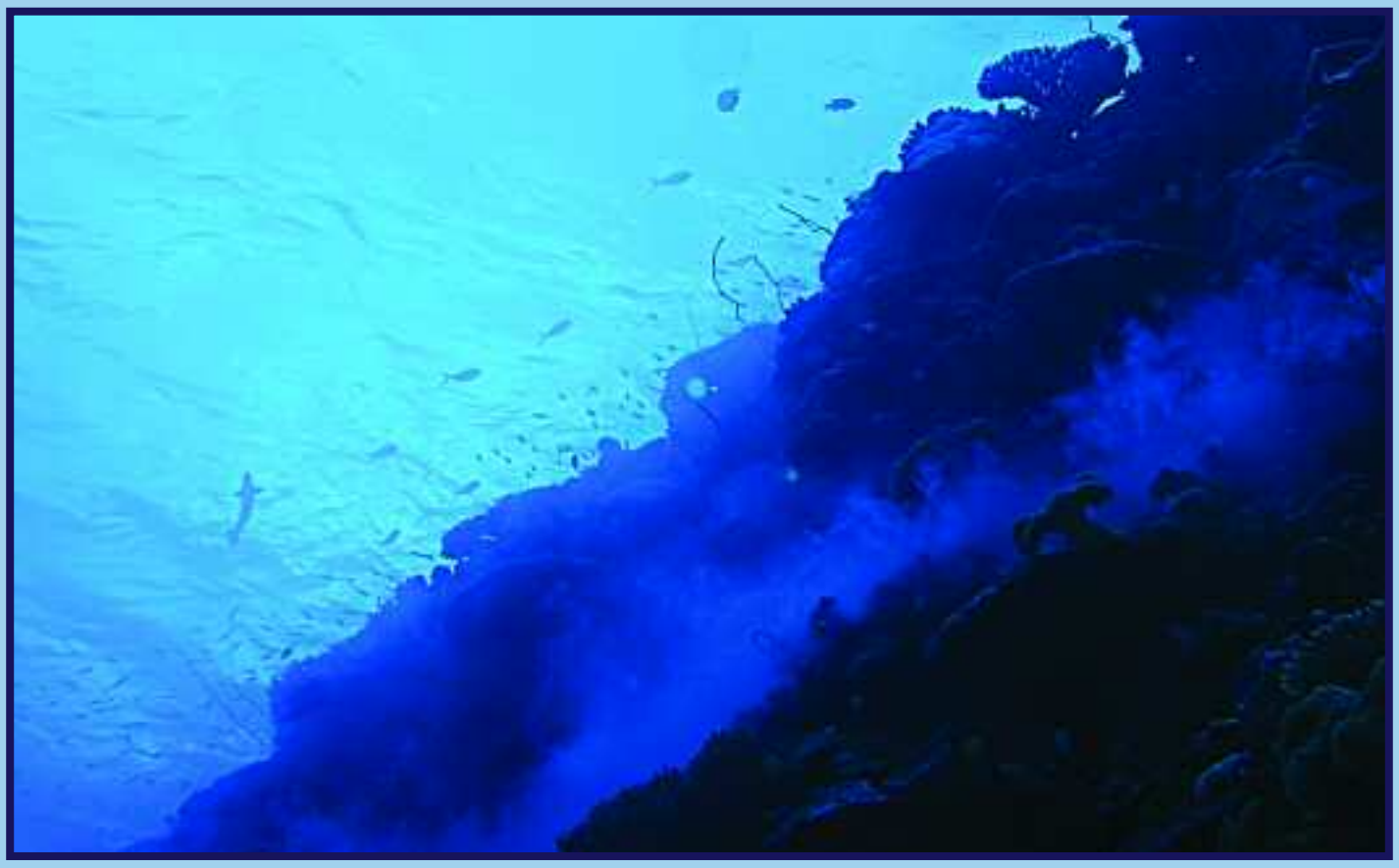
REEF ENCOUNTER

June 2008
No. 36

Newsletter of the International Society for Reef Studies



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Newsletter of the International Society for Reef Studies

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Editorial

Copy deadline for *REEF ENCOUNTER* 37 (due out September 2008) is 31 August 2008

Front cover
Photo by Alasdair Harris. Sponges spawning on Salomon Atoll, Chagos Archipelago, March 2008.

Design and Layout by Rodney Cash and David Ashby

The International Society for Reef Studies was founded at a meeting in Churchill College, Cambridge, UK in December 1980. Its aim under the constitution is to promote, for the benefit of the public, the production and dissemination of scientific knowledge and understanding concerning coral reefs, both living and fossil.

i. In order to achieve its aim, the Society has the following objectives:
ii. To hold meetings, symposia, conferences and other gatherings to disseminate this scientific knowledge and understanding of coral reefs, both living and fossil.
iii. To print, publish and sell, lend and distribute any papers, treatise or communications relating to coral reefs, living and fossil, and any Reports of the Proceedings or the Accounts of the Society.

To raise funds and invite and receive contributions from any persons what so ever by the way of subscription, donation or otherwise providing that the Society shall not undertake any permanent at 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 modeling.

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EDITORIAL

We apologise for the rather late arrival of this issue of *Reef Encounter* and many thanks to our patient and willing contributors for their help. Particular thanks to Mike Arvedlund who did all the lay-out and production for the last issue but has now had to step down through pressure of work. If anyone is interested in becoming part of the editorial team please get in touch – we need people to help look for interesting articles, correspond with authors, find illustrations, and edit and prepare material for lay-out. Once again, we have a very full issue – to make more space the Diary section has been moved from the newsletter to the website. Do please continue to send in news items and other articles of interest to readers.

As Rich Aronson says in his president's message, we must NOT "give up coral reefs for dead". Like the journal *Coral Reefs*, with its recent theme issue (Vol. 26, No.4, Dec 2007) on 'Aspects of interactions between humans and coral reefs', we can use *Reef Encounter* to show how scientists and other reef practitioners can best use their time and skills to tackle the issues that are leading to coral reef decline. Many readers will have followed the discussion on Jim Hendee's NOAA Coral-List on 'What can scientists do?' (December 2007/January 2008) which produced numerous suggestions, and illustrated the sense of desperation and frustration that we probably all feel. There is a real need now to show what can be done, and this issue of the newsletter has some good examples.

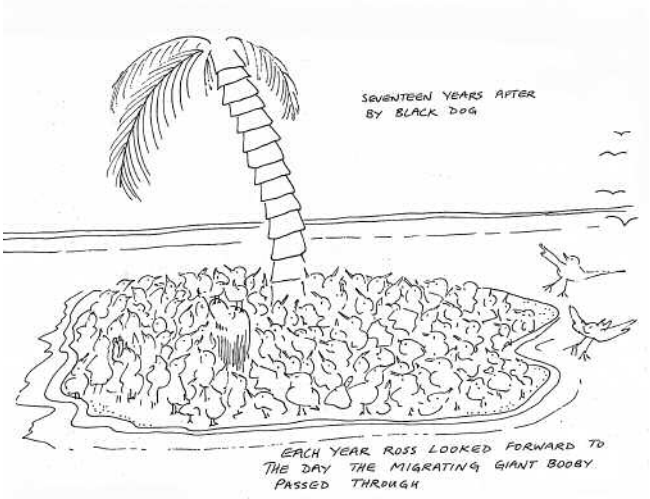
The cover photo by Alasdair Harris shows how resilient reefs can be in the absence of human beings, as on this atoll in the Chagos Archieplago (see Sheppard et al. in press. *Mar. Ecol. Progress Series*) – as also recently found in the Line Islands (Sandin et al. (2008) *PloS ONE* 3(2): e1548. doi:10.1371/journal.pone.0001548). This emphasizes the need for identifying and protecting such remaining sites. At the other extreme, Bernard Riegl and his co-workers describe some of the work underway in the Gulf States, a part of the world where rampant coastal development is overtaking climate change in hammering reefs, another recent topic on the NOAA Coral-List. Andrea Deri and her co-workers report on reef protection in the little known Laccadives archipelago. Alasdair Edwards describes the pros and cons of reef restoration, another hot topic of debate on the Coral-List. Reports from three of the six 2007 ISRS/TOC fellows give snapshots of current reef research aimed at improving our understanding of what is still a frequently mystifying ecosystem.

Amidst the doom and gloom of future predictions, we need to remember – and transmit to others – the fundamental reason why reefs are so important. Denny Hubbard's 'geologist's lament' is a reminder of why reefs are the focus of many of our lives, why we need an organisation like ISRS, and what we should aspire to be doing in the International Year of the Reef 2008.

Sue Wells, Steve Coles & Adel Heenan

ISRS elections

ISRS will be holding elections this year to replace outgoing officers and members of the ISRS Council. We will be electing a new Treasurer to replace retiring Treasurer John Ware and a new Recording Secretary to replace retiring Recording Secretary Robert van Woesik. In addition, we will be replacing six retiring members of the ISRS Council: Rolf Bak, Annadel Cabanban, Guillermo Diaz-Pullido, Lawrence McCook, Berhard Reigel, and Yoshimi Suzuki. The tenure of each elected position is 4 years, beginning January 1, 2009. These positions are open only to members of ISRS. Nominations must be sent by post or fax, or as an email attachment to Isabelle Cote (imcote@sfu.ca) by 11 July 2008 (see ISRS website for details). The biographical sketches of all the candidates will be posted on the web site until the day ballots are due. Ballots will be emailed to all members and will need to be returned to the Corresponding Secretary in September (exact date to be announced). The results of the election will be announced by email and on the Society's website in October.



ISRS COMMENT

From the President

To paraphrase an old joke, "Two reef scientists: three opinions." We are a contentious lot. Although it would be unhealthy for us to be monolithic in our outlook, I feel compelled to comment on a recent change in the flavour of discussions about "the situation" as the International Year of the Reef (IYOR) unfolds. That new tilt is the idea that we may have already gone past the tipping point for coral reefs, which would mean it is all over already. Not only do I not believe this to be the case, but to me it is absolutely the wrong message, both for ourselves and the public. If it is all over, we are wasting our time and energy, and there is no reason for anyone to bother. "The situation" is desperate and time is short, so we must fight for coral reefs on local and global scales.

Along these lines, the Officers and Council of ISRS are continuing to project the Society's profile as the leading professional organization in our field. On January 24th, Vice President Tim McClanahan and I attended the launch of IYOR in Washington, D.C. Clive Wilkinson, global coordinator of the Global Coral Reef Monitoring Network and long-time member of ISRS, released a book-length report on the impacts of the 2005 bleaching event in the Caribbean. The report and associated media activities drew attention to what the public needs to hear again and again: that coral reefs are in serious trouble. At the same event, Christian Estrosi, France's Secretary of State for Overseas Territories, spoke out for hope in announcing a major new initiative to protect the reefs of New Caledonia.

