

2007

*RCUK (Reef Conservation UK)
Dedicated to the Conservation and Awareness of Coral Reefs*

In Support of



Conference Committee

RCUK Meeting Organising Committee

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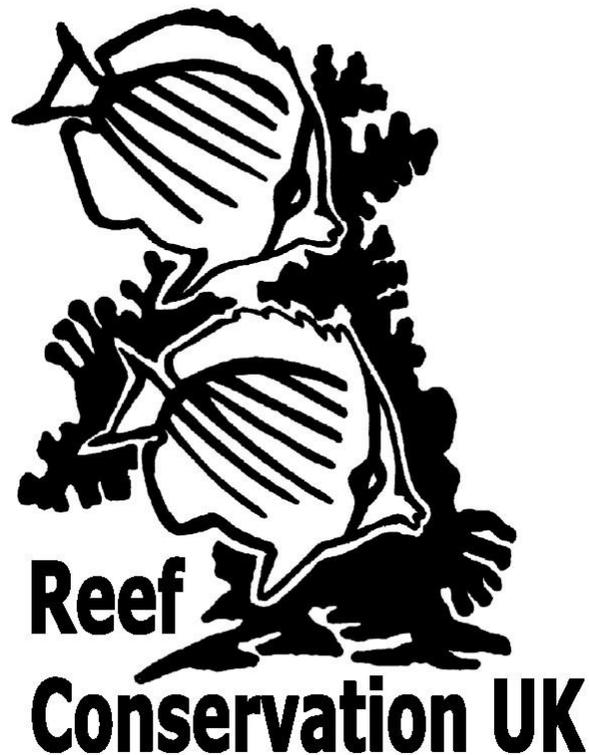
There are currently three ways to keep you up to date on RCUK news and events:

1. RCUK listserv - details of how to join can be found at:
www.jiscmail.ac.uk/lists/iyor-uk.html
2. RCUK website (www.rcuk.org.uk)
3. Any specific inquiries can be directed towards: rcuk@zsl.org

Many thanks to Guylian Chocolates (Belgium), for their support of this event. Guylian have been a long-term supporter of coral reef conservation through their partnership with Project Seahorse.

The Organising Committee would especially like to thank and recognise the following individuals for their valuable contribution to the success of the RCUK 2007 meeting:

Terri Young International Coral Reef Action Network
Rachel Jones Zoological Society of London
Caroline Walsh Access to Marine Conservation for All International



PROGRAMME & ABSTRACTS

Zoological Society of London

8th December 2007

**Presented by
REEF CONSERVATION UK**

*RCUK (Reef Conservation UK)
Dedicated to the Conservation and Awareness of Coral Reefs*

Welcome to the RCUK (Reef Conservation UK) Meeting 2007

Welcome to the **10th annual meeting of RCUK** at the Zoological Society of London. Once again we are pleased to have been able to assemble what we think you will agree is a very interesting programme. This meeting continues to illustrate the impressive array of coral reef interests and activities here in the UK.

The RCUK Committee has managed to organise this meeting every year through the voluntary efforts of many people and organisations, most of which are listed in the inside cover of this abstract booklet. However, RCUK relies on your continued support and participation to ensure that it maintains an active role in the UK in promoting coral reef conservation. There are many ways that you can contribute to RCUK throughout the year and we are happy to take you on board. Drop us a line (rcuk@zsl.org) if you are interested.

As well as this meeting representing the **10th anniversary of RCUK**, it also introduces 2008 as the **International Year of the Reef (IYOR 2008)**, a year long campaign of events and initiatives hosted by governments, individuals, corporations, and schools around the world to promote awareness, conservation action, and strengthen long-term support for coral reef conservation. RCUK serves as the UK Focal Point for IYOR 2008, and we hope that you will all join us throughout the coming year in helping raise awareness, and take action to help conserve the worlds' coral reefs.

We hope that you will find this day interesting and fruitful. If there is anything you think we can improve on, do let one of us know at rcuk@zsl.org.

We thank all of you for making this meeting and RCUK a continued success.

RCUK Committee

8th December 2007

RCUK Annual Meeting: 2008 Programme

Time	Title	Authors
8.30 - 9.00	Registration and Coffee	
9.00 - 9.10	Introduction	K. Teleki
	Session 1: Reef resilience	Chair: K. Teleki
9.15 - 9.45	<u>Keynote</u> . Thresholds and the resilience of Caribbean coral reefs	P.J. Mumby, A. Hastings & H.J. Edwards
9.45 - 10.00	Climate warming and the Ocean-scale integrity of coral reef ecosystems.	N. Graham and 15 others
10.00 - 10.15	Post-bleaching Reef Regeneration 1998-2007, Alphonse Atoll, Seychelles	A.B. Hagan & T. Spencer
10.15 - 10.30	A biophysical perspective of grazing in Pacific parrotfish	S. Bejarano Chavarro, V. Ticzon & P.J. Mumby
10.30 - 10.45	Fishing and coral loss; agents of change within reef fish communities	S.K. Wilson and 8 others
10.45 - 11.15	Coffee	
	Session 2: Cold water reefs / Reef management	Chair: E. Wood
11.15 - 11.30	Cold-water coral reef habitats in the Atlantic waters off the UK and Ireland	V.A.I. Huvenne, A.J. Wheeler, A. Foubert, D.G. Masson. & H. de Haas
11.30 - 11.45	Conservation & communities: 10 years of marine reflections with Frontier	H. L. Markham, N. R. Owen, D. G. Weaver & E. Fanning
11.45 - 12.00	Fishery decline in Utila: Implications for governance	R. Korda, J. Hills & T. Gray
12.00 - 12.15	Conserving coral reefs in Belize: from science to capacity building and policy development	M.J.C. Crabbe and 7 others
12.15 - 12.30	Understanding the patterns of dive site use for the sustainable management of coral reefs	M.C. Uyarra, A.R. Watkinson & I.M. Côté
12.30 - 14.00	Lunch	
	Session 3: Reefs and climate change	Chair: S. Harding
14.00 - 14.30	<u>Keynote</u> . Coral recovery in the absence of human stressors	C.R.C. Sheppard, A. Harris & A.L.S. Sheppard
14.30 - 14.45	Gulf reef environments: striking a balance between economic development and environmental considerations in an area of extreme climate	D. Medio
14.45 - 15.00	Historical sea-surface temperature variability predicts climate change-induced coral mortality in the western Indian Ocean	M. Ateweberhan and Tim R. McClanahan
15.00 - 15.15	Unravelling coral photoacclimation: <i>Symbiodinium</i> strategy and host modification	S.J. Hennige, D.J. Smith, K. McDougall, M. Warner & D.J. Suggett
15.15 - 15.30	Inter-specific differences in scleractinian immunity	C. Palmer, L. Mydlarz & B.L. Willis
15.30 - 16.00	Coffee	
	Session 4: Pacific reef management	Chair: A. Harborne
16.00 - 16.15	The next step for marine protected areas: A temporal assessment of co-management on San Salvador Island, Philippines	H.M. Bodley, J. Hills, P.D. Chaniotis & A.T. White
16.15 - 16.35	What are the key biological and socio-economic indicators for the establishment of a marine reserve in Diego Suarez Bay, Northern Madagascar?	N.K. Browne & H.L. Markham
16.35 - 16.50	CCC in the Philippines - over 10 years of marine conservation success	P. Raines, J. van Bochove & S. Harding
16.50 - 17.05	"To live with the Sea" – development of the Velondriake community-managed protected area network, south west Madagascar	A. Harris, R. Roy & K. Foerstel
17.05 - 17.20	Management control and trade offs in the ecological goods and services of coral reefs of southern Kenya	C.C. Hicks, T.R. McClanahan, J.E. Cinner & J.M. Hills
17.20 - 17.30	Report on proposed IYOR 2008 activities in the UK	S. Harding
	Discussion and Conclusions	
17.30 -	Reception	

International Coral Reef Initiative (ICRI)

The International Coral Reef Initiative is a voluntary partnership founded in 1994 of countries, international environmental and development agencies, scientific associations, the private sector and NGOs that are linked by a global Secretariat, run and funded by the government of one country but often with assistance of others.

It seeks to help implement the recommendations on oceans of the Rio Earth Summit (Chapter 17 of “Agenda 21”) and other international Conventions and agreements, to stop and reverse the global degradation of coral reefs and related ecosystems. ICRI, working with and through its sister networks, sets out to mobilise governments and a wide range of other stakeholders in an effort to improve international co-operation, management practices, increase capacity and political support, and share information on the health of these ecosystems.

