

Australian Coral Reef Society

Newsletter

Number 42, February 2013

A society promoting the scientific
study of Australian coral reefs



Australian
Coral Reef Society

Editorial

Dear Members,

Welcome to the 42nd edition of the Australian Coral Reef Society's annual newsletter. 2012 saw a new president take the reins and a fresh group of new councillors elected. With membership numbers up again in 2013 and the planning for our annual conference starting, the Society has begun a great year!

New and old faces were seen at our research stations, which continue to accommodate our many needs with new facilities and innovations to reduce carbon footprints.

The role of bacterial behaviour in structuring coral-bacteria interactions, the sensory system of elasmobranchs, epigenetic acclimation to increasing sea surface temperatures in a coral reef fish and the role of multiple climate change stressors on the early life history and reproductive stages of coral reef fish are a taste of the findings presented by student award winners at the end of the newsletter.

Coming off the back of a great turn-out at the ICRS in Cairns, and an increasing number of high profile coral reef researchers working within Australia, 2013 is likely to be a watershed year for coral reef research.

We are keen to hear your ideas, opinions and stories so don't hesitate to contact the Society if you would like to contribute to future ACRS newsletters or submissions.

David Feary

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President's Message

2012 has been an exceptionally busy year for the Society, largely in response to two national events. First, the Commonwealth government published its plans for an extensive marine reserve network that included a number of coral reef areas including the Coral Sea. The consultation process for the reserve network has been extensive and the ACRS responded to four reef-related consultations. Having now read the Report of the Director of National Parks on the consultation, I am pleased to see that a number of our recommendations are visible and will be borne in mind during the management planning activities to follow in 2013.



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The second major event of 2012 was the grave concerns expressed by UNESCO on development plans that are likely to affect the health of the Great Barrier Reef. The report has placed an international spotlight on planning processes and the need for strategic assessments for development. Recently, the Queensland government solicited feedback on their Ports

Strategy for the GBR. The ACRS submitted a response arguing that all options should be considered including abandoning plans for potential ports in environmentally sensitive areas, and supporting the proposed plan for a state-wide view of port requirements rather than planning on a case-by-case basis. The Great Barrier Reef Marine Park Authority published their Biodiversity Conservation Strategy which included a framework for action. Again, the ACRS provided feedback and will continue to do so when the opportunity arises. The ACRS also provided a submission on the proposed Great Keppel Island port development.

Contributing to the management consultation process has been time consuming but represents an extremely valuable role for the Society. I'd particularly like to thank the members of Council (both pre and post the 2012 elections) and Society Officers who've work so hard on these in the last 12 months. The submissions can all be downloaded on the ACRS website.

Of course, one of the most enjoyable events of 2012 was the International Coral Reef Symposium in Cairns and I'd like to express my thanks to Terry Hughes and his colleagues for putting on an outstanding meeting. The ACRS maintained a booth at the ICRS and raised funds by selling a variety of merchandise. I'd particularly like to thank Naomi Gardener and Maria Gomez-Cabrera (K-le) for all their hard work organising this and to all the volunteers that helped staff the stand. The International Society for Reef Studies (ISRS) meeting was so successful that we are currently in dialog with the ISRS about co-organising a future ACRS meeting. Our next ACRS meeting will likely take place in September 2013 in Sydney. We'll keep you posted.

The Society has done pretty well in 2012 and its membership now stands at 224 which is great. Financially, we have maintained our cash flow despite not having our usual annual meeting, due

in part to a donation from Queensland Industry Seafood Association in return for some advice provided by members of Council.

The website continues to be a useful source of information and I'd like to thank Ross Hill for all his work as webmaster. We've had scientist commentaries from Peter Sale, Laurence McCook, myself, Pat Hutchings, and a new one will be available shortly.



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I'd particularly like to acknowledge all the hard work of the officers (John Pandolfi, ex-President), David Booth (Vice-President), Naomi Gardener (Treasurer), Chico Birrell (Secretary), and Anna Scott (Membership Manager). Many councillors also contribute greatly and I'd particularly like to thank David Feary for creating this issue of the Newsletter; Ulrike Siebeck and Andrew Hoey for judging the 2013 student awards; Justin Marshall, Chico Birrell, Alyssa Marshall, David Booth, Maria Gomez-Cabrera, Selina Ward, John Pandolfi, and Brigitte Sommer for their work on consultations and reviews.

Although the ACRS Council is very active, I'd like to emphasize the opportunities for members to get actively involved in ACRS business. Next year promises to be another busy one for consultations and we'd welcome expressions of interest from members who feel that they've something to contribute. The pool of expertise on Council is not limitless (!) so we'd benefit strongly

from input from the wider membership. I'd also like to remind everyone that they are free to submit their personal views to government consultations and in this way we can all play a role in shaping policy to the benefit of coral reefs.

On behalf of the ACRS I'd like to wish everyone a Happy New Year for 2013 and I look forward to seeing you all at the next annual meeting.

A handwritten signature in black ink, appearing to read 'Peter J Mumby'.

Prof Peter J Mumby

ACRS President

Society News

Your ACRS council

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MINUTES - 2012 AGM

Chico Birrell

25th of May, 17:30hrs, Seminar Room, Australian
Topical Science and Innovation Precinct, Building
145 James Cook University, Townsville.

Chair: John Pandolfi

1) Apologies: Ian Poiner, Lynnath Beckley,
Rachel Pears, Pat Hutchings, Carden Wallace,
Andrew Chin, Kristin Keane, Zena Dinesen, Ross
Hill, Clive Wilkinson

2) Members present:

1	John Pandolfi	j.pandolfi@uq.edu.au
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24	David Wachenfeld	david.wachenfeld@gbmpa.gov.au
25	Peter Mumby	p.j.mumby@uq.edu.au

3) Minutes of last meeting motion to accept by
John Pandolfi seconded by Andrew Hoey

4) Business arising from last meeting

5) President's Report

Presidents Report ACRS AGM 2012

Thank you all for coming to this year's ACRS AGM.
As you know our Society plays a vital role in two
ways: mentoring and nurturing the next
generation of Australian reef scientists as
represented by our student membership, and as
an advisory role for government and other
agencies interested, and with a stake, in
maintaining and preserving coral reefs.

We are indebted to the dynamism and energy of
young Australian reef scientists and
conservationists and it is great to see the number
of students that ACRS continues to attract. Thank
you for being here!

Membership is very healthy again this year.
However, I have noticed that there are still a
significant number of students and post-docs
working on coral reefs who are not ACRS
members – please encourage the people working
in your lab to become members and let them
know the substantial benefits that go along with a
very small membership fee.

Thanks for excellent work and support over the
year:

Peter Mumby	Vice president
Justin Marshall	Immediate Past President
Naomi Gardner	Treasurer
Chico Birrell	Secretary
Selina Ward	Conference organiser (at Sunshine Coast)

Ross Hill Web-master (help from
Diana Kleine)
David Feary, Joe Newsletter wranglers
Pollock, K-le Gomez

All councillors

The University of Queensland, James Cook
University and the ARC Centre of Excellence for
Coral Reef Studies for technical and logistical
support as well as financial support.

2012 ACRS Student research awards:

Terry Walker Award: Jessica Tout (UTS) “The role
of bacterial behaviour in structuring coral-
bacteria interactions”

Danielle Simmons Prize: Sarah Van-Eyk (UQ)
“The sensory system of elasmobranchs”

ACRS Award: Heather Veilleux (JCU) “Epigenetic
acclimation to increasing sea surface
temperatures in a coral reef fish”

ACRS Award: Gabrielle Miller (JCU)
“Intergenerational effects of increased CO₂ on a
reef fish”

Thanks to Pat Hutchings and Zena Dinesen for
spearheading the selection committee.

Sunshine Coast 2011 ACRS Annual Conference –

The annual conference in Maroochydore was
another stunning success, brought about through
the leadership and organizing skills of Selina
Ward. Sponsors included the Southern Cross
University’s (SCU) Marine Ecology Research
Centre, the Great Barrier Reef Marine Park
Authority (GBRMPA), SCU, and UQ. Thanks also
to Quicksilver for 2nd prize sponsorship for
student presentations (see below).

Some highlights were:

1) The inaugural auction of a perpetual ACRS
lifetime membership, which went to Lawrence
McCook,

2) In Maroochydore we had a dynamite list of
keynote speakers:

Prof Terry Hughes	Coral reefs and climate change
Prof Hugh Possingham	Conservation of coral reefs
Dr Katharina Fabricius	Anthropogenic disturbances on coral reefs
Dr Scarla Weeks	Satellite oceanography of coral reefs
Dr Morgan Pratchett	The effects of climate change on coral reef fishes and fisheries

3) Public forum held on Saturday night, which
invited a mix of scientists, managers, and
industry leaders to address the question:
“How would you spend \$100 million to best
improve resilience of the reef?”

ACRS supported 18 student travel awards to
attend the Coffs Harbour conference -
congratulations to all of the student recipients of
these awards. Thanks to students and
supervisors who got students to the conference.
Great to spread it around Australia. Thanks again
to Selina Ward for a superb job of organising with
team Ross, Uli, Naomi, Emily, Andy and others I
may have forgotten.

Student Prizes for presentations:

1st - *Vicki Harriott Prize* for 2010 (a cheque for
\$500.00) for the best student
presentation was awarded to Rebecca Lawton of

the ARC Centre of Excellence for Coral Reef Studies at James Cook University for her paper Schmidt-Roach et al. (2012) *Geographic variation in resource use by specialist versus generalist butterflyfishes*. *Ecography*, 35, 566-576.

2nd - Fantasea Foundation - Prize of 7 days access to Reefworld at Hardy Reef for a team of four researchers, including two overnight stays, was awarded to Melania Trapon, also of the ARC Centre of Excellence for Coral Reef Studies at James Cook University, for her joint paper Pratchett, Trapon et al. (2011) *Recent disturbances augment community shifts in coral assemblages in Moorea, French Polynesia*. *Coral Reefs* 30, 183-193.

3rd - Quicksilver - The third major prize, a trip for two people on a Quicksilver outer barrier reef cruise, was awarded to Yui Sato also of the ARC Centre of Excellence for Coral Reef Studies at James Cook University, for his presentation of 'Drivers of microbial dynamics in the development of black band disease.

4 Research Station prizes (involving 4-7 days' bench fees at the various Great Barrier Reef research stations) in order of merit:

Heron Island Research Station - Andrew Chin

Lizard Island Research Station - Tom Hawkins

Orpheus Island Research Station – Stefanie Pontasch

One Tree Island Research Station - Joanne Bayes

The prize for the best student poster was awarded to Ai Hguyen, while various other book prizes were awarded to Nicola Browne, Alyssa Marshall, Andrew Olds and Tom Bridge.

Our congratulation to these prize winners, and thanks to all the students for their very interesting and high calibre presentations

The ACRS Council is very grateful to the Fantasia Foundation, Quicksilver Connections Ltd, the Research Stations, CSIRO, the Queensland Museum and Russell Kelly (BYO Guides) for generously donating these prizes. Thanks also to Selina Ward for helping to arrange for the donations of prizes.

(Judges for 2011 student presentation prizes: Zena Dinesen, Ross Hill, Naomi Gardner, Andrew Hoey, K-Le Gomez-Cabrera and John Pandolfi.

It's been a busy year for many ACRS folks. What have we been doing aside from conferences?

New ACRS website is functioning well

Thanks to Diana Kleine and Ross Hill with some help from Anna Scott and the IT team at the University of Queensland. In case you haven't checked out the new website it now includes:

- 1) Online membership
- 2) Online conference registration etc.
- 3) Archive of the Societies' activities including recent news and submissions
- 4) A place to go for tax deductible and other donations

Letters and communications

Public engagement and awareness increased - letters re oil spills, fisheries issues. Important for everyone to do!

Submissions: Just a reminder that a list of our recent submissions is kept up to date on the ACRS website. Some of our recent submissions over the past year included:

2012

[ACRS comments on proposed Coral Sea Marine Reserve: current proposed zoning omissions](#)

[ACRS submission on the Commonwealth marine reserve network proposal and draft Marine](#)

[Bioregional Plan for the Temperate East Marine Region](#)

2011

[ACRS submission to inquiry into Australia's biodiversity](#)

[ACRS submission on the independent scientific audit of marine parks in New South Wales](#)

[ACRS endorsement of developing Australia's national system of marine reserves](#)

[ACRS submission to Safe Work Australia regarding the model Work Health & Safety Bill in relation to scientific diving](#)

A submission to the Department of Agriculture, Fisheries and Forestry on the 2011 draft 'National Plan of Action for the Conservation and Management of Sharks

We also responded to a request from the Queensland Seafood Industry Association to evaluate a Draft EIS by XTRATA on their port developments at **BALACLAVA ISLAND - Fitzroy River Estuary**, Keppel Bay, QLD.