The most prominent event of IYOR will be the 11th International Coral Reef Symposium (11th ICRS) in Fort Lauderdale, Florida in July. The theme of the 11th ICRS is "Reefs for the Future," which reminds us all to maintain a proactive attitude toward saving coral reefs. Chairman Dick Dodge and his Local Organizing Committee are working night and day to ensure that the Symposium will be a resounding success, and SeaWeb is organizing a major media campaign. ISRS is proud to co-sponsor the Symposium.

The ISRS Council conferred Honorary Memberships on Ian Macintyre, Gray Multer and Bob Ginsburg for their research and service to coral reef science. Terry Hughes will be honored at the 11th ICRS as the 2008 recipient of the Society's prestigious Darwin Medal. Ian, Gray, Bob and Terry remind us that coral reef science must remain at its core scientific. The policy recommendations flow naturally from the research.

To further the science an anonymous donor, acting through The Ocean Conservancy (TOC), will once again sponsor the ISRS/TOC Graduate Fellowships for Coral Reef Research. The 2008 competition is underway, and the six winners will be announced at the 11th ICRS. We are grateful to our donor for supporting such a worthy cause.

As a last item of business, the recent referendum to revise the ISRS Constitution was successful. You can find the new constitution on the ISRS website, http://www.fit.edu/isrs/, and in the upcoming edition of the Society's Membership Directory.

In closing, each of us must choose what to believe about the fate of coral reefs, and what to say to our colleagues and the media. But please … don't give up coral reefs for dead.

Rich Aronson, President

2008 Darwin Medal: Professor Terry Hughes

Professor Terry Hughes is undoubtedly one of today's most prominent coral reef scientists, reflected in his award of the ISRS 2008 Darwin Medal. The Darwin Medal Award is the most prestigious honour bestowed by the Society and it will be presented to Terry at the 11th ICRS in July.

Terry Hughes measuring corals near Lizard Island Research Station, Great Barrier Reef, Australia. Photo: Mary Jo Boyle

Terry's exceptionally impressive publication record, his seminal contributions to coral reef ecology which have become classics in the field, his outstanding ability to obtain impressive national and international competitive research funding and direct large-scale research programmes, his collaboration with colleagues, both nationally and overseas, his pioneering innovative approaches to assessing coral reef resilience and scientifically underpinning the management of coral reefs, his admirable teaching career, during which he trained and supervised a large number of Honour, M.Sc., Ph.D. and post-doctoral students, his tireless extracurricular activities to increase public and government awareness world-wide of the global problem of the acute degradation of coral reefs and the urgent need to conserve their biodiversity, all point to his remarkable international scientific leadership in the field of coral reefs.

As a Ph.D. student at Johns Hopkins University in the 1980s, he developed novel mathematical modeling solutions for dealing with the demographic traits of organisms with an early dispersal phase but sessile as adults, tools that have since been widely applied. Then, as an NSF Postdoctoral Fellow at UC Santa Barbara, with Joe Connell (1984–1990), he broadened his research to explore the dynamics of coral reef communities, publishing a series of highly influential papers on the mechanisms of long-term changes in coral reefs. This early work on catastrophes, phase-shifts, and large-scale degradation of a Caribbean coral reef is, I believe, the best documented case of reef ecosystem collapse and the processes that need to be managed to prevent such events from occurring.

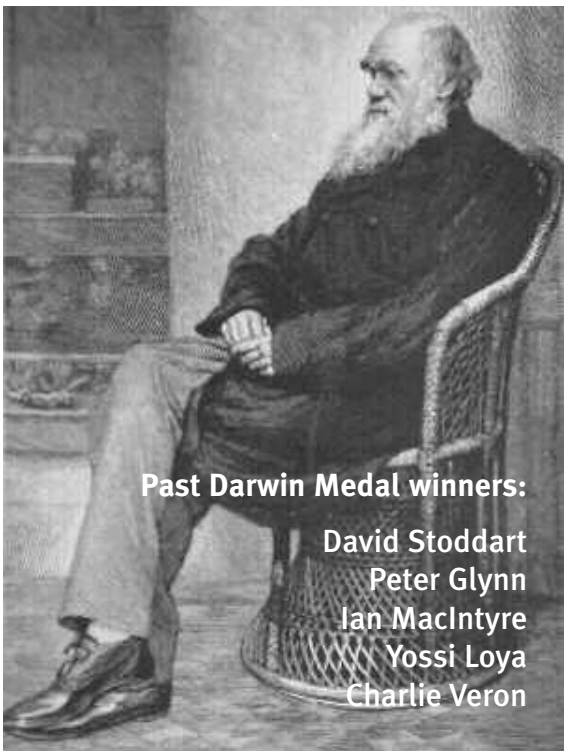
On moving to Australia in 1990, he developed a programme of innovative studies that explored the dynamics of the Great Barrier Reef and the South and West Pacific regions, using a characteristic combination of field sampling, experimentation and mathematical modeling. Terry has championed the importance of a longer-term and larger scale approach to ecology in seeking solutions to the problem of scale-dependency. Since 2000, he has further expanded the scope of his research to explore biogeographical processes at oceanic and global scales, particularly in the context of adaptation to climate change, leading teams to undertake fieldwork in Japan, Samoa, French Polynesia, the Solomon Islands, PNG, Indonesia, and the Caribbean. This ongoing research is innovative in its incorporation of spatial scale into the experimental and sampling design of field studies, providing a broader, landscape view of reef ecology, conservation, management of resources and biodiversity across international boundaries.

In all, Terry has published over 80 peer-reviewed articles and book chapters, 25% of which are in *Science* and *Nature* and >35% in *Ecology*, *Ecol. Monogr.*, *Ecol. Lett.* and *Evolution*. His publications are quoted extensively in the literature, and he is ranked as number 1 by ISI for peer citations from 1994–2005 in "coral reef ecosystems". His 2003 *Science* paper (with 16 colleagues), on climate change, human impacts, and the resilience of coral reefs, the result of a workshop convened and led by Terry, is regarded as a landmark study by all forums engaging with climate change, coral reefs and their management.

Terry has been elected to the Australian Academy of Sciences (2001), awarded two ARC Federation Fellowships, (2002–2007 and 2007–2012), the Centenary Medal (for services to coral reef science- 2002), and the inaugural JCU Research Excellence Award, and made it on to "Australia's Smart 100 List". He was made Personal Chair in Marine Biology at James Cook University in 2000, and recently established the highly prestigious Australian Research Council (ARC) Centre of Excellence: "Innovative science for sustainable management of coral reef biodiversity", of which he is the Director. Terry is the Australian Academy nominee to several highly important international bodies active in the field of coral reefs.

As Advisory, Topic and Managing Editor of *Coral Reefs* for ten years, he also contributed hugely to the success of the journal, for which he was presented with an Exceptional Service Award in 2000 by ISRS. Terry, on behalf of us all, thank you and congratulations; and on a more personal note: "Alle Vehatzlach".

Yossi Loya Ph.D., Professor of Marine Ecology, The Raynor Chair for Environmental Conservation Research, Dept. of Zoology, Faculty of Life Sciences, Tel-Aviv University, Tel Aviv, 69978 Israel.



ISRS Financial Report 2007

Total cash assets as of December 31, 2007 were US$115,599.67, all of which are in interest bearing checking accounts. At the beginning of the year cash assets were US$134,804.31. When the US$6,000.00 scholarship that is owed by the Society is included, there is a net loss of US$25,204.64. The Society continues to have difficulty retaining membership in non-ICRS years. Membership peaked at 1031 in 2004 and then dropped to 867, 832, and 779 in 2005, 2006, and 2007, respectively. Because of the 11th ICRS, we expect a marked increase in membership this year. ISRS is working on ways to decrease expenses, increase income, and retain membership. Income and Expenses for 2007 were as follows:

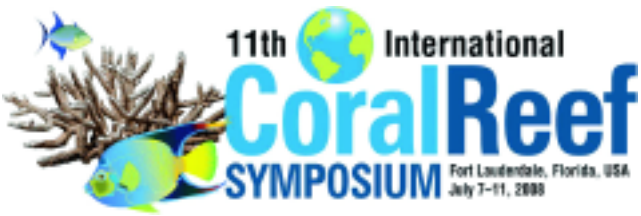
ISRS mug to go on sale at ICRS. Cold mug on left, hot mug on right.

Income	**US$**
Membership dues	54,435.00
Interest	1,129.99
Editorial Subsidies (from Springer-Verlag)	40,143.00
Bank Service Charge Rebate	5.00
Total Income	**95,712.99**
Expenses	
Editorial Subsidies Paid	40,117.99
Travel/Meeting Subsidies	3,834.65
Postal Permit & Fees	12,938.33
Bank Charges	95.00
Credit Card Charges	1,007.32
Management Fees – Allen Marketing & Management	10,640.46
Marketing Fees – Allen Marketing & Management	1,769.59
Coral Reefs – Springer-Verlag	15,595.95
Reef Encounter – Allen Press	8,415.75
2006 Tax Prep./Audit	1,512.50
Student Fellowship Paid	6,000.00
Student Fellowship Owed	6,000.00
Shipping Springer-Verlag	6,076.64
Document Translation Fee	3,000.00
Miscellaneous*	9,990.09
Total Expenses	**120,917.63**
NET INCOME (LOSS)	**($25,204.64)**

*Miscellaneous expenses include warehouse fees, international shipping fees, website costs and publication of membership directory.

John R. Ware, Treasurer

ISRS NEWS



The 11th ICRS is shaping up to be the largest ICRS in history and certainly will be the largest meeting of coral reef scientists in the entire world. Over 2300 abstracts have been submitted and over 900 oral presentations are planned. Attendance of over 2500 is expected. The central theme will be 'Reefs of the Future'. What is happening today will govern the future of coral reefs and it is up to us as scientists, managers, and conservationists to contribute the best knowledge and information for the best use of all to ensure our children and grandchildren have coral reefs to study, sustainably use, and enjoy.

The 11th ICRS is slated to be the first "green" ICRS, and will be a Carbon Neutral event, with Green Strategies adopted at all levels:

- Biodegradable potato starch utensils and cups.
- Air-conditioning set at 78°F, instead of the usual 68°F.
- Toilet paper and paper towels made of recycled paper.
- Reusable water bottles and/or coffee cups.
- Condiments served in bulk instead of individual wrappings.
- Abstracts and proceedings available electronically to reduce paper.
- Hotels within walking distance of the convention center, to reduce transport emissions.