The Johannesburg Plan of Action agreed at the World Summit on Sustainable Development (WSSD), in September 2002, gives us a clear mandate to further raise awareness of the importance of coral reefs and press for action to better protect and manage them. There are a range of WSSD commitments that ICRI can help to implement, in addition to those set out in its own Call for Action:

- Well-managed marine protected areas
- Integrated coastal zone management
- Sustainable livelihoods, including fishing and tourism
- Development and application of the ecosystem approach
- Better oceans governance

July 2007 saw the governments of Mexico and the United States taking up the stewardship of the ICRI secretariat, in conjunction with the UNEP World Conservation Monitoring Centre (UNEP-WCMC), ending the two-year term of Japan and the Republic of Palau.

For more information please contact icri@unep-wcmc.org or you can find out more about ICRI at: www.icrifroum.org



The International Coral Reef Initiative (ICRI), a partnership among governments, international organisations, and non-governmental organisations throughout the World, has designated 2008 as the

International Year of the Reef

The International Year of the Reef 2008 (IYOR 08) is a year long campaign of events and initiatives hosted by governments, individuals, corporations, and schools around the world to promote awareness, conservation action, and strengthen long-term support for coral reef conservation. ICRI will be launching IYOR 2008 during the ICRI General Meeting on the 24th of January in the United States to "kick start" efforts around the world. Everyone is encouraged to participate actively in this Initiative.

The first IYOR took place in 1997 in response to the increasing threats and loss of coral reefs and associated ecosystems (mangroves, seagrass beds, estuaries, etc.). It was a global effort to raise awareness and understanding of coral reefs, the threats they face, and support related conservation, research and management efforts. Over the last few decades, the health of coral reefs and their associated ecosystems have degraded considerably worldwide, and marine resources within and surrounding coral reefs have significantly declined, primarily due to human influences. Despite IYOR 97's success in raising global awareness with participation from over 225 organisations in 50 countries and territories, ten years later, there remains an urgent need to take action to conserve further and manage coral reefs.

IYOR 2008 aims to promote urgent conservation and management to better protect our coral reefs on a global scale. The goal is to communicate effectively the value and importance of the world's coral reefs and the threats to the reefs' sustainability to local communities, children, tourists, governments, even people who live far away from the coastline, and to motivate these target audiences to take action to protect coral reefs.

The overall objectives of IYOR 2008 are:

- To strengthen awareness about the ecological, economic, social and cultural value of coral reefs and associated ecosystems.
- To improve understanding of the critical threats to reefs, and generate both practical and innovative solutions to reduce these threats.
- To generate urgent action to develop and implement effective management strategies for conservation and sustainable use of these ecosystems.

So far twenty-three countries and twenty-one organizations representing different sectors; policy, conservation, research and the private sector, have signed up as focal points to facilitate participation in IYOR 2008 activities.

For more information on how you can participate in IYOR 2008, visit www.iyor.org



IYOR 2008

CORAL REEFS NEED OUR HELP

FROM

Jean-Michel Cousteau,
Ocean Explorer and Environmentalist

I am extremely pleased to see that global attention will once again be focused on coral reefs. Through the hard work and dedication of International Coral Reef Initiative partners, 2008 will be the second International Year of the Reef (IYOR). Although problems have mounted since 1997 when we launched the first International Year of the Reef, there is good news. We have a much clearer understanding of how reefs are being affected by climate change; ocean acidification is getting attention and was not even mentioned in 1997; we now have solid data that marine reserves and protected areas actually work; and the public is much more aware of the need to change unsustainable ways of living and doing business.

My personal perspective is based on having had the good fortune of traveling extensively and witnessing firsthand many coral reefs around the world. I have seen the vital connections between the health of coral reefs and the quality of people's lives. Coral reefs *themselves* are interconnected on wide geographic scales with other marine ecosystems through fish and bird migrations, the dispersal and recruitment of fish and shellfish larvae, and through people as we travel to exploit or enjoy the reef's resources. I have also observed how deforestation, agricultural runoff, pollution, over-fishing, and destructive fishing practices affect the vitality of coral reefs.

In spite of noble proclamations about protecting coral reefs, in every country I have visited I can cite examples of reefs severely overexploited or stressed from human mismanagement. Deforestation, over-development and agriculture in the Caribbean have released nutrients and sediments that stress reefs. In Papua New Guinea I have seen reefs reduced to rubble from dynamite fishing, and local people missing limbs from premature explosions. In Haiti a ten-foot-high wall of conch shells, called the pink cliffs, extends along a coastline for almost a mile. Fishermen now lament the collapse of their fishery and believe the conch population has moved, denying that over-harvest is the cause.

The over-harvest of fish throughout the Caribbean has upset ecological balances affecting entire reef ecosystems. On some of Florida's reefs there has been a 62 percent reduction of living coral cover from 1996 to 1998. Causes of these declines are complex but cumulative because everything is connected.

As with our bodies, once our general state of health is undermined, we are vulnerable to a host of maladies.

The most devastated reefs I have ever witnessed surround the tiny country of Nauru, which has had one of the highest per capita incomes in the world. Mining, and the resultant destruction of over 80 percent of the landscape, provided money but eliminated natural resources, the heritage for future generations. Young people with whom I have spoken have no need or incentive to work, and told me that their greatest wish would be to be able to dive and enjoy healthy and productive coral reefs.

In my opinion, the common denominator in these examples of mismanagement is a lack of understanding about coral reefs, how they function, their value to humans, why they are vulnerable to human impact, and how they can be managed sustainably. Education at every level - from international to national, from university to village children, and every level in between - is absolutely critical in protecting coral reefs. I am pleased to see that IYOR 2008 is tackling this important issue.

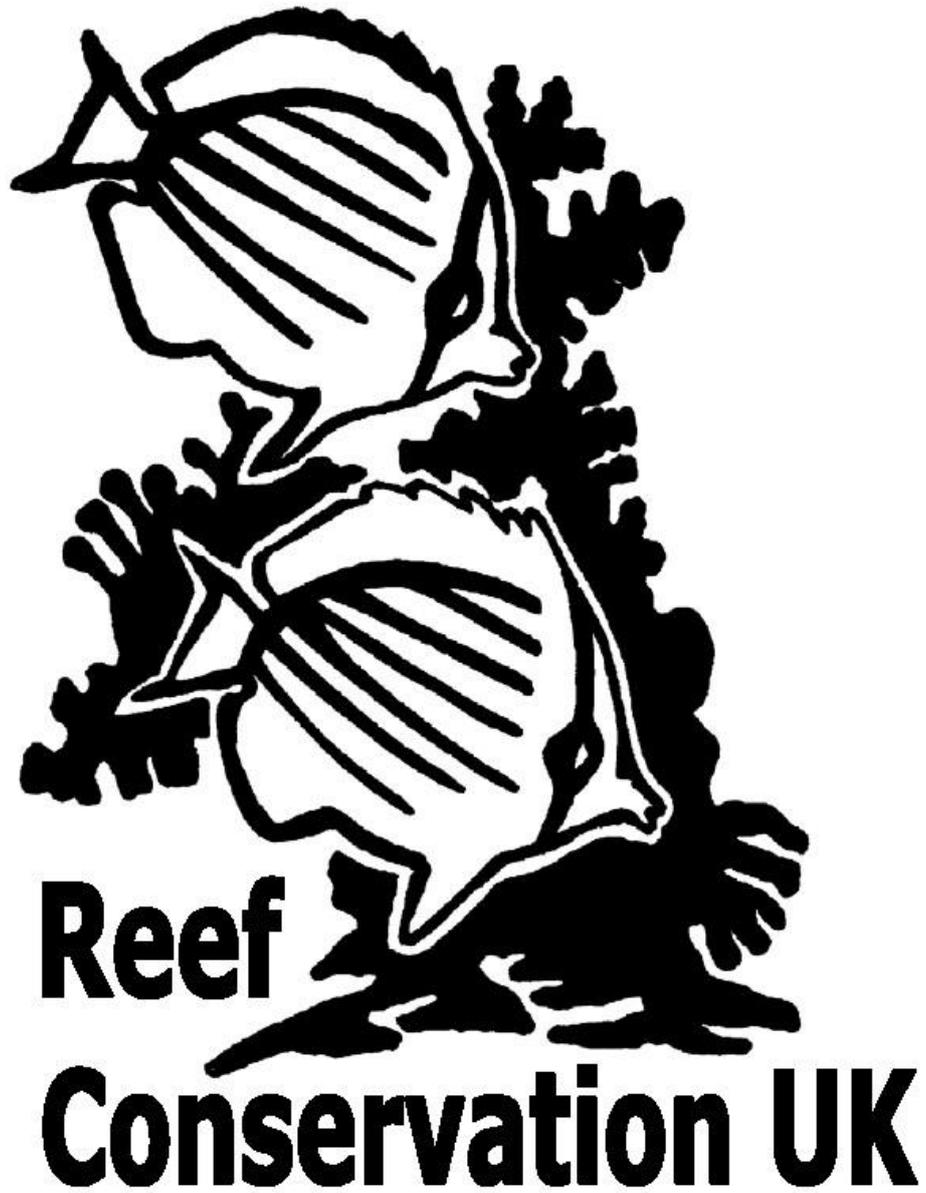
We at Ocean Futures Society totally support IYOR 2008 and share its goals of raising public awareness about the critical state of coral reefs and promoting sustainable management of reefs. For me this is a people issue; it will be people who will make the difference in the survival or loss of coral reefs. We all must work together to insure that our grandchildren have the opportunity to enjoy and benefit from these marvelous wonders of nature.