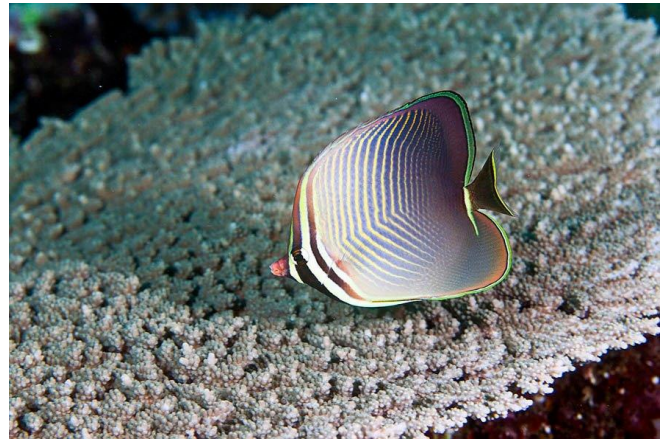
We continue to evaluate government management and fisheries plans and this has become one of the core activities of Council on behalf of membership – we invite help or guidance from our membership on this very important aspect of ACRS's activities.

ACRS continues to participate in Science & Technology Australia, the Australian science advocacy network that hosts the annual Science meets Parliament event. We hope to send two Councillors on behalf of the ACRS again this year – it's a bit late this year – 17/18 September.

Just a reminder to the membership that ACRS now has Tax deductible status

Thanks to Pat and Peter and Anna. So please, encourage others to donate. You can choose to

put tax-deductible funds into a specific fund or leave it unspecified for Council to decide where to deploy the funds. However, The Vicki Harriott fund remains a non-tax deductible contribution. Presently it is possible to donate either online or through Justin, or John.



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CoralWatch book

The Bahasa version has now been translated. Delegation to Indonesia occurring now to launch the newly translated book

Thanks for putting the ACRS 2011 AGM event together:

Rebecca Lawton, Shane, Naomi Gardiner, Andrew Hoey.

Thanks to Russell Kelly for being our special guest presenter for tonight.

Announcement of Pat Hutchings for Lifetime Membership

Announcement of Lifetime Membership to Laurence McCook auctioned at the Sunshine Coast ACRS Meeting

Announcement of Pete Mumby as new President of ACRS

Announcement of \$10K award to the Reef Finder by Peter Mumby

Retiring councillors – Pat, Selina, Zena, David W., Laurence M., and Rebecca L.

In remembrance – Pat Mather by Carden Wallace.

In conclusion

Do give your ACRS Council suggestions, do join if not a member and get your friends, students, supervisors, and relations to join. Reefs need as much help as they can get.

6) Election of Councillors results.

New Councillors elected are David Booth, Roger Beeden, Kyra Hay, Ida Fellegara, Andrew Chin, Alyssa Marshall, Kirsty Nash and Joseph Pollock

7) Treasurer's Report and acceptance of auditors.

The treasurer's report was presented by Naomi Gardiner. Motion to accept was made by Laurence McCook, seconded by Chico Birrell

8) Membership

The Membership report was presented by Naomi Gardiner. A motion to accept was made by John Pandolfi and seconded by Russell Kelley

9) Any other business

No specific mentions of other business were made.

10) Introduction of New President for 2013-14

John Pandolfi introduced Peter Mumby as the new ACRS President

11) Concluding remarks

John Pandolfi encouraged all members to seek active engagement in the Society and to encourage others to do so.

12) Presentation by Russell Kelley

Russell Kelley made a presentation to the audience to honour John Pandolfi and also to provide insight into the Reef Finder initiative.

Science Meets Parliament 2013

Naomi Gardiner (JCU) and Brigitte Sommer (UQ) represented ACRS at the 2012 Science Meets Parliament meeting in Canberra, 17-18th Sept. Science Meets Parliament (SmP) is an annual forum run by Australia's peak scientific advocacy body Science & Technology Australia (STA). Some ACRS members may be more familiar with STA's old name of 'FASTS'.



Science Meets Parliament 2012 brought together over 200 scientists from about 60 science and technology organisations. The meeting aims to engage politicians with scientists and vice versa. Day 1 centered on scientific communication workshops with presentations from peak media bodies, scientific policy and treasury advisors, and members of parliament. Day 2 revolved around meetings with parliamentarians, a National Press Club address by Prof Brian Schmidt (2011 Nobel Laureate, astrophysicist), and opportunities to attend question time. Meetings with at least 1 MP are organized for all delegates. Naomi met with Adam Bandt (MP for Melbourne, VIC and Deputy Leader of Australian Greens) and Brigitte met with Senator Lee Rhiannon (NSW Greens Senator). Additional conversations were held with Senator Christine Milne (Greens Senator for Tasmania and Leader of Australian Greens), Senator Larissa Waters (QLD Greens Senator), the Hon Dr. Sharman Stone (Liberal Party MP for Murray, Victoria) and Michael Symon (Labour Party MP for Deakin, Victoria). Follow up emails with additional information about ACRS have

been sent to these members, and acknowledged. Brigitte and Naomi were able to present the role and nature of ACRS to these parliamentary members. As ACRS is actively seeking to better engage with federal and state government policy makers, we sought to highlight the recent submissions ACRS has made regarding marine reserve networks, and the effects of climate change on marine biodiversity. We expressed concerns over expansion of QLD port developments with emphasis placed on the need for due scientific assessment of environmental impacts. Additionally we highlighted the need for data based marine reserve planning and implementation. We also had the opportunity to communicate the latest from our individual research projects.

Science Meets Parliament 2012 was a fantastic event. The workshops were engaging, relevant and novel, particularly for two early career researchers. The forum continues to be an excellent opportunity for ACRS to directly interact with federal government representatives and network with other societies working towards similar goals as ACRS. Parliament house is definitely a whole different world to our normal science day jobs. SmP gave substantial insight into the policy making process and various methods by which scientists can and need to interact with that process.

For more information about Science & Technology Australia see their website: <http://scienceandtechnologyaustralia.org.au/>



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Scientist Commentary

Sustainable seafood from the GBR??

Professor David Booth

University of Technology, Sydney

Much of the scientific research that we conduct on the Great Barrier Reef (GBR) and its biota now focuses on the impacts of anthropogenic stresses. Key stressors include land-based nutrient influxes, climate-change impacts, dredging and fishing pressure. However, few impacts face off scientists directly against those making a living on the GBR, like the effects of fishing.

Management initiatives to ameliorate human impacts seem limited especially for factors such as climate change. For fishing, however, management can have a more direct controlling function. One recent highly visible management initiative is the declaration of the world's largest marine protected area, the Coral Sea marine park. Clearly overfishing is a major impact that this initiative seeks to regulate; while the new protected system may act as a buffer against future climate-change, such benefits are not well-understood. As with the GBR, the Coral Sea MPA will operate on a multiple-zoning basis: highly protected no-take regions, limited fishing zones and less restrictive areas.

So why have a commercial and recreational fishery on the GBR and Coral Sea at all, if they are so risky? There are several arguments for: First, fisheries are part of Australia's food base (e.g., 2009-10 Fisheries value in Queensland was \$323 million, 1/7 of Australia's fish value, although note that Tassie farmed salmon are worth more!!), employ substantial numbers of Australians, and are important exports. Recreational and commercial fisheries on the GBR are worth close to \$200 million each. Fishers add political leverage: they have been important lobbyists for preservation of natural areas

worldwide including the GBR (e.g., Network for Sustainable Fishing, 2010) and get listened-to by Governments. And some funds from fishery revenue help support marine research.

What then are the real risks of fishing on the GBR and can we achieve a mythical sustainable fishery? Risks can be expressed against sustainability criteria. For instance, all export fisheries operating in the GBR Marine Park are assessed under the *Environment Protection and Biodiversity Conservation Act 1999*, with criteria for sustainability including,

1. Status of the stock – risks include lower densities than historical baselines; shorter-term temporal downward trends in stock abundance, changes in biological attributes such as age/growth demographics, sex ratios, etc.
2. Status of bycatch – incidental catch of species with vulnerable life histories; low survivorship of discards. GBR fisheries are generally multi-species with a range of life histories so are especially at risk.
3. Ecosystem effects – detrimental ecosystem effects of removed stock, gear damage to habitat.

Management and assessment of fisheries is often done against large gaps in data. The research needed to fill these data gaps can be cutting-edge, and addresses key ecological concepts such as roles of functional groups (e.g., Mora et al. 2011), effects of physical disturbance, predation, role of spatial closures in fish connectivity (Harrison et al 2012) and (un)natural selection of sex ratios (e.g., http://www.reef.crc.org.au/research/fishing_fisheries/CoralTrout.htm).

What are the roles/responsibilities of ACRS as an organisation, and individual members, in the debate? First, the solid research that underpins management decisions and theoretical assumptions needs to be done by coral reef

scientists, many of whom are ACRS members. Projections of future climate change scenarios and how they might impact fished species and their habitats, can allow managers to build in buffers to their catch allowances. Lobbying for protection of areas, e.g., through Marine Parks and their appropriate zoning, can occur at the organisation level (e.g., ACRS commentaries and submissions: as listed on our website), commentaries made in the media (e.g., blog sites such as <http://theconversation.edu.au>), individual submissions to enquiries, letters to editors, and general involvement in community debate. Members can also take an active interest in scientifically-based consumer seafood sustainability programs (e.g., <http://www.acfonline.org.au/be-informed/oceans-rivers/sustainable-australian-seafood>). Sorry, but many of these activities won't increase your h-index, however you just might help protect our iconic GBR.

References:

- Australian Bureau of Statistics (2012) <http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1301.0~2012~Main%20Features~Fishing~182>
- GBRMMPA (2010) Ecologically sustainable fishing in the Great Barrier Reef Marine Park Position paper 3pp.
- Harrison HB et al. (2012) Larval export from marine reserves and the recruitment benefit for fish and fisheries. *Current Biology* 22: 1023–1028. doi:10.1016/j.cub.2012.04.008
- Mora C et al. (2011) Global Human Footprint on the Linkage between Biodiversity and Ecosystem Functioning in Reef Fishes. *PLoS Biol* 9(4): e1000606. doi:10.1371/journal.pbio.1000606
- Network for Sustainable Fishing (2010) A review of concerns relating to the offshore gillnet fishery in the inshore waters of the Great Barrier Reef Marine Park in relation to the Guidelines for the Ecologically Sustainable Management of Fisheries with recommendations for early intervention. Ed. David Cook, NSF. Publ. Fishers for Conservation, 62pp. http://www.ffc.org.au/Grey_Mackerel.html#latest

ACRS Student Awards

Student Research Awards for 2013

The ACRS supports the research of up to four students each year by the provision of up to four Student Grants. The best proposals received are awarded the Terry Walker Prize of \$2500 or the Danielle Simmons Prize of \$2500. Given Terry Walker's commitment to field studies on Australian coral reefs and cays, this award is to support field studies on Australian coral reefs. Similarly, the Danielle Simmons Prize is to support student field work at Heron Island. The other research grants (up to two) of \$2000 may be used for laboratory and/or field studies relevant to Australian coral reefs. Any student who is currently enrolled at an Australian university and working towards a PhD or MSc on a topic involving research on Australian coral reefs is eligible to apply. Awards may not be used to fund conference attendance, or travel not related to field studies. For further details see <http://www.australiancoralreefsociety.org/student-awards#Research>

Proposals are judged on:

- Scientific merit of proposed research
- Relevance of topic to current Australian coral reef research
- Design of project and progress to date
- Project scope, given the degree to be awarded and applicable resources
- Proposal presentation
- Track and research record of the student (e.g. publications, talks, prizes).

Applications for the 2013 Student Research Awards for 2013 have closed.

The ACRS received almost 50 applications for the 2013 Student Research Awards with all applications being of an extremely high quality.

Congratulations to the successful applicants for the 2013 ACRS Student Awards:

Terry Walker Award (\$2500): Cait Newport (UQ)
"Complex pattern discrimination in the Ambon damselfish (*Pomacentrus amboinensis*)"

Danielle Simmons Award (\$2500): Alyssa Marshall (UQ)
"The grazing impact of common surgeonfish on macroalgal recruits within the coral reef epilithic algal matrix"

ACRS Award (\$2000): Jeroen van de Water (JCU)
"The effect of warming oceans on the immune responses of corals to disease"

ACRS Award (\$2000): Steve Doo (USyd)
"Assessing resiliency in large benthic Foraminifera communities to near future climate change"



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Conference Reports

ICRS 2012

Kirsty Nash



The 12th International Coral Reef Symposium was held in Australia for the first time in 24 years in July 2012. The conference was hosted by the ARC Centre of Excellence for Coral Reef Studies and James Cook University at Cairns Convention Centre, and welcomed 2081 participants from 80 countries, including over 500 students. The pace of the conference was hectic with the many concurrent mini-symposia presenting a wide range of excellent talks covering topics as diverse as Palaeontology, Technologies for coral reef science, Ocean acidification, and Management and monitoring.

The 8 plenary speakers and Jeremy Jackson delivering the Darwin Medal lecture, provided a series of thought provoking and stimulating talks. Highlights included the inspiring message of Geoff Jones that all students should stick to their guns even when the research seemed impossible, and Peter Kareiva's journey from grumpy old man of conservation to a place of hope and new perspectives.

A feature of the symposium was community involvement and awareness. This was kick started by the beautiful delegate badges made by

school children from primary schools in North Queensland, which depicted a variety of marine creatures and themes. The Future Forum aimed at answering the question 'Can coral reefs survive the 21st Century?' recorded by and aired on the ABC provided opportunities for public interest and input.

Celebration and some serious 'networking' opportunities were also provided in the form of a Welcome reception on the first evening, the Poster reception on the second evening and an open air conference banquet on the Thursday. The North Queensland food, wildlife and entertainment made this a stunning evening, which thankfully was not marred by the rain that had been threatening proceedings all week.