Media relations will be a very important aspect of the Symposium. Through a partnership with SeaWeb, the 11th ICRS will facilitate media coverage, working with both journalists and scientists to make information

readily available. The Educational Center part of the Exhibits will provide access to the latest outreach and education tools on coral reefs and the feature display will be the Caribbean Coral Reef Conservation Exhibit, an update of the dramatic display first shown in 1996 at the Panama 8th ICRS. Keep in touch through the 11th ICRS web site: **http://www.nova.edu/ncri/11icrs/**

We look forward to seeing you in Ft. Lauderdale.

Dick Dodge, Chair, on behalf of the 11th ICRS Local Organizing Committee

12th International Coral Reef Symposium, 2012

During the 11th ICRS, the hosts and venue will be chosen for the 12th ICRS, to be held sometime in 2012. The Symposia are a great opportunity to advance international understanding and appreciation of the most diverse marine ecosystems on earth, and to strengthen local, regional and international support and cooperation for their wise use, treatment, protection and conservation. The deadline for bids to host the 12th ICRS was May 30th and the groups that have submitted proposals will be invited to make a 20 minute presentation to the selection committee at the 11th ICRS in Florida in July, 2008. Any further enquiries should be sent to:

Dr. Robert Richmond,
Kewalo Marine Laboratory,
University of Hawaii at Manoa,
41 Ahui Street, Honolulu, Hawaii 96813 USA,
richmond@hawaii.edu. Tel. (1) 808-539-7331

ISRS Briefing Paper on Coral Reefs and Acidification Released

'Coral Reefs and Ocean Acidification', the 5th in the series of ISRS Briefing Papers, is now available on the ISRS website (http://www.fit.edu/isrs/). This briefing paper addresses the current knowledge of ocean acidification, its expected effects on coral reefs, management, and the research necessary to fully understand the consequences of this emerging problem. The piece was reviewed and accepted by the ISRS Council and members and is made available to members and the general public as a source of current information on this complex topic where public awareness and good judgment are required. The paper was released to the public as part of the International Coral Reef Initiative (ICRI) International Year of the Reef (IYOR) activities hosted by the US State Department in Washington, D.C. on the 24 January. The ISRS Briefing Series was created to develop consensus statements from our Society and previous statements on coral bleaching and diseases, pollution, marine protected areas, and fishing can be found at the website. We hope that members and the general public will use the Briefing Papers as part of their publicity and public awareness on coral reefs.

Tim McClanahan, Vice-President

Reports of the 2006 ISRS/TOC Fellowships

2006 was a bumper year for fellowships, with six recipients. We are providing the reports of three in this issue of *Reef Encounter*, with a further three to come in issue no 37 later this year.

Corals at the extreme: population dynamics and connectivity of reef-building corals in subtropical Eastern Australia.

Annika Noreen, Coral Reef Research Centre, Environmental Science and Management, Southern Cross University, Lismore NSW 2480, Australia.
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The capacity of coral reefs to cope with environmental challenges is directly related to their connectivity with surrounding reefs, as these serve as a source for replenishment after localized destruction. Likewise, levels of genetic diversity are important because of the direct link between low genetic diversity and the likelihood of extinction (Frankham 1995). This project involved sampling coral species at Eastern Australian subtropical sites and the Great Barrier Reef (GBR) to provide quantitative data on their genetic diversity and connectivity.

Subtropical reefs are considered to be especially vulnerable to the effects of global warming. This is partially due to decreasing aragonite saturation, a potentially low functional redundancy of species, and the low genetic diversity and connectivity of reef organisms compared to tropical reefs (Ayre and Hughes 2004). However, other data show that some subtropical reefs are increasing in coral cover and species richness (Harriott et al. 1995, Harrison et al. 1998, unpublished data) and might provide refugia during global warming (Greenstein & Pandolfi 2008). For example, on Lord Howe Island, the first comprehensive survey recorded 57 scleractinian coral species (Veron & Done 1979), and less than 30 years later, the number of confirmed species records exceeds 100 (Wallace 1999, Harriott et al. 1995, unpublished data). Thus, occasional migration between distant locations can be inferred from the large number of 'ephemeral' corals recorded from Eastern Australian subtropical reefs, with only one or a few individuals of

a particular species being present at a location hundreds of kilometres from another potential "source" reef.

This project used DNA microsatellite markers to glean population-level genetic information for five scleractinian species. Microsatellites are repeated sequences of double, trio, or quartet base pairs. The high mutation rates at these loci and the large number of alleles (i.e. gene variants) usually present within populations is the major benefit of using microsatellites for population level studies. The five study species (*Acropora solitaryensis, Goniastrea favulus, Platygyra daedalea, Pocillopora damicornis* and *Seriatopora hystrix*) vary in both biological and ecological attributes (e.g. reproductive modes, turbidity and light preferences, and geographic distribution).

Figure 2: Field work at Elizabeth Reef Photo: Simon Hartley

For *S. hystrix*, the allelic richness (i.e. genetic diversity) decreases with increasing latitude. However, there are a few exceptions where southerly reefs have a higher allelic richness than subtropical reefs further north. *S. hystrix* populations on the sampled reefs are highly subdivided, not only between locations, but also within different habitats on the same reef. For example, the lagoonal populations of *S. hystrix* at Middleton Reef and Elizabeth Reef are genetically differentiated from the populations outside the lagoon. The Lord Howe Island populations, however, show low levels of differentiation, despite major differences in the sampling environments (wave-exposed rocky shore versus sheltered lagoon). Flinders Reef (near Brisbane) could potentially be a 'stepping-stone' between the GBR and reefs further south but the *S. hystrix* population here is as genetically distinct from the GBR populations as the offshore subtropical reefs. It thus neither provides a significant source of recruits to reefs further south, nor acts as a substantial sink for larvae from the GBR. Despite the lower genetic diversity of *S. hystrix* in the subtropics compared to the GBR, sexual reproduction still appears to be the primary mode of reproduction, with few clones found in any of the locations sampled.

Figure 1: Sampling locations. Note: *not all species occur at all sites.*

The research supports the current high levels of protection (Marine Protected Area and Marine Park status) conferred on the study site reefs, as the low level of gene flow makes it unlikely that rapid re-colonisation would occur following mass coral mortality. However, the level of gene flow and genetic diversity of *S. hystrix* is higher than that found previously (at Lord Howe Island) using allozyme electrophoresis (Ayre and Hughes 2004), which means that there is potentially higher resilience than originally thought.

Acknowledgements: Southern Cross University for the IPRS/SCUPRS scholarship, ISRS/TOC Fellowship for project funding, and supervisors Dr. Peter Harrison (Southern Cross University) and Dr. Madeleine van Oppen (Australian Institute of Marine Science).

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Influence of the *Symbiodinium* genotype on the thermal tolerance of corals

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Corals associate with a diverse microbial assemblage, of which the best known are the endosymbiotic and phototrophic microalgae (i.e. dinoflagellates) belonging to the genetically diverse genus *Symbiodinium*. The association between corals and *Symbiodinium* is highly sensitive to local-, regional- and global-scale climate changes e.g. increasing seawater temperatures combined with high irradiance. A general stress response known as coral bleaching results from the loss of photosynthetic pigments and/or *Symbiodinium* from the coral host. During the past decade, much attention has been given to the potential physiological advantages of hosting different types of *Symbiodinium* (Ulstrup and van Oppen 2003). This study is the first to control for host-associated variability and local adaptation simultaneously, by infecting the same coral species with two different *Symbiodinium* types, with both corals and symbionts originating from the same location.

Traditional techniques, such as oxygen exchange and ^{14}C-incorporation, used to estimate the potential and decline of photosynthesis activity of *Symbiodinium* are confounded processes due to the coral host. Furthermore, the technology to estimate irradiance experienced by symbionts in the coral host tissue does not yet exist. Most measures of irradiance are obtained with a large probe (>1 cm diameter) deployed in the vicinity of a coral. However, due to the complex morphology of many corals and the colouration of the host tissue, the light climate measured at such large scales and external to the host may deviate substantially from the internal light climate (Ulstrup et al. 2006).

Photosynthesis regulation (net, gross photosynthesis and respiration, PSII activity, light absorption) and characteristics of the physico-chemical microenvironment (O_2 flux, diffusion boundary layer), as well as characterisation of the local (<5 mm in diameter) light climate of different *in situ Symbiodinium* phylotypes, was assessed using O_2 microelectrodes, variable chlorophyll *a* fluorescence (Imaging-PAM) and reflectance measurements in combination with determinations of chlorophyll *a* and xanthophyll. Measurements were performed on juvenile colonies of *Acropora tenuis* infected with a *Symbiodinium* type belonging to clade C or D from Magnetic Island.

Juveniles hosting *Symbiodinium* type C showed consistently lower metabolic costs as well as enhanced physiological tolerance at elevated temperatures compared to corals hosting *Symbiodinium* type D. The latter has been shown to impose higher thermal tolerance than *Symbiodinium* type C in a closely related species *Acropora millepora* (Berkelmans & van Oppen 2006). This suggests that the heat tolerance of corals may be contingent on the *Symbiodinium* strain *in hospite*. However, the results challenge the generally accepted notion that associations with *Symbiodinium* type D are more resilient to thermal stress.

Although our knowledge of the distribution of *Symbiodinium* worldwide is expanding, there is still limited information about the thermal tolerances of different coral/symbiont associations. Further efforts are needed to understand the bleaching potential of reefs in the light of their symbiont consortia for efficient management and pre-emptive strategies to conserve coral reefs.

Acknowledgements: The ISRS/TOC 2006 fellowship covered acquisition of essential equipment for field data collections and partial travel costs. I would like to extend my sincerest thanks to the ISRS and TOC for their generous contribution that enabled this work.

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Settlement and early post-settlement dynamics of *Porites astreoides* in relation to microhabitat characteristics

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Degradation of coral reefs to less-desirable alternative states, referred to as regime or phase shifts, is often accompanied by a loss of the physical habitat complexity and a concomitant change in the substrate community (e.g. Hughes, 1994). Because many species of coral larvae demonstrate strong settlement preferences for both the physical environment (Maida et al., 1994; Mundy and Babcock, 1998) and the benthic community structure (Heyward and Negri, 1999) which subsequently influence their future growth and survival (Harrington et al., 2004), changes to the local habitat complexity can have strong effects on the quality of the site with respect to recruitment potential. The focus of this research is to

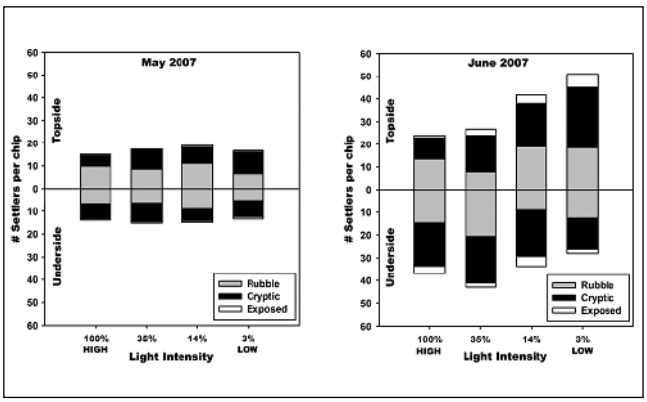

Figure 1. Average number of Porites astreoides *settlers per tile on the different substrate types (rubble, cryptic, exposed; gray, black, and white bars, respectively) on both the topside and underside of settlement platforms (top and bottom panes) for each light intensity treatment (x-axis) in May and June.*

assess settlement and early post-settlement survivorship and growth in relation to microhabitat characteristics. The basic approach for this research is to collect larvae from spawning adults of the brooding coral *Porites astreoides*, assess their settlement preferences for particular habitat conditions in the laboratory, and assess how various habitat conditions can affect their in situ growth and survivorship during the post-settlement phase.