Read on and learn more about coral reefs.

A handwritten signature in black ink, appearing to read 'Jean Michel Cousteau'. The signature is stylized with a large, sweeping initial 'J' and 'M'.

Jean Michel Cousteau

For more information about Ocean Futures Society, please visit www.oceanfutures.org



**Oral
Presentations**

Abstracts

Abstracts for oral presentation are arranged in alphabetical order of first authors. Abstracts were printed as they were received and have not been edited for content. Reformatting was only carried out to ensure uniformity. The responsibility of the content of each abstract rests solely with their authors.

HISTORICAL SEA-SURFACE TEMPERATURE VARIABILITY PREDICTS CLIMATE CHANGE-INDUCED CORAL MORTALITY IN THE WESTERN INDIAN OCEAN

M. ATEWEBERHAN AND T. R. MCCLANAHAN

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Coral reefs have become one of the major casualties of climate change. Many of the world's coral reefs suffered high coral mortality during the 1998 ENSO, with the highest mortality in the western Indian Ocean (WIO). Here we present results of a meta-analysis of field data on change in coral cover across the 1998 ENSO event for 36 major reef areas in the WIO.

Basin-wide change was highly variable and related to historical sea-surface temperature (SST) variability. Mortality was negatively associated with standard deviation (SD) SST until SD \sim 2.3, with increasing flatness of the SST frequency distributions. It increased with further increase in SD as the SST distributions became strongly bimodal. The predictable environmental patterns associated with the mortality suggest that future change during a warmer and more variable climate can be predicted and management priorities directed accordingly.

A BIOPHYSICAL PERSPECTIVE OF GRAZING IN PACIFIC PARROTFISH

S. BEJARANO CHAVARRO¹, V. TICZON² AND P. J. MUMBY¹

¹ Marine Spatial Ecology Laboratory, Hatherly Lab, Prince of Wales Road, University of Exeter, EX4 4PS, United Kingdom.

² Marine Science Institute, University of the Philippines, Manila, Philippines.

Parrotfish grazing is essential for processes of reef recovery. The parrotfish community is diverse in Micronesia. A species-level systematic evaluation of contribution to grazing is lacking as are the effect of fish total length (TL) and physical environmental factors. Bite rates were quantified by life phase and substrate type for 22 parrotfish species in Palau and complementary data on bite area generated for 23 species.

Parrotfish community composition and biomass varied among three sites studied. Most species focused their grazing on algal turfs but also included a broad range of substrates including live coral. Bite rate at a community-level decreased consistently in larger bodied parrotfish and was generally lower in the morning compared to midday and/or afternoon. Tidal direction had no effect on bite rate but an effect of tidal height interacting with the time of day was detected at one site (Ngederrak). During midday, bite rate decreased when tidal height increased, whereas no detectable effect of tidal height occurred at other times of day at a community level.

A more intensive study of *Chlorurus sordidus* revealed that its grazing intensity was minimal in the morning and significantly higher during midday and afternoon. Once again, the moderating influence of tidal height differed interacted with the time of day. Output models identify the relative importance of sites, species and size classes to overall grazing.

We show that the conversion of fish census data to modelled grazing will potentially give a more insightful metric of grazing than using biomass as a simple surrogate.

**THE NEXT STEP FOR MARINE PROTECTED AREAS:
A TEMPORAL ASSESSMENT OF CO-MANAGEMENT ON SAN SALVADOR ISLAND, PHILIPPINES**

H. BODLEY¹, J. HILLS², P. D. CHANIOTIS¹ AND A. T. WHITE³

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³ Coastal Conservation and Education Foundation, Cebu City, Philippines

Substantial resources have been applied to establish over 600 marine protected areas (MPAs) in the Philippines, yet their degree of effectiveness is variable, with many being described as ‘paper parks’. This paper takes an interdisciplinary approach to test the hypothesis that institutional and community capacity are important determinants of MPA effectiveness.

San Salvador Island, Philippines, has a relatively long history of coastal resource management, focused on a co-managed MPA established since 1989. Social and ecological data collected sporadically since 1988 are updated to provide a broader evaluation of the effectiveness of the MPA in achieving its objectives. Results indicate coral cover has increased but fish abundance continues to decline following a significant decrease since 1998. The potential of ecological and socio-political factors causing a change in the fishery over the last ten years are reviewed, such as the 1998 coral bleaching event and external pollution.

The next ten years are shown to be crucial for the sustainability of the MPA. The majority of respondents perceive the MPA as the best option for future management of San Salvador’s marine resources and are generally satisfied with a co-management regime. However significant conflicts are recognised between perceptions on how stakeholders work together to solve problems. Additionally, respondents suggest the main management improvements should be enforcement or unity, which are arguably contradictory, by encouraging a top down or bottom up approach.

In conclusion, the data collected supports community and management capacity as important determinants of MPA effectiveness. Unbalanced governance, particularly lack of communication and transparency between the residents of San Salvador Island is making the future of their MPA uncertain. Recommendations to ensure participatory governance include the need for impartial facilitators to encourage sustainability of marine resources.

WHAT ARE THE KEY BIOLOGICAL AND SOCIO-ECONOMIC INDICATORS FOR THE ESTABLISHMENT OF A MARINE RESERVE IN DIEGO SUAREZ BAY, NORTHERN MADAGASCAR?

N. K. BROWNE AND H. L. MARKHAM

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The use of marine reserves has been strongly advocated in recent years by resource managers highlighting greater potential benefits over conventional fisheries management. Reserves have been implemented to meet a number of politically regulated goals with biological aspects such as: the maintenance of diversity, the enhancement and restoration of fishery yields and research, alongside socioeconomic facets to include education and the generation of revenue from ecotourism. Extensive research is required to provide reliable data in order to design and implement an effective strategy, to promote ecosystem stability through sustainable coastal resource use.

This paper aims to establish how developing countries can tackle the problem of deteriorating reef health when faced with basic constraints such as time, money and expertise. A comprehensive assessment of Diego Suarez Bay in the north of Madagascar was conducted over 18 months in order to generate an ecological and socio-economic profile for the region. The biodiversity, health and extent of the reef ecosystems in the bay are evaluated, and detailed habitat maps highlight the extent of the reef systems that are currently in good condition, yet under increasing levels of threat due to uncontrolled coastal development.

Economic reliance on the reef is currently limited to the fishing industry, but this is set to change with increasing levels of tourism. Thus marine management initiatives must be considered in order to prevent a further decline in reef health. This research presents an opportunity to expand knowledge and develop key indicators, critical for reserve effectiveness under constraints of limited budget and marine capacity. The establishment of environmental awareness campaigns to foster local involvement, acceptance and compliance comprise an essential basis on which to implement coastal management schemes on a cost effective basis and are vital to the long term success of marine protection.

FISHERY DECLINE IN UTILA: IMPLICATIONS FOR GOVERNANCE

R. KORDA, J. HILLS, AND T. GRAY

Key Words: Market governance, Hierarchical governance, Participatory governance, Voluntary authoritarianism, Community co-management

The commercial fishing industry of Utila, Honduras appears to be in danger of acute decline. In order to confirm both the existence of the target fish stock crisis, and identify stakeholders' perceptions of the cause of and potential solutions to the aforementioned crisis, this study, employed a discourse analysis based upon interviews with Utilian fishers and key informants.

In analysing the discourses in the interview transcripts, it appeared that two alternative modes of fisheries governance were endorsed: (1) voluntary authoritarianism or (2) community co-management. Our conclusion is that voluntary authoritarianism is more likely to succeed in creating a governance mechanism, which will allow for effective management in the short-term, in preparation for community co-management, which is a more sustainable permanent solution for the island.

CONSERVING CORAL REEFS IN BELIZE: FROM SCIENCE TO CAPACITY BUILDING AND POLICY DEVELOPMENT

M. J. C. CRABBE¹, E. MARTINEZ², B. SHANK³, L. KAUFMAN³, C. GARCIA⁴,
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⁶Friends of Nature, Belize, Village of Placencia, Stann Creek District, Belize, Central America

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Belize is a Central American country which claims over 200 cayes which form part of the MesoAmerican Barrier Reef. There are two major coral reef areas in the south, the Sapodilla Cayes Marine Reserve (SCMR, a World Heritage Site), and the Port Honduras Marine Reserve (PHMR). The SCMR is a 125 square km reserve and has a collaborative agreement with the Fisheries Department and the Toledo Association for sustainable Tourism (TASTE) to manage the area since its declaration in 1996. The PHMR is a 160 square mile reserve and is managed by the Toledo Institute for Development and Environment (TIDE) since its declaration in January 2000. It is an integral part of the Maya Mountain Marine Corridor, which extends from the Maya Mountains to the barrier reef.

