archipiélago Jardines de la Reina has not decreased and remains as high as it was 30 years ago.

The coral reefs in the Archipiélago Jardines de la Reina appear to be among those with the greatest chance for survival in the Atlantic Region in light of:

- the preservation of a high scleractinian species richness;
- the incipient process of over-sheeting in *Acropora palmata*;
- the existence of numerous coral recruits;
- the width of the Cuban shelf and the presence of various reef types;
- the enormous size and central Caribbean position of the Cuban coral reef system; and
- the absence of significant negative anthropogenic impacts and the responsible and successful management of tourist and fishing activities.

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Vassil N. Zlatarski is the lead author on The Scleractinians of Cuba published 1980 (Russian) and 1982 (French) and may be contacted at vzlatarski@yahoo.com
Pedro M. Alcolado and Sergio González Ferrer, Instituto de Oceanología, Ave. 1a, No.18406, Playa, Ciudad de la Habana, Cuba
Philip Kramer, MGG/RSMAS, University of Miami, 4600 Rickenbacker Causeway, Miami, FL33149, USA

Reef Discovery and Utilization in Antongil Bay, Republic Of Madagascar

Located on the northeastern coast of Madagascar, Antongil Bay is a rich estuarine system that supports a diversity of marine life, including mangrove, seagrass and coral reef communities. Flushed with the warm currents of the Indian Ocean, the Bay spans an area of 2800 km^2 with depths ranging from 1-10 m near shore to 20-60 m in its central and southern reaches (Figure 1). The Bay is an important economic resource to the Malagasy people, supporting the traditional, artisan and commercial harvest of crustaceans, fin fish, and sharks for local consumption and export. The rich biological diversity of the region also attracts ecotourism revenue, particularly through whale-watching programs of the seasonal migration and calving grounds of humpback whales[1]. Additionally, the bay provides access to the Parc National Masoala (PNM), which contains the largest protected tract of eastern rainforest in Madagascar[2].

The Bay is an important economic resource to the Malagasy people

Within the Bay are two of the three PNM marine protected areas (MPAs), which were established in 1997 and were among the first MPAs in Madagascar. These marine parks, extensions of terrestrial protected areas of the PNM, harbor coral reef communities[2,3]. Field surveys conducted in order to designate the MPAs and to explore their ecological importance have focused on areas south of Tampolo (Figure 1), largely excluding the northeastern and western portions of the Bay[3,4].

During a recent Wildlife Conservation Society field expedition, several reefs were discovered in these areas of the Bay and were surveyed for benthic composition. Additionally, interviews with local fishermen were conducted in order to identify target species, historical fishing grounds and the extent to which the reefs are presently being fished.

Benthic surveys

Five reefs in the northeastern portion of the Bay (A-E, Table 1, Figure 3) and one reef in the western portion of the Bay (F, Table 1, Figure 3) were surveyed while snorkeling during February 2001. Eastern portions of the Bay are influenced by high turbidity and freshwater influx and typically sustain mixed coral/algal communities with comparatively higher species diversity than the western reefs (Table 2). The reef system in the western part of the Bay is made up of a network of patch and barrier reefs running parallel to the shoreline and reaching, at times, up to 100 m in length. Though maximum depth is about 10 m, most of the coral formations occur within the first 6 meters. The substrate typically consists

Figure 1 Typical species encountered within Antongil Bay include *Acropora* spp. (Photo by Priska Ketterer)

Table 1. Reefs surveyed in Antongil Bay. FW = fresh water influence; T = turbid; CC = coral cover. High coral cover >50%; low coral cover <50% estimated visually in ~100m^2 area. Locations correspond to reef sites in Fig. 2.

Reef	Location	Latitude (°S)	Longitude (°W)	Reef Type	Dominant Coral Species	Remarks
A	S of Navane	15º26'59.2"	49º54'08.6"	Fringing	*Porites, Pectinia*	T FW Low CC
B	NW of Ambianizana	15º37'55.5"	49º54'02.3"	Fringing/ Patch	*Porites, Tubinaria, Acropora*	FW Low CC
C	S of Ambianizana	15º37'43.1"	49º57'20.0"	Fringing/ Patch	*Porites,* Algae, Soft Corals	FW High CC
D	S of Ambianizana	15º38'41.9"	49º57'47.2"	Fringing	*Porites, Fungia, Favia*	High CC
E	W of Ambodiforaha	15º42'50.5"	49º57'39.0"	Patch / granite boulders	*Porites, Favia*	T Low CC
F	SE of Rantabe	15º45'52.7"	49º40'29.3"	Fringing	*Acropora* and branching species	High CC

of soft sediment and sand and the water column is generally turbid with a halocline detectable just below the surface due to fresh water runoff from adjacent rivers.

Invertebrate species diversity and coral cover increase moving south along the eastern side of the Bay (Tables 1 and 2). The forereefs of the northeastern are dominated by massive *Porites solida* colonies with diameters occasionally in excess of four meters. Hardy branching species of *Acropora* spp., *Stylophora* spp. and *Pocillopora* spp. occupy the shallowest portions of the fore-reef slope, at times forming extensive monospecific stands. In low flow, highly turbid areas (B,D,E, Figure 3), large tabular reef corals such as *Tubinaria* sp. and *Echinopora* sp. colonies abound. Areas closest to shore generally support shallow water, lagoonal species such as *Fungia* sp., *Galaxea* sp., *Goniopora* spp., and *Pectinia* spp., along with several species of colonial and solitary anemones and zoanthids. The reef south of Navane (A, Figure 3) supports a strip of seagrass a few meters wide that runs the length of the reef and maintains a community of sea cucumbers, pistol shrimp, commensal gobies and other invertebrate life. On the west coast, the reef south of Rantabe (F, Figure 3) extends for several kilometers and is characterized by very high coral cover (~80%) dominated by dense thickets of *Acropora* spp. with occasional patches of *Stylophora pistillata* and *Pocillopora* spp. Signs of bleaching were observed for all reefs surveyed, affecting various species of anthozoans including *Acropora* spp. and *Porites* spp. This bleaching event was likely due to abnormally high sea surface temperatures in the southern Indian Ocean near Madagascar during the month of February 2003 (visible on NOAA satellite imagery). Additionally, toppled colonies of *Porites solida* and *Favia* spp. were observed, a likely impact of the 2000 cyclone activity.

marine resources in Madagascar may suffer from increased utilization and habitat degradation

Fishing patterns and pressure

Interviews conducted throughout the survey region indicated that fishing pressure and fishing camp density was highest in the northern reaches of the Bay. At present, the fishery targets all common reef species (with the exception of poisonous species) with most of the harvest being consumed locally. Spearfishermen harvest common reef species such as butterflyfish (Chaetodontidae), parrotfishes (Scaridae), rabbitfishes (Siganidae), surgeonfishes (Acanthuridae) and angelfishes (Pomacanthidae), as well as sweetlips (Haemulidae) and damselfishes (Pomacentridae). Other reef species are caught using gill nets and hook and line and include squirrelfishes, (Holocentridae), big eyes (Centropomidae), snapper (Lutjanidae, Caesenidae), sweepers (Pempheridae) and small groupers (Serranidae). Additionally, local divers target lobsters, octopus, and sea cucumbers for food and export. Tridacnid clams and large carpet anemones (*Heteractis magnifica*) are also harvested for subsistence level

Table 2. Species of algae, sponges, cnidarians, mollusks, and echinoderms identified in Antongil Bay. Locations correspond to reef sites in Figure 3. Abundance for individual species ranges from occasional to common to abundant.

		SPECIES	LOCATION	ABUNDANCE
Algae		*Halimeda spp.*	A, B	Common
		Caulerpa spp.	A – C	Common
		Turbinaria spp.	B, D, E	Abundant
		Padina spp.	A – E	Abundant
Sponges		*Strepsichordaia radiata*	A – F	Common
Anthozoans	Hydroids	*Millepora spp.*	A – E	Occasional
	Lace Corals	*Stylaster spp.*	B, D, E	Occasional
	Anemones	*Heteractis magnifica*	C – F	Occasional
	Zoanthids	*Zoanthus spp.*	A, B	Common
		Palythoa spp.	A – E	Common
	Soft Corals	*Sarcophyton spp.*	B – E	Occasional – Abundant
		Sinularia spp.	A – C	Occasional
	Stony Corals	*Acropora spp.*	A – F	Common
		Echinopora spp.	B, D, E	Common
		Favia speciosa	B – F	Occasional – Common
		Favia favus	C, D	Occasional
		Favites spp.	C, D, E	Occasional
		Fungia spp.	A – F	Abundant
		Galaxea spp.	A – E	Common
		Goniopora spp.	A – E	Common
		Herpolitha spp.	D	Occasional
		Hydnophora spp.	A – E	Occasional
		Leptoseris spp.	A, B	Occasional
		Lobophyllia corymbosa	A – F	Common
		Pavona spp.	A – E	Common
		Pectinia lactuca	A – D	Common
		Platygyra daedalea	A – E	Common
		Pleurogyra spp.	B	Occasional
		Pocillopora verrucosa,	B – F	Abundant
		Pocillopora damicornis	A – F	Abundant
		Porites solida,	A – F	Abundant
		Porites cylindrica	D	Occasional
		Psammocora superficialis	D – F	Occasional
		Stylophora pistillata	A – F	Common
		Symphillia spp.	A – E	Common
		Tubinaria spp.	B, D, E	Common
	Octocorals	*Cirrhipathes sp.*	A – E	Common
Mollusks	Sea slugs	*Phyllidiella spp.*	B	Occasional
		Phyllidia spp.	B	Occasional
	Gastropods	*Lambis lambis*	A – E	Common
	Bivalves	*Hyotissa hyotis*	C – E	Common
		Tridacna maxima	B – E	Common
Echinoderms	Sea Urchins	*Diadema savignyi*	A – E	Occasional – Common
	Sea Cucumbers	*Holothurids*	A – E	Common
		Synaptids	A – E	Common
	Sea Stars	*Culcita schmideliana*	A, C, E	Occasional
		Fromia milleporella	A, D – E	Occasional

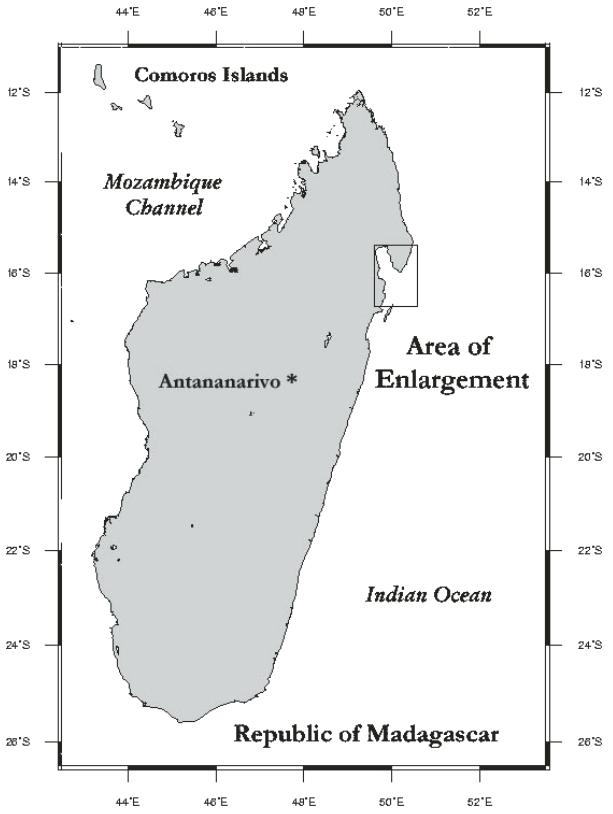

Figure 2 Republic of Madagascar

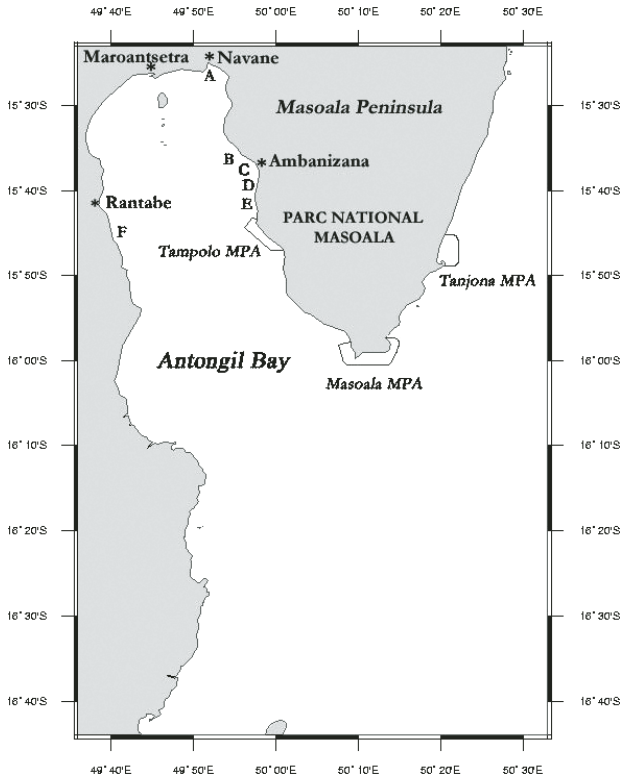

Figure 3 Antongil Bay where reef sites mapped in this study are lettered A-F and correspond to descriptions in Table 1.

consumption. Local fishermen point out that fishing of reefs closest to villages has been intense in the past and may have led to stock declines.

Antongil Bay has recently become the focus of numerous marine conservation efforts in an effort to protect the diversity and richness of its biological resources which, at present, are heavily exploited for local and commercial purposes[2,4]. These efforts are concentrating on the development of a comprehensive and adaptive ecosystem management plan that would include biological as well as socioeconomic factors. In order to develop the most comprehensive and encompassing plan possible, continued and in-depth research is necessary to better assess the extent to which reefs contribute to the overall productivity of the bay and their significance to local livelihoods. As terrestrial resources throughout Madagascar disappear at an unprecedented and alarming rate, and the current political crisis continues to cripple the economy, we predict that marine resources may suffer from increased utilization and habitat degradation, making their conservation and sustainable utilization through the development of appropriate management programs all the more urgent.

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Kenyon Mobley, Phaedra Doukakis, Mananjo Jonahson
Georgia Institute of Technology, School of Biology, 310 Ferst Dr. Atlanta, GA 30332-0230, USA Email <gtg842d@prism.gatech.edu>

Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, New York, 10460, USA. Email <pdoukakis@wcs.org>
Wildlife Conservation Society, Villa Ifanomezantsoa, Face II A 78 D, Soavimbahoaka, Madagascar Email <wcsmad@bow.dts.mg>

Seychelles' Coral Reefs Under Survey After the 1998 Bleaching Event

New bleaching event in the inner granitic islands of Seychelles, impact on coral recruits

The Republic of Seychelles, situated in the Western Indian Ocean, consists of 115 islands (41 granitic islands and 74 coralline islands) totaling a land area of 445 km². The 3 main islands, Mahé (154 km²), Praslin (37 km²) and La Digue (10 km²), host more than 90% of the total population. Small in terms of terrestrial environment, Seychelles possess a large Exclusive Economic Zone (EEZ) of 1.3 million km². The archipelago is located just south of the equator, to the north of Madagascar.

As a consequence of the geological origin of the Seychelles (part of the ancient native 130 million-year-old continent, Gondwanaland), Seychelles islands are characterized by a high level of endemism with some unique animals and plants such as the Aldabra giant tortoise (*Dipsochelys dussumieri*), the Seychelles anemonefish (*Amphiprion fuscocaudatus*) and the Coco-de-mer palm (*Lodoicea maldivica*).

Coral Threats in Seychelles

Human activities are relatively recent and anthropological disturbances on the marine environment have been noticed for the past 20 years with the development of some fisheries and an increase of coastal pollution (important reclamation areas, industrial activity, sedimentation). Actually, forms of pollution concern only the 3 main islands of the Seychelles (Mahe, Praslin and La Digue) and more specifically are concentrated around Victoria.

Unfortunately, the largest impacts on the Seychelles environment have been caused from the latest global phenomenon, coral bleaching, which correlates with world-wide human activities and the greenhouse effect.