During May and June of 2007, settlement experiments were performed under natural light conditions in an outdoor seawater facility to assess the preference of larvae for different substrate types, light intensity, and orientation, using a multi-factorial approach. Larvae responded most strongly to substrate type (Figure 1), preferring to settle on surfaces conditioned in cryptic orientations in shallow waters (3-5m depth) or on rubble pieces, and avoiding surfaces conditioned in exposed orientations. Although no differences were detected between settlement orientations or among light treatments, there was a significant light treatment-by-orientation interaction during one of the trials, where larvae preferred to settle under moderate light levels (Figure 1, "June 2007"). Overall, these results suggest that *Porites astreoides* has a complex set of larval settlement behaviors, responding to multiple cues concurrently to select appropriate settlement microhabitats, including the substrate community type and the light intensity of the environment.

To assess the fitness consequences of these settlement choices for preferred microhabitats, two separate sets of experiments were performed in 2006 and 2007 assessing the early post-settlement survivorship of *Porites astreoides* in natural reef conditions. The first experiment involved directly seeding larvae onto the reef on three different substrate communities (turf-dominated, crustose corraline algae dominated, and a mix of substrates dominated by bare patches) and monitoring survivorship; and the second experiment involved settling larvae onto small tiles in the laboratory, transplanting these tiles onto the reef after 4–6 days at different orientations (up, down, and vertical facing), and monitoring the survivorship.

Overall, survivorship of seeded larvae followed an exponential decline with less than 10% surviving after two weeks on average. In one trial, survivorship was dependent on the substrate community when only the first month was considered in the analysis (Figure 2a). Despite a lack of significance in the second trial, the ranking of the substrate types with respect to survivorship was the same, where individuals had the highest survivorship in the turf-dominated areas.

Survivorship of transplanted larvae was not dependent on the orientation (Figure 2b). Although the orientation effect was not significant, the downward-facing tiles did

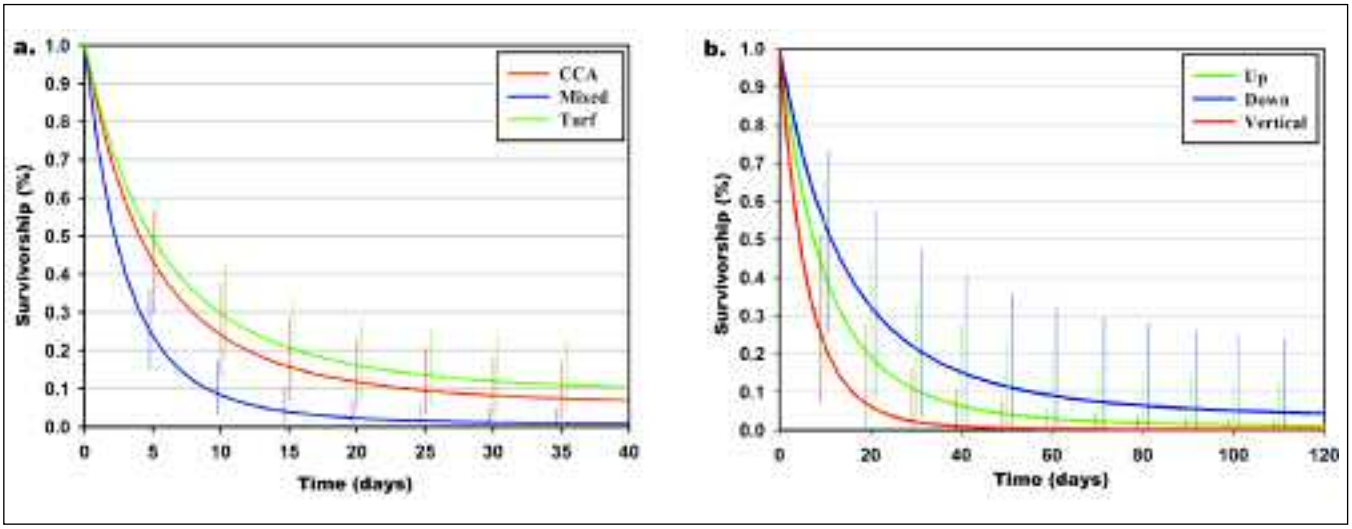

Figure 2. Estimated survivorship functions for Porites astreoides *spat with 95% confidence intervals (vertical bars) among (a) substrate community types (crustose corraline algae-dominated, turf-dominated, and mixed community); and (b) upwards-, downwards-, and vertical-facing orientations.* Note: *only one of two trials of the substrate experiment is presented in (a), but both trials had the same ranking of substrate effects.*

have the highest average survivorship, consistent with *a priori* expectations based on this species' settlement preferences. Additionally, a fitness advantage for the orientation may only be manifest in growth and not survivorship, and the data set is currently being analyzed to detect if this is the case.

This study demonstrates that larvae from the brooding coral *Porites astreoides* have a set of settlement behaviors for preferring cryptic settlement locations in shallow environments. Although survivorship was not statistically enhanced in cryptic orientations, the substrate community did have an effect on survivorship, consistent with a strong settlement preference for substrate type. Overall, the knowledge gained from this research on settlement choices and the fitness consequences of these choices is an important step towards expanding a process-based understanding of recruitment dynamics in an era of habitat degradation.

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Recipients of the 2007 ISRS/TOC Fellowships

There were 23 applicants for the 2007 Fellowships, out of which two were selected. The following provides a brief synopsis of their projects that are currently underway.

Understanding and Strengthening Effective Coral Reef Governance: A Map & Compass to Guide Strategic Change in Southeast Asia

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This research is developing a typology – or "map" – that describes approaches commonly used to achieve "effective" coral reef governance in Southeast Asia. Effectiveness is a multi-dimensional construct that includes a variety of ideas, ranging from equity and accountability to efficiency and productivity. The first phase of this research is to adapt a methodology from Organizational Theory to clarify the specific goals that motivate and direct coral reef conservation initiatives. The second phase will analyse existing approaches to coral reef governance in Southeast Asia to identify patterns within their goals and the strategies, structures, and systems commonly used to achieve them. It is expected that the map developed by this research will help strengthen coral reef governance by providing a framework that will allow practitioners to make more conscious choices about the concepts and approaches used to achieve effectiveness at their sites, as well as facilitating learning between sites.

Historical ecology of coral communities from the central inshore Great Barrier Reef: a palaeoecological approach

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Trajectories of decline have been observed in coral reefs throughout the Caribbean and Indo-Pacific region, resulting in long-term losses of abundance, diversity and habitat structure. Since European settlement of the Queensland coastline in the mid-18th century, extensive changes in land usage within the Great Barrier Reef catchment region have occurred as a result of increases in grazing, agriculture and land clearance. Through palaeoecological reconstruction of coral communities from reef sediment cores, this project intends to determine shifts in coral community structure throughout the late Holocene (0–3000yrs) to provide a baseline and trajectory with which to assess changes in modern day communities. Specifically, this research aims to determine the temporal dynamics of coral community structure and diversity of the inshore reefs of the central GBR, and to compare historical changes in coral assemblages (ca. 3000 yrs) with recent monitoring data (ca. 30 yrs) to determine the impacts of European settlements.

ISRS/TOC Fellows
Top Row: Annika Noreen, Karin Ulstrup, Wade Cooper. Bottom Row: Heidi Schuttenberg, Jez Roff.

CURRENTS

A geologist's lament

As the ICRS returns to the US after some 30 years, I am struck by how the Society has changed. In 1977, we were an interdisciplinary group that interacted to address basic questions about how reefs work. That year, at the Miami meeting, my greatest revelations often came from the non-geology talks. Today, we have shifted toward multi-disciplinary approaches and applied issues. Large research groups share facilities (or grants), but each researcher tends to "do his/her own thing". These are logical outgrowths of funding realities, but the result is less integration and, perhaps, even polarization. This time around, I'll bet we will each spend most of our day in one or two topical sessions closest to our interests.

As we get closer to hanging a sign that says, "Last coral out, lock the door and turn off the lights", we've shifted our focus to "saving the reefs". This is understandable, but I wonder if we've lost a little of the excitement we had on gleaning a piece of the reef story just for the sake of the knowledge gained. Who knows what bit of information will provide the answer for issues not on our radar screen today?

As we address the myriad causes of reef decline, we ask whether recent warming and the attendant disease/bleaching scenario trump our earlier arguments over local, top-down versus bottom-up stresses. Or, we argue that reefs might be able to overcome thermal impacts if other anthropogenic insults are absent. Amidst all the "gill flaring" about who's right, the reality is that the answer to the question, "Is reef decline the result of fisheries depletion, nutrification or global warming?" is "Yes". If the lack of action since the first IPCC report tells us anything, it is that science is irrelevant in the absence of public consensus and political will. In the meantime, might we be better served by asking esoteric questions such as "How will reefs exist in a 500 ppm CO_2 world?" or, "How do we get someone in Cleveland that just lost their job at that polluting steel plant to care about coral reefs?" – rather than who is right about what stress factor holds primacy?

This is only my opinion, but in the end, I'll win anyway. Unless we do something dramatic regarding public and political engagement, you're all going to have to become geologists if you want to study reefs, because they will exist only in the past.

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What role for reef restoration in the face of climate change?

Reef restoration tends to be inextricably linked in people's minds with coral transplantation and artificial reefs. Transplantation is often an attempt to relieve symptoms (loss of live coral) without treating the causes (e.g. pollution and human activities); whereas artificial reefs can seem like a displacement behaviour – with so much damaged reef substrate available, there appears to be little value in introducing new substrate in the form of concrete, ceramic or other materials. However, given the dire state of the world's coral reefs, perhaps we should look more carefully at the role restoration might play in their future survival.