We have conducted coral surveys in both reserves, determined coral growth rates, and tested whether hurricanes and severe storms limited the recruitment and survival of massive corals in the SCMR and PHMR, as had been found in Jamaica (Crabbe et al., 2002, 2004). We have also developed a capacity building programme for local stakeholders, in collaboration with NGOs and management authorities, to inform long-term resource management decisions in Southern Belize. This has enabled stakeholders' capacity to lead, educate, and support issues regarding sustainable development, and promoted networking amongst organisations who manage marine resources, enhancing their power to collectively influence policy decisions in the country.

Specific needs for the future include: enhancing and maintaining the legality of the marine parks in Belize, enforcement and the effectiveness of zoning, scientific underpinning and maintenance of coral and fish stock assessments, linking NGOs and marine parks in Belize in effective co-management, development of a shared database on the lines of that initiated by the MBRS project. These and other initiatives will be discussed in the presentation.

We thank the Oak Foundation, USA, and the Earthwatch Institute for funding.

References

Crabbe, M.J.C., Mendes, J.M. and Warner, G.F. (2002) Lack of recruitment of non-branching corals in Discovery Bay is linked to severe storms. *Bulletin of Marine Science* 70, 939-945.

Crabbe, M.J.C., Karaviotis, S. and Smith, D.J. (2004) Preliminary comparison of three coral reef sites in the Wakatobi Marine National Park (S.E. Sulawesi, Indonesia): Estimated recruitment dates compared with Discovery Bay, Jamaica. *Bulletin of Marine Science* 74, 469-476.

CLIMATE WARMING AND THE OCEAN-SCALE INTEGRITY OF CORAL REEF ECOSYSTEMS

N. GRAHAM¹, T. CLANAHAN, A. MACNEIL, S. WILSON, N. POLUNIN, S. JENNINGS, P. CHABANET, S. CLARK, M. SPALDING, Y. LETOURNEUR, L. BIGOT, R. GALZIN, M. ÖHMAN, K. GARPE, A. EDWARDS, C. SHEPPARD

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The 1998 bleaching event proved one of the largest disturbances to coral reefs in recent times, with the western Indian Ocean the most severely impacted region. The short-term, small spatial scale impacts of coral loss on fish assemblages has received considerable attention, however the longer-term, large-scale impacts have been harder to elucidate.

We have repeated extensive benthic composition and fish community surveys at seven countries across the region, including data from 66 sites; thus before and ~7 years after data are available at each site. Here I present a regional Bayesian meta-analysis of these data.

The extent of decline in coral cover and post-bleaching recovery varied greatly across the region. The worst impacted locations were Seychelles, Maldives and Chagos, followed by Kenya and Tanzania, while Mauritius and Reunion largely escaped any bleaching disturbance. While Chagos and Tanzania have recovered coral cover rapidly, the Maldives and Kenya have been slower and the Seychelles is showing little potential to recover. Loss in structural complexity of the reef structure was strongly correlated to loss in coral cover.

These cross-region trends in the benthos are reflected in the fish assemblages. Fish species richness declined significantly with loss in coral cover. Abundance of coral feeding and plankton feeding fish also declined, highlighting their dependence on coral for food and shelter. Herbivore numbers did not increase with the loss of coral, suggesting their role in controlling algae may not be affective at large scales. Species <20cm maximum length declined significantly with loss of coral highlighting their dependence on the physical matrix of the reef, and within this size group, small bodied herbivores also declined. Existing marine protected areas had little affect on the responses of coral reef ecosystems to large-scale disturbance which suggests future planning needs to identify regional refugia as priorities for protection.

POST-BLEACHING REEF REGENERATION 1998-2007,
ALPHONSE ATOLL, SEYCHELLES

A. B. HAGAN^{1, 2} AND T. SPENCER²

¹Khaled bin Sultan Living Oceans Foundation, 8181 Professional Place, Suite 215, Landover, MD 20785, USA.

²Cambridge Coastal Research Unit, Dept. of Geography, University of Cambridge, Cambridge, CB2 3EN, UK.

Better knowledge of rates and styles of reef recovery following severe disturbance are a key element in the assessment of future reef responses to global environmental change. Alphonse Atoll, southern Seychelles (7°01'S; 52°44'E) is a small (11.28 km²) atoll where significant anthropogenic influences can be discounted. Quantitative measurements of benthic cover commenced here in 1998 at the peak of the western Indian Ocean warming. Re-surveys of fixed transect lines were made in 2001/02, 2003, 2005 and 2007. This location thus provides a detailed long-term (> 9 yrs) record of post-bleaching recovery dynamics.

One year post-bleaching, scleractinian cover at Alphonse had greatly reduced but macroalgal cover had increased. This high level of macroalgae did not persist, and over time, scleractinian cover increased, reaching 23% by 2003-2005. Despite the increased percentage scleractinian cover, there was no associated increase in coral diversity. Immediately post-bleaching, the scleractinian community was dominated by *Porites* which survived the bleaching event and by the arrival of the opportunist species of *Pocillopora* and *Acropora*. Lagoon corals and many shallow water corals, presumably acclimatised to warmer water conditions, endured the 1998 thermal stress and likely acted as local refugia for coral larvae.

In December 2006, Cyclone Bondo passed close to Alphonse Atoll and caused considerable damage to reefs on the NW of the atoll. *Porites* colonies and large coral boulders (up to 1 m across) were deposited on the reef crest and increased macroalgal cover was observed on the fore-reef slope. Much of the coral debris on the reef crest was long dead, indicating the fragility of the reef framework post-1998 and its susceptibility to mechanical damage. Recovery on the NW fore-reef slope has been severely set back, highlighting how a combination of natural degradation events can interrupt the ability of reefs to recover in the absence of anthropogenic influence.

CCC IN THE PHILIPPINES - OVER 10 YEARS OF MARINE CONSERVATION SUCCESS

S. HARDING, J. VAN BOCHOVE AND P. RAINES

Coral Cay Conservation, Elizabeth House, 39 York Road, London, SE1 7NJ, UK.

Coral Cay Conservation, a UK-based non-profit organisation has been operating coral reef conservation projects in the Philippines since mid 1990's with some highly notable success stories. Since the first project began on Danjungan Island, Negros Occidental in 1995, CCC has operated four long-term coral reef conservation projects located from Palawan in the west to Southern Leyte in the east, as well as operating short-term assessments of reef status in X other locations.

The comprehensive habitat assessment of Danjungan Island in partnership with the Philippines Reef and Rainforest Conservation Foundation (PRRCFI) led to the designation of the Danjungan Island Marine Reserve and Sanctuaries in April 2000, the first to be created by Municipal Ordinance 99-52 in the country. The DIMRS was subsequently awarded the title of Best Managed Reef in the Philippines in 2001.

The current CCC work programme in the Philippines, the Southern Leyte Coral Reef Conservation Project, has been operating since 2002 in close collaboration with the Provincial Government of Southern Leyte. One focus of the project is to increase marine environmental awareness for coastal communities and assist the government and stakeholders with the installation and management of community-based MPA's in Sogod Bay. To date CCC has been instrumental in the designation of four such MPA's in the Padre Burgos Barangay and is planning to assess and improve the management effectiveness of a further five 'marine sanctuaries' on the eastern side of Sogod Bay.

A brief overview of CCC's marine conservation programme in the Philippines over the last decade is presented here along with preliminary plans and ideas for the programme of work over the next ten years.

UNRAVELLING CORAL PHOTOACCLIMATION: *SYMBIODINIUM* STRATEGY AND HOST MODIFICATION

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Light is often the most abundant resource within the nutrient poor waters surrounding coral reefs. As with all microalgae, symbiotic dinoflagellates of corals (*Symbiodinium*) must continually alter components of the photosynthetic apparatus to successfully track changes in light and thus optimise photosynthesis. It is this process, termed photoacclimation, which is crucial to the coral's productivity and ultimate success.

To accurately assess *Symbiodinium* photoacclimation *in situ*, differences in acclimation strategies and bio-optical signatures need to be characterised between genetic types of *Symbiodinium*. Using a systematic series of laboratory experiments, eight types of *Symbiodinium* were cultured under controlled nutrient and pH conditions at two light levels. A combination of techniques, including active Fluorescence Induction and Relaxation (FIRe) fluorescence, Photosystem I (PSI) and II counts, spectrophotometry and high performance liquid chromatography, were used to examine photoacclimation. Two key 'strategies' of photoacclimation are known to exist amongst microalgae: a preferential modification of the light harvesting antennae (σ -based) or of the reaction centre bed (n-based) for PSII and/or PSI. Our measurements demonstrated that acclimation strategies employed by *Symbiodinium* were highly varied between algal type.