The ACRS provided a strong presence at the conference, with a very busy and successful booth in the conference centre that was the focus of many an interesting discussion. In addition, ACRS continued its commitment to supporting students by sponsoring a number of students to attend the ICRS in Cairns through its ACRS Conference Travel Awards. The successful recipients of these awards were provided with funding to cover their registration fee. The 15 student recipients are listed below:

Rebecca Lawton (JCU)
Rebecca Fox (JCU)
Emily Howells (JCU)
Christopher Doropoulos (UQ)
Jacob Johansen (JCU)
Sutinee Sinutok (UTS)
Erika Woolsey (JCU)
Yui Sato (JCU)
Sebastian Schmidt Roach (JCU)
Mary Bonin (JCU)
Brigitte Sommer (UQ)
Jeroen Van de Water (JCU)
Charlotte Johansson (JCU)
Dirk Steenbergen (Murdoch)



Delegates meeting the local wildlife
(www.icrs2012.com)



Poster reception (www.icrs2012.com)



A packed plenary hall (www.icrs2012.com)



Professor Geoff Jones giving his plenary
(www.icrs2012)

Upcoming Conferences

Don't miss out on any of the exciting mix of ACRS conferences coming up over the next 3 years across Australia.

2013 ACRS in sunny Sydney

The 87th Annual ACRS conference will be held in Sydney in August or September. The dates and venue will be announced very shortly. Please keep an eye on our website for further details (www.australiancoralreefsociety.org)

This promises to be a dynamic event.

Get involved

Are e-mails and phone calls alone not quite getting your message across? Do you believe that face-to-face discussions, debate and workshops are essential to share ideas and celebrate successes? Have you ever hosted a party and want to take it to the next level? Then please consider contributing your time and enthusiasm, joining a dynamic committee to help organise the ACRS conference.

Please contact Ross Hill via e-mail ross.hill@unsw.edu.au

ACRS Membership

All ACRS membership application/renewals can now be made online

(<http://www.australiancoralreefsociety.org>).

Please note that the society now offers both Individual and Corporate memberships.

An important incentive is a \$10 reduction for all one year membership applications/renewals made before February 28 – think of it as a gift from the ACRS to thank you for your support, and to complement your New Year resolution to get active about contributing to Society issues.

Don't forget to tell your friends and colleagues.



ACRS comments on environmental management plans

The Society makes submissions from time to time on government plans relating to coral reef management. This is an important role for ACRS, which has some very knowledgeable and experienced members.

Take a look at some of the [comments and recommendations](#) submitted throughout 2010:

Solitary Islands Marine Park Draft Zoning Plan

ACRS submission on the Solitary Islands Marine Park (SIMP) Draft Zoning Plan

Recreational fishing in NSW

ACRS submission on the Parliamentary Enquiry into recreational fishing in NSW

All ACRS members are encouraged to write to federal and state as well as local government on a more regular basis. The voice of the voter is very powerful, even if it does not result in an instant and desired reaction.

All ACRS councillors are happy to provide guidance with such approaches and our President, Peter Mumby has convened a special sub-committee to help in this regard.

Email: j.pandolfi@uq.edu.au

How to get involved and add your expertise to the Society's pool of knowledge:

1. Keep a watch for submissions and opportunities to comment.
2. Send comments to coordinator by email and indicate clearly whether comments are for publication or to raise a query.

The more input we receive the more effective and scientifically sound will be our contribution.

The ACRS website and email list

www.australiancoralreefsociety.org

The ACRS website is the global doorway to your Society. The website contains the latest information on student grants, workshops and conferences, plus Councillor contact details. As submissions are lodged, they too are posted on the website.

The website also contains details on how to subscribe to the ACRS List (in case you are not already on it) and more importantly, a membership form so you can renew your membership and encourage your colleagues to join.

The website acts as a repository for documents and conference material. There are also links to other reef-related sites.

The Email List provides a discussion forum for current issues in coral reef science, and is also the main method by which the ACRS distributes information to its membership. The email list is open to all members and new members will automatically be added to the list once their membership has been approved. Alternatively, the ACRS website contains a link that allows members to subscribe to the email list themselves.

Tax-deductible donations to ACRS

The majority of funds raised by the ACRS go toward supporting the next generation of Australia's coral reef scientists. We support Australian student participation to the annual ACRS meetings and we provide several research grants to PhD students working on the biology and geology of coral reefs.

You can donate to the ACRS in several ways. Tax-deductible donations will be used to support student travel to annual ACRS meetings and student research grants. Presently, 4 student research awards are competed for annually and the two best are represented as the Terry Walker Prize (\$2500) and the Danielle Simmons Prize (\$2500). If you would like for your donation to be use in some other manner consistent with the goals of the Society, we would welcome your input.

Donate to the Vicki Harriott Memorial Student Prize

You can also make contributions to another individual ACRS award, such as the annual Vicki Harriott Memorial Student Prize given to the student with the best presentation at each annual ACRS meeting. Contributors should note, however, donations to this fund are NOT tax deductible.

Book Review - Chico Birrell

Wildlife & climate change : towards robust conservation strategies for Australian fauna edited by Daniel Lunney and Pat Hutchings. Published by: Royal Zoological Society of New South Wales, June 2012; Mosman, NSW, Australia; 207 pages; www.rznsw.org.au ISBN 978-0-980-3272-5-0 hardcopy / ISBN 978-0-980-3272-5-7 ebook

For any ecologists, biologist and conservationists it is a challenge to keep up to date in all topics relevant to the field, thus a book that clearly explains the implications and components of climate change for Australian wildlife, enabling researchers to focus on their individual areas of study, whilst being aware of climate issues is a welcome addition to any library. Clear goals are important to implement robust conservation strategies for wildlife, and changes to the Australian climate are among the largest factors that define the targets.

"Wildlife and Climate Change: Towards robust conservations strategies for Australian fauna" is a book that clearly identifies the multitude of challenges for Australian wildlife and ecosystems as the Climate of Australia changes over the 21st century. The knowledge presented is compiled from a forum of climate specialists intent on clearly identifying the implications for wildlife of the expected changes in Australia's climate, whilst the book also addresses social, economic and political challenges.



© 2011 David Wachenfeld, Triggerfish Images

The transformations expected for Australia resulting from unmitigated global warming include an alarming array of extreme weather patterns such as increased heatwaves, more intense storms, more severe droughts, and more frequent heavy rain events, dust storms, bushfires and heat stress. These trends are already seen over the past 50-100 years.

Many future impacts will be negative for wildlife, such as shrinking geographic ranges, increased fragmentation of distributions, changes in the balance of community interactions (e.g. competition, predator-prey ratios), shifts in geographic range, and increased frequency of invasive species that have potential to change the balance of entire ecosystems, and increased frequency of extinctions.

The challenges that the marine environment, including coral reef communities, will face as a result of foreseen climate change (rising seawater temperature, bleaching events, ocean acidification, increased freshwater and sediment runoff, increased storms) are succinctly explained in four papers. These address the challenges expected for non-coral invertebrate communities and rates of bio-erosion on coral reefs, the challenges for fish communities as a result of bleaching events, the effect of climate on diseases for marine organisms, and the overall

impacts of ocean acidification to the reproduction of marine organisms.

The book is an interesting read for scientists and friends or relatives alike. Beyond focusing on the effects of climate change and the impacts these will have on wildlife the book also contains papers focused on developing robust strategies in social-economic and political contexts, or considerations to increase the success of conservation objectives. Other papers consider the impacts of climate change on a range of wildlife including frogs, corals, invertebrates and fish on the Barrier Reef, bats responding to past climate change, alpine Wombats, and Koala throughout their range. The information is up to date, and the book makes it easy to appreciate the severity of climate change, making it easier and encouraging the reader to set realistic targets in wildlife research or conservation efforts.



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Membership Application and Renewal

ACRS membership can be completed online. You can apply for individual membership, or renew your existing membership at the following website:

www.australiancoralreefsociety.org/apply-individual

Membership types include:

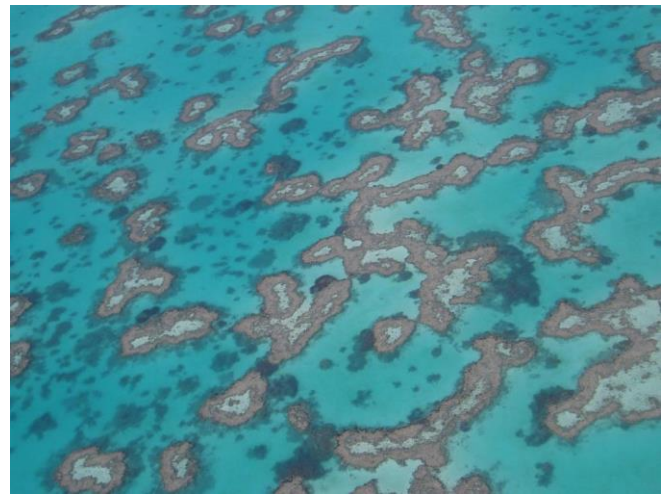
- Full (\$50)
- Student (\$30)
- 5 Year Full (\$200)

Remember: There is a \$10.00 discount on Full and Student single year memberships for applications received between 1 November (of the previous year) and 27 February. Memberships are valid until the end of the calendar year.

When renewing or applying for membership, you can also choose to receive the latest ACRS news by subscribing to the ACRS Email List.



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Corporations can also apply for ACRS membership by downloading and completing the PDF form at the following website:

www.australiancoralreefsociety.org/apply-corporate

ACRS on Facebook

To keep up to date with the latest ACRS activities, you can Like us on Facebook:

www.facebook.com/AustralianCoralReefSociety



Science, Conservation and Management

The Australian Coral Reef Society is the oldest organisation in the world concerned with the study and protection of coral reefs. ACRS plays a key role by promoting scientific research on Australian coral reefs and provides a forum for discussion and information transfer among scientists, management agencies and reef-based industries that are committed to ecological sustainability.

Reef Check Australia

This year our dedicated Board, staff and volunteers have been actively working to build the framework for a continuously growing Reef Check Australia program. Although this has required curbing some on-ground activities, we are confident that this process will allow our programs to grow sustainably, build more opportunities for our dedicated volunteers and create a powerful network for the Reef Check Australia community. We are proud of our accomplishments and excited about plans for the future.

We are incredibly thankful for the support of our volunteers, Board, funding agencies, industry partners and project collaborators. Our program is only successful because of our diverse and dedicated Reef Check champions.

Over the past year, our volunteer teams have surveyed both brand new sites and long-term locations with years of data, reaching 36 survey locations this year. In addition to growing our science programs, we have been seeking more ways to involve the broader community in our programs. Our REEFSearch pilot programs have received amazing support and we will be launching the national program in 2013. Volunteers have also dived in to underwater and coastal clean-up activities, community events and educational outreach.

With much pride (and extensive social media campaigning!) we doubled our staff at the end of the financial year. We welcome our second full-time staff member and long-term volunteer, Jodi Salmond. As our Community Engagement Officer, Jodi will be working extensively on expanding participation in Reef Check programs. As we look ahead, we are thrilled with the passionate people involved in our organisation, the strong partnerships helping to achieve more positive outcomes and the great possibilities. We look forward to sharing our success with you.

Reef Surveys and Data

During 2011/2012 our volunteer teams continued to monitor locations subject to the 2011 Brisbane floods and North Queensland cyclone. Our teams reached 17 sites on the Great Barrier Reef and 19 rocky reef locations in South East Queensland. We added nine new monitoring locations at Heron Island to our list of long-term sites. These new spots help us continue to close the gap on the Queensland coast between Reef Check sites on the Great Barrier Reef and in South East Queensland.

All data is being displayed to the public via our online [Reef Health Database](#). Launched in 2009, this system has been an incredibly important tool for us to share our data with diverse project stakeholders. We continued to work on

developing the functionality and resources for this significant data management and sharing system.



In September 2011 we presented *A comparison of the marine biodiversity of Queensland's tropical and subtropical reef habitats by the Reef Check Australia community monitoring program* at the World Conference on Marine Biodiversity in Aberdeen, Scotland. Results from pooled regional surveys show differences in substrate composition as well as distribution and abundance of fish & invertebrate communities between the two regions.

Dr. Terry Done is also working on finalising a precision study to support the excellent data collected by our trained volunteers. The study examines observer effects of Reef Check volunteers. Results show that differences between observers and subsequent transect deployments are low, with 6.7% of the random variation in hard coral estimates due to observer effects. In summary, we have confidence that observer errors are only minor contributors to the variability among pooled samples at the scales of individual reefs and across many reefs. This means with adequate training and suitable maps, trained volunteers can collect useful broad-scale reef health monitoring information.

Coral ecologist, Dr. Lyndon DeVantier took the time to review Reef Check protocols, investigating how Reef Check surveys can build

on a comprehensive 2010 Sunshine Coast marine biodiversity study. The results guide our efforts to continue strategically monitoring these reef locations and training local volunteers to participate with support from a three year Community Partnership grant from Sunshine Coast Council.