Between 1979 and 1990, approximately 60 major bleaching events have been observed and described around the world. Since 1980, the frequency of this phenomenon has increased with massive bleaching observed in 1983, 1987, 1991 and 1998. Generally, this observation has been correlated with high sea surface temperatures during the El Niño Southern Oscillation (ENSO) events.

In 1997-98, the ENSO observed by a scientific community was described as the largest to occur within the last 100 years. In the western Indian Ocean, this led to a huge coral bleaching event in the region, including Seychelles. Temperatures of well above 33°C to 34°C were recorded at the surface and at depths up to 20 meters. Moreover, temperatures in excess of 30°C persisted for more than 3 months.

Due to the combined effects of coral bleaching and starfish predation, corals around the inner islands of the Seychelles were amongst the worst affected areas in the region.

These high temperatures maintained for a prolonged period around the inner granitic islands of Seychelles, which lead to a significant reduction in live hard coral cover. Mortality was very high in branching corals such as *Acropora* spp., *Pocillopora* spp., *Millepora* spp. and *Heliopora* spp. In June 1998, approximately 80 to 95 % of hard coral mortality was recorded around Mahe Island.

Coral reefs around the inner granitic islands of the Seychelles had already suffered in the late 1990's from significant reductions in live cover of scleractinian hard corals as a result of localised crown-of-thorns starfish (*Acanthaster planci*) outbreaks. Active *A. planci* outbreaks were first reported in some parts of Mahe in 1996 and starfish outbreaks remained active until the middle of 1998.

Due to the combined effects of coral bleaching and starfish predation, corals around the inner islands of the Seychelles were among the worst affected areas in the region. In 2000, two years after the mass coral bleaching of communities of both scleractinian and soft corals, coral reefs around Mahe remained in a severely degraded state with very low percentage cover values (0 to 5% of live coral cover on 90% of the sites surveyed under GEF project).

Typical underwater view of *Pocillopora* spp. recruits on a granitic reef. Photo: Engelhardt, December 2001

Generally, those reef areas that have suffered from the bleaching and resulting coral mortality have been rapidly overgrown by algae.

Coral reef survey in the Seychelles

As a consequence of the dramatic ecological changes observed on Seychelles reefs, several programs were initiated in the Seychelles to (i) follow the status of coral reefs in Seychelles, (ii) identify and detect "key reefs" with significantly higher values of live scleractinian coral cover (capable of improving hard coral recovery), and (iii) follow the natural restoration (focusing on coral recruits) of the reefs. Main scientific programs focusing on these activities in the last 3 years were the Shoals of Capricorn Program, the Marine Ecosystem Management Project – GEF the Coral Reef Degradation in the Indian Ocean program (CORDIO) program, and the Environment Program from the Indian Ocean Commission.

Moreover, a new challenge was set up with the Marine Ecosystem Management Project – GEF, coordinated by the Conservation Section (Ministry of Environment), focusing particular attention on coral recruitment. These surveys not only record data on baseline parameters, but also provide detailed information on the key ecological factors known to control coral recovery on larval settlement.

We know that a wide range of often unpredictable parameters are involved in coral recruit settlement, such as density, size and location of the mature coral, life duration of coral larvae, type of substrata, impact of pollution, hydrodynamic linkages (water circulation patterns) between spawning areas and settlement areas, etc. However, it clearly appears in scientific publications that levels of siltation, substrate-associated sedimentation and the extent of coralline algae cover are critically important factors that may control actual rates of larval settlement and subsequent successful recruitment. Following successful settlement of coral larvae, other ecological parameters control

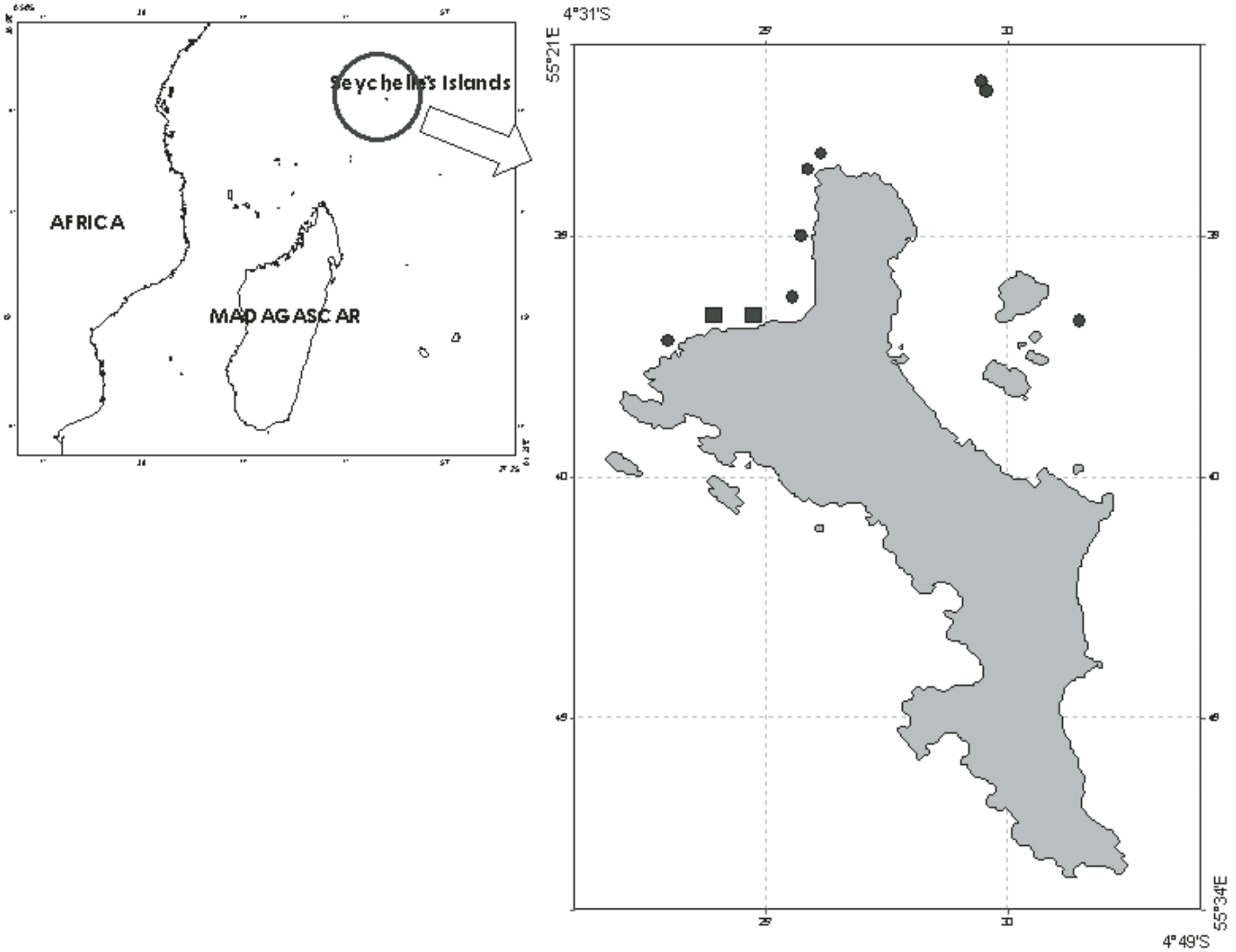
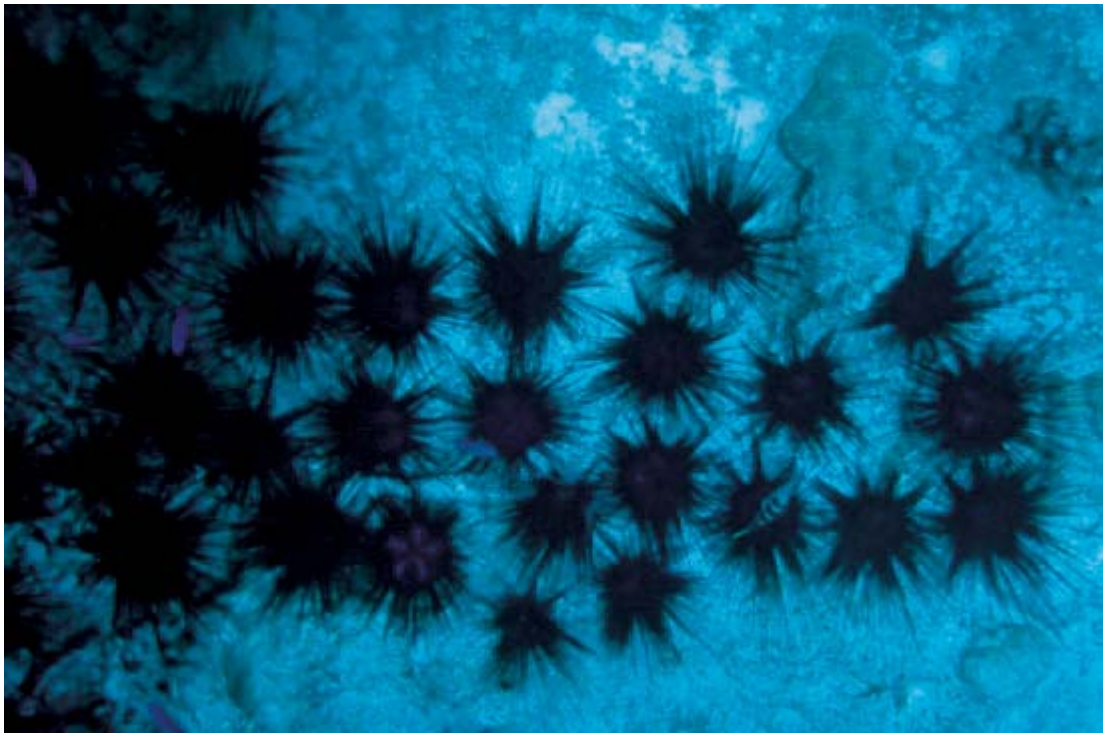


Figure 1 Seychelles islands (left) and Mahé Island (right). Position of the study sites (squares), Whale rock (left), Corsaire reef (right) and other areas (circles) where bleaching colonies (full or partially bleached were observed by divers from Underwater Center Seychelles (Glynis Sanders, pers.com).

subsequent recruitment success such as predation pressure by 'true' coral predators (e.g. crown-of-thorns starfish, *Drupella* snails), incidental grazing organisms (e.g. sea urchins, fish) or other coral diseases (bacteria).

All these parameters were followed for several months as part of the GEF program to assess the relative importance of each and evaluate interactions to the process of coral recruitment.



Typical high concentration of black sea urchins (*Diadema* spp.) an incidental coral grazer which has been identified as a key factor in coral recruitment. Photo: Wendling 2002.

New bleaching event in the inner granitic islands of Seychelles, impact on coral recruits

In April 2002, the first observations with proof of new bleaching were recorded by the Ministry of Environment (Conservation Section, Marine Unit) in the framework of a Coral Reef and Sea Urchin monitoring. These observations relate to the high temperatures in consequence of seasonal trends (highest sea surface temperature were up to 30°C in the first week of April). Moreover, this was exacerbated by calm seas, sunny periods, and a total absence of wind.

All data collected from 1998 to 2001 around the inner granitic islands of Seychelles showed that the percentage of coral reef cover is now very low

Temperatures observed (divers information) reached 31°C during the first week of April at depths of up to 20 metres on several dive sites. These temperatures remained at 29°C until the end of April. An alert message was sent to several organisations involved in marine conservation (Marine Park Authority, Marine Conservation Society of Seychelles, Coast Guard) to extend information about the sites where bleaching has been observed. More information was given by a dive centre (Underwater Centre Seychelles), which identified more than 15 dive sites where coral colonies were partially or totally bleached (figure 1).

At the same time, a more specific bleaching monitoring was set up by the Conservation Section (Marine Unit) to follow the event and evaluate the consequences on Scleratinians. The methodology used is based on 2 objectives: (i) to estimate the level of bleaching on corals (i.e. the percentage of colonies bleached), and (ii) to follow the recovery or mortality rate.

Methodology

Following the huge bleaching event observed in 1998 which has caused massive mortality of mature colonies, this monitoring is focused on coral recruits. Two sites (figure 1) were selected taking into account the actual ongoing monitoring on sea urchins: Whale rock (rocky reef) and Corsaire reef (coralline reef), representing the 2 characteristic reefs of Seychelles. Coral recruits were counted from benthic belt transects. Fifty meter transect lines were placed from a shallow depth (~2-3 m) down to a greater depth (~7-15 m). Within these transects (at least 2 per site), two sub-transects were sampled for recent coral recruits: a 0-10 m segment and a 40-50 m segment. In both these segments, a 60 cm wide path on either side of the central tape measure was sampled for coral recruits, giving a total area of 2 x (10 x 1.2 m) = 24 m^2 per transect.

Coral recruits were classed by size range (<2 cm, 2-5 cm and 6-15 cm) equivalent to different age classes and by groups (*Acropora* spp., ACR; *Pocillopora* spp., POC; and Massive – Encrusting – Fungid forms, MEF). The recruits were put into four possible categories: unbleached, partially bleached (obvious signs of bleaching across parts of the colony), fully bleached (the entire colony is bleached, but still alive), and dead colony.

Previous Results

Our analyses on the impact of the new bleaching event are still ongoing, but some important trends can be pre-

sented for our two sites. Until the end of April, Pocillopora forms (Photo d) are the principal colonies affected by the bleaching.

Mid-May, 45 days after the first observation of bleaching, the percentage of *Pocillopora* spp. concerned was 50.0 % (± 12.3), with 14.4% (± 12.2) of colonies fully bleached and 43.6% (± 12.3) partially bleached. No bleaching was measured on *Acropora* spp. (photo b) and some, 6.7% (± 1.9), on M.E.F forms (essentially on young recruits of *Porites* spp.), with 0.3% (± 0.63) of colonies fully bleached and 6.4% (± 3.3) partially bleached.

At the end of April (60 days after the first bleaching observations), the first dead colonies of *Pocillopora* spp. were observed, while no bleaching or mortality was observed for the other coral families. Partial and full bleached colonies were observed until mid-June. That is to say that the bleaching event occurred over a period of 70 to 80 days. After each bleaching event, dead colonies were rapidly covered by algal overgrowth, and some weeks later, it appeared impossible to identify dead colonies from substrata.

To evaluate the impact of the bleaching, an assessment was undertaken to estimate the mortality of *Pocillopora* spp. recruits (0-2) and (2-5) cm. Our first analyses show that on the 2 sites, the average mortality rate on *Pocillopora* is around 35.5 % (respectively 51% on 1 year old colonies and 20% on 2 year old colonies). Impacts seem to be higher in shallow water (less than 5 meters), probably associated with the higher temperatures and solar irradiance.

What is the future for Seychelles' corals?

The new bleaching could not be compared to what was observed in 1998, where more than 90% of mortality on branching corals occurred. However, the new impact draws us to the threats influencing the livelihood of coral reefs in the Seychelles.

Taking into account climate change prediction models developed by scientists, in the future (50-100 years), it appears that the risk of bleaching will increase in the same way that annual global mean temperature changes.

The global average surface temperature (the average of near surface air temperature over land and sea surface temperature) has been increasing since the beginning of the 20th century. Over the past 100 years, the best estimate (by 'Intergovernmental Panel on Climate Change') is that the global average surface temperature has increased by 0.6 ± 0.2°C. Global ocean heat content has been increasing since the late 1950s, the period for which adequate observations of sub-surface ocean temperatures have been available.

The globally averaged surface temperature is projected to increase by 1.4 to 5.8°C over the period from 1990 to 2100. The projected rate of warming is much larger than the observed changes during the 20th century and is very likely to be without precedent during at least the last 10,000 years, based on paleoclimatic data.

Predictions from climate models are subject to uncertainties because of limitations in our knowledge of how the climate system works, different climate models can give different predictions.

All data collected from 1998 to 2001 around the inner granitic islands of Seychelles showed that the percentage of coral reef cover is now very low, even if recovery is ongoing with new larvae coming from mature colonies. With their geographical position (near the equator where Sea Surface Temperature is important in March to May), the inner granitics of Seychelles coral reefs must be considered as an endangered ecosystem. The survival of this ecosystem is now based on the settlement of new larvae from mature colonies (probably coming from neighbouring region) and resistance of both new and older corals to human activities, pollution and high sea temperatures.