However, despite this variability, many optical signatures were conserved. Also, when absorption was considered per photosystem, a 1:1 balance was observed between PSII and PSI. Acclimation strategies of intact *Acropora formosa* and *Seriatopora caliendrum* at two light levels were further examined using fluorescence and optical signatures to determine host contribution to acclimation.

Overall, our results demonstrated that (1) biophysical (active fluorescence, photosystem-specific) but not bio-optical signatures were highly variable between algal types; consequently, bio-physical signatures that are altered by an adaptation of the algal community structure may be misinterpreted as photoacclimation and (2) host acclimation and modification of the light environment plays a key role in *Symbiodinium* photoacclimation.

MANAGEMENT CONTROL AND TRADE OFFS IN THE ECOLOGICAL GOODS AND SERVICES OF CORAL REEFS OF SOUTHERN KENYA

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This study examined the adaptive capacity of coastal communities, their socio-economic conditions, how these relate to the goods and services and the control of resource management.

We examined nine fish landing sites along a 150 km stretch of the Kenyan coast and assigned values to goods and services identified across three types of reef management: (1) government imposed park management in the Mombassa Marine Park; (2) community initiated co management with the fisheries department of gear, and (3) community initiated fishery closure management, where a community controlled, temporary closed area has been initiated. We compared the community level ecosystem goods and services and the broader total economic value to explore how the history of these sites, their socio-economic conditions and different management choices were associated with these values.

A clear distinction exists in their macro-economic values between the sites that have or have not had some sort of national management intervention. Greater total economic values are associated with management interventions and are probably due to government involvement in high value beach tourism destinations. This is, however, associated with losses in a range of community level values and the self-adaptive capacity of the resource-user community. The marine protected area had the lowest values of biological knowledge. Sites displaying a wide range of community level values were characterised by high levels of social capital and users reflected the most confidence in their resource.

The results reflect the scale of management choices on economic and social resilience, where trade-offs in management and local social resilience are apparent.

COLD-WATER CORAL REEF HABITATS IN THE ATLANTIC WATERS OFF THE UK AND IRELAND

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Although the existence of cold-water corals was already known to Linneus in 1758, and their reef-building capacity was described by, for example, Le Danois (1948), it is only about a decade ago that the scientific community started to realise (again) the extent and uniqueness of the large cold-water coral reefs offshore the UK and Ireland. This contribution will present the results of several habitat mapping exercises in the British and Irish waters, and through these case studies will illustrate the different types of cold-water coral reefs that can be found plus the main environmental factors that influence the coral distribution and reef build-up.

In deeper waters (up to 1100 m) large 'mounds' are found, built up of coral framework embedded in baffled sediments. They can be more than 2 Ma old (Kano et al., *subm.*), up to 200 m high and partly or entirely buried by the surrounding sediments. Variable amounts of live coral and associated fauna have been found on their flanks, their distribution being related to the local current regime and sediment input.

Smaller reefs, up to 5 m high, represent a new phase of reef initiation at similar depths, which may have started as recently as the beginning of the Holocene. The occurrence of the Darwin and Moira mounds in association with sandy contourite sheets again illustrates how sediment dynamics and current regime influence the development of cold-water coral reefs.

In addition, cold-water coral reefs have also been described from shallower waters, such as the Minch (Outer Hebrides, 100-350 depth; Roberts et al., 2005). Also in this case the sediment load in the water column and the strong tidal current regime appear important factors.

Throughout those years of discovery and habitat mapping, the awareness of cold-water coral reefs and their vulnerability increased, which resulted in different protection measures for different areas (e.g. the Darwin mounds or recently the Irish reefs).

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CONSERVATION & COMMUNITIES: 10 YEARS OF MARINE REFLECTIONS WITH FRONTIER

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Frontier is committed to safeguarding the integrity and biodiversity of marine ecosystems in parallel with building sustainable livelihoods for marginalised communities utilising apolitical and community-driven solutions. Since inception in 1989, almost twenty years of experience has refined a multi-disciplinary and participatory approach to marine conservation. Engaging stakeholders at all levels has resulted in tangible conservation achievements and community projects. Recognising that conservation rests on sound science, comprehensive biodiversity research is combined with assessments of anthropogenic pressures to enable prioritisation of conservation needs. Therefore targeted initiatives have been developed, including institutional and community capacity building and awareness-raising.

Frontier research has led to the gazettelement of marine parks in Quirimbas, Mozambique and Mafia Island, Tanzania - one of the world's most successful multi-user marine parks. Training and education programmes based on workshops and the production of educational materials has been a central tenet of our work in East Africa. Unique BTEC qualifications accredited by Edexcel have formalised the training of hundreds of volunteers and in-country partners. A bespoke BTEC qualification in coastal management and turtle monitoring was successfully developed for local officials and NGO personnel in Nicaragua. Projects in Madagascar have focused on the assessment of artisanal fisheries, as well as local capacity building through training in marine monitoring, survey techniques and SCUBA. Major grants for these projects have been awarded from WWF, Darwin Initiative, DfID, FINNIDA, NORAD and PADI.

Conservation priorities for the coming years include: monitoring programmes to assess the impacts of climate change and catastrophic climatic events, valuation of ecosystem services, reconciling the needs of growing human populations, and conserving highly threatened species. Frontier is proud to develop projects to address these changing needs, from mangrove replanting and education in Madagascar, to the identification of coastal zone management needs and the initiation of a turtle conservation programme in Fiji.

GULF REEF ENVIRONMENTS: STRIKING A BALANCE BETWEEN ECONOMIC DEVELOPMENT AND ENVIRONMENTAL CONSIDERATIONS IN AN AREA OF EXTREME CLIMATE

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Coral communities in the Gulf live in the most extreme and stressful marine environment on earth where high and low seawater temperatures and high salinities have acted over millennia to limit their relative diversity and abundance. Despite this, an increasing number of rich coral communities are being identified and described.

At the same time, the magnitude of large scale coastal development in the region is unprecedented adding further pressure on these sensitive communities making the balance between economic development and ecological conservation all the more difficult.

The challenge is convincing developers and government authorities that these coral communities are of (a) regional significance because of their abundance (in terms of density), extent (in terms of total area), diversity and healthy condition and (b) global significance as they could provide a unique living laboratory for assessing the effects of raised seawater temperatures on hard corals globally.

Moreover, this precious and unique natural resource provide us with critical baseline information on the way forward in terms of (a) marine conservation and (b) developing a comprehensive coastal zone management policy in the region.

THRESHOLDS AND THE RESILIENCE OF CARIBBEAN CORAL REEFS

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The deteriorating health of the world's coral reefs threatens global biodiversity, ecosystem function, and the livelihoods of millions of people living in tropical coastal regions.

Reefs in the Caribbean are among the most heavily affected, having experienced mass disease-induced mortality of the herbivorous urchin *Diadema antillarum* in 1983 and two framework-building species of coral. Declining reef health is characterized by increases in macroalgae. A critical question is whether the observed macroalgal bloom on Caribbean reefs is easily reversible.

To answer this question, we must resolve whether algal-dominated reefs are an alternative stable state of the ecosystem or simply the readily reversible result of a phase change along a gradient of some environmental or ecological parameter. Here, using a fully parameterized simulation model in combination with a simple analytical model, we show that Caribbean reefs became susceptible to alternative stable states once the urchin mortality event of 1983 confined the majority of grazing to parrotfishes. We reveal dramatic hysteresis in a natural system and define critical thresholds of grazing and coral cover beyond which resilience is lost. Most grazing thresholds lie near the upper level observed for parrotfishes in nature, suggesting that reefs are highly sensitive to parrotfish exploitation. Ecosystem thresholds can be combined with stochastic models of disturbance to identify targets for the restoration of ecosystem processes.

We illustrate this principle by estimating the relationship between current reef state (coral cover and grazing) and the probability that the reef will withstand moderate hurricane intensity for two decades without becoming entrained in a shift towards a stable macroalgal-dominated state. Such targets may help reef managers face the challenge of addressing global disturbance at local scales.

INTER-SPECIFIC DIFFERENCES IN SCLERACTINIAN IMMUNITY

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The ability of hard coral to resist infection and to recover from injury remains poorly understood, yet with the increase in coral disease and coincident global reef degradation, a greater understanding of the immune capabilities of corals is becoming increasingly important.

Many invertebrates induce a basic inflammatory response to tissue invasion using the melanin producing signalling pathway and phagocytosis to encapsulate and remove the invading foreign organism. The presence of the pro-phenoloxidase activating melanin pathway was investigated as a potential defence mechanism in two species of coral, *Acropora millepora* and massive *Porites* sp.. Compromised tissue was compared to healthy tissue for both species using L-DOPA (3-(3,4-Dihydroxyphenyl)-L-alanine) substrate based enzyme activation assays for each species.