With generous support from the University of Queensland's Biophysical Remote Sensing Group and Heron Island Research Station, we expanded our Southern Great Barrier Reef sites and closed the gap between our established GBR and South East Queensland monitoring locations. The 9 new monitoring sites were selected to represent diverse management and use areas on Heron Reef, including protected Green zones, general use areas and scientific research zones. Reef Check transects were planned to overlap with geo-referenced photo-transects and benthos photos for further validation of Worldview 2 satellite images. This coordinated research trip builds on research conducted by Dr Chris Roelfema and Prof. Stuart Phinn since 2001 and helps investigate synergies between the multiple data collection approaches while contributing to long-term monitoring program for Heron Reef.

Training

Eighteen new volunteers joined the ranks this year. Volunteer training is an essential component of our data collection and community engagement activities, so this year we have focused on improving training for our Reef Check volunteers. This saw the development and implementation of a new Reef Health Surveyor PADI Distinctive Specialty course, online volunteer resources and improved training materials.

We are also planning some additional capacity-building opportunities through a new Team Leader course, helping more qualified divers take

an active role in leading our volunteer teams to action!

Cleaning-up our oceans

In addition to collecting data about marine debris on survey dives, Reef Check has been diving in to take action on this pressing issue. Sixteen out of 36 survey dives in 2011-2012 found marine debris... and we think that's 16 too many.

In February 2012, we partnered with Townsville City Council to implement the first ever Tangaroa Blue clean-up workshop in the area. Our collaborative project introduced the program to the region and ensuring that clean-up efforts are documented in the Australian Marine Debris Initiative to develop solutions to this growing problem. In South East Queensland, we have joined forces with 14 other community groups to run a coastal, mangrove and underwater clean-ups in Moreton Bay. Throughout the year, volunteers collected almost 300kg of rubbish.

We also are working to help reduce rubbish before it enters our oceans. We are continuing to partner with Tangaroa Blue and The University of Queensland's Turtles in Trouble program to share the data collected by our teams under the water to investigate how it relates to their extensive beach clean ups and analysis.

REEFSearch

May 2011 saw the launch of REEFSearch, a new pilot program for snorkelers and divers. This reef identification and observation program makes it easier for more people to get involved in Reef Check activities, as well as increasing understanding and awareness of reefs and reef health issues. The REEFSearch program featured on Tourism Queensland's Best Expedition in the World, with trials on Lady Elliot Island, Magnetic Island and Palm Island. The Expedition also carried out REEFSearches all along the 1,600

kilometer journey up the length of the Great Barrier Reef from May to September 2011. REEFSearch has even gone international, with a trial in Fiji as part of a University of the Sunshine Coast ecotourism project. We are thrilled to have received such enormous support for this program and with growing support and resources; we will be officially rolling the program out in early 2013.



Upcoming developments in 2012/2013

In addition to launching our new REEFSearch program to expand our number of volunteers and locations, we were awarded Australian Government 'Caring for Our Country' funds to establish new Reef Check sites in Great Sandy Marine Park and on the Ningaloo Coast. We're thrilled to continue growing our reef coverage in Australia and helping to fill gaps in reef monitoring and community engagement.

We are also planning to undertake an assessment of long-term monitoring data from Great Barrier Reef sites; find new and meaningful ways to share data collected by our trained volunteers with the public; engage the community in direct actions to protect reef ecosystems through clean-ups and participation in daily conservation activities and train new and current volunteers in reef monitoring methods that support reef & ocean management efforts.

Reef Check Australia

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Email:

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Web:

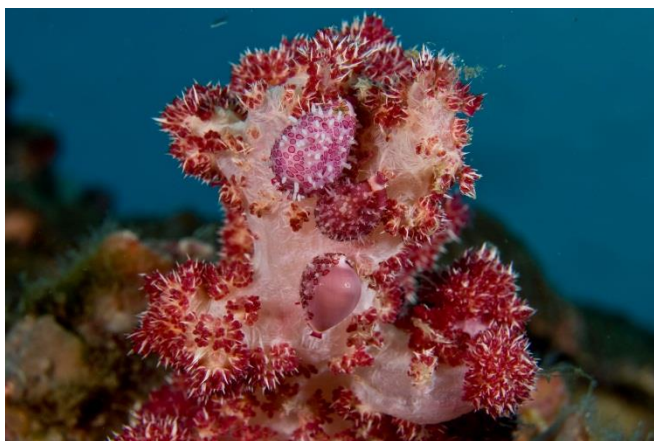
www.reefcheckaustralia.org



Research Station News

National Marine Science Centre

The NMSC celebrated its 10 year anniversary as a research and teaching facility in 2012. During the past decade a total of 182 referred publications (journal articles, book chapters and books) were published by researchers based at the NMSC. Major research projects undertaken during 2012 are detailed below:



Molluscs living in association with other fauna are a primary focus of biodiversity research at the NMSC. Photo: Steve Smith

Threats to Anemones

The causes and impacts of coral bleaching on reef ecosystems have been much researched over the past decade. However, little work has been done on the vulnerability of symbiotic sea anemones, which harbour *Symbiodinium*, which play a key role in helping the host tolerate changing environmental conditions. Dr Anna Scott in collaboration with Dr Ross Hill (The University of New South Wales) evaluated the susceptibility of the symbiotic sea anemone, *Entacmaea quadricolor*, to rising ocean temperatures under different irradiances. Located on Australia's east coast, the Solitary Islands provided an ideal

location for investigating these cnidarians in a region highlighted as a hot-spot for climate change. This project addressed knowledge gaps and highlighted the potential ecological impacts on subtropical reefs where *E. quadricolor* dominate the reef substrate and provide essential habitat for anemone-fish.

Sustainable Seaweed Aquaculture in South-east Asia

Dr Symon Dworjanyn has been working with colleagues from Hasanuddin University and Mars Symbioscience in Indonesia on ways of making seaweed aquaculture more profitable and sustainable. The team have isolated and quantified growth stimulating hormones called cytokinins from seaweed processing waste. They are running trials to test whether these waste products boost the growth of rice and cocoa seedlings. If they show promise, it is hoped that seaweed farmers in rural coastal Indonesia will be able to produce a profitable fertiliser product to enhance their income, reduce poverty and contribute to food security in the region.

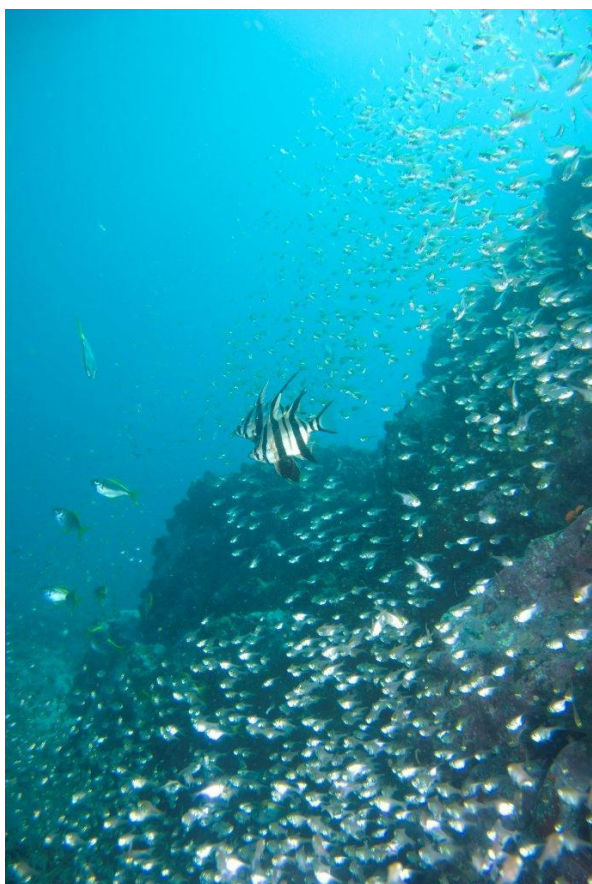


Our teaching program provides opportunities for students to observe and interact with marine life in situ. Photo: Steve Smith

Sustainable fishing

Dr Steve Purcell received funding from the NSW Saltwater Recreational Fishing Trust to oversee a PhD project examining the fisheries biology and ecology of mangrove jack in northern NSW. Toby Piddocke's PhD project is using acoustic tagging

to monitor the movement of mangrove jack, which will help to better refine management plans for the species.



The offshore Solitary Islands support a diverse and abundant fish fauna. Photo: Steve Smith

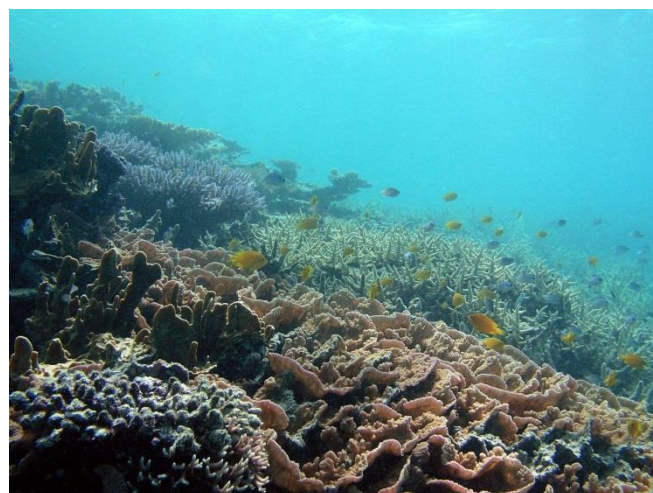
The ecology and global importance of subtropical reefs

Assoc Prof Steve Smith and his team continued their work on the long-term evaluation of changes in biodiversity of near-shore reefs throughout the Solitary Islands Marine Park. This work was part of a larger body of research by marine scientists across Australia that identified subtropical reefs as critical habitats in a changing climate. Work was done on the effects of rising sea levels on rocky shore communities (with Jaqueline Thorner) and patterns of spatial and temporal variation of sub-tidal mollusc assemblages (with Matt Harrison). This work on natural and anthropogenic changes in near-shore reef communities will help predictions on the

future structure of marine communities in this important region.



Some of the new Aquaculture tanks at the NMSC. Photo: Carol Smith



Wistari Reef vista 2. Photo: Steve Smith

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Kimberley Marine Research Station

Located on the mainland Kimberley coast 200km north of Broome, the Kimberley Marine Research Station (KMRS) at Cygnet Bay is the only fully-operational marine research facility in WA's far north and is Australia's only privately funded and owned marine research station. As a subsidiary of Cygnet Bay Pearls, KMRS operates year-round and is home to a complete team of personnel representing over 65 years' worth of local marine experience and expertise.



Green coral gametes at KMRS, March 2012.

Photo: P Strain

2012 has been a busy and exciting year for the KMRS. With the Station turning 3 this year, we have been thrilled to see an influx of research interest in the region coinciding with the first significant State & Commonwealth government funding dedicated specifically to marine research in the Kimberley. KMRS has hosted over 30 teams on-site in 2012; double that of 2011 which in turn was triple the previous years' total. The KMRS newsletters completed their first full 12 month cycle covering life at the Station and our communications and supporters network has grown considerably over that time. To subscribe, please join our mailing list through our website www.kmrs.com.au.

Highlights in 2012 include:

- KMRS shortlisted as a finalist in the 2012 WA Science Awards under the Science Engagement Initiative of the Year category alongside the International Centre for Radio Astronomy Research amongst others;
- New long-term projects including another UWA PhD study on coral, a CSIRO-UWA-AIMS postdoctoral study on sediments;
- UWA PhD candidate Sana Dandan presenting her KMRS coral research at the ICRS in Cairns entitled "Coral resilience to extreme tidal induced environmental fluctuations in the Kimberley region of WA" which is revealing remarkable adaptations and resilience in coral species in reef areas which experience temperature changes of over 7-8°C over a single tidal period;
- The KMRS team and AIMS' Dr Andrew Heyward observing & documenting the near-shore Kimberley hard and soft coral spawning in March & April for the first time;



Coral work March 2012, Photo A McCarthy, A, Heyward and J Brown.

- Communication of research activities and related science to the community at public events including the Roebuck Bay Working Group's Celebrate the Bay event and WAMSI Kimberley Marine Science Seminar series as well as on-site initiatives including

presentations by research teams to the Cygnet Bay Pearl Farm crew;

- New collaboration with the One Arm Point High School Bush Rangers Program to engage students interested in science and the environment with research at the Station including an interactive coral reef field day;
- Provision of an intensive field service program to consulting agencies managing the broad-scale environmental assessment of Cone Bay as part of the WA Department of Fisheries strategic impact assessment for the Kimberley Aquaculture Zone at Cone Bay;
- Photographic identification of cetaceans frequenting the greater Cygnet Bay area during the first year of inshore cetacean surveys by the Murdoch University Cetacean Research Unit hosted at KMRS. This included at least 53 individual Australian snubfin dolphins, 22 Indo-pacific humpback dolphins and two false killer whales as well as bottlenose dolphins and humpback whales.



Cygnet Bay. Photo Ali McCarthy

We look forward to welcoming our return researchers back to KMRS in the new year as well as the new projects set to kick off in 2013 including those incorporated in the WAMSI & marine parks programs. Likewise, we look forward to hosting our first university level work experience student on-site as well as further developing the Bush Rangers program collaboration. In 2013 we will also be opening our custom-built aquaculture facility and marine

laboratory which will include temperature and light controlled wet and dry lab areas with air, filtered and raw sea water on tap and a series of tanks up to 10t capacity, all of which will be available to research use through KMRS.