Based on some of the climate change predictions, with sea surface temperatures up to 32°C in less than 100 years in the region, it is an opportune moment to ask ourselves if the coral reefs can adapt to these very rapid environmental modifications or if this new bleaching event is new proof of the theory of the collapse of some coral families in this part of the world?

B Wendling, PA Adam, U Engelhardt, G Rosine, R Alcindor, V Zialor and A Louange
Ministry of Environment -Division of Environment - Conservation Section
Botanical garden, Mont Fleuri BP

Acropora sp. recruit (2-5 cm). Photo: Engelhardt, December 2001

A New MPA Experience in Brazil: The Recife de Fora Marine Park, Bahia, Brasil

Bahia State has the most extensive coastline (830 km), as well as the largest and most diverse coral reefs of Brazil. They were formed by Holocene biogenic structures that differ from the well-known coral reef models of the Caribbean, Red Sea and Indo-Pacific[4]. Though they exhibit a relatively poor stony coral fauna (18 species) when compared to other reef areas worldwide (Table 1), they are characterized by a high degree of endemism (39%). Such endemism is not restricted to stony coral species, but extends to fishes (59 endemic species), octocorals (4 species) and hydrocorals (2 species). Furthermore, unlike most reefs, these occur under high levels of turbidity and sedimentation. It is assumed that the sea-level drop observed along the Brazilian East Coast over the last 5,000 years has been the main contributing factor for the intermixing of reefal carbonates with siliciclastic deposition[5], resulting in a functionally more resistant coral. Most of the frame-building coral species in Brazil are massive, displaying large polyps and exhibiting encrusting forms in tidal pools and along reef edges. Branching forms, typically more fragile, are entirely absent[6].

Table 1. Scleractinian coral species richness in different regions

Coral Reef Region	Nº of species	Reference
Southeast Asia	>400	Wilkinson, 2000
Australasia	>360	Wilkinson, 2000
Red Sea - Persian Gulf	>260	Wilkinson, 2000
Indian Ocean	>200	Wilkinson, 2000
Caribbean	~ 65	Wilkinson, 2000
Hawaii	55	Wilkinson, 2000
Brazil	18	Laborel, 1969

Bahia state . . . coral reefs . . . are characterized by a high degree of endemism (39%)

The south coast of Bahia State, also known as Discovery Coast, presents the most extensive continuous area of coral reef in Brazil (~200 km - Fig. 3). Notwithstanding the intrinsic value of its coral reefs, the south coast of Bahia, is also of significant historical interest. In April 1500, Portuguese sailors first set foot onto South American land here and developed the first urban core of Brazil's colonial period. Despite the emergence of settelements along the coasts, most of the region's natural landscape, which includes mangroves,

Fig. 1. Aerial view of the Recife de Fora.

river systems, coastal plains, Atlantic forest and sandy beaches, remained well preserved until about 30 years ago. In the 1970s, the construction of highway BR-101 and the associated migratory flux of people from mainland areas to the region's coastal cities have led to severe environmental degradation. Statistics show that population numbers rose from 7,271 inhabitants in 1980, to 93,073 in 2000. Over the same time period, tourism has grown even faster, providing the main revenue of Porto Seguro city (US $100 million in 1999, according the Bahian Tourist Board).

The Recife de Fora ("outer reef" in Portuguese) (Fig. 1) is a shallow bank reef located 5 miles off the coast of Porto Seguro, Bahia, the fastest growing tourist destination in Brazil. The Recife de Fora Marine Park was established in 1997 and is managed by the Environment Secretary of Porto Seguro City.The reef itself is an important contributor to the city's fame and one of the most visited tourist attractions of the whole Discovery Coast. In 1997, fearful of the consequences of the growing numbers of tourists visiting the reef (about a thousand a day during the high season), the city council decided to create an MPA and initiate the gathering of data to develop its management plan. The MPA, officially designated on December 16, 1997, covers a total area of 17.5 km^2. Access to the reef is only possible by sailing in one of the registered schooners, which offers trips out to the reef on a daily basis. The journey lasts 45 minutes.

The reef has long been known to local communities as an important fishing ground and is widely considered the principal spawning area for a multitude of invertebrates and fish from the Porto Seguro Bay. Since MPA designation, fishing activities have been prohibited within park boundaries. A decision which, sadly, was taken by the government without any "technical support," as the area remains one of the least studied of the Brazilian coast.

Since MPA designation, fishing activities have been prohibited within park boundaries

Only now, four years after its designation, are the first results of scientific investigations within the park area beginning to appear.

Two recently completed theses became available in the last six months, one discussing the distribution of Echinodermata within the MPA[1] and another evaluating the effects of nutrification on the benthic community structure[2]. A paper presenting the distribution of the benthic macroalgal community on nearshore and offshore reefs of Porto Seguro Bay is also scheduled to appear in the July edition of the journal *Botanica Marina*[3]. Preliminary results of that research were presented at the 9th International Coral Reef Symposium and will be published in the symposium's proceedings. Results of the benthic community surveys have shown that due to differences in wave energy between both sides of the reef, these areas are distinctively characteristic both in terms of their physiography and diversity. The dominant wind pattern within the marine park changes throughout the year (due to the seasonal displacement of the trade wind divergence zone), moving from

Fig. 2. Detailed view of the small embayments characteristic of the reef crest, highlighting the Recife beach, where the schooners cast anchor.

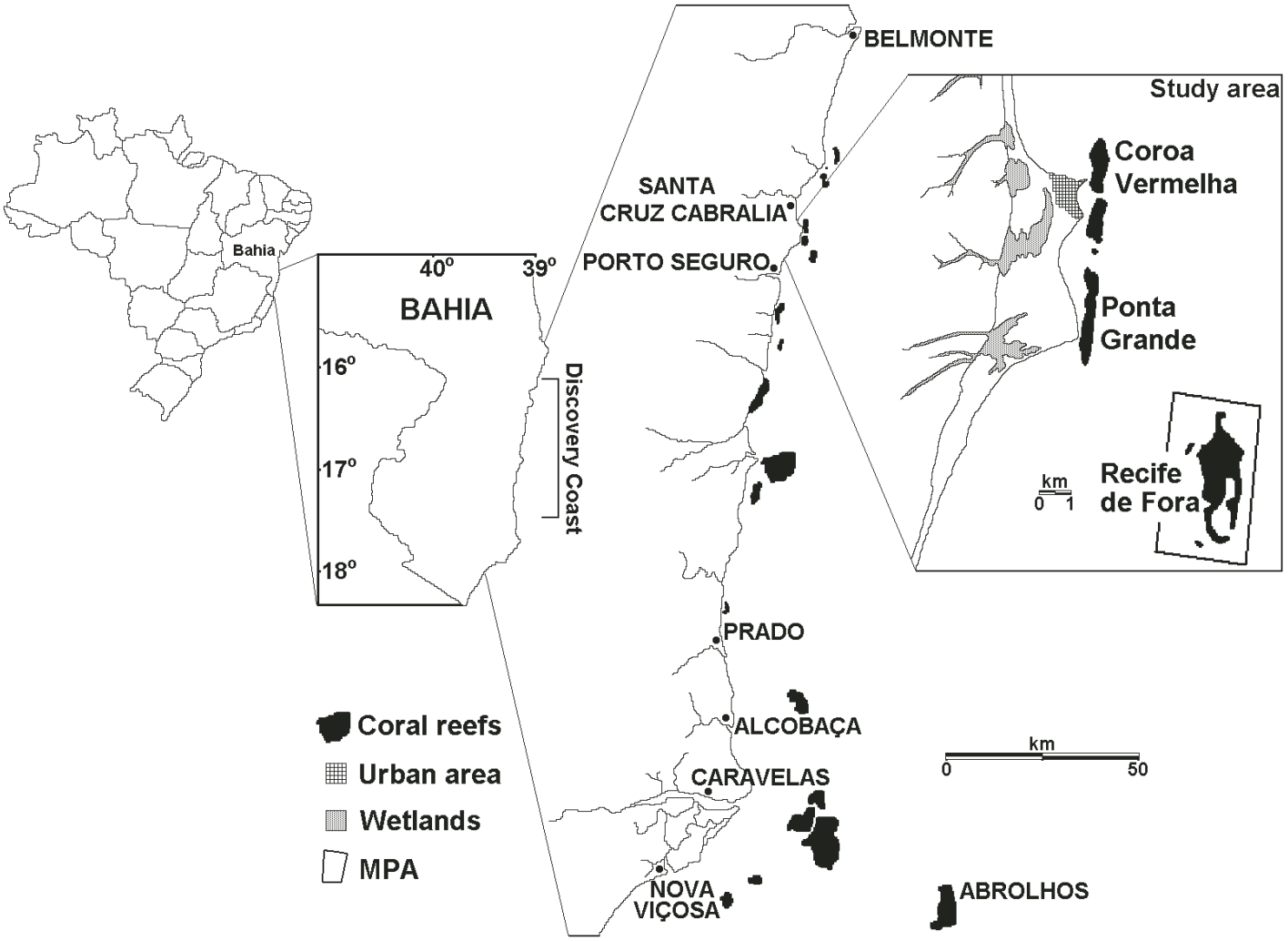


Fig. 3. Location map of the Porto Seguro Bay reefs in the south coast of Bahia State.

east-southeast in the winter (June - August) to northeast during the rest of the year, and thus determining the direction of wave approximation. In both instances, the landward side of the reef is protected from the main wave action except occasionally during winter months, when south-southeast winds blow due to the migration of cold fronts. At low tide, an area of about 2.5 km^2, with maximum dimensions of 2.3 km long and 1.1 km wide, become exposed for up to 9 hours. Depths around the reef vary between 6 and 8m off the landward side, but can reach 12m depth in the northeastern portion of the windward slope. In contrast to the landward reef, which is very steep, the windward side is characterized by a shallow slope. A mixture of siliciclastic and carbonate sediment dominate the seabed. Visibility is normally around 5m, but can reach 10m on calm days. Many pools of varied shape and depth occur on the intertidal reef flat. The reef crest is irregular, frequently forming small embayments such as the Enseada do Mourão, the Enseada da Coroa and the Recife beach (Fig. 2).

It is hoped that the result of the above described study and others mentioned, will be used by MPA managers as a baseline for evaluating the effectiveness of the current fishing restrictions. They should also help managers in outlining a monitoring plan that will assess trends and identify changes in reef health since MPA implementation.

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Ozéas Costa Jr has recently finished his PhD (biogeochemistry of nutrients and coral reef ecology) at the Department of Biological Sciences, University of Plymouth, UK. You can email him at ozeasc@hotmail.com

Zelinda Leão is professor of coral reef geology at the Geosciences Institute, Federal University of Bahia, Brazil. She can be reached at zelinda@ufba.br

Implications Of Predator-Prey Relationships For Marine Protected Area Design

The world's fisheries have experienced great decline, and coral reef associated fisheries are no exception. As a result of this decline, an ever increasing management option for reef fisheries is the establishment of marine protected areas, or marine fisheries reserves[1]. In terms of fisheries management, it is hoped that marine reserves will increase the abundance and species richness of target fishes, provide breeding grounds and ultimately export fish biomass by means of adult emigration and larval export[2]. There is some evidence of increases in target species within reserves[3] and limited evidence of spillover to non-reserve locations[4]. But what is happening with the non-target species? The predation hypothesis states that post-settlement mortality due to piscivory largely determines patterns of abundance of adult fish[5]. With this in mind, an associated decrease in abundance of target species (often predatory fish) due to fishing should result in an increase in their prey; a "prey release" response. Conversely, an increase in target species due to marine reserve protection may result in a decline in their prey. A small amount of evidence is available for this pattern in reef fish communities in Kenya and the Caribbean[6]. However, evidence is much less conclusive in more complex systems towards the Indo-West Pacific[7,8].

Recent studies on the inshore islands of the Great Barrier Reef (GBR) have shown substantial differences in density and biomass of coral trout between fished and no-take zones[9]. Intensive gut-analysis studies have been conducted on the coral trout (*Plectropomus leopardus*), identifying their favored prey fish items[10] on both closed and open reefs of the GBR[11]. I have used both these pieces of information to look at the density of favored prey fish species of the coral trout on the inshore islands of the GBR. The study has shown that the majority of prey species surveyed had a higher density in the fished than the no-take zones even after differences in habitat complexity were taken into account[12]. These data suggest that a trophic effect can be found in more complex reefal systems such as those of the GBR.

the majority of prey species surveyed had a higher density in the fished than the no-take zones

Previous modeling work has suggested that prey gradients of this nature (between reserve and non-reserve locations) may attract predators out of protected areas and thus facilitate adult target species spillover[13]. The results of my study are a stepping stone towards investigating such a system. If this effect is taking place, it has huge implications for marine reserve design. Work on the movement of predators, such as coral trout, has shown large intra-reefal movements, but little movement between reefs across channels[14]. Therefore, from a fisheries perspective, marine reserves encompassing part of a reef or a section of an island's reef would be more beneficial than protecting the whole reef if spillover of target species is a primary objective. Further study in this area would clearly be of benefit.

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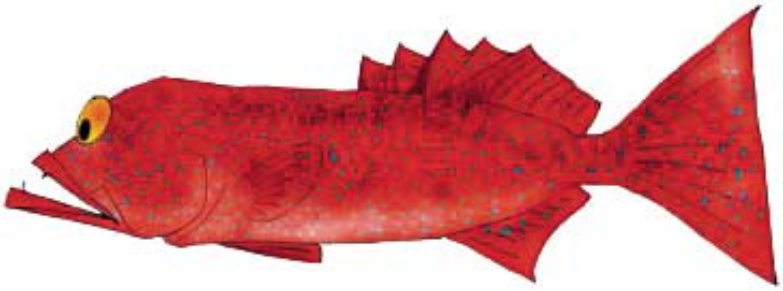
Nicholas AJ Graham,
School of Marine Biology and Aquaculture, James Cook University of North Queensland, Townsville, Qld 4812, Australia.
Email: naj_graham@hotmail.com



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Coral Reefs and bleaching: death by a thousand cuts?

As the southern hemisphere summer passes for another year, reef managers and scientists are again counting the damage due to coral bleaching. The Great Barrier Reef (GBR), French Polynesia, Fiji, Tuvalu and American Samoa all experienced mild to severe bleaching between January and April 2002. Dedicated aerial surveys to document the bleaching on the GBR reveal that around 60% of total reef area was bleached this past summer. This compares with around 44% in 1998. However, total reef area in the highest bleaching categories was essentially similar between '98 and 2002. The most surprising result from these surveys was that the pattern of bleaching is completely different between the two events. Although the worst affected reefs in 2002 still occurred inshore, many more mid- and outer-shelf reefs were affected in 2002, affecting ~2/3 the length of the GBR. Areas with high bleaching in 1998 such as the Palm Islands, Franklin Islands and the Capricorn Bunker group showed little or no bleaching in 2002. On the other hand, areas with little or no bleaching in 1998, such as Princess Charlotte Bay and the Whitsunday Island Group had high bleaching.

60% of total reef area was bleached this past summer

Since 1998, reefs that suffered patchy, but, in places, high mortality (such as Orpheus Island - up to 80% of coral cover), have not recovered. Recruitment of *Acropora spp*. is low, and the once abundant fire coral, *Millepora sp*., is still locally extinct. In the 2002 event, it was the reefs in the Bowen area, 200km to the south of Townsville, which suffered high mortality. Plating and staghorn *Acropora* gardens, which covered >90% from the reef crest to the bottom of the reef slope, are now 80-90% dead. Pocilloporids of any descrip-

tion were virtually wiped out (>99.9% mortality). Mortality was also high on a number of reefs in the Whitsunday Island and Sir James Smith Groups in the inshore central GBR. At Daydream Island, a popular tourist destination, the needle coral, *Seriatopora hystrix*, once formed a carpet several hundred metres in length between 7 and 14m depth. This is now an ex-carpet. *Millepora sp*. suffered ~50% mortality, but thankfully, the majority of staghorn *Acropora* recovered. Pocilloporids (*Seriatopora hystrix, Stylophora pistillata* and *Pocillopora damicornis*) also suffered near total mortality at a number of other nearby islands. We may think of these species as the weeds or 'lab rats' of the coral world, but with successive bleaching events, each following closely on the heels of the previous event, it won't be long before we loose them completely from our reefs.