Histological samples of compromised tissues were taken to assess differences between these and healthy tissues at a cellular level. Phenoloxidase was found in healthy tissue of both *A. millepora* and *Porites* massive sp., with an up-regulation in compromised tissue of *A. millepora*. Histological examinations show reduced numbers of zooxanthellae in compromised tissue of both species and increased pigment cells in the epithelium of compromised *Porites* sp. Histological investigations also conclusively determined the presence and location of melanin in *Porites* sp. although not in *A. millepora*.

These results indicate that the prophenoloxidase pathway is active in areas where tissue is compromised in scleractinians and suggest that it is part of a generalised defence response to localised stress. However, inter-specific differences in the use of the melanisation pathway, are particularly pertinent given the current rate of global climate change and the potential implications of ocean warming for the coral reef ecosystem.

This study demonstrates the presence of the melanisation cascade as part of the immune response of scleractinian corals and also contributes to current understanding of how differential development of innate immunity might influence ecological and life history differences among coral species.

**“TO LIVE WITH THE SEA”
DEVELOPMENT OF THE VELONDRIAKE COMMUNITY-MANAGED PROTECTED AREA
NETWORK, SOUTH WEST MADAGASCAR**

R. ROY

Blue Ventures

Madagascar’s south-west coast supports some of the largest coral reef systems in the western Indian Ocean. These reefs not only provide critical habitat to thousands of marine species but also are essential to the survival of the indigenous Vezo people who rely on healthy marine resources for food, cultural identity and income. However, coastal populations are growing rapidly and international fisheries companies have begun exploiting the region’s waters through a sophisticated collection network to supply an expanding export market. In recent years local fishers have reported declines in the size and number of their catches.

Building on the success of a pilot marine no take zone launched three years ago in the remote fishing village of Andavadoaka, Blue Ventures Conservation (BV), Madagascar’s Institute of Marine Sciences (Institut Halieutique et des Sciences Marines - IHSM) and the Wildlife Conservation Society (WCS) are now working with 21 villages and fisheries collections companies to develop a network of community-run marine and coastal protected areas that will span more than 800-square kilometres, aiming to benefit more than 10,000 people and protect coral reefs, mangroves, seagrass beds and other threatened. The villages, grouped into three geographic regions, have established a management committee which serves as a liaison between conservation scientists and community members.

Along with protecting biodiversity and livelihoods, the network is working to increase environmental awareness, expand local and national capacity for biodiversity conservation and serve as a model for other community conservation, economic development, and governance initiatives across Madagascar and elsewhere. Velondriake aims to benefit villages within the network by empowering members of the local communities as managers of their own natural resources, enabling communities to contribute directly to the development of sustainable resource management systems to support local culture and livelihoods.

CORAL RECOVERY IN THE ABSENCE OF HUMAN STRESSORS

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From a condition of very heavy loss of coral and soft coral cover caused by the 1998 warming event, there has been substantial recovery in reefs of the Chagos archipelago, which span 200 x 300 km. Best line fits of SST curves during the 2000s show a continued rise, though years fluctuate heavily, and two years had dangerously high peak and annually averaged temperatures. This led to several repeated bleaching events over the whole archipelago, but without subsequent mortality in most locations.

This paper shows the nature and pattern of coral recovery, using various measures. Cover has been restored to pre-1998 values in shallow water, but has scarcely recovered at all in deeper waters. However, I highlight the danger of using coral cover values in monitoring recovery, since, although coral cover in shallow water is restored, the 'scene' remains utterly different today, being composed of encrusting and juvenile forms only, compared to the 3-dimensional 'forest' structure extending 2 m tall seen prior to 1998. This 'maturity discrepancy' is usually overlooked, is vital, but perhaps is being reflected in present differences in fish populations.

Using numbers of coral colonies, the pattern across atolls is very varied, showing substantial patchiness. Only one atoll was significantly different, in that it has experienced substantial repeat mortality. Recruitment of new colonies, about 20-70 recruits m⁻², is 1-2 orders of magnitude greater than in other sites reported so far. Species strongly represented are similar to those which existed pre-1998, unlike say, the situation in Arabian reefs where there is a shift from *Acropora* to Faviids. Density is greatest in shallow water; deep water recovery is lagging by this measure also.

By comparison, heavily stressed sites have not recovered at all. Examples are shown from Arabian reefs.

Many governments have begun to excuse their lack of desire or ability to manage their marine reserves by saying that there is no point, given global temperature rise outside their control. However, the remarkable recovery in Chagos is attributed to a lack of other, local and locally controllable factors such as pollution, over-fishing and sedimentation, even with rising temperatures. By comparison with sites which experience local stressors too, it is clear that if such governments do implement local management measures, then they may 'buy' perhaps 20-40 years of time before their reefs become too degraded to retain any value.

UNDERSTANDING THE PATTERNS OF DIVE SITE USE FOR THE SUSTAINABLE MANAGEMENT OF CORAL REEFS

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The popularity of coral reefs is continuously increasing within the diving industry. Due to the vulnerability of coral reefs to natural and human disturbances, a fundamental goal of coral reef managers is to regulate the spatial distribution of divers in order to allow the sustainable human use as well as effective protection of coral reefs. There is therefore considerable interest in understanding the general rules that can explain the distribution of people (resource users) across reefs. We tested the existing relationships between tourist stated preferences, actual conditions of coral reefs and level of use of dive sites around the Caribbean island of Bonaire.

Using standardized questionnaires, we asked 200 divers to select their most and least favourite dive sites and indicate the attributes that contributed to that selection. We also carried out ecological surveys at 76 of the 81 dives sites around the island to assess the actual conditions of the attributes indicated as important for site selection. Additionally, 8 of the 12 dive shops in Bonaire provided information on the destinations of dive boats and 400 tourists indicated where they dove and how they accessed sites; this information helped us to develop an index of dive site use from boat and shore dives.

Fish- and coral-related attributes were key features affecting dive enjoyment. Divers appeared to be able to perceive differences between sites in the true condition of biological attributes whereas the perception of physical environmental attributes was not empirically validated. Finally, biological and environmental features influence the distribution of boat and shore divers respectively, across dive sites in Bonaire.

Understanding the relationships between perception, reality and use of dive sites is a useful tool that allows the identification of specific attributes that can become the focus of management.

**FISHING AND CORAL LOSS;
AGENTS OF CHANGE WITHIN REEF FISH COMMUNITIES**

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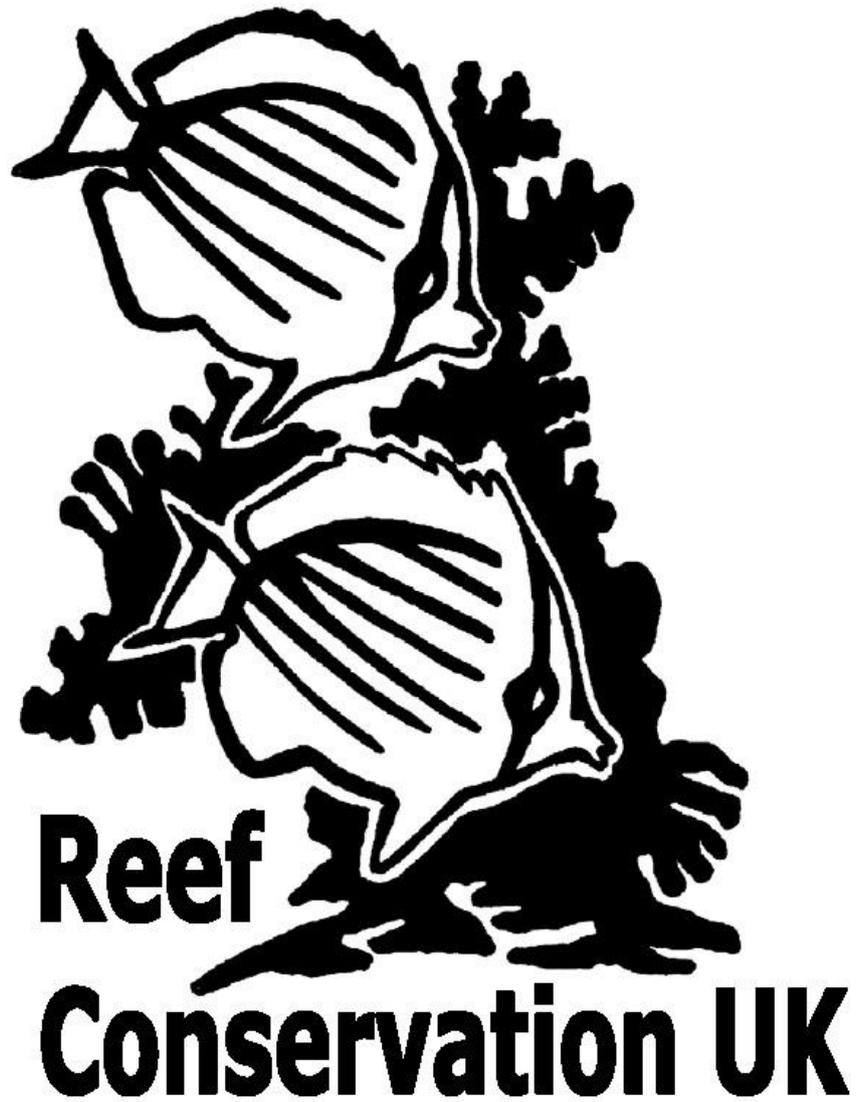
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Over exploitation and habitat degradation are two of the major drivers of change in ecology. We investigated how reduced exploitation of fish stocks and loss of coral due to bleaching and COTS outbreaks have affected the fish communities on remote Fijian reefs.