We would like to thank our research visitors and supporters for an amazing year and look forward to what's ahead in 2013. For more information, please visit our website www.kmrs.com.au or contact us at research@cygnetbaypearls.com.au

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Heron Island Research Station

Heron Island Research Station (HIRS) is the oldest and largest marine research station on the Great Barrier Reef. HIRS is ideally positioned on Heron Island, a diversely populated eight hectare island, stretching 0.8 km along the leeward edge of a 27 km² coral reef platform. The island is bisected by the Tropic of Capricorn, 80 km offshore from Gladstone, at the southern tip of the Great Barrier Reef.



Busy Research Aquaria Deck. Photo Elizabeth Perkins

HIRS is owned and operated by The University of Queensland (UQ), one of the most highly recognised and esteemed research and learning universities worldwide. UQ's reputation for excellence has earned it a position within the top 100 universities globally in all three major international university ranking indices. UQ is

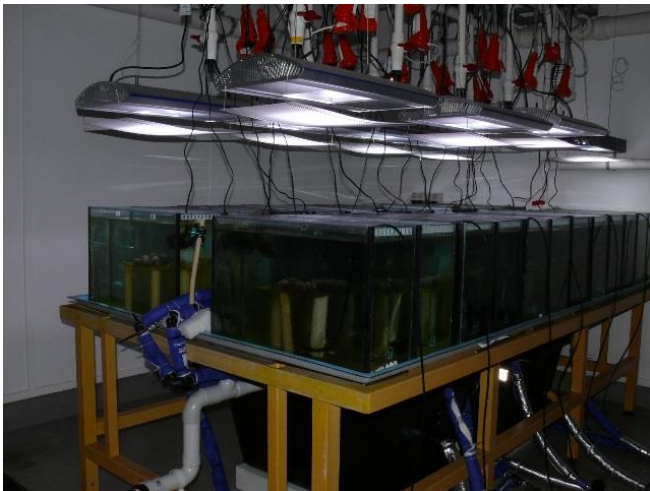
driven by the challenges and opportunities presented by a globalised environment and strives to enhance opportunities presented through global collaboration and cooperation. With its world class facilities, UQ, domestic and international clientele and unlimited opportunities for marine research, HIRS represents the epitome of these ideals.

HIRS was developed in 1950 by the Great Barrier Reef Committee. UQ was brought on as a partner to the Committee in 1970 and took over the ownership and operation of the station in 1980. Following a devastating fire in 2007, HIRS has been completely rebuilt and the facility was formally re-opened on 15 February 2009. Today, HIRS accommodates up to 150 research and education visitors. The station maintains six boats kept in 2C commercial survey and a full array of diving and snorkelling equipment, including access to compressed air and Nitrox, a range and quality of laboratory equipment rarely found at offshore research facilities and a versatile indoor/outdoor 40,000 litre capacity natural sea water flow through aquarium facility (including a 20,000 large animal/ behavioural tank). HIRS works in close collaboration with the Moreton Bay Research Station (MBRS) on North Stradbroke Island, just off the south-east coast of Queensland.

HIRS's Commitment to Environmental Sustainability

UQ is a signatory of the Talloires Declaration for sustainability in higher education, affirming its commitment to attaining best environmental performance and embedding sustainability into all aspects of UQ life. In 2012, HIRS, in collaboration with the Queensland Parks and Wildlife Service, increased its solar power infrastructure through the addition of a 20 kWp array, bringing the station up to 90 kWp of photovoltaic solar power. Additionally, major

works were completed in 2012 to replace all station lights with energy efficient light bulbs, resulting in a further reduction of the stations carbon footprint.



Experimental setup in the Indoor Aquaria Room.
Photo: Elizabeth Perkins

HIRS Research in 2012

The quantity of research effort at HIRS in 2012 surpassed previous efforts by 13%, while the quality of this effort remains clearly visible through the number of and calibre of resulting publications. Current investigations at HIRS include projects on various aspects and implications of climate change, the effects of marine debris on seabirds and ecological impacts of species over a range of trophic levels. The recently added molecular facilities at HIRS have also received wide-spread research use and add to the broad array of high quality research facilities and equipment that HIRS has to offer.

Some of the key publications stemming from research at HIRS in 2012 include:

- Behrendt, L., Schrameyer, V., Qvortrup, K., Lundin, L., Sørensen, S. J., Larkum, A. W. D., and Kühl, M. (2012) Biofilm growth and near infrared radiation-driven photosynthesis of the chlorophyll d-containing cyanobacterium

Acaryochloris marina. **Applied and Environmental Microbiology** 78: 3896-3904.

- Bender, D., Diaz-Pulido, G., Dove, S. (2012) Effects of macroalgae on corals recovering from disturbance. *Journal of Experimental Marine Biology and Ecology*, 429: 15-19.
- Cheney, K. L. (2012) Cleaner wrasse mimics inflict higher costs on their models when they are more aggressive towards signal receivers. *Biology Letters*, 8 (1):10-12.
- Doropoulos, C., Ward, S., Diaz-Pulido, G., Hoegh-Guldberg, O. and Mumby, P. J. (2012) Ocean acidification reduces coral recruitment by disrupting intimate larval-algal settlement interactions. *Ecology Letters*, 15: 338-346.
- Fahey, B., Degnan B. (2012) Origin and evolution of laminin gene family diversity. *Molecular Biology and Evolution*, 29 (7): 1823-1836.
- Jimenez, I. M., Larkum, A. W. D., Ralph, P. J., and Kühl, M. (2012) In situ thermal dynamics of shallow water corals is affected by tidal patterns and irradiance. *Marine Biology* 8: 1773-1782.
- Kaniewska, P., Campbell, P. R., Kline, D. I., Rodriguez-Lanetty, M., Miller, D. J., Dove, S., Hoegh-Guldberg, O. (2012) Major cellular and physiological impacts of ocean acidification on a reef building coral. *PLOS One*, 7 (4): 10.1371.
- MacKellar, M. C., McGowan, H. A., Phinn, S. R. (2012) Spatial heterogeneity of air-sea energy fluxes over a coral reef - Heron Reef, Australia. *Journal of Applied Meteorology and Climatology*, 51 (7): 1353-1370.
- McNamara, M. K. A., Adlard, R. D., Bray, R. A., Sasal, P., Cribb, T. H. (2012) Monorchiids (Platyhelminthes: Digenea) of chaetodontid fishes (Perciformes): Biogeographical patterns in the tropical Indo-West Pacific. *Parasitology International*, 61(2): 288-306.
- Rafferty, A.R., Evans, R.G., Scheelings, T.F. & Reina R.D. 2012 Limited oxygen availability in utero constrains the evolution of live-birth in reptiles. **Am Nat**, USA, *in pres*.
- Reef, R., Pandolfi, J. M., Lovelock, C. E. (2012) The effect of nutrient enrichment on the growth, nucleic acid concentrations, and

elemental stoichiometry of coral reef macroalgae. **Ecology and Evolution**, 10:1002/ece3.330.

- Sweet M, Kirkham N, Bendall M, Currey L, Bythell J, et al. (2012) Evidence of Melanoma in Wild Marine Fish Populations. *PLoS ONE* 7(8): e41989. doi:10.1371/journal.pone.0041989.



Heron Island. Photo: Chris Roelfsema

An expanded list of research publications based wholly or in part on research conducted at HIRS can be found on the [HIRS website](#).

A vast amount of information continues to come out of the multifactorial CO₂-dosing and temperature-control long-term research project run by Associate Professor Sophie Dove at HIRS. HIRS fully supports and encourages long-term research projects and is currently inviting applications for this type of work.

2012 marked the 50th year of the photographic survey for Joseph H. Connell's long term coral quadrats on Heron Reef. These coral quadrats were first surveyed by Joseph Connell in 1961 and resulted in numerous publications demonstrating the roles of predation and competition as mechanisms for structuring communities. It is one of the world's longest, regularly surveyed individual-based field observations of coral with researchers returning to Heron every year to conduct the surveys.

Griffith University researcher Sonya Clegg returned to Heron this year to undertake banding of Heron's silver eye population. For over 30 years researchers have been coming to Heron to band bird populations to understand the ecology and evolution of island birds and the population dynamics of Heron's silver eyes.

UQ researcher Chris Doropoulos returned to monitor coral recruitment on the reef flat and reef slope, monitoring he has been performing every six months since 2009. The work aims to understand coral population dynamics in both habitats, focusing on rates of coral settlement, early survival, and early growth.

James Cook University Researchers were back acoustically tagging fish and sharks around Heron and neighbouring reefs. They are studying small-scale movement patterns of fish such as redthroat emperor and coral trout and also different reef sharks. The acoustic listening station located around Heron Reef record the movements of tagged fishes within and between the reefs.



New solar panels. Photo: Elizabeth Perkins

From 2012, into 2013

HIRS received a number of significant infrastructure upgrades during 2012. A new microwave internet link has been installed,

allowing the internet to operate at a speed comparable to what can be found on the mainland. Internet usage is now prepaid and charged at a more affordable rate. Additionally, a new back-up generator was installed at HIRS, which now ensures continual seawater pumping and data back-up capabilities in the event of power failures. The new generator will provide a much more reliable experimental setting and reassurance for continual data monitoring and collection protocols. HIRS's website was given a facelift this year, and we encourage everyone to view the new site, <http://www.uq.edu.au/heron-island-research-station/>. The new website provides a fresh, clean interface for current and prospective station visitors, a greater amount of information and a forum for researchers to share publications and research activities.

HIRS has introduced a new pricing model which will take effect from 1 January 2013. The new model will result in discounts of up to 50% for researchers. HIRS will also be implementing a new online booking system in 2013, which will offer a much more convenient way to book into the station. Visitors will be able to check availability and book accommodation, lab space and equipment directly through the HIRS website.



Ongoing climate change experiment. Photo: Elizabeth Perkins

The UQ Faculty of Science and HIRS is also happy to announce the recent appointment of the new HIRS Manager, Dr Elizabeth Perkins. Liz will be a familiar face to many of you, as she joined the HIRS team three years ago and has since held the positions of Laboratory Manager and Deputy Station Manager. Liz is very personable and brings a great amount of professionalism, experience and knowledge to the position.

Dr Elizabeth Perkins

Station Manager

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Coral Bay Research Station

Following a biological survey undertaken in 2002 in response to the (now defunct) Coral Coast Resort proposal at Mauds Landing on Ningaloo Reef, discussions were had by some of the survey team members to look at encouraging a sustainable research effort in the region. One of the key considerations was a base for researchers to operate from in what is a fairly remote part of the world. It was decided that a research field station would provide a useful base of operations for researchers, providing basic lab and field research facilities and accommodation for small groups. A new group, the North West Research Association, was established to help put this plan into effect. A building was donated by the Brogan family, who run a number of businesses in Coral Bay, and was completed in early 2004. The NWRA entered into an arrangement with Murdoch University to operate the field research station in 2006 and the station is now a Murdoch University facility. Facilities include basic laboratory facilities, two small boats, SCUBA equipment and full accommodation for up to eight researchers.



Coral Bay Research Station with the two smaller vessels. Photo: Mike Van Keulen

Since 2004 numerous students, researchers and research groups have used the Coral Bay Research Station for their research; the number of users is steadily increasing each year.



Nicole Pinnel using a suction sampler to help collect coral spawn on the beach at Coral Bay. Photo: Mike Van Keulen

Also arising from the Coral Coast Resort proposal was a new management plan for Ningaloo Reef, released in 2005; linked to the new plan was a funding programme for marine research at Ningaloo, in recognition of the lack of understanding of ecological processes of this iconic Western Australian region. In 2006 a node of the CSIRO Wealth from Oceans Flagship was established for Ningaloo Reef. Both these programmes have provided significant seed funding for Ningaloo research and it is estimated that some \$30 million of research is currently



Porcupine ray tagged as part of a study on the biology and ecology of benthic stingrays at Ningaloo Reef. Photo: Mike Van Keulen

underway at Ningaloo. As the only research facility on the reef, the Coral Bay Research Station has become more and more attractive to researchers from these and other programmes.

Major projects that have been undertaken or are currently underway through the Coral Bay Research Station include:

- Biodiversity and habitat mapping of Ningaloo Reef
- Metabolism of corals in relation to coral spawning
- Community metabolism of benthic habitats on coral reefs
- Distribution and productivity of marine plants at Ningaloo Reef and Exmouth Gulf
- Surveys of human impacts on corals in Coral Bay
- Reproductive biology of corals
- Human usage of the Ningaloo Marine Park
- Oceanography and plankton distribution, and their impact on manta ray distribution
- Interactions of grazers with coral reefs at Ningaloo



Janja Ceh collecting bacterial samples from Coral Bay. Photo: Mike Van Keulen

This year sees the launch of an intensive undergraduate winter short course offered by Murdoch University, which will include a two-

week field camp using the facilities of the research station.



Fiona Webster monitoring grazing of settling plates in Coral Bay. Photo: Mike Van Keulen

For further information about the Coral Bay Research Station, please contact

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**North
West
Research
Association**



Lizard Island Research Station

A facility of the Australian Museum

This year has been the first for many years without a major building project. Since 2005, the station has been progressively upgraded. All facilities – buildings, boats, labs, the aquarium system, scuba filling system, power etc. - have either been replaced or substantially refurbished. LIRS is well set now for many more years of productive research. Private-sector support of LIRS through the Lizard Island Reef Research Foundation is vital to the station's continuing success.