> the 2002 summer exceeded 1998 temperatures on the GBR

The thermal anomaly associated with the 1998 bleaching event was, until now, the worst on record for both the GBR and reefs globally. Just four years later, the 2002 summer exceeded 1998 temperatures on the GBR by every metric. Given the rapid return of another record thermal anomaly, though this time with a different spatial pattern, we may well be realizing the dire predictions of death by a thousand cuts[1]… or perhaps only a few dozen would be enough?

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Ray Berkelmans, Australian Institute of Marine Science, Townsville, Australia. Email< r.berkelmans@aims.gov.au>

Fisheries Engineer, MSc. Technical advisor to DAP/MMA, and campaign coordinator. E-mail: dap@mma.gov.br and ana-paula.prates@mma.gov.br

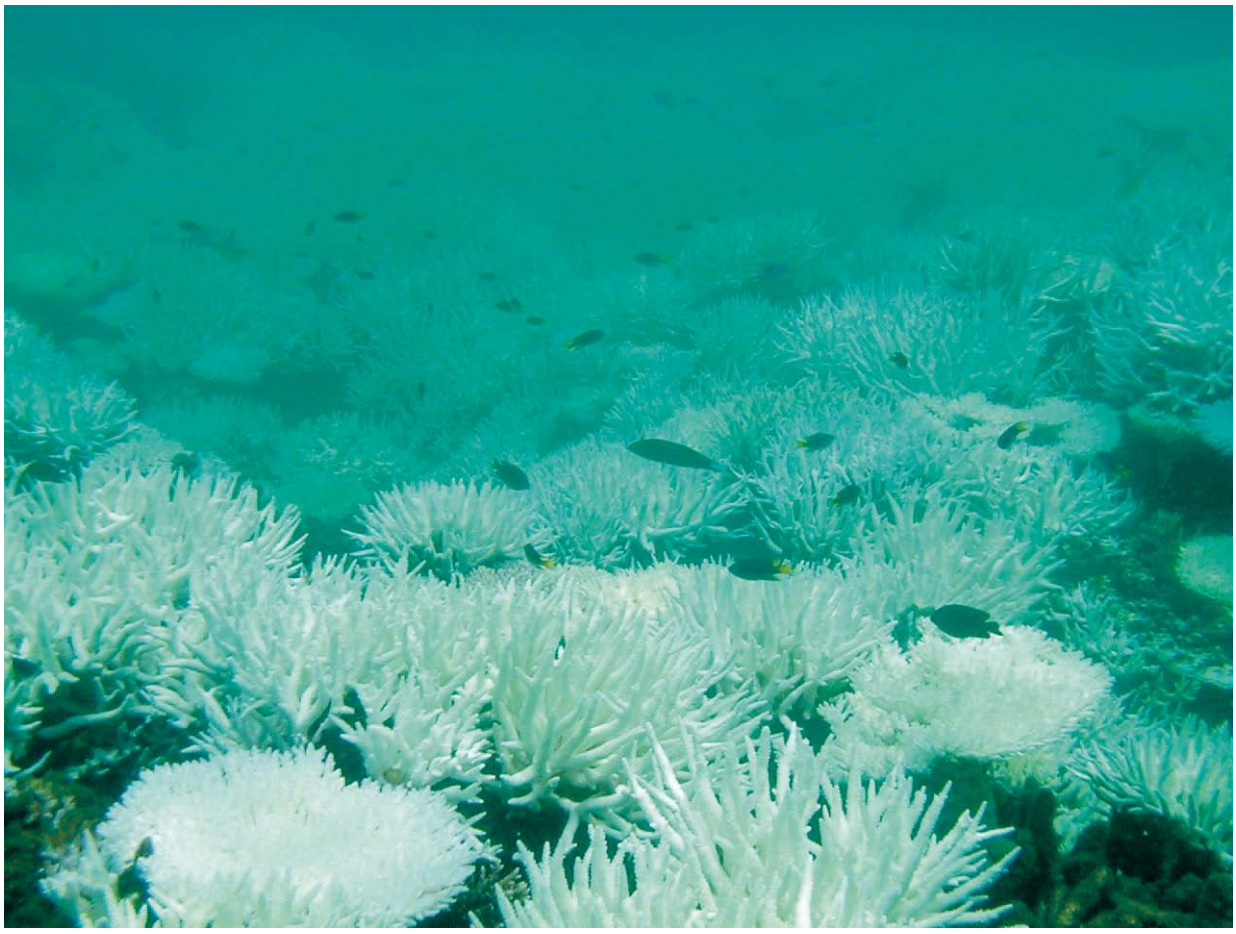

Photo 1. Fields of snow, …. just prior to the thaw. Reef flat at Halfway Island in the southern inshore Great Barrier Reef, February 2002.

REEF FISHERY MANAGEMENT IN DISCOVERY BAY, JAMAICA

The Fishery

The inshore reef fishery of the north coast of Jamaica is one of the most over-exploited in the Caribbean. Discovery Bay Marine Laboratory researchers have documented the decline of this fishery[1] where the average fish caught has decreased from a mean weight of 135g in 1996 to 119g in 2001[2]. The abundance of more valuable species such as groupers and snappers has been markedly reduced. Today, 30% of the local catch consists of small parrotfish (e.g. *Sparisoma aurofrenatum*) and surgeonfish (e.g. *Acanthurus bahianus*). These are categorized as trash fish in most other countries[3]. There are approximately 130 active full time fishers in Discovery Bay. Traditional Lesser-Antillean Z traps (mesh 1¼"- 1½") are used by 70% of the fishers as their main fishing gear. The average fisher owns about 10 traps but not all are deployed simultaneously since a lack of motorized vessels restricts the number than can be deployed. About half of fishers troll on their way to check their traps. A small number of fishers use gill nets, and about 25% are spear fishers.

Fishing Effort

On a typical day, approximately 20 boats fish the inshore reefs where an average of seven traps are hauled from 27m. The majority of the fishermen use the 1¼" mesh traps that soak for and average of 2.8 days. A quarter of the fishing is done with the 1½" mesh traps that soak for an average of 5.2 days. It is estimated that Discovery Bay fishermen make 34,300 trap hauls/year or about 264 boat days of work per year resulting in a catch weight of 29,700 kg/year while spear fishermen spend 5,000 fishing days/year and catch 23,000 kg/year. Five net fishers make 340 boat trip days/year and bring in 2,150 kg/year while 19 line fishers spend 2400 boat days/year at sea and catch 4740 kg/year (drop line) and 1,110 kg/year (trolling). The total fish catch around Discovery Bay is approximately 60 tons per year[3], worth about $US300,000.

Shared among the 130 active fishermen in this area, this represents an average annual income of $2,400 per year, even less than that of Ocho Rios fishermen which approximates $ 3,200 per year[4]. This must cover the cost of purchasing fishing gear, fuel and supporting a typical family of five people.

Since 1968 catches have fallen 13% in weight and 17% in value[2]. Today, the average catch of fish pots is less than 1 kg / haul^{-1}, worth little more than $4, and the fishery is still in decline. The reefs have an average of 10% coral and 45% algal cover. This is due, in part, to the slow recovery of the long-spined black sea urchin *Diadema antillarum* from a Caribbean-wide die off in 1984. Compounding this problem is the lack of herbivorous fish, caused by intense fishing pressure and destruction of inshore nursery habitat due to coastal development and poor inland agricultural practices.

> …the high demand for seafood products in the context of a degraded resource means that a broad-scale public education initiative throughout Jamaica is also needed for any fisheries management policy to be effective.

The Fisheries Improvement Program

In 1988, the Fisheries Improvement Program (FIP) began to address the issue of an over-exploited reef fishery. FIP helped fishers to modify their fishing gear by implementing a Mesh-Exchange Program in 1991 that provided enough 1½" wire mesh to make two traditional lesser Antillean Z traps in exchange for each working trap made of smaller mesh returned by the fisherman. Within three years the number of fish caught per fish trap, the catch weight per fish trap and the mean size of individual fish had increased while the catch composition had shifted towards larger and more valuable species[5]. Another aspect of FIP was to increase the fisher's awareness of the importance of adopting sustainable fishing practices. This message spread and in 1996 the Mesh Exchange program was expanded into the neighboring fishing beaches of Rio Bueno, Runaway Bay and Salem at the request of the fishermen there. FIP has also been instrumental in assisting the local fishing community to organize into a Co-Operative for the ultimate purpose of creating an assemblage of organized fishing communities with the capacity to implement management techniques.

A fourth initiative of FIP was assistance to the ALLOA Fisherman's Co-Operative, a group of fishermen working out of the Old Folly Fisherman's Beach in Discovery Bay, to establish a marine protected area (Fig. 1) in 1996. The reserve consisted of 27.5 ha of shallow back reef and lagoon habitats (< 20m depth) that were known to be an important breeding ground for many of the fish recruiting into the reef fishery. The reserve was shown to have a positive impact on local catches by delaying the size and age at recruitment into the fishery for fish that use the reserve as a nursery area. A few species have shown reduced mortality rates as a result of periodic residence in the reserve and have consequently attained larger sizes. Subsequently, fishermen from the Top Beach Fishing Beach requested that the area of the reserve be extended to include the eastern part of the Bay. A third group of fish have shown increases in spawning stock biomass and thus increased recruitment rates resulting in a larger average number of fish per catch[6].

Future Considerations

Sustained progress in improving the fishery around Discovery Bay has also been difficult. Widespread illiteracy and unemployment, and the lack of a traditional culture of community-based resource management have encour-

aged high levels of distrust in this small fishing society. The enforcement of the reserve area has been discontinued due to a lack of funds in 1999. While many fishers catch more today than in 1996, the average size of most species caught has still decreased. The FIP continues to seek management alternatives for this dwindling fishery. Research has shown that the placement of rectangular escape holes in the mesh of the traps enables smaller fish move freely out of the traps, and thus to delay size and age at recruitment into the fishery. The catchability of larger fish is not decreased[7].

Another possibility for alleviating pressure on the reef fishery is the introduction of Tilapia mariculture techniques. Recent research at DBML has sought to evaluate the environmental and economic costs and benefits of this alternative. Yet another way of reducing fishing effort on the inshore reef fishery may lie in the exploitation of off-shore pelagic and deep stocks such as deep water snapper and grouper. Information from a stock assessment of these species would bolster proposals to supplement the incomes of the local fishing community by setting up a small-scale long-line fleet. Such off-shore fisheries may hold the most potential for alleviating the pressures on inshore stocks throughout the Caribbean.

There is increased awareness amongst local fishermen regarding the importance of modifying fishing practices to reduce fishing pressure. However, the high demand for seafood products in the context of a degraded resource means that a broad-scale public education initiative throughout Jamaica is also needed for any fisheries management policy to be effective. The implementation of this third initiative is critical to halting the practice of catching and selling undersized fish. Without it, the decline of the reef fishery will continue as long as people are willing to buy undersized catch.

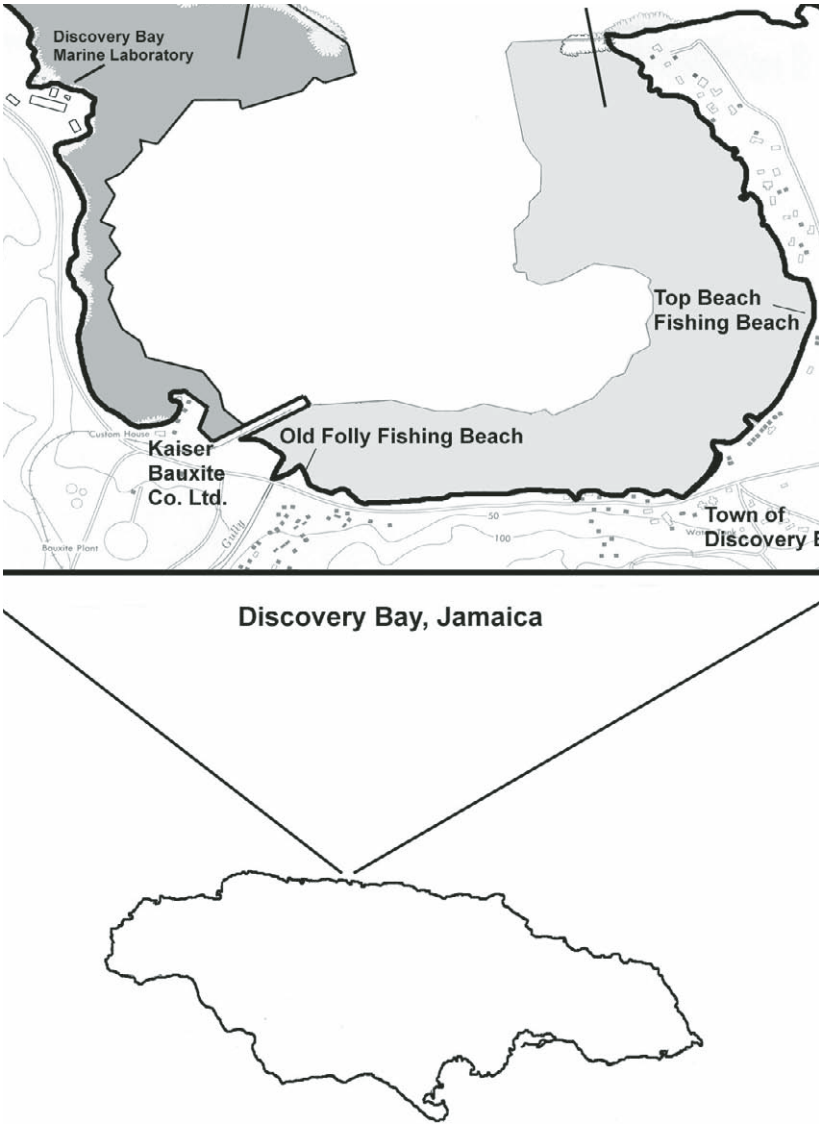

Figure 1. Map of Discovery Bay

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Peter M. H. Gayle is the Principal Scientific Officer (pgayle@uwimona.edu.jm) and Michael J. Sikora is the Environmental Awareness Officer at the Discovery Bay Marine Laboratory, Centre for Marine Sciences, University of the West Indies

A NEW PROTOCOL FOR SURVEYING ELKHORN AND STAGHORN CORAL

Biologists and GIS-specialists from the US Geological Survey, National Park Service and the University of the Virgin Islands are collaborating on surveys of *Acropora palmata* (elkhorn coral) around the US Virgin Islands to determine if this species is recovering following decimation from white band disease and hurricanes over the last 25 years. Over time, we expect to be able to document if there is an increase in both the number and size of the elkhorn colonies. We have developed a new protocol for mapping and assessing the condition of elkhorn colonies (presence of disease and predators, percent dead) based on recording GPS waypoints for each surveyed colony along with data on depth, size and condition. Photographs are also taken of each colony and all data are entered into a database.

The GPS waypoints are mapped onto geo-referenced aerial photographs providing information on spatial patterns. Because elkhorn coral primarily reproduces via fragmentation, it is logical to assume that groups of colonies will form the basis of new stands of live elkhorn. It is also possible that groups of colonies will be either more or less susceptible to some stresses (for example, predation by snails, disease) than isolated colonies. Because this coral species has a relatively high growth rate (up to 10 cm per year), substantial increases could be seen within 3-5 years. Evidence of a decrease in the abundance of elkhorn could be correlated with the presence of predators, disease, storms, or other factors, although we will not necessarily be able to conclusively show causation. A subset of colonies can be monitored over time to collect more detailed data on these stresses. We have focused mostly on elkhorn coral but are also collecting data on *A. cervicornis* (staghorn) with this same protocol.

Figure 1. Elkhorn coral in the US Virgin Islands in 1966.

This spatially based approach represents an early step in adapting methods from the developing field of terrestrial landscape pattern analysis to marine systems.