Twenty years ago we were primarily worried about local anthropogenic impacts on coral reefs. Now, climate change driven threats are at the forefront, including both rising seawater temperature and ocean acidification. With an estimated 20% of the world's 255,000 km^2 reefs degraded and a further 24% under imminent risk through human pressures (Spalding and Grenfell 1997; Wilkinson 2004) there are several tens of thousands of km^2 of degraded reefs that need management action – and potentially restoration.

Most attempts at *active* reef restoration (as opposed to *passive* restoration – that is, management actions that improve the environment, reduce overfishing, promote herbivory, etc) have centred on ship-groundings because such events generate funds to repair damaged reefs. The scale of damage is typically in the order of 10^{-2} to 10^{-1} ha, but the largest attempt at active restoration has involved about 7 ha of reef. This suggests that there is a six orders of magnitude mismatch between what we would like to do, and what can be achieved. Furthermore, costs are high. If coral transplantation alone is considered, then costs are in the order of several US$10,000s per ha, not dissimilar to those for restoring other ecosystems such as mangroves, seagrasses or saltmarshes. But if damage to the reef framework is so severe that physical restoration (civil engineering) is needed, costs can reach US$2.0–6.5 million per ha (Spurgeon, 1999). And at this current experimental stage, it is clear that we cannot create fully functional reefs (Edwards and Gomez, 2007).

This means that two general restoration maxims are particularly appropriate for coral reefs:

(1) "Although restoration can enhance conservation efforts, restoration is always a poor second to the preservation of original habitats."

(2) "The use of *ex situ* 'restoration' (mitigation) as an equal replacement for habitat and population destruction or degradation ('take') is at best often unsupported by hard evidence, and is at worst an irresponsible force in its own right." (Young, 2000)

Couched in these terms the case appears bleak. But a key point often overlooked, is that the role of ecological restoration is to *assist* the recovery of ecosystems that have been degraded rather than to try to re-create them (SER, 2004). *Active* restoration should be regarded as just one tool in the manager's toolbox, and one that is only used after careful consideration of the costs, benefits and alternative management actions.

Healthy coral reefs are resilient systems with natural recovery processes that allow them to weather storms, Crown-of-thorns starfish outbreaks, and even mass-bleaching events. Examples of such reefs abound in Palau in the West Pacific and the Maldives and the Chagos Archipelago in the Indian Ocean, where most *but not all* reefs are recovering well from the 1997/98 ENSO. However, other areas, such as the granitic Seychelles, and anthropogenically impacted reefs in the Philippines, have shown little recovery. Identifying which reefs are unlikely to recover naturally and may benefit from active restoration is the key to focusing costly interventions where they are really needed. Healthy resilient reefs with negligible human disturbance are probably best left to recover naturally. Restoration of chronically impacted reefs that have undergone hysteresis and flipped into an algal dominated state, or that have been pulverised to rubble by blast fishing or coral mining, would require an impossibly huge investment. Between these two extremes, lie reefs that require a range of management actions, perhaps with active restoration to put them on a trajectory to recovery or to prevent them sliding into algal domination.

If a reef is anthropogenically impacted, it will likely need *passive* restoration *prior* to any active restoration. Kaneohe Bay in Hawaii, where diversion of sewage discharges into deep water offshore allowed corals to survive, is a good example. If management to ameliorate human impacts is successful, then transplantation of corals – an instant addition of keystone species, rugosity, shelter for fish, and a local source of coral recruits – *may* be a necessary step to kick-start recovery, particularly in areas with little larval supply. Too often, a rush to transplantation or deploying artificial reefs is the first, and often inappropriate, response. A reasonable intermediate goal for reef restoration is a *sustainable* coral dominated system, i.e. one with its natural recovery processes functioning adequately so that corals can reproduce and recruit new generations, grow to create topographic diversity, harbour fish, etc. If that can be achieved, natural recovery processes should in time add species diversity, and the trajectory towards an ecosystem state similar to that before degradation should continue. However, if resilience is severely impaired, active restoration interventions are likely to be a waste of effort, and without other management actions, transplants are likely to persist as just a single exogenous generation that dies within a few years.

Transplanted coral fragments, Bolinao, Philippines. Photo: James Guest

A major concern in reef restoration has been the collateral damage caused to natural reefs in procuring transplants. Recently, coral nursery (or coral farming) technology (asexual reproduction) has advanced dramatically and culture of coral fragments in floating and seabed-attached nurseries is being trialled in countries around the world. Fragments obtained from donor colonies or from so-called "corals of opportunity" (detached fragments that are unlikely to survive unless rescued) are used, and tens of thousands of small colonies can now be produced from tens of donor colonies within a year. Despite concerns about the viability of such 'nursery-coddled' colonies, they have been shown to survive well when transplanted on the natural reef. In a different approach (sexual propagation), gravid coral colonies have been spawned experimentally and the hundreds of thousands of planular larvae settled out and grown into thousands of small colonies that can be cultured then outplanted into the field within a year. These advances now make it feasible to transplant hectares of reef with small coral colonies, with negligible collateral damage. They may also provide opportunities for large-scale culture of genetic strains that show greater resistance to stressors such as elevated temperatures. Costs are steadily decreasing with full-costs of cultured transplants now around US$1 per transplant. In summary, the technologies for active reef restoration and their cost-effectiveness are improving fast.

These advances derive largely from a number of international projects that are studying aspects of reef restoration, including the European Commission funded REEFRES project and the GEF/World Bank funded Coral Reef Targeted Research program (www.gefcoral.org) which has a working group focused on reef restoration. These projects have been evaluating the relative aptitudes of a range of coral species for nursery rearing and trans-

plantation as well as trying to develop more cost-effective methods so that restoration can be attempted at meaningful scales on actual degraded reef substrate. In addition, they have been trying to build up data on natural recovery processes so that modelling can be used to focus future research and move reef restoration from a largely empirical to a more science-driven discipline.

Given the huge task, limited resources and limited capabilities, it is essential that active reef restoration is focused on biological restoration of natural reefs that actually need it and where there is a reasonable chance of success. Furthermore, restoration activities should be integrated into broader coastal management planning. Criteria are therefore urgently required to allow managers readily to identify when (and what) passive restoration measures may be needed and when reefs are most likely to benefit from active restoration. Modelling work is providing a basis on which such criteria can be built and this is an area of active research.

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NEWS

Coral Reef Conservation in Abu Dhabi and the United Arab Emirates

The United Arab Emirates (UAE), a federation of seven states that border both the Arabian Gulf and the Arabian Sea, are currently famous for the extraordinary feats of coastal development in Dubai – the world's biggest dredge-and-fill projects (the Jumeirah and Jebel Ali Palms, and The World). They are perhaps not so well known for their coral reef management efforts but this year saw the completion of Abu Dhabi's first national coral reef conservation plan.

The Arabian region boasts remarkably high marine biodiversity, the crown jewels of which are the reefs. Environmental conditions are, however, difficult for corals. The Arabian Gulf lies in a subtropical hyper-arid region with significant insolation differences between summer and winter that, combined with the *Shamal* – a unique local cold wind – results in seasonal temperature fluctuations of over 20°C, the highest that coral reefs can withstand. In addition, high evaporation and limited circulation leads to significant salinity stress (>43 ppm) that causes a near- to total absence of corals in the most extreme environments. In its turn, the Arabian Sea is influenced by a monsoonal-driven upwelling that also restricts reef-building.

Coral reefs occur (or occurred) abundantly in the emirates of Abu Dhabi, Fujairah and Dubai, and probably also occur in Sharjah, Umm al Qawain and Ras al Khaimah. There are three types of reef: true coral reefs (fringing reefs around off-shore islands and parts of Fujairah); stringer reefs (elongated structures, forming an interconnected maze on banks like Bu Tinah, Mubarraz); and patch reefs (common throughout). The abundant coral areas along the mainland coast are 'biostromes' or coral carpets, a thin, continuous coral framework. Non-framework-building coral communities are also widely distributed throughout the Gulf at 2–10m depth. Only Abu Dhabi and Dubai have mapped their coral reefs; in Abu Dhabi, coral growth is widespread throughout territorial waters, and is found in variable densities on all offshore islands and banks as well as near all major headlands on the mainland.

Acropora downingi *in Abu Dhabi* Photo: Bernard Riegl

Google Earth image of the new coastal developments in Dubai

The Arabian Gulf has 56 scleractinian species and one solitary free-living coral (Riegl 1999). Species richness is subject to fluctuations caused by mass mortality events that affect *Acropora* in particular. Six species of *Acropora* disappeared from the reefs of Abu Dhabi and Dubai after the sea-surface temperature anomaly of 1996, but at least three have returned through settlement (*A. clathrata*, *A. downingi* and *A. arabensis*). Species composition is typically Indo-Pacific, with at least three endemic coral species in the Gulf and several more in the Arabian Sea. The Gulf coral fauna is largely made up of scleractinians; alcyonaceans are confined to the Straits of Hormuz and the Iranian side of the Gulf (K. Savimi, pers. comm.) although they are common in the Arabian Sea.

Coral assemblages in the Arabian Gulf are rather uniform, and the previously widespread assemblages dominated by *Acropora* that suffered heavily from the anomalously high temperatures of 1996/1998 and 2002 have been slow to recover. At present the densest coral growths, mainly in the western areas of Abu Dhabi, are dominated by nodular *Porites harrisoni* (previously known as *P. compressa*) which forms monospecific stands in highly saline areas (43–45 ppt) and in places that become very hot during summer and cold during winter.

UAE coral reefs have received considerable scientific attention but much research has been in the commercial domain, undertaken by consultants and thus never published. The Jebel Ali area in Dubai is one of the best-studied reefs (e.g. Riegl 1999, 2002; Purkis and Riegl 2005; Burt et al. 2008) and is presently being studied by scientists from local universities under the sponsorship of the developer Nakheel. Reefs in Abu Dhabi have received treatment by George and John (1990), Sheppard and Loughland (2002), and are being mapped and monitored in a joint project by EAD/WWF/EWS/NCRI with sponsorship from Dolphin Energy.

The most important natural threats to coral reefs in Abu Dhabi are the extreme high and low temperatures that will be exacerbated by global climate change. At present however, rampant coastal development, driven by the need to diversify and decrease dependence on oil, is the main threat. The Arabian Gulf region has witnessed recent spectacular economic growth, sparking a massive building boom in the coastal zone for residential, tourist and commercial development which has resulted in massive loss of natural coastal ecosystems and the devastation of some the regions richest reefs. Dubai for example, has lost most of its coral reefs to dredge-and-fill projects, and it is uncertain how much can be saved. Efforts are under way to transplant corals from newer construction sites (although the success of these remains to be seen), and to mitigate some of the negative impacts that have occurred. Coastal development is accelerating in all the other Emirates, fueled by the need for new ports, desalination and power plants, and tourism infrastructure.