Using a combination of multivariate techniques and path analyses we demonstrate that obligate coral feeding specialists and coral dwellers have declined as a consequence of reduced cover by *Acropora* corals. An associated decline in habitat rugosity has resulted in reduced abundance of small bodied territorial herbivores. In contrast, reduced fishing pressure and increased algal cover have contributed to increased abundance of piscivores and large bodied roving herbivores. Direct and indirect effects of both fishing and coral loss on fish are stronger when testing their influence of individual species, rather than functional groups.

This suggests interactions between fish and their environment are more discernable at species level, and questions the utility of using functional groups when searching for trophic cascades and pathways in complex systems such as coral reefs.

Fishing continues to have an influence on Fijian fish communities, however the over riding agent of change is habitat loss. The importance of coral loss mediated by climate change is expected to have an increasing contribution to fish community dynamics, particularly in remote locations or where the influence of fishing is waning.



Poster Presentations

MARINE RESOURCE DEPENDENCE, RESOURCE USE PATTERNS AND IDENTIFICATION OF ECONOMIC PERFORMANCE CRITERIA WITHIN A SMALL ISLAND COMMUNITY: KALEDUPA, INDONESIA

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Marine resources in the Wakatobi Marine National Park, Indonesia, are heavily relied upon for food, raw materials and income. Most marine ecosystems in the region are regarded healthy, but there is concern over the rapid deterioration of some of the more accessible areas of reef, mangrove and seagrass. Several management initiatives have been attempted, with little success.

A major reason why past conservation management initiatives have failed to reach their goals is lack of compliance of local communities to management rules and regulations. This is due largely to actual, perceived, or expected, economic losses to communities utilising natural resources for their own sustainability. Hence a key role of management should be to maintain or improve the economic status of local people.

The development of a simple series of economic performance criteria, i.e. testable parameters through which changes could be identified would allow economic status to be assessed. If appropriate methods can be developed, values generated could be used to implement economically and ecologically sound management practices with stakeholder support. To work towards this aim we need to understand local resource use patterns and economic importance, quantify local dependence, and describe existing livelihood strategies.

This study used the example of the Kaledupa sub-district, Indonesia, to provide a detailed case study of a small island community with high natural resource dependence. The study details natural resource use patterns and the extensive local complexities that must be understood for any chance of management success, it also highlights the importance of marine resources to the local economy. A series of potential economic performance criteria were developed which could be used in the development of appropriate management plans that aim to maintain ecological wealth and develop sustainable utilisation, whilst maintaining or improving the economic status of local user groups and maintaining local participation and support.

A COMPARISON OF THE HABITAT STRUCTURE AND ECOLOGY ASSOCIATED WITH THE COLD WATER CORAL REEFS AT THE MINGULAY REEF COMPLEX (OUTER HEBRIDES) AND THE SULA RIDGE REEF COMPLEX (NORWAY)

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The presence of cold water corals has been identified in a range of latitudinal, hydrodynamic and bathymetric settings. The study presented here involved the application of side scan sonar data and Remotely Operated Vehicle and manned submersible camera footage to establish the similarity of two relatively shallow (~150 - 320 m) aphotic reefs, one at Mingulay in the Outer Hebrides of Scotland, the other the Sula Ridge Reef Complex on the Norwegian margin.

The results of this study suggest similar habitat structure at these sites with a characteristic pattern of background sediment overlain by coral rubble and topped with dead and living coral framework, dominated by *Lophelia pertusa*. Similar proportions of each habitat were recorded within a mapped area at the 2 sites. Ecological assessment also suggests analogous distinctive ecological assemblages may be associated with the individual habitat types recorded at both sites. A tentative estimation of the biodiversity showed that the diversity at the Sula Ridge Reef Complex may be higher than that recorded at Mingulay, but the relative difference between species richness on and off the coral framework seems not as high as expected. This may partly be the result of the limited quality of some of the video data, and of the simplicity of the methodology applied.

Anthropogenic activities can have detrimental impact on cold water coral reefs. Trawling, oil exploration and ocean acidification are all potentially destructive. However, video footage studied in this project did not contain evidence for physical destruction. This led to the suggestion that wider scale studies with a regular sampling period are needed to fully assess impacts. The importance of finding indicators for ecosystem stress, such as indicator species was also noted in order to optimise management of cold water coral reef ecosystems.

ASSESSMENT OF THE GREAT ASTROLABE REEF IN THE KADAVU ISLANDS, FIJI

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Following on from the work conducted by Coral Cay Conservation (CCC) in the Mamanuca Islands as part of the Fiji Coral Reef Conservation Project (FCRCP), CCC were engaged in 2005 to assist in coral reef assessment and management in the Kadavu Islands.

Fieldwork commenced in March 2006 using a quantitative version of CCC's baseline survey technique. Surveys concentrated on the fringing, lagoonal and seaward facing reefs of the Great Astrolabe Reef in the northern part of the Kadavu Island archipelago.

A total of 340 survey dives were completed at 77 survey stations for three main reef types at four depth bands. Live hard coral cover was considerably higher on outer barrier reefs than on the other two reef types, which did not exceed 10% at any depth band for fringing or inner barrier reefs. Comparison between reef types for selected reef fish families indicated that densities were generally higher on barrier than fringing reefs. Highest densities of giant clams, octopus and edible sea cucumbers were recorded on fringing reefs. Lower densities of long-spined sea urchins were observed in comparison to the 'Coral Coast' region of Viti Levu. Very few Crown of Thorns seastars (*Acanthaster planci*) or Triton Trumpet shells (*Charonia tritonis*) were recorded for all reef types.

The results indicate that the coral reefs in the region are generally in very good condition, particularly for seaward facing slopes of the main ribbon reef, which are of high ecological importance with a diverse and abundant coral reef community. Low-level local anthropogenic impacts were seen on lagoonal and fringing reefs. However, if considerable development occurs in northern Kadavu, these impacts are likely to increase in both distribution and intensity. A number of recommendations were made for the prudent future management of the marine environment of northern Kadavu.

**MOHÉLI MARINE PARK, COMOROS:
LESSONS LEARNED IN MPA CO-MANAGEMENT**

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Mohéli Marine Park (*Parc Marin de Mohéli, PMM*) was the first Marine Protected Area (MPA) to be established in the Comoros in 2001. Initially regarded as a model for co-management of marine resources, PMM is now operating at a vastly reduced capacity following an end to external funding sources.

An assessment of current perceptions of local stakeholders of PMM was recognized as an essential first step in rebuilding its capacity and effectiveness as an MPA. This study aimed to ascertain stakeholders' current perceptions of PMM, using focus group interviews to evaluate six key parameters: (1) basic awareness, (2) value, (3) effectiveness, (4) environmental threats and solutions, (5) stakeholder roles and responsibilities and (6) future aspirations and expectations.

It was apparent that most local communities were aware of the importance of PMM, but felt that it had failed to include their needs or consider their input in its management. Concern was expressed for the lack of sustainability or alternative livelihoods; inequitable distribution of benefits; exclusion of women; continuing environmental threats and a concurrent lack of enforcement of regulations.

The key recommendations to arise from this work were: (1) ensure sustainability through effective financial planning and promotion of low-cost, appropriate management techniques; (2) mobilize local communities to create a truly co-managed PMM; (3) ensure tangible benefits to local communities through realistic alternative livelihood options, particularly for fishers; (4) ensure equitable sharing of benefits and awareness of PMM, (5) involve women in the management of PMM, they are the primary local educators and motivators for future generations; (6) inform law enforcement officials and members of the justice system to ensure understanding, respect and enforcement of PMM regulations.

This study was part of the project: Operation Mohéli: Linking Conservation of Marine Flagship Species with Sustainable Development, supported by a Future Conservationist Award from the BP Conservation Leadership Programme and conducted by C3 in collaboration with PMM and AIDE.

IS OVERFISHING A THREAT TO DIEGO SUAREZ BAY'S ICHTHYOFAUNA?

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The coral reef ecosystems of developing countries are fundamentally recognised for their complex roles within both the economic and social stability of their coastal communities. Ever depleting land based natural resources within the coastal provinces of Madagascar have caused the fragmentation of many inland settlements. The resulting pressure on nearby shore-based populations has led to an increase in unsustainable fishing practices and a resulting desolation of fish stocks. Reduced stocks of target commercially important species have also caused artisanal and traditional fisheries to 'widen their nets' in order to include species that were previously not commercially viable. Antsiranana; a province in the far north of Madagascar is a region with a high coastal area to province ratio, within which many indigenous populations rely on arable farming techniques alongside subsistence fishing as a result of the availability of fertile soils and their proximity to the coast.