Usage remains very high throughout the year except for a month of planned low usage in winter to allow for maintenance and staff holidays. Of the 7400 visitor nights occupied in 2011/12, almost 5300 (71%) were for research. The remainder were occupied by student groups, volunteers, commercial users, contractors and others.



A small Crown-of-Thorns Starfish spawning at night, 3 December 2012

In 2011/12, LIRS facilitated 104 research projects involving scientists from 30 institutions in 8 countries: 65 senior researchers, 51 PhD students, 3 Masters students and 1 Honours student. Eight high school or undergraduate student groups also used the Station's facilities

during the year. The library collection gained 116 publications (peer-reviewed papers and theses) that are based on work conducted at LIRS.

LIRS hosted field trips before and after the International Coral Reef Symposium in July. The participants were mostly from overseas and many had not been to the Great Barrier Reef before. Battling unseasonal rain and extreme wind conditions, they were able to get out diving and snorkelling daily. The first trip was a very successful coral identification workshop run by Russell Kelley. The second was an exploratory trip led by Lyle Vail and Anne Hoggett which made the best of the poor weather conditions. Four places were subsidised by the Lizard Island Reef Research Foundation to allow participation by people working on coral reef conservation in other parts of the world: Dr Cainho Seoane (Brazil), Dr Vineeta Hoon (India), Andalus Punongbayan (Thailand) and Chris Poonian (UK and Egypt).

New fellowships and grants valued at \$103,000 were awarded in 2012 to:

- Justin Welsh (James Cook University; Lizard Island Doctoral Fellowship)
- Sharon Wismer (University of Neuchatel, Switzerland; Lizard Island Doctoral Fellowship)
- Oona Lonnstedt (James Cook University; Ian Potter Doctoral Fellowship at Lizard Island)
- Dominique Roche (Australian National University; Ian Potter Doctoral Fellowship at Lizard Island)
- Dr Vanessa Messmer (ARC Centre of Excellence for Coral Reef Studies, James Cook University; Isobel Bennett Marine Biology Fellowship)
- Dr Ashley Frisch (ARC Centre of Excellence for Coral Reef Studies, James Cook University; John and Laurine Proud Fellowship)

- Dr Shelby Temple (University of Bristol, UK; Yulgilbar Fellowship)
- Dr Timothy Clark, Dr Steven Cooke, Dr Vanessa Messmer, Dr Andrew Tobin and Prof Morgan Pratchett (Australian Institute of Marine Science, ARC Centre of Excellence for Coral Reef Studies and Fishing and Fisheries Research Centre at James Cook University, and Carleton University, Canada; Peter Teakle Sustainable Fishing Grant)



Govinda Lienart and Cecilia Villacorta-Rath at LIRS

As well, fellowship-supported research was conducted in 2012 by:

- F. Joseph Pollock (James Cook University; 2011 Lizard Island Doctoral Fellowship)
- Sandra Binning (Australian National University, 2011 Ian Potter Doctoral Fellowship at Lizard Island)

All fellowships will be awarded again for 2013 – the winners will be announced in January. Applications for the 2014 fellowships will close in August or September 2013.

In mid-2012, Lance and Marianne Pearce retired after working at the research station since 1988. We sincerely thank them for their dedication, enthusiasm and friendship. They formed close

and long-lasting friendships with many researchers over the years.



Giant Trevally on the outer reef near Lizard Island



Dr Anne Hoggett & Dr Lyle Vail, Directors

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Orpheus Island Research Station

A faculty of James Cook University



Orpheus Island Research Station has had another great year despite the impact of several weather events. Following on from Cyclone Yasi in Feb 2011, the station experienced major weather events in Feb (Cyclone Justine) and March 2012 (Townsville Tornado). Research teams have reported strong recruitment and recovery of coral reefs in areas impacted by these weather events as well as numerous areas that remain in very good condition despite these various events.

Educational Study Groups

OIRS hosted 33 educational field trips during 2012 including four international groups:

- University of St Andrews, Scotland
- Global Links, USA
- Emmanuel College, USA
- ICRS 2012 field trips

Research Projects

2012 saw some exciting developments with 40 different research projects being undertaken.

There continued to be a good international presence with the return of **Mikhail Matz** from the University of Texas, USA continuing his project on reef building corals, as well as the addition of **Michael Ollermann** from the Alfred Wegener Institute for Polar and Marine Research Integrative Ecophysiology who began a project investigating intertidal octopuses.

The additional thirty eight research projects were undertaken by Australian based researchers, looking into a wide range of subjects including:

- **Audrey Schlaff** who expanded upon research into reef shark distributions using the AATAMS network.
- **Fernanda de Faria** who began a project on stingray movement patterns in Pioneer Bay utilising the AATAMS network.
- **Muhammad Azmi Abdul Wahab** who continued investigations into intertidal sponges.
- **Professor David Miller's** team **who** continued investigations into Fungidae (**Susanne Sprungala**), soft coral spawning (**Wiebke Wessels**), and Heliofungia (**Anthony Bertucci**).
- **Professor Bette Willis's** coral spawning team continued investigations into *Acropora millepora*.



2012 developments:

A major highlight of the year was the delivery of two new vessels which replaced some of the aging research dinghies. The new custom built design is a Cairns Custom Craft build capable of carrying up to 10 persons within Pioneer Bay and 6 further afield. Powered by a 40HP electric powered Suzuki engine the new vessels are able to get up on the plane fully loaded and the dreaded pull start has been eliminated.



Upgrades to the JCU phone network saw OIRS integrated within the Townsville campus network on the new VOIP system improving connectivity with JCU. An added inclusion to this changeover included an upgrade to the wireless network and improved access speed throughout the station.

Another upgrade means tight water restrictions are a thing of the past with installation of a chemical free water desalination plant.

Just in time for some Xmas joy, on the 7th December with Reef HQ released at OIRS “Stacey Sunshine” a juvenile green turtle rescued here in June 2011. Sunshine had overcome serious odds and successfully recovered from a punctured lung.



- A further two new research dinghies
- A replacement vessel for the Longboat which was severely damaged in the March tornado.

Also planned for early 2013 are several upgrades to the stations moorings including a full replacement of the aquaculture line and marker buoys damaged in Cyclone Yasi, plus the addition of three additional mooring points within Pioneer Bay, giving better access to the main research and education locations.

Further upgrades to the temperature control rooms are also planned, including replacement of water damaged floors, improvements to DDC control setup and installation of additional in room waterproof temperature probes.



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Upcoming developments in 2013

2013 will see four new vessels arriving at OIRS:

- The long awaited Challenger IV is expected to arrive in January.

One Tree island Research Station

The University of Sydney holds a lease on One Tree Island, and operates the research station which is located at the south eastern end of the expansive lagoon at One Tree Reef.

The island is a rubble cay, about 4 hectares in area. The lease area of the station is positioned adjacent to the lagoon and is surrounded by National Park. One Tree Reef in its entirety is a Scientific Research Zone, the only entire reef on the GBR to have this status. As a result, research can be undertaken in an area relatively free of anthropogenic disturbance. The accessibility to a protected lagoon and surrounding pristine marine and terrestrial habitats are unique features of the geography of One Tree Island. The lagoon is totally enclosed at low tide. This provides an ideal and protected setting for research. The unique features of One Tree Reef have been central to a long legacy of internationally significant research undertaken at OTIRS. The only permitted activities are research and limited education.

Take a tour of the station here:

<http://youtu.be/-oBbXl3Ss2o>



In 2012 Professor Maria Byrne resigned from being the director of One Tree Island Research Station, after 11 years. During Maria's reign at the helm, she managed our major infrastructure upgrade. Over the last 10 years we built a new accommodation block, aquarium building and our large vessel Linckia II. Our sustainable footprint

was facilitated by a major increase in our solar power capacity. Maria worked tirelessly for the research station over the years in funding, promotion and upgrades; as well as her own research, and raising a family. Each year Maria also teaches her Masters Coral Reef Science and Management course at the station. Prof Byrne's association with One Tree Island will long be remembered. Maria will remain as Deputy Director over the next few years.



Prof Robyn Overall, Head of School, Biological Sciences, University of Sydney and Prof Maria Byrne

The new Director is Dr Ana Vila Concejo
ARC-Future Fellow
Senior Lecturer



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Dr. Vila Conjejo's research interests are in the contemporary processes and morphodynamics of coastal systems. In 2010 Ana started researching the morphodynamics of sand aprons in reef

platforms collaborating with Dr. Jody Webster in the supervision of Dan Harris' PhD thesis. Ana is a keen fieldworker and has experience in acquiring and processing hydrodynamic, topographic and bathymetric data. She has also worked with fluorescent tracers for studying sediment transport processes. At present she is also using Geographic Information Systems (GIS) as a tool to analyse recent and present data.

Postgraduate teaching in Marine Science and Management

Dr Vila Conjeco is involved in the new [Postgraduate Programme in Marine Science and Management](#) that started in 2012 and which is a consequence of Sydney University's partnership in the Sydney Institute of Marine Sciences (SIMS).

If you want more information about this Postgraduate Programme please send an e-mail to Postgrad Marine Science and Management (geomarinepg@sydney.edu.au) or visit the website (<http://sydney.edu.au/science/marine/>).

eggs. The body pit and chamber seem more shallow than nest's you would see on sand islands. Not much is known of the success rate of the hatchlings, but there have been sightings of hatchlings making their way through the rubble to the surface and down to the sea.



THE UNIVERSITY OF SYDNEY

Completed by Jennifer Reiffel and Prof Maria Byrne



A green sea turtle *Chelonia mydas*

One Tree Island is a harsh environment for the green sea turtle and loggerhead turtle to lay her eggs; but nearly every year they slowly make their way up the coral rubble to do so.

Loggerhead turtles are more common than the green turtles for some reason to make One Tree Island their nesting grounds. Bleeding flippers from the diggings in the rubble, after a few attempts to find the right spot, they will lay their

Advances in Coral Reef Science

In 2010, the major marine science institutions in Australia continue to produce numerous press releases that highlight significant research advancements. Check out the following websites to keep up with the latest coral reef research!



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Centre of Excellence for Coral Reef Studies

[*China's corals facing 'wicked problem'*](#)

27th December, 2012

[*Scary news for corals - from the Ice Age*](#)

11th December, 2012

[*Marine reserves 'must adapt to climate change'*](#)

27th November, 2012

[*Humanity urged to make best use of 'borrowed' time*](#)

26th November, 2012

[*Naïve fish: easy targets for spear fishers*](#)

13th November, 2012

[*Historic coral collapse on Great Barrier Reef*](#)

7th November, 2012

[*Discovery of mega-rich coral biodiversity in Aceh, Indonesia*](#)

31st October, 2012

[*Researchers find 'killer solution' for a reef killer*](#)

8th October, 2012

[*Climate is changing the Great Barrier Reef*](#)

24th September, 2012

[*Seafood caution as Ciguatera attacks rise*](#)

10th September, 2012

[*Sea life 'facing major shock'*](#)

21st August, 2012

[*New study helps predict impact of ocean acidification on shellfish*](#)

6th August, 2012

[*Our coral reefs: In trouble - but tougher than we thought*](#)

12th July, 2012

[*New book inspires children to protect Dugongs*](#)

10th July, 2012

"We can still save our reefs": Coral Scientist

10th July, 2012

Save what remains of our reefs, scientists urge

9th July, 2012

Food security at risk in coral countries

7th July, 2012

Fish learn to cope in a high CO2 world

2nd July, 2012

Caribbean wins the seaweed Olympics

7th June, 2012

A new study finds that Caribbean seaweeds are far

Australia 'has two distinct white shark populations'

5th June, 2012

Coral: Rekindling Venus film and Rise song launch

26th May, 2012

Marine reserves provide baby bonus to fisheries

25th May, 2012

Weed-eating fish 'help protect jobs, livelihoods'

9th May, 2012

Call to save Australia's disappearing sea snakes

3rd May, 2012

Coral reef winners and losers in a warmer world

13th April, 2012

CO2 'is messing with coral skeletons'

11th April, 2012

Corals 'could survive a more acidic ocean'

2nd April, 2012

Avoiding the tragedy of overfishing

20th March, 2012

Parenting comes at a price for male fish

8th March, 2012

Scientists call for no-take coral sea park

23rd February, 2012

Big fish reveal shelter secrets on reefcam

13th February, 2012

Lessons in coral reef survival from deep time

23rd January, 2012

Multiple partners not the only way for corals to stay cool

20th January, 2012

Carbon dioxide is "driving fish crazy"

16th January, 2012

Publications

Publication list for 2012

AIMS: Australian Institute of Marine Science

AM: Australian Museum

ANU: Australian National University

CoE: ARC Centre of Excellence for Coral Reef Studies

CSIRO: Commonwealth Scientific and Industrial Research Organisation

GBRMPA: Great Barrier Reef Marine Park Authority

JCU: James Cook University

SU: Sydney University

SCU: Southern Cross University

UQ: University of Queensland

UTS: University of Technology Sydney



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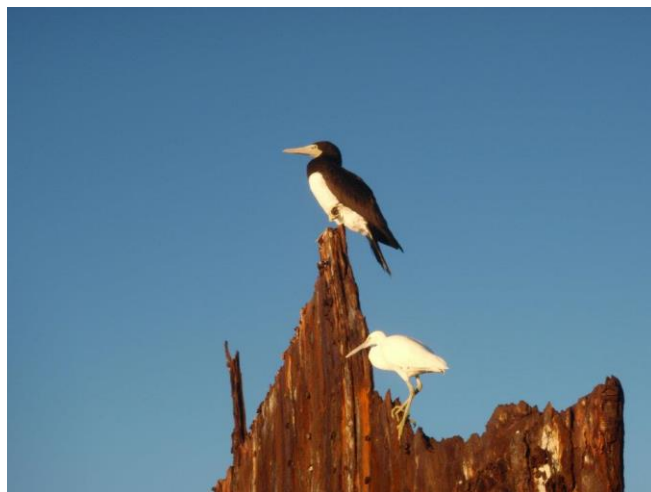


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Reports from ACRS Student Research Fellows

2012 Terry Walker Award: Jessica Tout

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The role of bacterial behaviour in structuring coral-bacteria interactions

Within the coral holobiont, microbial communities are now considered a functional part of a tripartite symbiosis, which also includes the coral organism and symbiotic dinoflagellate algae (zooxanthellae) from the genus *Symbiodinium* (Rowher et al. 2002). Scleractinian corals host a dynamic community of bacteria, which colonise various internal and external niches including the skeleton, the gastrodermal cavity and the Coral Surface Microlayer (CSM) (Rosenberg et al. 2007; Mouchka et al. 2010). These microbial communities are phylogenetically distinct, more active and more abundant than populations in adjacent waters (Ducklow and Mitchell 1979; Paul et al. 1986; Rohwer et al. 2001, 2002; Frias-Lopez et al. 2002; Kellogg 2004; Rosenberg et al. 2007; Sweet et al. 2011).