Two Federal Laws drafted in 1999 provide the legal framework for coral reef protection in the UAE. Trawling has been banned, initially in Abu Dhabi, and then in 2005 in the entire UAE. As yet there is no comprehensive framework for integrated planning and management of the coastal zone as a whole, but the Coastal Zone Management Law that has recently been proposed for Abu Dhabi is a potential starting point.

The guardian of Abu Dhabi's coral reefs is the Environment Agency (EAD), which until 2005 was known as the Environmental Research and Wildlife Development Agency (ERWDA). Abu Dhabi's coral reef plan was prepared by EAD with support from WWF and the National Coral Reef Institute (NCRI) of Nova Southeastern University in the USA. It recognizes coral reefs as the Emirate's most diverse ecosystem and calls for the better understanding and monitoring of reefs, embedded in improved stewardship of the ocean. If implemented, it will be a model for the rest of the region. In Dubai, responsibility for reef management has been transferred from the municipality's environment department to the main development corporation, thus reducing the state's influence on management decisions. In the other Emirates, responsibility for coral reef management usually lies within the municipalities, whose capacity is low.

The first four marine protected areas in the UAE were established in 1995 on the east coast of Fujairah at Dibba, Al Faqueet, Dadna and Al Aqa. Abu Dhabi designated Marawah Marine Protected Area in 2001 (to become the first UNESCO (MAB) Marine Biosphere Reserve in the region), Al Yasat Marine Protected Area in 2005 and Bul Syayeef Marine Protected Area in 2007. Dubai de-

Porites harrisonii *in Abu Dhabi* Photo: Bernard Riegl

clared the Jebel Ali coral reef a protected area in 1998, but most of this has now been lost due to coastal construction. In the UAE, many coral reefs lie adjacent to land belonging to the ruling family and other dignitaries, and are managed by the relevant private offices.

The Arabian Sea and Arabian Gulf ecoregion is classified as 'critically endangered' by the WWF and is a focus for conservation action. While significant challenges remain, governance has improved, and public and official understanding of the worth of reef resources has increased dramatically in the recent years. Industry is now actively involved in conservation efforts and the public is demanding responsible natural resource management. Nevertheless, there is a real urgency to ensure protection of the remaining reefs, which are not only unique for surviving in one of the world's harshest environments for coral reefs, but are increasingly important as a natural laboratory for the study of coral adaptation in relation to climate change.

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Coral reefs in the Lakshadweep Archipelago: Agatti Conservation Reserve

Atolls in the Lakshadweep Archipelago

The Lakshadweep archipelago, the only atoll formation in India, is one of the least researched coral reef systems in the Arabian Sea. It lies about 500 km from mainland India and comprises 32 km^2 of land spread over 36 islands (of which 11 are inhabited), 12 atolls and 5 submerged sand banks, and is surrounded by 4,200 km^2 of lagoon rich in marine wildlife.

The population – directly dependent on marine resources – is growing rapidly and had reached 60,000 by 2001. The indigenous islanders are designated as a scheduled tribe by the Indian government which gives them special entitlements to help their integration into Indian society such as free education (including higher education) and subsidized energy. Only those born in Lakshadweep may own land, and permits are compulsory for all outsiders, whether other Indians or foreigners, to visit the islands. The entry restriction protects the unique culture of the archipelago, where matrilineal Muslim traditions prevail and women have significant status in the community.

The difficulties of access in terms of transport and

entry restrictions and the brief season suitable for field research, have meant that Lakshadweep's rich coral reefs are poorly known scientifically. Early work focused mainly on the most southerly atoll, Minicoy (e.g. Pillai, 1971) and on Kalpeni and Kavaratti (e.g. Mallik, 1985). More recent studies have included Rodrigues (1997), Hoon (2002), and Arthur (2000) and Arthur et al. (2005) who looked at the impact of bleaching in the archipelago.

More recent studies are underway in the context of a three-year (2005–8) Darwin Initiative (UK government) project to establish marine protected areas (MPAs) in the archipelago. The ecological research component of the project is lead by the Bombay Natural History Society (BNHS), and LEAD International (UK) is facilitating the socio-economic research and capacity development. Other key partners include the Lakshadweep Administration, Department of Science and Technology, the Department of Environment and Forests, Department of Tourism and SPORTS (Society for Promotion of Nature Tourism and Sports) of the Union Territory of Lakshadweep.

During the preparation phase, reefs around 24 islands, within 11 lagoons, have been studied and 165 permanent transects have been established for long-term monitoring, using the random 100m long line-transect method. Data for three seasons are now available. Giant clams (*Tridacna maxima* and *T. squamosa*) and live coral cover are the key indicators; giant clams are a particular focus as three of the four species found in India are protected under Schedule I (highest level of protection) of the Indian Wildlife (Protection) Act, 1972.

There are over 100 so-called 'MPAs' in India but most

*Giant clam (*Tridacna maxima*)* Photo: Deepak Apte

Community meeting, Photo: Andrea Deri

are coastal areas with no marine habitat; fewer than 15 are 'true' MPAs enclosing sub-tidal and inter-tidal waters, all of which are managed by the government. The project is focusing on the proposed Agatti Conservation Reserve which will be the first co-managed MPA in India (as provided for by the Indian Wildlife (Protection) Act, 1972), with government and local communities taking responsibility for planning, monitoring and managing the area for both sustainable use and biodiversity conservation. The idea of establishing an MPA at Agatti was triggered by the dwindling bait fish population in the lagoon, a sign of reef degradation caused by several anthropogenic stresses. A healthy bait fish stock is fundamental to the pole-and-line tuna fishery, the backbone of Lakshadweep's cash economy, and so the local communities expressed interest in an initiative which aimed at restoring this population.

Household surveys have been undertaken and over 50% of the island's adult population (some 1,800 people) has been consulted. The islanders have shown unanimous support for the proposed Agatti Conservation Reserve, and a set of recommendations have been prepared on how they wish to conserve their coral reefs, improve their livelihoods, and continue to learn about reef conservation in the future. The unique values and traditions of the archipelago provide a supportive social environment for community-based natural resource management and conservation. The Agatti Village Panchayat (elected local government) submitted a formal recommendation to establish the reserve to the Lakshadweep Administration in January 2008. The proposal and a draft Management Plan are being discussed by the Administration, and in the meantime, Agatti's community has agreed to begin volunteer conservation actions in the proposed MPA. On the strength of this, BNHS and LEAD International are planning to develop a network of MPAs in the archipelago over the next 10 years.

Project website: http://www.lead.org/page/89

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MEETING REPORTS

Coral Reef Futures - Australian National Forum

A major forum on the future of the world's coral reefs was convened by the Australian Research Council (ARC)'s Centre of Excellence for Coral Reef Studies at the headquarters of the Australian Academy of Science in Canberra in October 2007. Open to media, researchers, policy makers and interested members of the public, the Forum covered a wide range of topics including coral bleaching and disease, coral reef resilience, ocean acidification, management of Australia's coral reefs under climate change, protection of sea water quality from activities on land, the efficacy of No-Take Areas on the GBR, and threats to reef sharks and other top predators.

An associated evening of public discussion on coral reef science, conservation and management was broadcast on Australian public radio. The Forum resulted in a *Consensus Declaration on Coral Reef Futures*, agreed by over 50 scientists (see box). Talk highlights are posted on the ARC Centre's website at www. coralcoe.org. au/events/webseminar/webseminar.html

Consensus Declaration on Coral Reef Futures

- We call on all societies and governments to immediately and substantially reduce greenhouse gas emissions. Without targeted reductions, the ongoing damage to coral reefs from global warming will soon be irreversible.
- Ocean acidification due to increased atmospheric CO_2 is accelerating, and will detrimentally affect the growth and skeletal strength of calcifying species, such as corals. Reducing CO_2 emissions is the only way to prevent further damage to coral reefs. Loss of coral also impacts on many other species and reduces reef fisheries.
- Coral reefs are economically, socially and culturally important, and therefore need to be sustained. For example, the Great Barrier Reef contributes $6.9 billion annually to the Australian economy – $6 billion from the tourism industry, $544 million from recreational activity and $251 million from commercial fishing. This economic activity generates more than 65,000 jobs.
- Climate change, overfishing and pollution continue to cause massive and accelerating declines in abundance of coral reef species and global changes in reef ecosystems. Even remote and well-managed reefs are under threat from climate change.
- Coral bleaching has greatly increased in frequency and magnitude over the past 30 years due to global warming. For coral reefs, climate change is not some potential future threat – it has already caused enormous damage that will increase in coming years. Bleaching due to climate change has already caused widespread damage to the Great Barrier Reef in 1998 and 2002.
- The world has a narrow window of opportunity to save coral reefs from the destruction of extreme climate change. Substantial global reductions of greenhouse gasses must be initiated immediately, not in 10, 20 or 50 years.
- No-fishing reserves (green zones) are an important management tool for preserving targeted stocks of coral reefs, and the ecological functions they provide. To be effective, 25–35% of marine habitats should be no-take (no fishing) for long-term protection. In Australia, many coral reefs have yet to achieve this level of protection (especially in the Northern Territory, Western Australia, south-east Queensland, and the Coral Sea).
- Coral reef megafauna (e.g. dugongs, turtles and sharks) continue to decline rapidly, and are ecologically extinct on most of the world's reefs. In Australia, current management practices are failing to maintain populations of megafauna, which are already severely depleted. Commercial harvesting and marketing of these species should be banned to allow the recovery of depleted stocks.
- Local action can help to re-build the resilience of reefs, and promote their recovery. It is critically important to prevent the replacement of corals by algal blooms, by reducing runoff from land and by protecting stocks of herbivorous fishes. However, reefs cannot be "climate-proofed" except via reduced emissions of greenhouse gasses.

OBITUARIES

Joshua Tracey

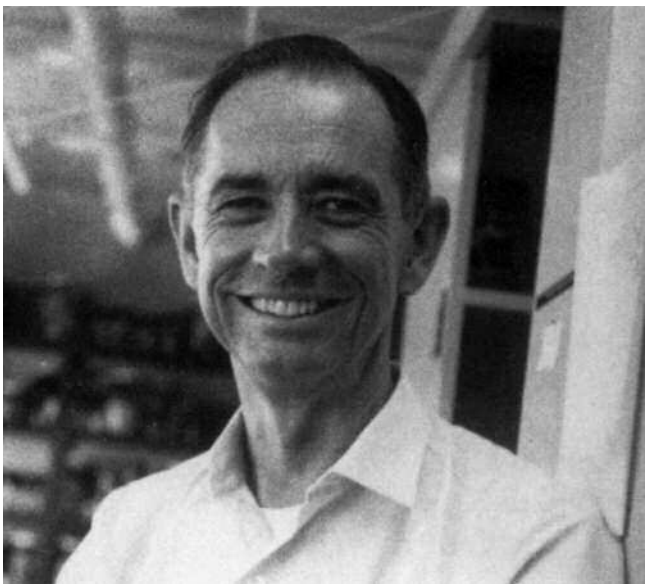
Joshua I. Tracey, an Honorary Member of ISRS, died of heart disease on October 18th, 2004, at the age of 89. ISRS regrets that an obituary was not published earlier, and we are grateful to Ian MacIntyre for correcting this omission.