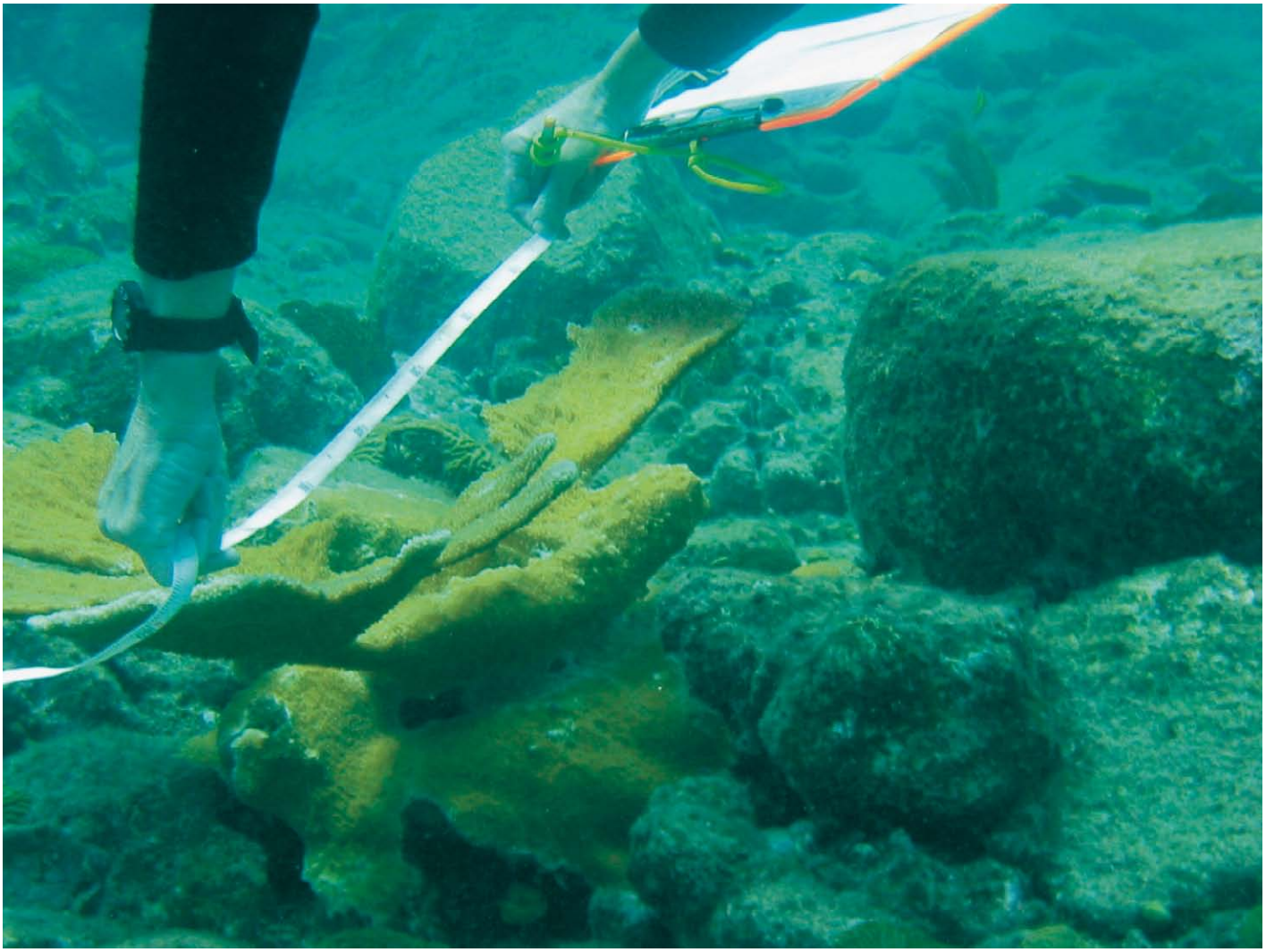

Figure 2. Measuring an elkhorn coral.

This method can be done efficiently with 3 people, with one person taking the GPS waypoints, and two others completing the field sheet for individual colonies. One of these team members or a fourth individual can take digital photos of each colony or group of colonies. A breakdown of the method is as follows:

- Select the reef zone or area to be studied
- Use GPS unit to get a waypoint at the anchor site or mooring (we are using a Garmin 12XL in a waterproof case on a kick board)
- Locate an elkhorn colony or group of colonies
- Get GPS waypoint of each colony (or group of colonies if they are very close together)
- Take digital photo of colony (colonies)
- Fill out field data sheet with information on depth; size (estimated from "height", "width" and "length" measurements); presence of disease, snails; percent of recent dead; percent total dead
- Return to office and download waypoints using Ozi Explorer software (available at OziExplorer.com) and ArcView
- Generate a map (on benthic maps or on geo-referenced aerial photos) with coral distribution

The protocol is more difficult to use when colonies are in dense stands. However, the GPS unit can be used to delineate a polygon around the stand, and at least some of the desired data can be collected. The density of the stand can be calculated from the area of the polygon and the number of colonies. These polygons can also be shown on the maps.

With this GIS-based information, we should be able to look at the patterns of elkhorn distribution to see if new patch reefs or stands are forming in certain areas over time. The maps will also illustrate patterns in distribution of disease, predation, size, fresh breakage

Figure 3. Information on the number of *Coralliophila* snails and the percent of tissue loss are also recorded.

or percent dead. As part of the study, we may learn that elkhorn colonies in certain locations are much more susceptible to predation or disease. This information could then be linked to genetic studies and further experimental research. This spatially based approach represents an early step in adapting methods from the developing field of terrestrial landscape pattern analysis to marine systems.

For a copy of the detailed protocol and the field data sheet, contact Caroline Rogers at caroline_rogers@usgs.gov.

Caroline Rogers, Christy Loomis, Barry Devine

Coral Reefs of the Fiji Islands: Current Issues

Geography and Distribution

Fiji is a scattered archipelago made up of about 330 islands and 500 cays, located two-thirds of the way between Hawaii and New Zealand. Approximately 1000 diverse fringing and barrier reefs are found across Fiji with one of the most spectacular reef systems being the 370 km Great Sea Reef. Geographically isolated in the South-West Pacific, Fiji shares species with the highly diverse Indo-West Pacific, but has lower diversity.

The population of Fiji in July 2001 was about 844,330, with a growth rate of 1.41 percent[1]. Ninety percent of the people live on the two large islands of Viti Levu and Vanua Levu while less than half (about 104) of the other islands are inhabited[2]. Taveuni and Kadavu islands are important tourist dive destinations. The major island groups are the Mamanucas, home to the majority of tourist resorts, the Yasawas, a popular destination for tourist boats and the Lau Group which supports almost no tourism.

Threats to Reefs

Fiji's reefs are considered to be in relatively good condition. Coral bleaching has had widespread impact in recent years, with reefs near large urban centers being subject to urban pollutants, heavy gleaning, coastal development and siltation. Destructive fishing practices, including dynamiting and poisoning with the root of a local plant *Derris* sp., cause locally serious damage in some parts.

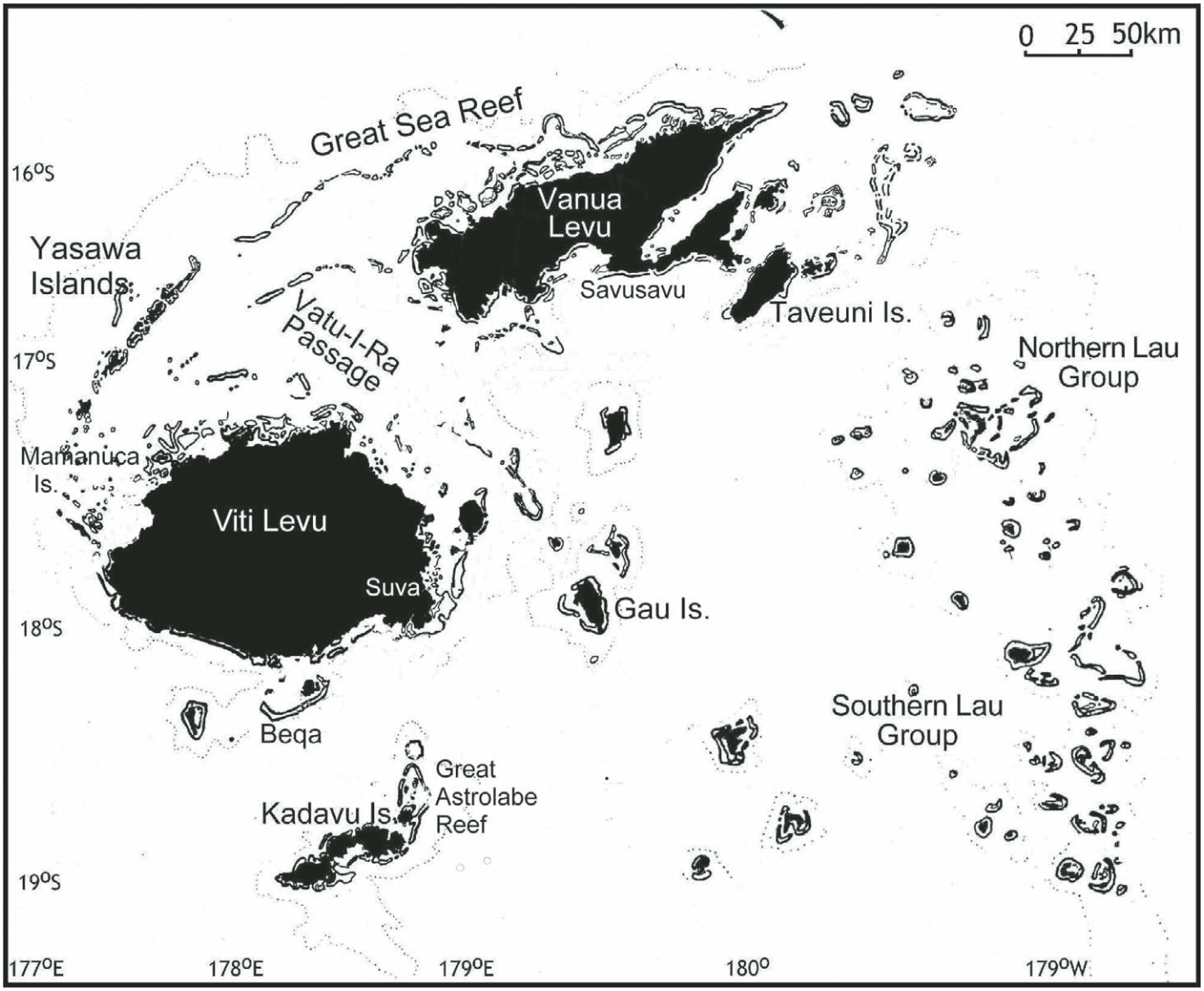

Figure 1. Map of Fiji, excluding Rotuma in the north (12.5° S, 177.1° E) and Ono-i-Lau (20.7° S, 178.7° W) and Ceva-i-Ra (21.77º S, 174.52º E) in the south. Adapted from Cumming et al. (in press).

Overfishing:

Most reefs in Fiji are moderately to heavily fished. Reefs near to cities are under heavy pressure from commercial fishing[3] while those near villages are subject to subsistence and artisanal fishing. Fishing has resulted in a stock reduction of invertebrates such as giant clams, and over targeting of reef fish species such as *Lethrinus harak*, *Lethrinus xanthochilus*, *Lethrinus nebulosus*, and *Bolbometopon muricatum*. In most areas, B. muricatum has been fished to local extinction.

Crown-of-Thorns Starfish (COTs)

A major COT outbreak occurred in 1965-70, followed by outbreaks in 1978-1982, 1983-1985[4] and 1993-present[5] leading to coral reef degradation. Since 1996, new outbreaks have been reported annually at widely dispersed sites in Fiji[6], including the Mamanucas, Wakaya, Lau, Taveuni, southern Viti Levu, Kadavu and Gau[7,8,9].

Pollution

In urban areas, sewage pollution, reclamation and poor land use contribute to high sedimentation and eutrophication[10]. Most urban areas lack sewage treatment and proper waste disposal. High levels of nitrates and phosphates have been found in long-term studies in Laucala Bay, off Suva[11,12].

Litter is common around all urban areas in Fiji. Most garbage dumps are located in mangrove areas, posing serious health risks to the public and environment. For example, leaching toxins from the Suva dump[13] contaminates Suva Harbor. Pollution can also occur in the immediate vicinity of more desolate tourist resorts and villages.

Coral Bleaching and Cyclones

The Seawater Temperature Monitoring Program at the University of the South Pacific (USP) has been recording seawater temperature at numerous sites throughout Fiji since 1996. Studies have suggested that seawater temperature is a factor in coral bleaching with seawater in Fiji generally cooling during El Niño and warming during La Niña events.

Major and minor coral bleaching became an annual event during summer (December-April) from 1998-2002. Minor bleaching, involving a small proportion of colonies and/or mainly partial bleaching, occurred in 1998 and 1999 while mass bleaching occurred in 2000 throughout Fiji (except north of Vanua Levu) affecting 64% of coral colonies. Severe mortality of Acropora at Beqa outer reef slopes (99%) and Pacific Harbor lagoon patch reefs (80%) near Beqa occurred between April 2000 and April 2001[14].

In early March 2001, minor bleaching was widespread and some sites were on the verge of major bleaching due in part to a drop in seawater temperature caused by Cyclone Paula. Cyclone Paula overturned corals and removed many dead standing colonies and further impacted reefs, that were bleached during the 2000 incident. In 2002 Fiji had bleaching coinciding with reports of severe mass bleaching on the Great Barrier Reef in Australia. This event was less severe than 2000 with mass bleaching being restricted in most areas to shallow inshore reefs and reef tops due to a thermocline at 2-3 meters.

Reef Harvesting

Corals are harvested in Fiji for septic systems, the curio trade and the marine aquarium trade. Occasionally, massive corals of the genera *Goniopora* and *Alveopora* are also exported for medical use in bone replacement. All harvested corals are exported except those for septic systems.

Septic systems

Live colonies of the genus *Porites* have historically been harvested from reefs near Suva for use in septic tanks, a practice that continues in present times. The coral is sold on the roadside for construction of drains and soakage pits for septic tanks, as required by Suva City Council regulations. This practice is based on the invalid assumption that the smell of wastewater overflow from sewage systems will be removed by the presence of coral, and that only corals can perform this function. The average age of collected colonies is 40-80 years and reef degradation is apparent, though no environmental impact assessment has been carried out[15].

Trade in reef products

Since 1984 the curio trade (bleached coral skeletons) was the principal reef product exported from Fiji until the growth of the marine aquarium trade in the mid 1990s Fiji is the only regular supplier of curio coral from the Pacific. Although the US bans curio collecting from its own reefs, it is the major export market for Fiji's curio trade where corals are sold as ornaments or for use in aquaria. Selling ornamental corals to tourists is banned in Fiji, although local unregulated handicrafts stalls do sell them on a small scale. The fishery is under review by the Fisheries Division, which is seeking to confine the harvest to sustainable levels through prohibition and limitation. Over 124,000 pieces (mostly whole colonies) are currently exported annually[16].

Fiji is the world's second largest exporter of live reef products for the marine aquarium trade behind Indonesia. The trade includes corals (hard, soft, gorgonians), other invertebrates (anemones, zooanthids, coralimorphs, molluscs, echinoderms), reef fish, "live rock" (calcium carbonate reef rock covered with coralline algae and associated fauna and flora) and "live sand" (reef sand with resident interstitial fauna and flora). Live rock is used for substrate and bio-filtration in aquaria. Live sand aids in water filtration and provides a substrate for microorganisms. This market is also dominated by the US, but also includes Japan and Europe.

Seven companies currently export live reef organisms from Fiji. Collection is contracted out to villages with an *i qoliqoli* (customary reef rights area) from which collectors fill orders for species and quantities. The market is expanding and many villages are keen to become involved for the cash income. Live rock is removed as blocks of reef rock 15-35cm diameter. These are either packed on the beach and

taken directly to the airport, or taken to holding facilities for "curing." Curing involves keeping corals moist with a fine spray of seawater so the coralline algae survive while less hardy associated organisms die. Cured product is considered higher quality and has a higher value because associated organisms are less likely to die in aquaria and affect water quality.