Many of the processes behind coral reef bacterial interactions, including rapid shifts in community composition and the mechanisms involved in coral infection by pathogenic bacteria, are not yet fully understood. We propose that chemotaxis, which is the ability of bacteria to rotate their flagella to direct movement in response to chemical stimuli (Lux and Shi 2004), may be a significant behaviour within the coral reef habitat, where the establishment of associations with benthic (animal and plant) hosts and the exploitation of chemical microenvironments may be particularly important. Despite the shift towards a greater understanding of chemotaxis in marine ecosystems, there has been little focus on the role of chemotaxis in coral reef microbial ecology since 1976, when it was suggested that marine bacteria may be attracted to coral and zooxanthellae exudates (Chet and Mitchel 1976) and that ecological and biogeochemical cycles of an ecosystem can be affected by the chemotactic characteristics of bacterial communities (Bartlett and Matsumura 1986; Stocker and Seymour 2012).

Chemotaxis has been shown to be involved in the pathogenicity of coral disease causing bacteria where the coral pathogen *Vibrio shiloi* attaches to the coral *Oculina patagonica* through chemotaxis to a receptor on the corals mucosal layer under elevated sea temperatures (Banin et al. 2001; Koren & Rosenberg 2006; Rosenberg et al. 2007; Rosenberg et al. 2009). Banin et al. (2001) suggests that zooxanthellae exudates present in the coral mucus act as chemoattractants for *Vibrio shiloi*, which is chemotactic to and only infects mucus containing zooxanthellae exudates. Similarly, chemotaxis is involved in the infection of *Pocillopora damicornis* by *Vibrio coralliilyticus* ([Mitta et al. 2011b](#)).

More recently, Vega-Thurber et al. (2009) illustrated using metagenomics and manipulative experiments on the coral *Porites compressa*, that under altered environmental conditions the

relative frequency of bacterial genes involved with chemotaxis and motility increased. These findings indicate that changes in environmental conditions, e.g. increase in temperatures cause increases in bacterial chemotaxis & virulence genes, which are important in bacterial infection of host organisms and in turn this can shift the bacterial community to highly opportunistic pathogenic state. However, despite this recent research, neither the specific chemical attractants nor the chemotactic abilities of natural communities of coral reef-associated bacteria have previously been examined. My research aims to establish:

1. If bacterial chemotaxis assists with the establishment of coral-bacterial associations and affects the bacterial community composition of corals.
2. If bacteria that cause coral disease are chemotactic to coral-produced chemicals and if elevated temperatures cause pathogenic bacteria to be more chemotactic towards such chemicals.
3. If frequency in motility and chemotaxis genes change across a coral reef.
4. How changes in environmental conditions will alter the behavioural interactions, function and community assemblages of coral-associated bacterial communities.

As a successful recipient of the 2012 Terry Walker Prize I was given the opportunity to carry out fieldwork and laboratory work to complete and fulfil Aims 1 and 4 of my PhD research at Heron Island on the Great Barrier Reef. To test our hypotheses, we used a combination of laboratory and field-based research, with the aid of cutting-edge microfluidic technologies coupled with next generation sequencing tools to characterise the ecological dynamics of coral-associated microbes.

Field Studies: Bacterial Behaviour

To identify specific chemical cues (“infochemicals”) released by organisms in the coral holobiont that affect colonisation by coral-associated bacteria, a novel microfabricated “*In Situ Chemotaxis Assay*” (ISCA) was deployed. This device consists of a matrix of 24 cylindrical chambers (each chamber = 75 µL volume) (Fig 1.a). Each chamber comprises a 1 mm diameter opening, connecting the interior of the chamber to the external environment (Fig 1.b). Individual chambers are filled with specific coral infochemicals such as amino acids, sugars, zooxanthellae exudates, ammonium chloride and dimethylsulfonopropionate (DMSP) which have been selected in accordance to their presence in coral mucus (Meikle et al. 1988; Wild et al. 2010) and their diffusion into the external environment triggers chemotactic migration of bacteria into the chambers. This allowed us to examine what chemical cues influence bacterial community composition on corals, potentially leading to coral disease. The ISCA were deployed at different coral reef microenvironments on Heron Island to see if bacterial behaviour changes across different microenvironments such as in the lagoon and reef crest, on the sand under water and in the open ocean outside the reef. Relative numbers of chemotactically attracted bacteria that were collected within the ISCA were compared between attractants and were analysed with a flow cytometer (Becton Dickinson LSRII) at UTS. We have also extracted and amplified DNA from the ISCA using 16S rDNA specific primers to characterise and determine the taxonomic composition of the bacterial community responding to the different chemical cues using 16S tag pyrosequencing. Currently, the extracted DNA is being sequenced using 454 pyrosequencing technology at Mr DNA Molecular laboratories (Shallowater Texas, USA).

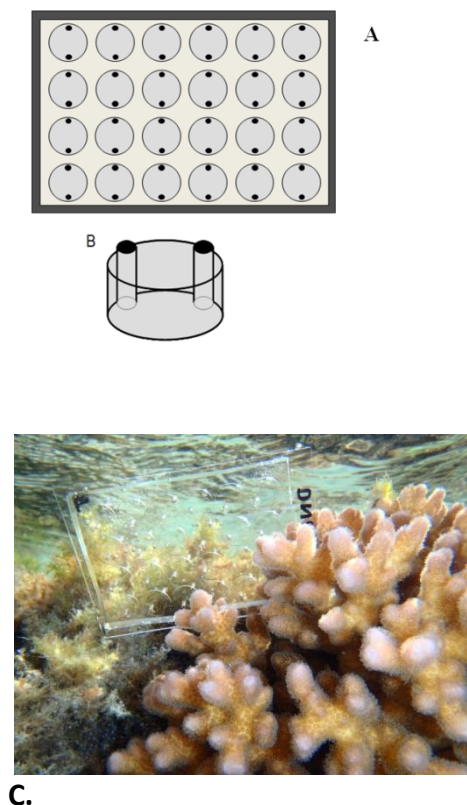


Figure 1 a) Diagram showing the microfabricated *In Situ Chemotaxis Assay* (ISCA). b) Represents a cross section of an ISCA showing one chamber where 75 μ L of chemoattractant were pipetted into. Varieties of chemoattractants were used in one ISCA. (Source: Justin Seymour) c) Photograph showing the deployment of ISCA chambers adjacent to coral colonies of *Pocillopora damicornis* in coral-reef associated water on Heron Island 2010. (Source: Jessica Tout)

Thermal Stress experiments

Temperature conditions experienced by the coral holobiont were altered in laboratory experiments conducted in flow through tanks at Heron Island. To our knowledge, this is the first time a variety of coral disciplines were combined including photobiology, microbiology and microsensors to monitor the microbial community during thermal stress experiments. A variety of tools were used throughout the experiments to provide a complete picture of what is happening to the coral holobiont during increased temperature and include the assessment of zooxanthellae health using PAM fluorometry, and the measurement of coral respiration rate using oxygen optodes. Bacterial community

composition and function throughout the experiment were also characterised using molecular tools such as 16S rRNA pyrosequencing and metatranscriptomics to indicate which species of bacteria were present and what genes they were actively expressing during increasing temperatures as well as targeting specific chemotaxis and motility genes that are important to this research. The composition of coral mucus compounds throughout the experiment are undergoing analysis at UTS using FTIR spectroscopy and concentrations of DMSP compounds are being analysed with collaborators at AIMS.

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Danielle Simmons Prize: Sarah Van-Eyk

The sensory system of elasmobranchs

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Elasmobranchs have long been regarded to possess an acute sense of smell that aids in their ability to detect prey (Sheldon 1911, Hodgson and Mathewson 1978, Silver 1979). Yet our understanding of their olfactory capabilities is relatively superficial.

The morphological structure and function of the elasmobranch olfactory system has been described in relative detail for an array of elasmobranch species (Bell 1993, Schluessel et al. 2008, Meredith and Kajiura 2010), and has been used to infer the possible olfactory capabilities of elasmobranchs in relation to their known ecology (Bell 1993, Schluessel et al. 2008, Theiss et al. 2009, Meredith and Kajiura 2010). Furthermore electrophysiological studies have been conducted on both sharks and rays to determine the olfactory sensitivity of these species to an array of amino acids (Nikonov et al. 1990, Tricas et al. 2009, Meredith and Kajiura 2010). Reported olfactory sensitivities are relatively high in regard to amino acids tested. The hammerhead shark, *Sphyrna lewini* was reported to respond to alanine and cysteine at concentrations as low as 4×10^{-11} M. Electrophysiological experiments allow for a direct understanding of the physiological responses of the animal, however they cannot determine how the animal will react physically, this requires behavioural experiments.

Early behavioural studies established the role of the paired nasal organs as olfactory receptors and identified their importance in locating prey items (Sheldon 1911, Parker and Sheldon 1913, Parker 1914). Additional studies have investigated the

role of olfaction in shark feeding behaviours and recorded the types of behaviours elicited by sharks in response to biological substances including amino acids and prey items (Tester 1963, Hodgson et al. 1967, Mathewson and Hodgson 1972, Kleerekoper et al. 1975, Johnson and Teeter 1985). Although the olfactory capabilities of elasmobranchs have been examined from anatomical, electrophysiological and behavioural perspectives, no studies have attempted to integrate the information to understand how elasmobranchs may utilise olfaction and how the ecology of different species may reflect their olfactory capabilities. The sensitivity of sharks, skates and rays to different chemical stimuli of biological relevance needs to be investigated through behavioural discrimination experiments and interpreted in relation to the anatomy and ecology of the species. Such experimental approaches can help determine how the anatomy of the olfactory system of elasmobranchs reflects their olfactory capabilities.

The aim of my study was to determine the olfactory sensitivity of the giant shovelnose ray, *Glaucostegus typus* (Anonymous [Bennet], 1830) behaviourally to previously classified attractant stimuli derived from extracts of penaeid prawn and teleost fish. Experiments were conducted at Heron Island Research Station between January and March 2012. Juvenile rays were captured in the shallow waters near Shark Bay and held in large aquaria in an outdoor covered area. During experiments rays were exposed to extracts of either penaeid prawns or teleost fish at differing concentrations and the behaviour of the rays were recorded.

Stimuli to be tested were prepared by macerating prawns and teleosts to paste form. Portions of the stock material were suspended in a predetermined amount of seawater which was then continually diluted with seawater to

produce a range of different concentrations daily for testing. In a given trial the behaviour of the ray being tested was recorded for a 10 minute period. After the initial five minutes the stimulus to be tested was administered to the tank *via* one of two pipes that entered the aquarium and the behaviour of the ray recorded for a further five minutes. Rays were exposed to different concentrations of the stimuli sequentially to determine the point at which the rays first detected the stimulus to identify their olfactory threshold.



Shovelnose ray resting in the water at Shark Bay, Heron Island, Australia

Rays exhibited both feeding and non-feeding behaviours throughout trials. Non-feeding behaviours witnessed included swimming around the perimeter of the tank and resting on the tank floor. These behaviours were observed both before and after olfactory cues were added to the aquarium. Food searching behaviours consisted of circling within the vicinity where the stimulus was released very near to the floor of the tank and attempting to feed off the tank floor. Food searching behaviours were classified as a response to the stimulus as they were only witnessed after the stimulus had been added to the tank if rays detected the stimulus (Fig. 1). Juvenile giant shovelnose rays responded behaviourally to both prawn and teleost extracts at concentrations as low as 10^{-9} ppm, demonstrating that this species possesses a highly sensitive olfactory system. This is equivalent to detecting 1 g of either macerated

prawn or teleost fish in the amount of water required to fill 400,000 Olympic sized swimming pools.