Diego Suarez Bay is situated at the heart of the Antsiranana Province; it is unique both in terms of its geographical and topological attributes. This combined with varying degrees of anthropogenic activity within the bay lead to highly heterogeneous marine ecosystems. This paper evaluates the results of an eighteen month census of the ichthyofaunal composition, distribution and abundance within Diego Suarez Bay. Underwater visual census techniques were used to determine the quantity and dispersal of individual fish species across Diego Suarez Bay. Spatial distribution of ichthyofaunal biomass and their relative vulnerability are discussed in relation to any associated declines in fish stocks. Results highlight a number of areas of high diversity and potential biological 'wealth' within the bay and their possible future uses in both tourism and commerce are discussed.

INVESTIGATING REEF SOUND

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Coral reefs are noisy environments. Snapping shrimp, rasping urchins and croaking fish are packed into a matrix of scleractinian corals, while abiotic sources of sound: rainfall, swell and breaking surf, add to their ensemble to produce a broadband 'crackling' noise - audible to humans - which emanates from the reef, broadcasting information far out to sea.

My project looked into exploring this reef sound around the Las Perlas Archipelago in Panama. I recorded sounds propagated by eleven reef sites and looked for associations between this broadcast sound and resident reef fish communities. A range of ecological factors (including rugosity and benthic data) which could help explain reef sound were also examined. Multiple regression analyses allowed identification of the ecological predictor variables that best explained the sound produced by each site.

Each reef site produced a sound profile that was specific to that particular site, with variation in noise intensity explaining over 90% of this site disparity. Comparison of sound intensity with reef factors showed it correlated positively with the total number of fish at the site, and in particular, the abundance of *Stegastes flavilatus*, a commonly occurring and highly soniferous damselfish that dominated the reefs.

The two best predictors of sound were the number of fish and the coral diversity: combined, these were able to explain 97% of site variance in sound. Passive sound recording has the potential to be an invaluable conservation tool for future remote sensing and biomonitoring of reefs: in ten years time a two minute hydrophone recording could be used to predict reef health and fish numbers, offering an efficient alternative to diver surveys.

We also constructed a visual map of sound intensity across the archipelago, emphasising the importance of sound for larval recruitment. The study raises the issue of marine noise pollution, and its impact on reefs.

**DOES AN INCREASE IN TURBIDITY PROTECT REEFS FROM CORAL BLEACHING?
CASE STUDY: DIEGO SUAREZ BAY, NORTHERN MADAGASCAR**

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As a result of recent trends in global climate change causing both elevated sea temperatures and solar radiation, Coral bleaching is considered to be a major threat to coral reefs worldwide. The effects are thought to be augmented, however, when a reef system is under pressure as a result of anthropogenic stressors such as eutrophication, overfishing and sedimentation. In regions subject to such stresses, bleaching is often high with low rates of coral recovery. However recent studies indicate that the effects of sedimentation may be acting synergistically to buffer the deleterious effects of high irradiance, thus increasing the reef's ability to survive conditions that would otherwise result in a potentially fatal bleaching event.

This paper presents the findings of a study into the health of reefs in Diego Suarez Bay following the 2005-bleaching event and compares the recovery of corals subjected to varying levels of suspended sediment. The extent of the bleaching and recovery of corals across the five study sites was assessed, relative to both coral community structure and biophysical fluctuations. Results highlight a correlation between sites of low coral mortality and high levels of sedimentation indicating that high levels of turbidity within the most anthropogenically affected sites may be offering some protection from the negative effects of summer irradiance and an increase in sea surface temperature.

REDUCING THE IMPACT OF THE MARINE ORNAMENTAL TRADE ON CORAL REEF ECOSYSTEMS

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At least 10 million invertebrates are traded every year for the marine aquarium industry including several hundred thousand sabellid (fan worm) polychaetes. The impacts of this trade can be significant as many sabellids are attached to the coral substrate; consequently removal can damage both the worm and surrounding habitat. In addition, many species are broadcast-spawners, requiring high adult densities for fertilization and so are vulnerable to over-exploitation. This project aims to firstly develop a low-tech system of aquaculture that can be implemented within the resources of exporting nations. This has the potential to provide significant long-term environmental and economic benefits to these stakeholders. Secondly, a full understanding of the UK trade in polychaete species is required to assess potential impacts now and in the future and inform sustainable collection levels.

Aquaculture is important in the conservation of reef habitats, but artificial fertilization in sabellids has had very limited success. Utilising their excellent regenerative powers we aim to produce new 'individuals' from those collected. *Sabella pavonina*, native to the UK, was used as a model to optimise and quantify the regeneration process. Whole worms can be cut into halves, quarters or eighths of the overall length (collar segment to the pygidium) with significant survivorship and 90% regenerating fully (crown or posterior segments) within four weeks. Regeneration in three popular tropical sabellids confirms that they can also regenerate fully within 4 weeks, mortality is minimal and the process does not differ between species.

The assessment and identification of species most frequently imported to the UK will be approached through collaboration with TMC (Tropical Marine Centre) Ltd, a MAC (Marine Aquarium Council) certified importer in the UK and aquarium retailers. Information will inform the trade and identify species at risk from over-collection, as well as direct any future management schemes.

SEAGRASS FISHERY RESOURCE VALUATION: A CASE STUDY FROM INDONESIA

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Inshore fisheries such as those from seagrass beds are currently suffering unprecedented levels of exploitation, whilst these and other habitats are becoming increasingly threatened by anthropogenic activities. Unsustainable practices often result from fishers, stakeholders, managers and industry having limited appreciation for the economic value of a habitat, and the potential monetary benefits of effectively managing that it.

This poster describes how placing a monetary value on the standing stock of a seagrass fishery using ecological and socio-economic data can provide information pertinent to habitat management.

We determined that seagrass habitats are a vitally important fishing resource and calculated that the mean value of the fisheries resources of unmanaged seagrass beds is US\$ 1072 ± 430 ha⁻¹. Modelling of our locally determined values indicates that MPA management and fisheries spillover could significantly increase the value of fisheries resources. Placed into a wider context we estimated that unmanaged seagrass fisheries resources in Indonesia are worth approximately US\$3.2 billion to the nation.

Our study demonstrated the potential economic benefits of a small MPA on the value of a fishery standing stock, and we concluded that the provision of small-scale financial value estimates for natural resources can provide vital information for local and national marine management planning decisions.

EUROPEAN TRADE IN CORALS FROM 1996-2005

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Keywords: coral trade, marine ornamental, Europe, CITES.

In 2003, 1.5 - 2 million people were believed to keep marine aquaria. The main destination markets were the United States, European Union (EU), Japan and Canada. This trade, involving the harvest, sale and use of live marine animals for display in aquaria, has now become a multi-million dollar industry.

The international legal trade in all stony corals, including live rock has been recorded since their listing on Appendix II of the Convention for International Trade in Endangered Species (CITES) in 1985. This convention requires trade in all species listed to be accompanied by an export permit, providing a mechanism to regulate international trade. In addition, the EU also requires import permits to be issued for species listed on Appendix II entering the European community.

This paper focuses on trade in live stony corals reported as imported into the EU between 1996-2005. Trends in the trade are analysed in terms of volume, species traded and their geographical origin. Over the study period, approximately 230 species of corals were imported into the EU with trade volume estimated to have increased from 140,000kg in 1996 to 450,000kg in 2005. Recent data is also presented examining trends in the contribution of corals from the wild and from mariculture.

The harvest of coral reef organisms can potentially have long-lasting effects on the structure and function of coral reef ecosystems, due to their vulnerability to overexploitation. The implications of the trade in certain coral genera are discussed in relation to natural history characteristics and shifting proportions of certain coral genera contributing to the trade.

This analysis is, to our knowledge, the first to focus on the trade of live coral into the European Community over 1996-2005 and to present the recent contribution of mariculture to this trade.

NOTES

The RCUK Organising Committee would like to thank everyone for participating in the RCUK 2007 Annual Meeting.

We hope you have found this a valuable experience in continuing to promote multidisciplinary conservation, public awareness and education about coral reefs through bringing together fellow UK reef workers and interested parties.

The **10th Annual Meeting of RCUK** has been an important anniversary that reflects the successes over the past 10 years, aptly leading us into the International Year of the Reef 2008. The meeting emphasises the importance and value of communication and information exchange as a powerful tool, to assist in the global fight to conserve the world's reefs and associated ecosystems.

The organising committee would like to invite everyone to join efforts in promoting coral reef awareness and education through their respective networks, helping to make RCUK's contribution to **IYOR 2008** a valuable one.