No export limits or formal management plans exist for reef harvesting. Export is limited only by market demand, restricted freight space on airplanes and availability of properly sized corals (less than 15 cm) to fit in aquaria. Conflict exists between the coral trade and tourism sectors because of the lack of a national coral reef management plan.

In 1998 Fiji became a CITES (Convention on International Trade in Endangered Species) signatory obliging it to control trade in endangered species, or species that may become endangered if trade is unregulated. This requires setting quotas, but by January 2002 required legislation had not been passed, annual reports had not been filed, and quotas had not been set so that Fiji defaulted on the terms of CITES. The CITES Secretariat in Geneva recommended that all signatory countries, including the US, cease trade with Fiji in CITES-listed species from January 14, 2002. Yemen and Vietnam were also included in this suspension, which covered giant clams (*Tridacna* spp.), all hard corals, stony corals (Scleractinia), organ pipe corals (*Tubipora* spp.), black corals (Antipatharia), fire corals (*Millepora* spp.) and lace corals (Stylasteridae). Despite the CITES recommendation, export continues to the US and Japan although trade with Europe has stopped. Aquarium fish and benthic organisms are unlisted under CITES and are not affected by the recommended ban (which also includes iguanas, parrots and flora such as timber species). In March 2002, a delegation was sent to the CITES standing committee meeting in Geneva to seek a lifting of the suspension. An agreement was reached that in order for the ban to be lifted a quota of 50% of the 2001 permitted exports had to be imposed and the CITES legislation must be ratified by Fiji's Parliament. This legislation is currently being formulated.

Research and Monitoring

Historically, coral reef research in Fiji has been confined largely to Suva, where the Marine Studies Program (MSP) of University of the South Pacific (USP) has a field station located in close vicinity to Suva's barrier reefs. Postgraduate and staff research projects are evaluating reef health with studies looking at impacts of fishing, mass coral bleaching, marine protected areas and aquarium harvesting, remote sensing, ecology of reef organisms and soft-sediment benthos, aquaculture of corals, algae, corallimorphs and fish, taxonomy, social aspects of subsistence fishing and marine law.

Scientific research of harvesting impact has been inadequate, but recently Reef Check, the International Marine Alliance (IMA) and the South Pacific Regional Environment Program (SPREP) have begun organizing scientific research, capacity building and monitoring. The Marine Aquarium Council (MAC) has commissioned Reef Check to develop an assessment and monitoring strategy for evaluating sustainability and collection impacts, and pilot field-testing is being carried out in Fiji. SPREP is coordinating coral identification workshops in Fiji and throughout the region to build capacity within Fiji's government in anticipation of the larger role of customs departments and fisheries personnel in CITES compliance. Mariculture of live coral and other aquaria products is in the research phase, and some products are already being marketed.

The mass coral bleaching event of 2000 triggered the first major activity of The Global Coral Reef Monitoring Network (GCRMN) in Fiji, when eight independently operating research groups collaborated on a country-wide quantitative assessment of intensity and impact of the bleaching event. This included evaluation of 19 geographically broad areas where monitoring still continues in many instances[17].

The logistics and costs of coral reef monitoring in Fiji currently preclude a single research group from surveying such a large area. The GCRMN relies on the activities of various research groups, NGOs such as Greenforce and Coral Cay Conservation, and reef-based tourist operations such as the Fiji Dive Operators Association, to provide surveying. The GCRMN recently mounted a campaign to involve tourist resorts in monitoring their local reefs using Reef Check and GCRMN methodology. Training workshops for the local community and courses for resort staff are being conducted about Reef Check's reef monitoring program, which is simple enough to allow non-scientific personnel to contribute reproducible data to a large survey, in order to create a network of monitors. The GCRMN is also establishing monitoring sites around Suva and is collaborating with the World Wide Fund for Nature (WWF) South Pacific Program for monitoring a newly established marine protected area (MPA) at Ono Island, Kadavu[18].

In July 2001, Fiji joined Kosrae, Pohnpei, Palau, The Philippines, Malaysia, Papua New Guinea, and Australia in the SeagrassNet to monitor changes in sea grass beds. Fiji established a site on Nukubuco Reef off Suva, to be monitored for a two year time period with observations taking place every three months. This program also has a community–based component, involving training communities to do monitoring, which is modeled after Sea Grass Watch, the Australian community sea grass-monitoring program.

Management and Conservation

Community-based marine protected areas (MPAs)

No established system of national MPAs exists to date in Fiji, however a growing network of village-owned and managed MPAs is in place based on Fiji's strong tradition of custom-

ary marine tenure. As early as 1992 traditional Fijian chiefs in the Macuata area of northern Vanua Levu closed their fishing grounds in an attempt to counter a perceived decline due to over harvesting. The intervention was based on the Fijian tradition of closing fishing grounds in times of mourning, such as the death of a chief. This closing was not scientifically monitored.

In 1996, work began in Verata *tikina* (shire, incorporating 6-10 villages) of eastern Viti Levu with the Institute of Applied Sciences (IAS) at USP, and local group South Pacific Action Committee for Human Ecology and the Environment (SPACHEE), supported by the Biodiversity Conservation Network of the USA government. A series of environmental awareness activities were held at both the village and *tikina* levels, resulting in the following actions being approved:

- Suspend issuing commercial fishing licenses to outsiders
- Ban turtle and coral harvesting
- Limit size of gill nets used (minimum 3 inches)
- Ban use of poison from the plant *Derris* sp.
- Consider declaring *tabu* (no take zone) marine areas

A subsequent two-week workshop resulted in declaration of a sea grass and coral reef *tabu* in one village. Participants were trained to monitor indicator species identified by the community, the mangrove lobster in mangrove communities and *kaikoso* clams (*Anadara* sp.) in sea grass beds. The villagers estimated a 300% annual increase in *kaikoso* in the *tabu* area and 100% annual increase in nearby harvested areas, which encouraged other villages to establish *tabu* areas. There are now nine *tabu* areas for several important marine species in Verata.

In 1997 villagers in Ono, Kadavu declared a *tabu* area on a portion of their reef that contained two deep "blue holes". In 1999 they began work with WWF South Pacific Program to carry out scientific surveys[19] and seek formal governmental declaration of an MPA. In April 1998, Waitabu village on Taveuni declared a reef *tabu* area in collaboration with Resort Support, a Suva-based tourism and training company, and funded by the New Zealand Overseas Development Agency via Tourism Resource Consultants. The impetus was to develop a tourism snorkeling area and to train locals as snorkeling guides. Since 2000 it has been self-supporting and now draws an average of 22 tourists/month, with an average income of F$700/month. The *tabu* area covers 1 km of shoreline and the full width of the fringing reef, about 300m from beach to deepwater drop-off. Previously, the reef flat in particular was heavily gleaned for subsistence food items (fish and invertebrates). Surveys began in 1998 and have documented increases in fish and invertebrate abundance, and have improved fishing in adjacent areas[20].

In 1999, the Foundation for the Peoples of the South Pacific (FSP) introduced the Coral Gardens project to help communities in Fiji rehabilitate degraded coral reef habitats. They assisted Cuvu *tikina* of southern Viti Levu to develop an environmental committee that resulted in three coral reef *tabu* areas and one mangrove MPA. They worked with the major local resort, Shangri-La Fijian, on sewage management and mitigation of freshwater and pollution impacts around the resort. The tourism industry is an important factor in marine protection in Fiji. The Fiji Dive Operators Association and resorts, such as the Cousteau Resort and Namenalala, seek to work with nearby communities to establish protected areas.

SPREP has funded development of an MPA at Ono-I-Lau, the southernmost and most isolated island group in Fiji. It is a collaborative effort between USP and The Women in Fisheries Network and Southern Cross University in Australia. Preliminary scientific surveys and discussions with stakeholders have been carried out, and this site may be nominated as a UNESCO Man and the Biosphere (MAB) reserve. The Women in Fisheries Network, a regional agency, IAS and WWF hold workshops on marine conservation that are leading to the development of more *tabu* areas. Reports of the successes of these projects have attracted interest in government departments. The Fisheries Department has recently established a conservation unit that has started work with a *tikina* in Gau to promote village-level management of their marine resources. They manage an MPA around its research station at Makogai Island, east of Viti Levu.

A new initiative to encourage the different agencies to work together towards locally managed marine areas (LMMAs) is being facilitated by USP with the establishment in 2001 of a discussion/action group called Fiji-LMMA, which includes the above-mentioned groups plus the Marine Aquarium Council (MAC) and the International Marine Alliance (IMA). Management and conservation of reefs and their resources in Fiji is largely up to the traditional owners, and this organized network is intended to assist village, *tikina* and provincial authorities to make responsible marine resource utilization decisions.

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Scientist contact information:
R.L. Cumming[1], W.G.L. Aalbersberg[2], E.R. Lovell[3], H. Sykes[4] and V.C. Vuki[5]

[1]PO Box 184, Bullcreek WA 6149, Australia. Tel (618) 9310 4238, email cumming_r@yahoo.com.au
[2]Institute of Applied Sciences, The University of the South Pacific, P.O. Box 1168, Suva, Fiji Islands. Tel. (679) 212440, email Aalbersberg@usp.ac.fj
[3]Biological Consultants, Fiji, P.O. Box 3129, Lami, Fiji Islands. Tel. (679) 361358, email lovell@is.com.fj
[4]Resort Support, PO Box 2558, Govt Bldgs, Suva, Fiji Islands. Tel (679) 302073, email resortsupport@is.com.fj
[5]Marine Studies Program, The University of the South Pacific, P.O. Box 1168, Suva, Fiji Islands. Tel (679) 212873, email vuki_v@usp.ac.fj

Mauritius: a small refuge with conservation potential?

T.R. McClanahan, The Wildlife Conservation Society, Bronx, NY

K.R. Moothien Pillay, Mauritius Oceanography Institute, France Centre, Quatre-Bornes, Mauritius

H. Terashima, Laboratory of Marine Ecobiology, School of Fisheries Science, Kitasato University, Japan

Email address: tmcclanahan@wcs.org

While the coral reefs in the western Indian Ocean were badly bleached and experienced high coral mortality in 1998[1], Mauritius experienced some bleaching but largely escaped the mass mortality experienced in other parts of the Indian Ocean[2]. In 2002 and 2003 there was also bleaching and low-level coral mortality in much of the Mascarene Islands but again it had little effect on Mauritius. The current ecological conditions of these reefs, therefore, lie in stark contrast to most of the Indian Ocean. Why would this tiny coral-fringed island escape the devastation common to this region and what are the implications for management and conservation?

A possible explanation is that Mauritius is in the southern Indian Ocean cyclone belt and cyclones form nearby during these warm years. This weather system is associated with clouds and stirring of the water, which may create low-light and cooler conditions that could prevent coral mortality due to increased temperatures. This was probably the case in 1998[3]. Time-series analysis of temperature trends and predictions into the future suggest this southern Indian Ocean region will experience the effects of rising seawater temperatures later then the rest of the Western Indian Ocean region[4]. Furthermore, the local topography of the near-shore areas causes high water flow and hence low retention of warm water that would be responsible for extensive coral bleaching[2]. Although the exact reasons behind mild bleaching remains elusive, Mauritius for conservationists is a refuge and for scientists a control for much of the recent environmental disaster that has occurred in the region. Evaluating the status of these reefs and insuring that appropriate conservation measures are in place is, therefore, a regional priority for conservation.

Geographic Background

Mauritius was formed 10 million years ago by a series of volcanic eruptions[5,6]. There were two major periods of volcanic eruptions, one between 10 and 5 million years and a more recent one at 3.5 million to 25,000 years[5]. Water clarity is unsurpassed in Mauritius compared with most of the Indian Ocean and a view of the color satellite data indicate that Mauritius is in one of the lowest water color or chlorophyll regions of the Indian Ocean. Not surprisingly, coral reefs are well developed around the island and the fauna is typical of the western Indian Ocean. There are 150 km of fringing reefs around Mauritius except for breaks on the Southern and Western coasts. A short strip of barrier reef is found off the southeastern coast of Grand Port. A shallow lagoon, with depths averaging from 1 to 6 meters, is present between the shore and the fringing (barrier) reef

and varies in widths from 200m to 7km. Lagoons are absent in the south and south eastern regions where there are no fringing reefs.

Reef Faunae and its History

The study of the fauna in Mauritius has a history of almost three hundred years following the age of exploration starting at the end of the 15th century. Sampling works in the region were undertaken during several expeditions organized by the colonial governments. The identification and curation of the collected specimens were completed at museums in Europe. From 1845-1982, a total of 139 of hard corals were reported from Mauritius[7]. A recently published study[8] describes 159 species of which twenty-one species (*Seriatopora dentritica, Acropora branchi, A. striata, Montipora spongiosa, M. kellyi, M. calcarea, Leptoseris yabei, Pavona danai, Goniopora savigni, Porites annae, P. cumulatus, P. palmata, P.australiensis, Favia rotundata, Favites bestae, Leptastrea pruinosa, Parasimplastrea sheppardi, Platygyra pini, Plesiastrea devantieri, F. veroni* and *L. aequalis*) are new records to Mauritius. Furthermore, the study shows the highest number of species to be from the Acroporidae, followed by Faviidae ,Poritidae and Agariciidae. A few species, which are likely new to science have also been found and are presently being described[9].

Studies on the fish include species lists which cited 735 species[10], collected 654 species in 1995[11], and a published, annotated checklist containing 992 species[12]. Most of the recorded species are common to the tropical and sub-tropical region of the Indo-Pacific. Endemism of fish is reported to be high for this region, similar to the Red Sea[13]. However, a recent survey reports a few endemics such as *Amphiprion chrysogaster* and *Stegastes pelicieri*[14]. Some species, notably *Parapriacanthus elongatus, Pomacanthus semicirculatus*, and *Balistoides conspicillus*, common in tropical or sub-tropical Indo-Pacific region are, however, rare in Mauritius.

Reef Ecology

The amount of living coral on many of the reefs is unsurpassed in the western Indian Ocean[15]. This is particularly true of the eastern side of the island where *Acropora formosa, A. intermedia, A. cytherea, A. aculeus, A.austera, Montipora aequituberculata, M. digitata, Pavona cactus*, and *Porites annae* form spectacular monospecific stands and these species often leave very little room for other genera. *Acropora* is highly sensitive to bleaching and has been eliminated in large areas throughout the western Indian Ocean. Some of the colonies are 10-20 m wide and must be hundreds of years old. Near the reef crest, the most common corals are *A. abrotanoides, A. nobilis, A.austera, Pocillopora damicornis, Porites lutea* and *Porites lobata*.

The western side of the island has much less *Acropora*, although still quite abundant, but many of the other taxa that may be competitive subordinates to *Acropora* are found on this side. The reef slopes harbor a comparatively high diversity of corals, the most common ones being *A. humilis, Porites cylindrica, P. nigrescens, P. lobata, P.australiensis, P. lutea, Goniopora tenuidens, Platygyra daedalea, Leptoria phrygia, Favia matthaii, F.stelligera, Favites flexuosa, F. pentagona, Symphyllia recta, Echinopora hirsutissima, E. gemmacea, Hydnophora exesa* and *Plesiastrea versipora*. Some coral species such as *Stylocoeniella guentheri, Pocillopora indiana, Seriatopora caliendrum, S. guttatus, Leptoseris yabei, Goniopora savigni, P. palmata, Cyphastrea serailia, F. vasta, Leptastrea aequalis* and *Ctenella chagius* are rare on the reefs of Mauritius and may be seen in only a few locations[8]. There is likely to be some intriguing distribution and community structure patterns of the coral and competitive interactions on the different sides of the islands that are poorly studied and understood at present.