Sequence illustrating how rays were captured on Heron Island.

G. typus' highly sensitive olfactory system is likely to aid in orientation towards and detection of prey items. This behavioural study provides insight into the role olfaction plays within the ecology of *G. typus* that cannot be achieved from examining the morphological structure of their olfactory system. Although olfactory thresholds of species to amino acids have been reported, the differences in methodology and olfactory cues used do not allow for direct comparisons between *G. typus* and other species. Future

studies utilising the experimental protocol designed for use in these experiments to test the olfactory capabilities of other elasmobranch species would facilitate the comparison of olfactory thresholds across species in relation to actual prey items.

Thank you to the Australian Coral Reef Society for granting me the Danielle Simmons Prize 2012.

This award helped fund my travel and bench fees at Heron Island Research Station.

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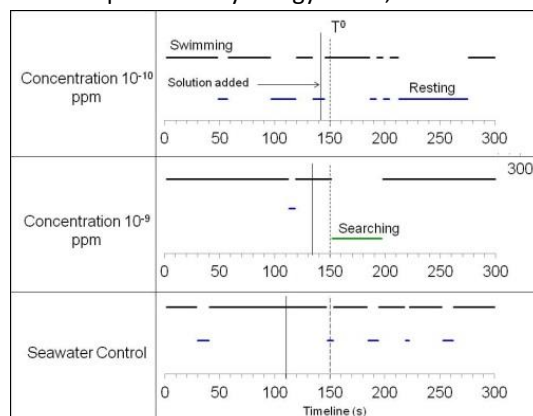


Figure 1. Timeline illustrating the behaviours witnessed in separate trials for two concentrations of penaeid prawn stimuli and a seawater control before and after rays encountered the stimuli. Swimming (black) and resting (blue) represent general behaviours, while searching (green) represents a detection of the stimulus. Solid line represents the time the stimulus was administered to the tank. Dotted line represents the point T^0 , the time at which the rays first encountered the stimulus, estimated from dye trials. Note: Rays only detected prawn extract at a concentration of 10^{-9} ppm as evident from the searching behaviour recorded after T^0 . This behaviour was not witnessed prior to encountering the stimulus, or during seawater control trials. Additionally rays did not react to stimuli derived from concentrations lower than 10^{-9} ppm.

Epigenetic acclimation to increasing sea surface temperatures in a coral reef fish

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Introduction

Climate change is predicted to raise sea surface temperatures by as much as 3°C by 2100 (1,2) with profound implications for the function and productivity of marine ecosystems (3). Although many short-term experimental studies have demonstrated detrimental effects of elevated temperature on marine species (4,5,6), the capacity for species to acclimate to rising temperature over multiple generations is largely unknown.

However, exciting new research by Donelson et al. (7,8) revealed almost complete acclimation of metabolic rate in the reef fish, *Acanthochromis polyacanthus*, when exposed to elevated temperatures in both parental and offspring generations. This has led to an important question: *how* are these fish acclimating? Understanding the mechanisms of transgenerational thermal acclimation will be critical for predicting long-term prospects for populations of marine species.

The overall aim of my research, therefore, will be to elucidate transcriptomic responses by which thermal acclimation occurs in reef fish. To begin, I evaluated two candidate genes in *A. polyacanthus* that have been studied in other fish exposed short-term to temperature stress: lactate dehydrogenase-B (*Ldh-B*) and heat shock protein 70 (*Hsp70*). *Ldh-B* encodes an enzyme involved in maintaining aerobic metabolism while *Hsp70* is a molecular chaperone expressed to protect, refold or remove proteins.



Acanthochromis polyacanthus adult and eggs

Methods

Snap-frozen *A. polyacanthus* liver samples were obtained from Dr. Jennifer Donelson, School of Marine and Tropical Biology, JCU. The wild fish were caught from two locations on the Great Barrier Reef, Heron Island (lower extent of species range) and Orpheus Island (middle of species range). Their offspring (first generation) were exposed shortly after hatching to current day (+0°C), and elevated average temperatures (+1.5°C and +3°C) for 2 years, as per Donelson & Munday (9). In addition, +0°C adult fish were exposed to either +1.5°C or +3°C for 28 days or 8 months (Orpheus fish only); this will highlight differences associated with temperature stress experienced during development, or during acute or long-term exposure as adults. A second generation of these fish was also produced to determine the effect of elevated temperatures across generations (hereafter referred to as transgen), as well as carrying out similar adult acute and long-term temperature treatments.

RNA was extracted from first and second generation fish and converted to complementary DNA. Quantitative PCR (qPCR) was used to evaluate gene expression, normalising with housekeeping genes and GeNorm software.

Results

Surprisingly, expression of *Ldh-B* in the first generation was unaffected if exposed to temperature stress during development or acutely as an adult, from either location. Long-term adult temperature stress, however, significantly decreased *Ldh-B* expression, possibly indicating a shift in aerobic metabolism if exposed chronically as an adult. The second generation showed very different results, in which the transgen fish had significantly increased *Ldh-B* expression, consistent with increased aerobic scope as shown by Donelson *et al.* (8). This suggests that *Ldh-B* is an important gene for restoring aerobic metabolism across generations affected by temperature stress.



Heather Veilleux in the Molecular Ecology & Evolution Lab, JCU

Hsp70 expression showed a clear trend in the first generation of Heron fish. Developmental temperature stress showed no change, while acute adult treatments had elevated expression. A similar trend can be seen in Orpheus fish, though the increases are not significant. Interestingly, the long-term treatments returned expression to baseline levels. *Hsp70*, therefore, is only required for short-term stress and is no longer needed after long-term exposure, indicating the fish is either recuperating or other genes are required for chronic stress. In the

second generation, however, developmental stress unexpectedly increased *Hsp70* expression. The transgen fish also had increased expression compared to current day temperatures, though not compared to similar developmental temperature treatments. Adult transgen fish from the highest temperature were put back into control temperatures; after acute exposure, *Hsp70* levels dropped to control levels but following long-term treatment, expression returned to the original elevated transgen level. This may indicate that exposure to high temperatures over two generations resets baseline levels of *Hsp70* expression, thus ensuring maximal survival if the stressed conditions resume.

Current Work

This was the first study evaluating the transgenerational changes in gene expression of two widely studied stress-response genes, *Hsp70* and *Ldh-B*. After discovering interesting trends in only two genes, I have now expanded my research to evaluate expressional changes in hundreds of genes. F₁ and F₂ RNA samples were sent to King Abdullah University of Science and Technology (KAUST) in Saudi Arabia where a cDNA library for each sample has been produced and sequenced using Illumina technology. Currently I am visiting KAUST, learning how to employ the most up-to-date methods to analyse and compare the transcriptome of these transgenerational temperature stressed reef fish.

Future Work

Transcriptomics will identify key genes affected by transgenerational temperature stress. Using this information, we will test for epigenetic inheritance – how parents will pass gene expression levels appropriate for a stressed environment to their offspring to aid in their survival, without actually changing the DNA sequence.

Acknowledgements

I would like to thank the Australian Coral Reef Society for awarding me the ACRS Fellowship. This funding allowed me to purchase critical components for all my laboratory protocols, including the preparation of RNA for Illumina sequencing and qPCR. In addition, I would like to thank my supervisors: Drs. Lynne van Herwerden, Philip Munday and Bill Leggat for their guidance; the members of the Molecular Ecology and Evolution Lab; and the invaluable support from Dr. Jennifer Donelson.

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Heather Veilleux at KAUST, Saudi Arabia

Intergenerational effects of increased CO₂ on a reef fish

Atmospheric CO₂ concentrations are higher now than at any point in the past 800,000 years and could reach as high as 1000ppm by 2100 (IPCC 2007, Caldiera & Wickett, 2005). As atmospheric CO₂ levels increase, there is a proportional increase in CO₂ levels in the ocean (Doney 2010). As a direct result of increased absorption of CO₂, ocean pH has declined by 0.1 units and is expected to fall by 0.3 - 0.4 units by the end of the century. Sea surface temperatures are also increasing, due to global warming associated with higher atmospheric CO₂ concentrations, and are predicted to increase 1.5°C - 3°C over the next 100 years (IPCC, 2007). Although marine fish are often thought to be relatively tolerant to high CO₂ (hypercapnia) (Kikkawa et al, 2004; Kurihara, 2008) recent studies suggest that there could be unexpected consequences of near future levels of CO₂ for marine fishes, especially during early life history stage. New studies have shown that juvenile reef fishes exposed to high CO₂ are smaller than juveniles reared under current day conditions (Baumann et al 2012, Miller unpublished data). Furthermore, there is increasing evidence that elevated CO₂ alters a range of behaviours and impairs sensory function of juvenile reef fishes (Dixon et al. 2010, Munday et al. 2010, Nilsson et al. 2012) and could possibly reduced reproduction and fertilisation success (Pankhurst and Munday 2011). In addition marine organisms must also cope with increasing temperature. Critically, growth of juvenile fishes (Munday et al 2008) and the reproductive capabilities of adult fishes (Donelson et al 2010) have been shown to be reduced under higher temperatures. Reductions in the growth and survival of juveniles, coupled with reductions in reproduction, could affect population size and possible sustainability. Ultimately the ability of

species to adapt or acclimate to these changing conditions will determine how they are impacted by climate change and ocean acidification (Donelson et al 2011a). Recent studies have shown that juveniles perform better under increased temperature when their parents are also under the increased temperature (Donelson et al 2012). This suggests that transgenerational acclimation may be a much stronger mechanism for mitigating the effects of climate change than previously expected. My PhD investigates how multiple climate change stressors will impact on the early life history and reproductive stages of coral reef fish. For this part of my PhD, I examined the effects of ocean acidification on the reproduction of a coral reef fish and how transgenerational (parental) effects may influence the susceptibility of juveniles to ocean acidification.

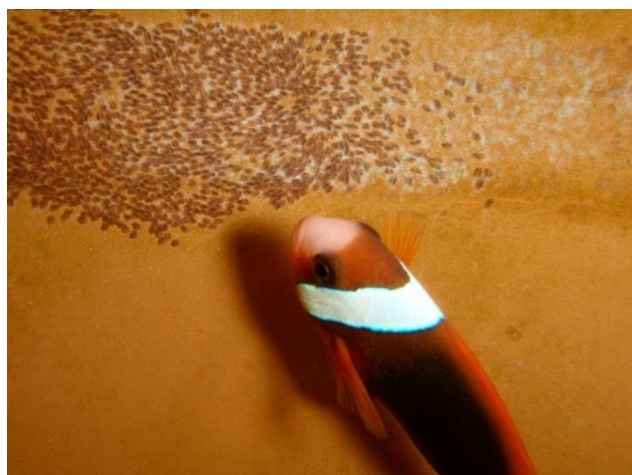
Experiments were carried out over a 9-month period from November 2010 to early May 2011 at ocean acidification research facilities at James Cook University. For the first part of the study, breeding pairs of the anemone fish *Amphiprion melanopus* were maintained in three different CO₂ conditions; current-day control, moderate or high CO₂. The moderate (~600 µatm) and a high (~1000 µatm) levels were consistent with predictions for CO₂ increases over the next 50-100 years. Pairs were allowed to breed naturally under these conditions and their reproduction was tracked throughout the breeding season. In contrast to the negative impacts of ocean acidification seen reproduction in some studies with invertebrates (Havenhand et al 2008; Parker et al 2009), I found that higher CO₂ levels stimulated reproduction. Across the season there was a 51% increase in the number of clutches produced per pair under High CO₂ compared to the Control and Moderate groups. There was also an increase in the number of eggs produced per clutch, with approximately 45% more eggs produced by the High group. This dramatic

increase in reproduction did not come at a cost to the offspring however, with larvae from all groups being the same length at hatching. These results show that increased CO₂ stimulates reproduction, without an obvious cost to the offspring. Exactly how this occurs is yet to be determined.



The second experiment took the offspring from the three CO₂ groups and reared them under the same CO₂ conditions as their parents, except for some clutches from Control parents that were raised at High CO₂ conditions. Juveniles were then individually raised until 31 days post hatching. My results showed that Control-High offspring of control parents raised under high CO₂ were significantly shorter and lighter, had a higher routine metabolic rate and lower overall survival in comparison to the Control offspring. These results are in line with the negative impacts of ocean acidification that have previously been reported. Remarkably, however, these negative impacts were alleviated when the parents were also exposed to increased CO₂. Moderate and High offspring were generally in as good if not better physical condition in comparison to the Control group, with the same or lower routine metabolic and a similar survival rate. This indicates that there may be the potential for parental effects to mitigate some of the negative effects of ocean acidification on marine organisms.

These results, which improve our understanding of the likely impacts of ocean acidification on marine fish, have recently been published in *Nature Climate Change*. I would like to thank the ACRS for the student funding I received. The funding has greatly contributed to the ongoing costs of my project.



Why we do the things we do

The objectives of the Australian Coral Reef Society are to promote, develop and assist in the scientific study of all aspects and attributes of the Coral Reefs of Australia and, by means of publications, meetings, symposia and such other methods as may be considered appropriate, to provide for the exchange of information and ideas among those interested in coral reefs. We are also charged with the protection and conservation of the Coral Reefs of Australia. We typically approach these goals from the standpoint of support of student participation and mentorship.