A native of New Haven, Connecticut, Josh received his bachelor's in physics and mathematics from Yale University in 1937. In his second year of graduate school he switched to geology and obtained a master's in 1943 and a doctorate in 1950, both at Yale. In 1946 Harry Ladd invited him to join a team planning to drill Bikini Atoll before and after the two atomic-bomb explosions, work that led to some of Josh's most important contributions. He provided conclusive evidence in support of Darwin's classic hypothesis about atoll formation, demonstrating that atolls originate as sinking volcanic islands with fringing coral reefs and, with continued growth, form a circular reef pattern after the volcano has submerged.

Subsequently, Josh served as party chief during the detailed geological mapping of Guam, and surveyed the islands of Pagan, Fais, and Ifaluk. In 1965 he joined a drill team on Midway Atoll and once again was able to penetrate to the basalt base, thereby again proving the volcanic origin of these atolls. This was followed by the CARMARSEL Expedition to Micronesia in 1967, when he worked with a distinguished group that included Francis P. Shepard, William A. Neuman, Arthur L. Bloom, and Norman D. Newell. Working on elevated sea level rise over the last 6,000 years, they found concrete evidence for a higher than present Holocene sea level on tectonically active Guam but none at the more stable Caroline and Marshall Islands. In 1970 Josh served as co-chief investigator of the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES) D/V *Glomar Challenger* 8th Leg, extending from Johnson Atoll to Tahiti. This work provided important information on aspects of seafloor spreading and plate tectonics. Other drilling operations followed at Enderbury in 1971 and in 1971–74 on Enewetok Atoll.

Josh retired from the US Geological Survey in 1985 and took up residence in Smithsonian's National Museum of Natural History, where he spent his final years as a Research Associate. He was survived by his wife, a sister, two sons, eight grandchildren, and six great grandchildren. All who worked with Josh miss this easy-going quiet man.

Dr Ian MacIntyre, Smithsonian Institute, National Museum of Natural History, 10th and Constitution Ave, NW, Washington, DC 20560-0121



Frederick "Ted" Bayer

Frederick "Ted" M. Bayer, 85, a retired Smithsonian curator in the Department of Invertebrate Zoology and one of the world's leading experts on marine invertebrates, died on October 3, 2007 after a long illness, in Washington, DC.

Ted was long acknowledged as the doyen of soft coral research, attracting visitors and collections to the

Smithsonian from all parts of the world. He published over 130 papers and books on the taxonomy and natural history of soft corals, describing over 170 new species, 40 genera, and even three families. Several dozen species have been named in his honor, including the hydroid *Hydractinia bayeri*, described by his colleague, the Emperor of Japan, Hirohito. Although an expert on corals, he was a broadly based naturalist, perhaps one of the most knowledgeable deep-sea biologists in the world.

Ted was born in Asbury Park, New Jersey, but grew up in southern Florida, where he became an amateur naturalist at a young age, his early passion being the collection of seashells. His undergraduate education was interrupted by WWII, when he served as a photographic technician in the Army Air Corps (36th Photo Reconnaissance) and traveled to New Guinea, the Philippines, and Okinawa, in his spare time making collections and drawings of shells, fish, and butterflies. He eventually received his BSc from the University of Miami, and his MSc and PhD degrees from George Washington University in 1954 and 1958, respectively.

He was hired as a Smithsonian curator at the National Museum of Natural History in 1947. Almost immediately he was sent to Bikini Atoll to survey the marine fauna just two years after the nuclear testing at that island. He also spent many months of fieldwork in Micronesia at Ifaluk (1953) and Palau (1955). In 1961 he became a Professor at the School of Marine Science, University of Miami, and participated in numerous deep-sea collecting expeditions in the Caribbean and off western Africa, as well as mentoring over a dozen graduate students in the classification of exotic marine invertebrates. He returned to the Department of Invertebrate Zoology, Smithsonian Institution in 1975 where he remained until his retirement in 1996. But he continued to work and publish papers at the Museum as a Curator Emeritus until 2006.

He was an outstanding biological illustrator, producing black and white line drawings (the stipple technique) as well as color paintings. He painted a series of fourteen beautiful, scientifically accurate underwater scenes that were used for a set of postage stamps for Haiti in 1973. After the scanning electron microscope was invented, he employed it assiduously to examine the microscopic anatomy of the octocoral skeleton, ultimately amassing a collection of over 40,000 images, many taken in stereo view.

Ted was a commissioner of the International Commission of Zoological Nomenclature for 23 years (1972–1995), a member of the Washington Academy of Sciences, and an ardent supporter of the Handel Society in Washington D. C.

Dr Stephen Cairns, Smithsonian Institute, National Museum of Natural History, 10th and Constitution Ave, NW, Washington, DC 20013-7012

BOOK REVIEWS

Coral: A Pessimist in Paradise

Steve Jones, 2007
Little Brown, London, 242pp. ISBN 978-0-316-72938-3, price UK £15.99.

A BBC television series, *Connections*, written and hosted by James Burke and first aired in 1978, famously looked at science and technological innovation across history, showing how various discoveries, social change, and world history built on one another to bring about key developments in modern science and technology. In *Coral: A Pessimist in Paradise*, Professor Steve Jones of University College in London, a successful science popularizer and broadcaster, takes an approach reminiscent of Burke. Under whimsical chapter titles: The King of Cocos Keeling; The Hydra's Head; The Plover and the Crocodile; The Empire of Chaos; and The Maharajah's Jewels, Jones spins an engaging tale of the biology and evolutionary development of corals and coral reefs, with a final chapter on the current dire situation of coral reefs in an era of rapid climate change. The net result is an erudite, educational, eccentric, English-centric, eclectic, entertaining, and occasionally exasperating popular account of history, science and reefs.

The book is packed with lush historical detail. Who knew, for example, that Darwin, a non-swimmer, used a vaulting stick to leap from coral outcrop to outcrop to gain the reef edge and peer into the depths; or that Cook's Hawaiian disaster on his third voyage might have had much to do with a roundworm infestation and his excessive use of opiates; or that anemones collected in 1862 by the University of Edinburgh were kept until they perished in 1942; or that Karl Marx used corals as a political analogy, noting that tiny, weak, ephemeral individuals can work together build something mighty and everlasting? Some of these non-stop diversions tread the line to exasperation. I had no idea that Alex Comfort,

the author of the *Joy of Sex*, a Baedeker of the emancipated 1960s, was also the author of a classic text on aging and worked on pigments in dog whelks.

In his exploration of the complex web of inter-relationships between coral biology and ecology and the history of exploration and scientific discovery, the author invariably takes an unexpected turn at each crossroad. He spent his early career studying *Hydra* in the "broad church of narrow minds" of academic science, and uses his understanding of the physiology of this primitive relative of the corals to discuss genetic expression, the evolution of wound healing and cancer resistance, and the hope for the future of stem cells. This might have left the reader reeling in a maelstrom of seemingly unrelated detail, but this brilliant synthesizer gathers the threads and leaves us smiling at his power to astonish.

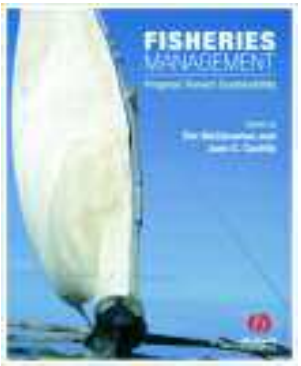
Jones' tale spans human history from the discovery of Cocos Keeling in 1609 by an East India Company captain; to the first voyage of Captain James Cook in 1769; to the visit by Charles Darwin in 1834 and the crystallization of his incubating ideas; to the King of Cocos, John Clunies-Ross in 1825; to the Challenger Expedition; to the Pacific atomic test programs of the U.S. and France; to the Cold War and the development of modern deep sea survey technology. After five chapters of breezy, joyous, intellectual high jinks, the mood in the last chapter suddenly changes. Jones covers the dramatic decline of coral reefs from the relentless onslaught of the Big Three human disturbances of fishing, pollution and global climate change, acknowledging that the first two might be managed by enlightened changes in human behavior, but that with climate change our global society is up against a disturbance unprecedented in human experience.

Classically, science urges dispassion in the policy implications of research, even when confronting apocalypse. Isaac Newton, for example, made obscure calculations of the date of Armageddon which are just as obscurely, but interestingly, interpreted by the author as 2060, the year that the globe's human population is currently expected to peak. In the early days of the Cold War, nuclear holocaust was a fact of life and cold scientific calculations of "Nuclear Winter" had some people packing their bags for the Southern Hemisphere. Ironically, we now face the opposite end of the temperature scale and the calculations are almost as alarming. Now is not a time for coral reef scientists to hold back from the public policy debate on living sustainably with the environment. Coral, the "canary in the mine" for the oceans, has fallen off the perch and lies twitching on the bottom of the cage. We must heed this warning and use the tools at our disposal to control fishing and pollution, understanding that reduction of these stresses is good. For the broader issue of global climate change there are as yet undiscovered synergies that may make managed reefs more resilient. To be sure, none of us can precisely predict the future of coral reefs, but in the words of F. Scott Fitzgerald "*the test of a first-rate intelligence is the ability … to see that things are hopeless yet be determined to make them otherwise*."

John Ogden, University of South Florida, USA.

Fisheries Management: progress towards sustainability

Tim R McClanahan and Juan Carlos Castilla (Editors), 2007
Blackwell. ISBN-13: 978-1-4051-3932-8 £99.50 (hardback), US$199.99



In an era of sound-bite media, it is unpopular to remind people of the complexity of 'sustainability' but this has to be done in the context of fisheries, if the current tragic outcomes are to be reversed. As the first chapter of this book (Defeo, McClanahan & Castilla) highlights, the ecological dynamism, multi-species character, and socio-economic and governance contexts of fisheries all challenge the traditional technocratic heartlands of management. This book focuses on the social side of management and this means that co-management ('a proactive institutional arrangement where fishers, scientists and managers interact to improve the quality of the regulatory process', p.15) figures prominently.