The fish fauna mainly consist of fishes associated with coral reefs such as Pomacentridae, Serranidae, Chaetodontidae, Labridae and Scaridae, furthermore species of Carangidae, Lutjanidae, Lethrinidae, Mullidae and Acanthuridae are also abundant and highly valued as fishery products[14]. In the lagoons, two gregories, the territorial *Stegastes lividus* and *S. nigricans* are common in the branching *Acropora* areas mainly dominated by *A. nobilis*. The densities of these two species sometimes exceed 100 individuals /100 m^2 [16]. Aggregations of *Chromis viridis, Dascyllus aruanus* and *Abudefduf sparoides* are also found in coral rich areas in the lagoons and reef slopes. Small groupers such as *Epinephelus fasciatus, E. hexagonatus, E. macrospilos, E. merra* and *E. spilotoceps* usually take refuge in rubble areas or beneath tabular corals in the lagoons and shallow reef slopes. Among these groupers, young *E. hexagonatus* is the most common grouper seen in the lagoons.

On the reef slopes, some hinds such as *Cephalopholis sonnerati, C. spiloparaea* and *C. urodeta* are often observed though the larger individuals are rare. Corallivorous or omnivorous butterflyfishes such as *Chaetodon trifascialis, C. terifascialis, C. auriga, C.guttatissimus, C. kleinii, C. madagaskariensis* and *C. vagabundus* are habitually seen around the coral reef areas. Large aggregations of planktivorous *Hemitaurichthys zoster* are also often seen above natural or artificial reefs on lower reef slopes. The most frequently observed species of wrasse, rambling around coral and rubble substrata in the lagoons and upper to lower reef slopes are *Thalassoma genivittatum* and *Halichoeres hortulanus*. *Anampses caeruleopunctatus, A. meleagrides, Halichoeres scapularis, Stethojulis albovittata* are also abundant in the shallow lagoons, while *Bodianus axillaris, Cheilinus triobatus* and *Epibulus insidiator* are observed mostly on lower reef slopes. Schools of young or juvenile parrotfish such as *Chlorurus sordidus* are a common feature in coral and rubble substrata of the lagoons. Many Gobiidae hiding in burrows usually inhabits the sandy bottom areas. *Papillogobius reichei* and *Vanderhorstia ornatis-*

sima usually appear in shallow sandy bottoms near shores or river mouths while *Amblyeleotris steinitzi* and *Valenciennea puellaris* are found on fore reef sides. In addition to the species mentioned above, many trevallies (e.g. *Carangoides fulvoguttatus, Caranx ignobilis, C. melampygus, C. sexfasciatus* and *Selar crumenophthalmus*), snappers (e.g. *Etelis carbunculus, E. coruscans*), jobfishes (e.g. *Aprion virescens, Pristipomoides argyrogrammicus, P. auricilla, P. filamentosus, P. zonatus*) and emperors (e.g. *Lethrinus mahsena, L. neblosus, L. rubrioperculatus*) are common to off shore reefs and are exploited for local consumption.

Reef Condition

The effects of fishing are clear and fishermen in favor of pelagic or deep benthic fisheries have abandoned many of the near-shore reefs. Fish trapping is very common and most of the reefs are littered with active but also a large number of inactive or "ghost" traps, often made of chicken wire. There are notable differences in abundance, size, species composition and relationships with depth that are similar to those patterns reported in East Africa[17]. Many of the shallow reefs on the western side of the island have high densities of the sea urchins, *Echinometra mathaei* or *Echinothrix diadema*, and they are feeding intensely on the reef substratum and eroding the reefs in many areas. This is less commonly observed on the eastern side of the island. Some of the reefs are small and narrow and not well developed and, therefore, the erosion by sea urchins may quickly reduce the size of these reefs. The effects are noticeable as many of the reefs are pockmarked with sea urchin burrows and one would expect to see the reefs reduced in size in the coming decades. Sea urchin predators are very uncommon in shallow water, but more common in deep areas and sea urchins are uncommon below four meters.

Analysis of the official fisheries statistics indicates an increase in catch up to 1986 and then a decline after 1994. Most of the rise in catch from the 1980s is due to the development of a tuna fishery, which is currently more than half of the total catch landed. This is an offshore fishery and tuna have a very high trophic level of 4.5 and this explains the unusual rise in the trophic level of the catch. The official reported statistics for the local demersal fishery is rather stable and there is no evidence of fishing down the food chain. The official statistics do not report many of the common fish that are caught, notably many herbivorous fish such as parrotfish. The lack of reporting of these groups may explain the stability and there is a need to expand the fish catch categories to include these other groups.

One might expect high levels of pollution from the sugar cane fields and the high population density of people on the island to be responsible for the demise of the fishery, however, the effects are not obvious. In fact, Blue Bay Marine Park, is at the mouth of a river which drains sugar cane fields, and water clarity is high and the corals are thriving, with some colonies being more than 10 m wide. It is unclear where the nutrients and fertilizer end up and how such high clarity water is maintained, but probably a low nutrient baseline, high currents and good flushing are contributing factors.

Management Institutions

The government is stable and the economy is highly developed for the region. Tourism is a major part of the economy and seems to be increasing along with the political and economic problems in other regions, such as Bali, Israel and East Africa. Tourists view the Island as a safe alternative to areas with poverty, ethnic or religious strife. Most people speak both French and English, are welcoming to tourists and tourism is expected to continue as a major economic force on this island.

The University has an Environmental Studies as well as a Biology Department. There is a strong interest in science and technology and to use this capacity to develop the economy. Coral reef researchers and managers are largely employed by two institutions, the Government's Fisheries Department, and the three-year old parastatal, the Mauritius Oceanography Institute (MOI). JICA (Japanese Government Aid) has helped develop the fisheries and coral programs of Fisheries department but left in November of 2002. There are a number of small local conservation NGOs, but no permanent involvement from the larger international NGOs.

The Fisheries Department is responsible for the management of the marine parks and also with monitoring of the coral reefs. The two parks were designated many years ago but they were not officially proclaimed until June 2000. They have not achieved fishing restrictions and, therefore, there are no unfished reefs in Mauritius and there are about 1500 fishermen on an island of about 1 million people.

The coral reef monitoring program has been active since 1997 and has been repeated since 1998 twice a year at 17 sites around the island. The method used largely produces hard coral cover and the abundance of five species of fish in 250-m^2 belt transects[18]. The method used lacks adequate replication for the undertaking of robust statistical analyses and counts of the fish often produce many zeros, as some species are patchily distributed or uncommon. Therefore it is unlikely for small changes to be detected, except for coral cover across disasters such as mass bleaching and mortality events.

Findings of the three-year monitoring program (1997-2000) have shown a significant decline in live coral cover at two of the eight coral sites surveyed but stability in the other sites[16]. The decline may be due to the 1998-bleaching event[2].

Conclusions

There are a number of unique conditions in Mauritius that justify establishment of marine conservation and associated science initiatives. One is the location in the cyclone belt, where water temperatures appear to be rising

more slowly than other regions[4]. This may make it a potential refuge from warm water and coral bleaching that could lead to the persistence of coral in case of global climate change. Another reason is the reported but poorly studied endemism. Heavy fishing in near-shore areas is, however, a concern as this could reduce the stability of these reefs and their ability to resist change, and may erode the biodiversity and resilience of these unique reefs. Fortunately, the economic conditions and high levels of tourism make the prospects for closed-area marine parks very likely[17]. Additionally, tourism-based and offshore fishing alternatives of tuna make it politically less sensitive than in many other tropical areas. There is keen interest among the government, parastatals and academics to interact with international partners for science and conservation and efforts to do so should be encouraged.

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Hawaiian Coral Reef Ecology

David Gulko. 1998. Mutual Publishing, Honolulu. 244 pages.
ISBN 1566472342 Paperback US$25

This is a highly informative, innovative, colorful, entertaining book that is designed for educational use at the middle school, high school, and community college level. Instead of a textbook centered on a long narrative, this book dances along with color photos, diagrams, graphics, and paragraphs explaining the graphics. It is easy to read, which is quite an accomplishment, since the author introduces many technical terms, and every page is filled with information ranging from basic concepts of ecology to the myriad details of how reef organisms live and interact on Hawaiian reefs. After an initial introductory section that explains how the book is organized and some basics of ecology, the author treats corals as organisms, then corals as condominiums (hosts for symbionts), and finally coral reefs as ecosystems, including the effects of humans on coral reefs. Concepts are explained so well that the average person with no technical training would find it easy to read. This is likely to make it appealing to naturalists, divers, snorkelers, and tourists who wish to learn more about coral reefs and understand the processes that control them. Although much of the material is likely to be familiar to reef scientists, every reader is likely to discover new and fascinating facts of which they were previously unaware. While re-reading the material, one finds things that had been forgotten or missed on an earlier read.

This book is primarily about Hawaiian reefs, of course, but it deserves a much wider audience. All the general processes and principles have applications to coral reefs around the world. Most of the species discussed are found widely in the Indo-Pacific, or are so similar to species found elsewhere in the Indo-Pacific that only a taxonomist could differentiate between them. Moreover, the author introduces some Indo-Pacific organisms such as anemonefish, fire corals, and giant clams that are not found in Hawaii. The net result is a book with a much wider application than its title suggests and the ability to help educate people worldwide about coral reefs. In order to save coral reefs, we need as many people as possible to appreciate their beauty and complexity. This book will help build a constituency to do exactly that.

Douglas Fenner, Australian Institute of Marine Science, PMB 3, Townsville MC, QLD 4810, Australia Email <d.fenner@aims.gov.au>

Fire in the Turtle House

Osha Gray Davidson

Just the inclusion of the word “turtle” in the title of this recently published book would ordinarily peak the curiosity of sea turtle lovers everywhere. This non-fiction work chronologically tracks the first known observation of fibropapilloma tumors in sea turtles through the very latest research in battling this disease. Although the book’s subject appears to be technical in nature, this work is not full of arduous scientific jargon or complex technical information. Davidson weaves a true tale in terms that are easy to comprehend, so that any adult will certainly grasp both the intended and underlying messages with little or no effort.

Davidson uses the sea turtle’s plight with this disease as his vehicle to present larger environmental issues affecting the global oceans and natural environments. The author’s deft words convey an air of “mystery” to this fast-paced book that reads more like a novel than scientific non-fiction. Fire in the Turtle House establishes where the research is today, and allows our imaginations to wander to “where we might be in the future”. Names, places and events mentioned in the book will be familiar to many Save-A-Turtle members, as quite a bit of the action takes place in Florida and The Keys.

If you would like a copy of “Fire in the Turtle House” and would like to make sure your monies are spent on the research of fibropapilloma in marine turtles, please purchase your copy from Save-A-Turtle.Org. Save-A-Turtle is committed to aiding in the end of this affliction on marine turtles and has contributed over $50,000 (to date) to researchers worldwide in the plight to find a cure. Help insure the future of Marine Sea Turtles by supporting this important research. As quoted by the foremost authority in Fibropapilloma research, Dr. Larry Herbst: “Without the support and funding we will see that the Marine Sea Turtles will be Extinct within the next ten years!”

“Tropical Mike” Hall, President, Save-A-Turtle Inc. of the Florida Keys

“The Fragile Reef”

30 minute video

This beautiful video on coral reefs addresses two main topics. The first subject presented is the project to chart the world’s coral reefs. This video shows how this project culminates in a new coral reef atlas. The video also discusses the environmental problems affecting coral reefs and their solutions. It concentrates primarily on overfishing and tourism in Tanzania and Egypt, and shows promising programs to reduce the destruction of coral reefs and use reefs sustainably.

This video presents an excellent introduction to these topics. It is easy to understand and would be great for classroom use, and the beautiful presentation should inspire students. Due to the brief nature of the video, instructors may want to supplement the these subjects with additional information.

Doug Fenner

Field Guide to Corals of Mauritius

2002. Pillay RM, Terashima H, Venkatasami A, and Uchida H. Albion Fisheries Research Centre, Mauritius. 334 pages.

By Douglas Fenner

This is the first field guidebook to the corals of any location in the western Indian Ocean that I am aware of. It includes 163 species, 159 of which are Scleractinia. The book includes a short, easy to read, and informative introduction to corals, reefs, and Mauritius. It also includes keys to all the genera and species included in the book.

Two pages are devoted to each species. The left hand page provides a description of the species with suborder, family, full name (including author and year), description, habitat and abundance, and distribution. The appearance of the living coral on the reef is described and the appearance of the skeleton is occasionally included. The right hand page presents 3-4 quality photos, 2-3 of which are color photos of the living coral, and one black and white photo of the skeleton. The largest photo at the top is of the whole colony, and below it are smaller close-ups of parts of the colony. The photos are sharp and have good color.

The book includes 21 species that are newly recorded for Mauritius, and 10 are new records for the western Indian Ocean. One species was previously known only in the Red Sea, two were previously known only in Oman and Yemen, and another was previously known only in the Chagos archipelago. The authors are clearly very familiar with the latest information on coral species, and include several species named only a couple years ago. This is the first report of several of these species outside of their type location. All of these things are significant achievements and will be of great interest to the scientific community.

This book will prove to be an invaluable tool for scientists, naturalists, conservationists and government officials not only in Mauritius, but in nearby islands and throughout the western Indian Ocean. Many of the species included in this work have very wide distributions, occurring in the Red Sea and well into the Pacific Ocean. Thus, this field guide book can be utilized far beyond Mauritius.

This book will also help to build a constituency for the conservation of coral reefs in Mauritius, as many Mauritians will be amazed to see the many beautiful corals that live in their waters.

Aquarium Corals

2001 By Eric H. Borneman. T.F.H. Publications, Neptune City, New Jersey. 463 pages

By Douglas Fenner

This book presents information on the keeping of hard and soft corals and their relatives by aquarium enthusiasts, which might be referred to as amateur biologists or laypersons. This book introduces the reader to the biology of coral reefs and corals, and reviews the many different coral groups (to the genus level among the hard corals). This book was not written solely to describe how to keep healthy, closed home aquaria. Rather, this book explains to the home aquarist the different kinds of coral, how easy or difficult they may be to keep in the home aquarium, what sort of populations there are of these corals in the wild, and whether their collection is likely to impact the wild populations.

It would be a mistake to underestimate the contribution of aquarists to the understanding of corals and other aquarium-kept organisms. If there are any doubts about this book, it would be wise to read the forward by “Charlie” Veron. The forward is an incredibly eloquent statement on the value of naturalists observing corals in aquaria, and the role of this book in encouraging this activity.

The keeping of corals in saltwater aquariums has made giant strides in the last few decades. Once, corals kept in home aquariums were handed a certain death sentence. This is no longer the case, as aquarists are now not only able to sustain corals, but grow and reproduce them as well. Coral clones have been spread around the world in aquaria.

Aquaria have long been used by biologists studying corals, and continue to be an invaluable tool for experimental studies. Now laypersons are able to make valuable observations and even conduct experiments in home aquaria. In the process of growing and asexually reproducing corals, aquarists are making many interesting observations, including events that have yet to be observed in the wild, such as forms of reproduction never seen before.

The author is very much involved in the efforts to reduce the impacts of coral collection for the aquarium trade, as well as increasing the ability of aquarists to keep these corals alive, healthy, and reproducing. The book includes a mammoth set of references that can be used to learn an astounding amount about corals.

Coral Reef Conservation Campaign

The Ministry of the Environment in Brazil, MMA's National Protected Areas Program and DAP recently launched the *Coral Reef Conservation Campaign*. This campaign was jointly developed with Coastal Reefs Project (www.recifescosteiros.org.br) (BID/UFPE/IBAMA/FMM), and the National Environmental Education Program (PNEA/MMA).

This initiative is part of The Natural Ecosystems Conservation Campaign supported by the MMA last year. The purpose is to raise awareness of users of protected areas (visitors and others). This campaign also intends to promote principles of environmentally aware behavior based on the international "Leave No Trace" Campaign.

Tourism to protected areas will allow protected areas to be self-sustaining. Therefore public awareness regarding the roles and importance of biodiversity and wild areas is a key step to environmental conservation. Building on this principle, MMA/DAP has launched an awareness campaign at designated preserves to focus on environmental education for visitors. Part of the aim is to encourage ethical attitudes when engaging in leisure activities in wild areas.

The first goal of campaigns for the conservation of wild areas is the creation of behavior guidelines regarding the various tourism and leisure activities. The decision was made to follow-up on the campaign by developing adequate guidelines to be applied to the remaining Brazilian ecosystems, including coral reefs.

In Brazil, coral reefs cover approximately 3 thousand km along the coast – from Maranhão State to the South of Bahia State. They represent the only reef systems in the South Atlantic[1].

The boost in tourism, together with increased popularity of diving activities, has drawn attention to this breathtaking ecosystem from all over the world[2]. It is also the source of new problems and, according to Maida et al.[3] and Castro[4], the issues below deserve special notice:

- **Physical damages to the biota**: Caused by trampling and uncontrolled boat traffic (anchorage). This is due to an increase in the number of boats and tourists/vacationers that occupy the reef area during summer, the low tide period;
- **Predatory fishing by non-professional fishers**: This activity is highly selective and very few species are taken. This can cause a dramatic reduction in the targeted species, such as fish from the Serranidae family (jewfish, wrasses and groupers), or those species considered to be "suitable" for display in aquariums or as souvenirs; and,
- **Pollution**: trash (solid waste).

In view of the vulnerability of such ecosystems by human actions in the coastal zone, several protective measures are necessary, including a public awareness campaign regarding the population's role in protecting and preserving these ecosystems. This motivated the creation of the *Coral Reef Conservation Campaign*.

Below is a set of sixteen guidelines that people should bear in mind when visiting reef areas, whether or not these areas are conservation units:

- Scuba diving is a means of getting acquainted with the beautiful coral reef environments. Before going diving you should contact professional divers and the managers of Protected Areas for information.
- Respect the rules of protected areas by learning about their regulations in advance.
- Anchor on sand only to avoid damaging corals or other reef organisms. Anchoring on reefs is prohibited by law.
- Do not touch or step on corals, because they are very fragile organisms.
- Feeding fish with particles of human food is harmful to their health.
- When swimming in sea ponds, avoid using all types of skin lotions, because they contain chemicals harmful to sea animals.
- Remnants of shells, corals, starfish and other shells are shelter to other organisms - do not remove these animals from their habitat.
- Scuba equipment including submerged pressure gauges, cameras, backup regulators and other items of equipment must be secured near the diver's body to prevent accidental damage to the corals.
- Avoid wearing fins in shallow water, because they can damage corals and other organisms, and/or stir up sediments.
- Move slowly when diving to prevent scaring animals.
- Laws prohibit buying and selling of handcrafted works made from corals because it encourages destruction of reefs.
- Try to obtain information on tide cycles and timing in order to avoid unexpected problems and dangerous situations.
- Using bombs, liquid bleach and other chemicals is extremely harmful to the reef environment and is prohibited by law. All fishers (non-professional or professional) must obtain a permit from the authorities. In some Protected Areas, such as National Parks and Biological Reserves, fishing is prohibited.
- Avoid using harpoons and fishgigs, as they scare animals and can provoke accidents.
- When visiting a natural ecosystem, take the trash you produce back with you. Never throw plastic bags in the ocean.
- Do not collect anything, make sure you "leave no trace" by taking away only memories and pictures.

The overall purpose of the campaign was to create attractive materials so that the guidelines could be easily remembered. Three different types of campaign materials have been designed to help with this goal. The materials contain lighthearted pictures associated with each guideline, which work as icons. The materials include an A3-sized,

impermeable poster, to be displayed on tourist boats that travel to reef areas; an impermeable brochure, 21x15cm, to be handed out to divers and visitors in general and a booklet containing more detailed information to be disseminated in schools, travel agencies, city halls, and other relevant locations. A CD-ROM containing campaign material artwork has also been developed for distribution. Full campaign information can be obtained from the MMA's website: www.mma.gov.br and at: www.parquesdobrasil.com.br.

The protected areas involved in the project are: Costa dos Corais Environmental Protection Area; Piaçabuçu Environmental Protection Area; Ponta da Baleia/Abrolhos State Environmental Protection Area; Recifes de Corais State Environmental Protection Area; Parcel Manoel Luis State Marine Park (state unit – MA); Recife de Fora Municipal State Marine Park; Abrolhos National Marine Park; Fernando de Noronha National Marine Park; Atol das Rocas Biological Reserve; and Corumbau Extractivist Marine Reserve.

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Coral Reef Conservation project team: Ana Paula Leite Prates (DAP/MMA); Ângela Magalhães Duarte (DAP/MMA); Beatrice Padovani Ferreira (Coastal Reef Project); Maria Carolina Hazin (DAP/MMA); Maria Helena Reinhart (Coastal Reef Project) and Paula Moraes Pereira (PNEA/MMA). Drawings: Cristina Georgii.

Ana Paula Leite Prates
Fisheries Engineer, MSc. Technical advisor to DAP/MMA, and campaign coordinator. E-mail: dap@mma.gov.br and ana-paula.prates@mma.gov.br

10th ICRS Pre-Symposium Workshop on Coral Reefs and Global Change

Dr. Andréa Grottoli and Participants* (see photo caption for participant list)

January 2004

There is a growing consensus among marine scientists that various aspects of global change are increasingly threatening to coral reefs. A series of mini-symposia on Coral Reefs and Global Change (CRCG) is planned for the 10th ICRS in Okinawa. On January 13-16, 2004, co-chairs of these six mini-symposia and members of the planning and coordinating committee for the 10th ICRS met at the University of Tokyo, for a pre-symposium workshop (Figure 1). Seminars on the state of the science and new research directions submitted for the Okinawa symposium in June were presented and discussed for the following six mini-symposia (in theme two): sea level and climate interactions through time (2-7), corals as recorders of past climate (2-8), corals, carbon and climate (2-9), reef community responses to bleaching: recovery or degradation? (2-10), prediction and societal implications of coral bleaching (2-11) and understanding the interactive roles of light, sea temperature, and CO_2 in coral growth, recruitment, bleaching and health (2-12). The participants reviewed the submitted abstracts, and planned schedules for poster and oral presentations, and the CRGC special session. The workshop ended in the beautiful setting of Hakone, with an afternoon of discussion on the future of research on global change and coral reefs. The participants decided to begin putting together a position statement on the topic and will seek support from the ICRS to release it in 2004. Overall, the workshop was very successful in organizing the CRGC mini-symposia and in stimulating discussion. Everyone looks forward to the presentations at the 10th ICRS in Okinawa.

**Dr. Andréa Grottoli, University of Pennsylvania, Department of Earth and Environmental Science, 240 South 33rd Street, Philadelphia, PA 19104-6316 tel: 215-898-9269*

fax: 215-898-0964, email: grottoli@sas.upenn.edu

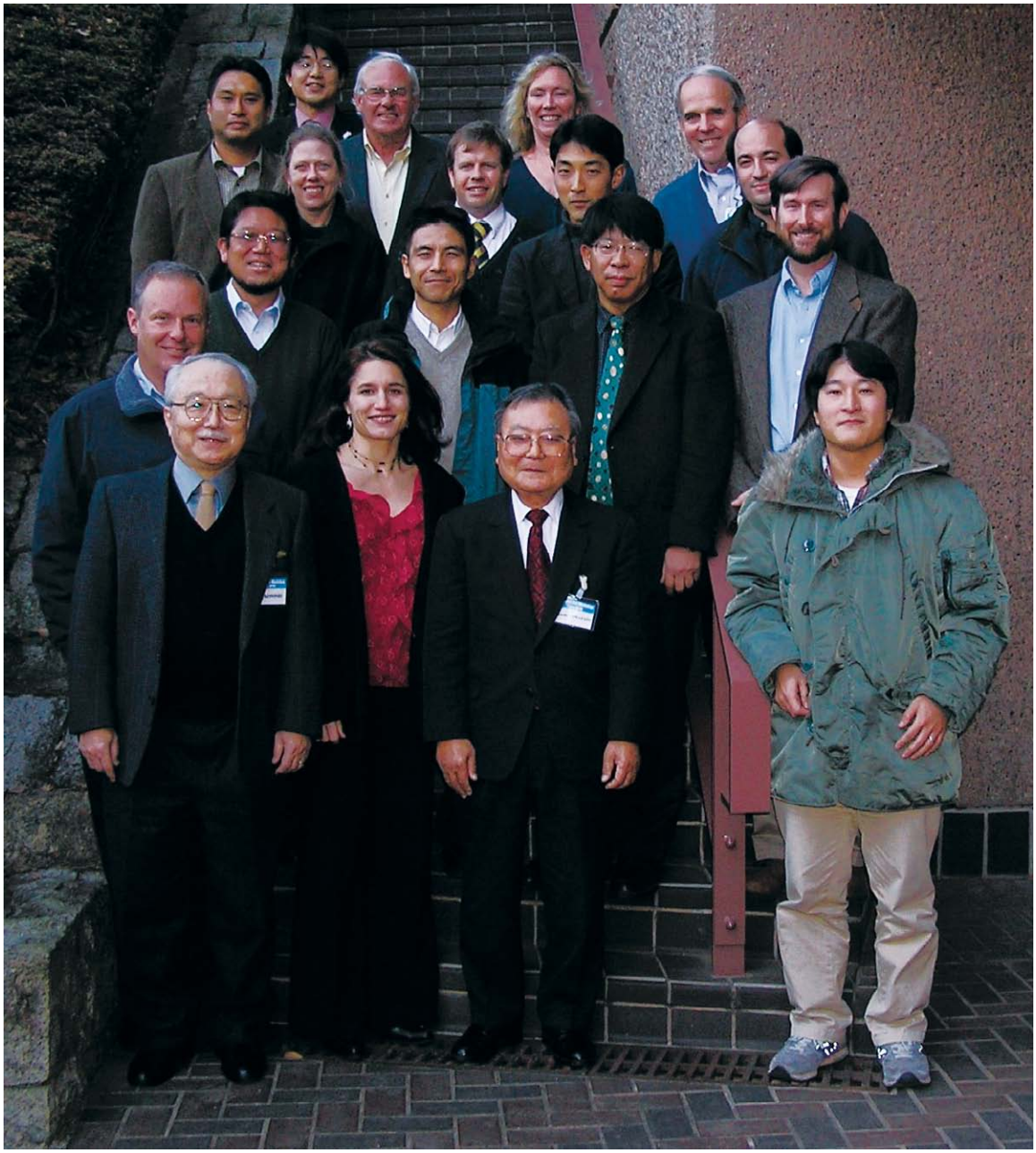

Figure 1: Participants from the 10th ICRS Coral Reefs and Global Change pre-symposium workshop at the University of Tokyo, January 13-16, 2004. From left to right first row: Kenji Konishi, Andréa Grottoli, Kiyoshi Yamazato, Hiroya Yamano; second row: Chris Langdon, Hajime Kayanne, Keisuke Takahashi, Yoshimi Suzuki, Mark Eakin; third row: Joanie Kleypas, William Skirving, Kohei Hibino, Juan Maté, fourth row: Hironobu Kan, Hiroyuki Fujimura, Roger McLean, Peggy Fong, Al Strong; not shown: Kazuyuki Shimoike, Atsushi Watanabe, and Hiroko Iijima. Special thanks to the Japanese Ministry of the Environment, Japanese Coral Reef Society, University of Tokyo Wildlife Research Center, and the Japanese National Institute for Environmental Studies for financial support for this workshop.

Don't Spend Your Vacation Walking On Eggshells: Check Out CORAL's Turtle Watching Guide

You are fortunate enough to encounter an ancient and endangered creature: a giant sea turtle. What do you do? Do you:

a. Charge ahead and set your camera on flash to get a good shot
b. Shine your light in its face to get a better look
c. Consult the newly published Coral Reef Alliance's Turtle Watching Guide, to make sure your next step might not further endanger this threatened species

Answer: C. Now available from the Coral Reef Alliance (CORAL), the single page Turtle Watching Guide offers easy-to-follow tips on how to best behave if you encounter a sea turtle while boating, scuba diving or roaming the beach. Sea turtles' easy-going nature can be deceptive, and well-meaning turtle watchers may be unaware that their actions are harming the very creatures they adore, especially when they come ashore to lay their eggs on their home beaches. Park managers and marine tour operators can request copies of the Guide to educate their visitors on how to enjoy turtle observation while looking out for the turtle's safety. To request a copy of the Turtle Watching Guide, contact the CORAL at parks@coral.org (or download a copy from www.coral.org).

This guide is the first in a series for coral reef tourists to be produced by the CORAL as part of the Coral Parks Program, a global initiative to support the development and success of tourism-supported Marine Protected Areas. The Turtle Watching Guide was developed in cooperation with the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), a network of sea turtle conservation groups throughout the Caribbean.

The Ecology of Fishes on Coral Reefs

Edited by PF Sale

A comprehensive and up-to-date review of the ecology of reef fishes. Contents include trophic ecology, larval and juvenile ecology, community organization, and fisheries management. Contains many important and useful methodologies of interest to ecologists in general.

724 pages, b/w photos, figs, tabs. 2002
Academic Press GBP 69.95 US Price: $99.95 ISBN 0126151857

Reef Fishes, Corals and Invertebrates of the South China Sea Including Thailand, Hong Kong, China, Malaysia, Taiwan, Singapore, Indonesia and the Phillipines

Elizabeth Wood and Michael Aw

Comprehensive guide to 275 species containing colour photos, identification details and at-a-glance information on a spectacular array of fish, corals and invertebrates to be found in the waters stretching from Thailand to Indonesia.

144 pages, 300 col photos, 60 b/w illus.
New Holland Publishers (UK); Price GBP 10.99 ISBN: 1859748910

Coral Reefs

Charles Sheppard

Contains stunning photography of the world's largest coral reefs and asks what is damaging them (a third of the world's reefs have been destroyed in the last 30 years alone) and what must be done to save them.

72 pages, 40 col photos, maps.
Colin Baxter; Price GBP 9.00 - 2002 -

The Great Barrier Reef: Finding the Right Balance

David Lawrence, Richard Kenchington and Simon Woodley

Discusses policies for managing the dynamic, diverse and fragile environment of the Great Barrier Reef.

263 pages, col photos, b/w illus, maps.
Melbourne UP, Australia Price GBP 12.95 - 2002 -

10TH INTERNATIONAL CORAL REEF SYMPOSIUM
STABILITY AND DEGRADATION OF CORAL REEF ECOSYSTEMS

28 June - 2 July 2004, Okinawa Convention Center, Okinawa, Japan

The 10th International Coral Reef Symposium, Okinawa, Japan, is being organized and coordinated by the Japanese Coral Reef Society in collaboration with the ISRS.

The Organizing Committee has selected Stability and Degradation of Coral Reef Ecosystems as the main theme of the 10th Symposium, and has identified four concurrent sub-themes for further discussion and elaboration:

1) The evolution of coral reef ecosystems;
2) Environmental factors controlling coral reef formation in time and space;
3) The relationship between ecosystem stability and biogeochemical cycles;
4) Moving towards a system where humans and coral reefs coexist.

For more information on the 10th ICRS please contact:
Plando Japan, e-mail <icrs@plando.co.jp>, Fax 81-3-5470-4410 or www.plando.co.jp/icrs2004/

Climate Change and Aquatic Systems: Past, Present & Future

21-23 July 2004, University of Plymouth, Plymouth, UK

The aim of this international conference is to bring together scientists working in marine and freshwater systems with an interest in the impact of climate change on the physico-chemical, biological and ecological aspects of their systems. We aim to find individuals working on historical climate change, those investigating the current impacts of climatic variation and people modelling future climatic trends. The intent is to provide a shared experience, with sessions containing papers from all aquatic systems.

For more information:
http://www.biology.plymouth.ac.uk/climate/climate.htm

4th International Bioerosion Workshop (IBW-4)

August 30th - September 2nd, 2004; Prague, Czech Republic

The aim of the workshop series is to combine the knowledge of biologists (working mainly in reef ecosystems) with the experience of palaeontologists interested in bioerosion of all types of substrates (reefs and other calcareous matters, wood, bone, etc.). All participants should communicate their results or problems as talks, posters or presentations of specimens. The workshop will be held at the Czech National Museum in Prague. Several additional days of field trips are planned prior to and during the meeting (e.g., Devonian and Jurassic reef facies, Cretaceous and Miocene rock grounds and hard grounds, Miocene bored mollusc deposits, recent wood borings).

For more information please contact:
Dr. Radek Mikuláš, Institute of Geology, Czech Academy of Sciences, Rozvojová 135, CZ - 165 00 Praha 6;
E-mail: mikulas@gli.cas.cz