Part II of the book examines small-scale artisanal fisheries because these constitute conditions under which co-management is more likely to succeed. Three chapters address coral-reef case studies. Chapter 5 (White, Gomez, Alcala & Russ), on the Philippines where marine resource management has been presaged by devolution to local governments and a series of donor-assisted projects, issues other than fisheries are touched on, with marine protected areas (MPAs) at Apo and Sumilon being a rare case of local benefit to target fish, and now a 'classic' piece of evidence for MPA evangelists. Chapter 7 (Wells, Samoilys, Anderson, Kalombo & Makoloweka) reviews how the Tanga Coastal Zone Conservation and Development Programme has successfully increased ownership of fisheries management in the six Tanga collaborative management areas (CMAs) but scarcely yet improved compliance with respect to key issues such as dynamiting. Chapter 8 (McClanahan) reviews Kenya's MPA system, born in 1968, and shows how it has greatly contributed to understanding fishing effects at population and ecosystem levels, rates of recovery from fishing, socio-economic aspects of conservation and climate impacts such as through coral bleaching. Kenya is also helping

to place MPAs in the wider management context, for example in relation to technical measures with respect to gears, and the limitations inherent in 'co-management'. The message, clearer than ever, is that the single simple fix we often wish for does not exist, and scientists, managers and fishers, and their masters, need to face the complexity of real world sustainability questions.

In Chapter 9 (Marsh) the experience of trying to manage indigenous green turtle and dugong hunting in the Hope Vale Aboriginal community of Cape York highlights territory that will be familiar to many outside Australia, including the need to address social justice matters, to look at fishing and hunting in the wider context, to be culturally 'sensitive', and to aim for truly equitable co-management. As in Tanga, progress has been slow and most of the funding has been spent on negotiation and research, as opposed to on-ground management activities.

Part III is devoted to temperate meso-scale fisheries, but Chapter 11 (Phillips, Melville-Smith, Caputi) on the Western Australia rock lobster fishery reminds us that natural resources can be successfully managed where there is significant participation by the industry involved. The social, environmental and management diversity of the tropical setting (e.g. conflicts between biodiversity conservation and sustainable exploitation) may mean that much more management experience is needed before the relative success of some of the temperate management regimes can be assured. I often worry that to some players, co-management is an opportunity to achieve both fiscal and governance targets simultaneously, and thus is not always perceived as a good thing. The messages for co-management are in fact both negative and positive. While participatory management can succeed, the learning process demanded by complex tropical social-ecological settings requires large amounts of time that we generally do not have. And without extra resources the threat of co-management failure is likely to be greater in resource-poor countries. A positive is that, given the inherent challenges, sustainable management has to have an element of user buy-in, otherwise the likely mistakes of 'managers' become points of mistrust of management as a whole.

I cannot say this book is well compiled or edited, but the patchy nature of the subject matter is also a reflection of its perceived lack of importance and thus weak funding. It addresses a current management paradigm with much relevance to coral reefs at a crucial time. As summarised in Chapter 14 (McClanahan & Castilla), the case studies repeatedly remind us of the trial and error nature of fisheries management, particularly in socially and/or ecologically complex settings. As such this book represents a valuable milestone towards interdisciplinary conservation science that, with luck, will be quickly passed.

Nicholas Polunin, School of Marine Science and Technology, Newcastle University, UK

Book Shelf

Tsunamis and Coral Reefs.
Special issue, *Atoll Research Bulletin* No. 544, 2007.
David R. Stoddart (Editor).

The Smithsonian Institution has released a special issue of *Atoll Research Bulletin* containing eight papers describing the effects of the Indian Ocean Tsunami on coral reefs. The issue includes descriptions from field surveys in Indonesia, the Chagos Archipelago, Thailand, the Maldives and the Seychelles as well as an introductory chapter describing the generating processes and ocean-wide patterns of impact. Available for download at: http://www.botany.hawaii.edu/faculty/duffy/atoll.htm. Hard copies have also been produced.

Status of Coral Reefs in Tsunami affected countries: 2005
Clive Wilkinson, David Souter, and Jermey Goldberg (Editors), 2006
Australian Institute of Marine Science, Townsville, 154 pp.

The tsunamis of 26 December 2004 caught many people unprepared and unaware in Indian Ocean countries, resulting in more than 250,000 people killed or missing and causing massive destruction to coastal resources and infrastructure. This book focuses on the impacts on coral reefs and associated ecosystems, and the responses by the international community. The long history of previous earthquakes and tsunamis in the Indian Ocean is also summarised. Available for download from http://www.aims.gov.au/pages/research/coral-bleaching/scr-tac2005/index.html

Status of Caribbean Coral Reefs after Bleaching and Hurricanes in 2005
Clive Wilkinson and David Souter (Editors), 2008
Global Coral Reef Monitoring Network and Reef and Rainforest Research Centre, Townsville, 152 pp.

This is a report from 70 coral reef scientists and managers documenting what happened to their coral reefs as a result of the warming and storms of 2005, documenting the devastating effects of the hottest year on record for the Northern Hemisphere. Available for download from http://coris.noaa.gov/activities/caribbean_rpt/ or from http://www.reefbase.org/ or from http://coralreefwatch.noaa.gov/caribbean2005/

Reef Restoration Concepts and Guidelines: making sensible management choices in the face of uncertainty.
A.J. Edwards and E.D Gomez, 2007
Coral Reef Targeted Research and Capacity Building for Management Programme, St Lucia, Australia. 38pp. www.gefcoral.org

At last, a final resting site for ISRS members ...

"The **Neptune Memorial Reef** project is the largest man made reef ever conceived and provides an extraordinary living resting place for the departed, an environmental and ecological masterpiece, a superb laboratory for marine biologists, students, researchers and ecologists, and an aesthetically exquisite, world-class destination for visitors from all walks of life. The most innovative concept in artificial reef design is currently emerging in 50-feet of water, 3.25 miles east of Key Biscayne, Miami. Wrapped in the silence of the clear blue ocean a new reef is evolving. The Neptune Memorial Reef is attracting recreational scuba divers, as well as homeless fish while enhancing the coastal environment and reducing demand on other fragile natural reefs.

... cremation and placement in the Neptune Reef is a non-polluting process that consumes no above-ground real estate while reducing stress on other fragile marine reefs which actively support the continuation of life and aliveness on our planet. Done properly, this marine habitat enables life to thrive in the ocean. What better way to give back to the environment and our planet than this environmentally friendly way to replenish the coral growth.

... This reef serves many purposes from being a training ground for students of marine biology to an underwater theme park that is complete with no admission charge for all scuba divers.... The location allows for glass bottom boat tours, snorkeling, and SCUBA diving. Divers of all ages and ability will find the reef a pleasure to dive and explore.

... Participating members in the Neptune Society are now invited to memorialize themselves in the living reef by placing loved ones' keepsakes or cremated remains into the concrete structures that form the reef. Placement in the reef varies in price depending on the type of feature you select and its location on the reef.... Families are welcome to be present during placement and we will be happy to assist with arrangements if requested. We take a lot from our environment while we live. Here's an opportunity to give something back when we depart."

Source: https://www.nmreef.com

Reef Sights

These guidelines contain simple advice on coral reef restoration for coastal managers, decision makers, technical advisers and others. They summarise lessons learned from a number of projects and give a clearer idea of what can and cannot be achieved through different reef restoration approaches.

Coral Reefs: Nature's wonders
Walter and Jean Deas, 2005
Western Australian Museum, 296pp,
ISBN 1920843183.

This is a primarily a handbook on hard and soft corals, suitable for field identification, with over 150 photographic plates of Australian and Indo Pacific corals. It is also a useful reference book for amateur marine biologists with accompanying text covering general coral biology and ecology of coral reefs, the use of a community based approach to coral regeneration, coral reef photography, the pioneers of diving, a glossary and a list marine environmental organisations. The book can be ordered and further details can be accessed at:
http://www.seawestproductions.com/books.html

Treasures in the Sea: Our Bahamian Marine Resources

This is a resource book that provides educators with scientific information and engaging, hands-on activities for students. There is a companion website where the book or sections of the book can be downloaded, and links made to resources related to the activities, training workshops in the Bahamas, and where teaching ideas and experiences in marine conservation education can be shared. Treasures in the Sea grew out of the Bahamas Biocomplexity Project, an interdisciplinary study to improve understanding of the potential for marine protected area networks, involving a partnership comprising the American Museum of Natural History's Center for Biodiversity and Conservation, the Bahamas National Trust, and the Bahamas Ministry of Education, Youth, Sports and Culture. http://treasures.amnh.org?mid=55

Peppy's Coral Kingdom
Nancy T. Lucas, 2007

This children's book is aimed at educating students in Grades 1–5 about threats to coral reefs, with emphasis on coral disease and anthropogenic stressors. It was created by a young artist in Charleston South Carolina in consultation with scientists from the Marine Resources Center at Fort Johnson, Charleston SC USA. The book has a main story-line with identifiable characters, and also short informational asides that could be used by teachers to support a unit on coral reef decline. For availability see www.thirdfloorcell.com

MEMBERSHIP

The annual subscription for individual membership of ISRS is currently US$80, provided renewal payments are made by 1 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 benefitsinclude all of the above except the journal *Coral Reefs.* The Category - Patron Member- is for those supporting the society with a subscription of $200. In addition to the standard benefits, Patron Members will see their names printed in each issue of *Reef Encounter.* Renewals received between 1 March and 30 April cost US$30 for a student member, US$90 for a full member and US$100 for a family membership. Those received after 1 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 Dr Isabelle Côté at imcote@sfu.ca. 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.

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. 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 newsletter 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 normally 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.

Articles should range between 200 and 1000 words. If you are planning a substantial contribution, it will help the Editor plan ahead by contacting her first. Except in exceptional circumstances, text should be sent by email to suewells100@tiscali.co.uk. We welcome contributions regardless of when they arrive, but submissions for issue 37 should arrive no later than 31 August 2008. Thank you for your support.

DEADLINE FOR COPY FOR
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(DUE OUT September 2008) - 31 August 2008

Please send correspondence and submissions to one of these addresses: Editor, **Sue Wells** 95 Burnside Cambridge CB1 3PA, UK. Email: suewells100@tiscali.co.uk, Associate Editor **Michael Arvedlund** Reef Consultants, Raadmand Steins Allé 16A, 2-208, 2000 Frederiksberg Denmark Email: arvedlund@speedpost.net, Associate Editor **Steve Coles** Department of Natural Sciences, Bishop Museum, 1525 Bernice Street, Honolulu, HI USA, Email: slcoles@bishopmuseum.org, Associate Editor **Adel Heenan** School of Biology, University of Edinburgh, Ashworth 2, King's Buildings, Edinburgh EH9 3JT, Scotland. Email: adel.heenan@gmail.com

APPLICATION FORM FOR MEMBERSHIP

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

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