



Australian Museum Lizard Island Research Station

2013



nature culture **discover**





Lizard Island Research Station 2013

A facility of the Australian Museum

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A Day in the Life

WHO: A team of 15 researchers led by Dr Pat Hutchings of the Australian Museum plus a photographer, a chef and several helpers. The researchers are from Spain, Germany, Norway, Russia, Brazil and Australia (see page 16). Most are specialists in the taxonomy of a particular group of polychaetes (bristle worms) and one is a PhD student.

THE PROJECT: This "Polychaete Workshop" is documenting the diversity of polychaetes at Lizard Island. It is enabling the researchers to learn from each other by bringing them together in the field with a huge variety of living worms to examine.

WHY? Polychaetes are abundant and ecologically important on coral reefs but we have a long way to go to understand their diversity. It is important to fill this knowledge gap at Lizard Island where so much ecological research takes place.

WHAT'S HAPPENING ON THIS DAY? The team splits up to collect worms in different places and habitats. Two teams go diving: one at the outer ribbon reefs and the other stays at Lizard Island. The divers collect samples of sediment, rubble and algae to be searched later for worms. Two other teams take advantage of the low tide to collect in different habitats: the sand flats in front of LIRS and the reef flat off Coconut Beach.



Then it's back to the lab to sort through the samples - some rubble smashing required! Everyone does "rough sorting" using microscopes by picking worms out of sand, rubble or algae and putting them into family groups. The relevant expert in each group then sorts them into finer groups. Finally, they preserve and label the worms and record the location data. The specimens are now ready to send to the researchers' museums for more detailed study. The team's photographer is kept busy taking microscope photos of these often-beautiful creatures before they lose their colours in the preservative. A beach barbecue is enjoyed by all but it's back to work afterwards.

HOW LONG DID IT TAKE? The team spent two weeks at LIRS and they collected more than 1700 samples comprising at least 45 polychaete families. It will take more than a year for the individual researchers to work through their samples to discover exactly which species are present at Lizard. We already know that there are many species new to science that need to be properly described. The results will be published in a special issue of a taxonomic journal, comprising 20 to 25 separate papers.

HOW IS THE WORK FUNDED? The Lizard Island Reef Research Foundation generously provided the funds for this workshop. This project contributes to one of the major goals of LIRS – enhancing knowledge of the biodiversity of Lizard Island and making it readily accessible.



Top: Martina Prazeres (2013 Ian Potter Doctoral Fellow) is finding out how reef organisms will fare in near-future environments.

Above: North Point, Lizard Island.

Opposite: Davina Poulos (left) and Lauren Nadler.

Previous page photos: Page 2, top centre & right, bottom centre & right: Alexander Semenov. Page 3, top right: João Nogueira, centre left: Maite Aguado, middle: Vasily Radashevskiy, right: Alexander Semenov, bottom left: Joana Zanol, middle: João Nogueira, right: Alexander Semenov.

Fellowships

Five fellowships were awarded in 2013 by the Australian Museum for field-intensive research at Lizard Island. Funding is provided by the Lizard Island Reef Research Foundation and its donors: The Ian Potter Foundation; the Hermon Slade Raiatea Foundation, the John and Laurine Proud Estate Trust and the Coral Reef and Marine Science Foundation.

Two fellowships are for PhD students. These provide up to \$8,000 per year for up to three years for field work at Lizard Island. For the first time, both fellowships also provide \$4,000 to present at an international conference in the second or third year of the fellowship.

Three fellowships are for early-career scientists whose PhDs were awarded within the past five years. These provide up to \$11,000 for field work at Lizard Island.

Details of the conditions and selection criteria can be found in the LIRS section of the Australian Museum's web site. Applications close in August or September each year for funding that becomes available in March of the following year.



Davina Poulos

2014 Ian Potter Doctoral Fellow at Lizard Island
James Cook University (\$8,000 in 2014, \$6,500 plus \$4,000 conference funding in 2015)

Prior residency effects and the dynamics of fish communities in a changing environment

Coral reefs are ecologically diverse ecosystems where many organisms interact and compete for resources. The nature of these interactions can determine how local communities are shaped. We need to know the mechanisms involved to understand how community dynamics will change, particularly in light of our changing environment.

When organisms enter a new habitat, existing residents often have a competitive advantage. The effects that prior residents have on intruders, *priority effects*, are a major influence on the dynamics of communities. However, the outcome of interactions between residents and intruders is not fixed. Life history and performance attributes will influence who is dominant. Coral reef fish settling to a habitat patch for the first time, or migrating to a new habitat vary greatly in their characteristics and have a unique set of experiences that will affect individual success. How, and the extent to which, a habitat patch meets the individuals' requirements will depend on the nature of the habitat and the occupants of the patch.

However, marine habitats generally are under increasing stress and this can change the characteristics of habitats. Predictions are that many of these fishes will migrate from degraded habitats in search of higher quality resources. Fish communities can change dramatically in response to coral death but we know little about the mechanisms that underlie such changes.

Davina aims to discover the effects that prior residents have on the establishment and persistence of intruders, and how the characteristics and resource requirements of individuals and species affect the outcome of resident-intruder interactions in a changing environment. To do this she will set up various experiments using coral reef fishes to examine the behavioural responses of residents and intruders with varying traits and in different habitat contexts.

Few studies have focused on the facultative or inhibitive effects of prior residents or intruders in marine systems. Davina's research will seek to uncover how coral reef fish communities are shaped and change, and the driving factors involved. This novel approach to exploring the assemblage structure of fish communities will provide a deeper understanding from which to subsequently build upon and make predictions for the future.

Lauren Nadler

2014 Lizard Island Doctoral Fellow
James Cook University (\$8,000 in 2014, \$8,000 in 2015 plus \$4,000 conference funding in 2015)

Influence of climate change on schooling behavior in coral reef fish

Many animals live in cooperative groups so that they have a greater chance of finding mates, avoiding being eaten, and learning about food resources. Over half of all fish species in the world's oceans live in "schools" at some point during their lives. These species live in all types of aquatic habitats and come in all shapes, sizes and colors. On coral reefs, schooling behavior is particularly prolific. Yet, few studies have examined this behavior in coral reef ecosystems. Therefore, the particular benefits of schooling for coral reef fishes remain unknown.

While many studies have examined the possible effects of climate change on the physiology and behavior of individuals, these may not provide a complete picture of the impacts on gregarious species. Recent studies suggest that multiple processes essential for effective schooling behavior could be disrupted by ocean warming and rising carbon dioxide levels, including decision-making abilities, sensory performance, and swimming capacity.

The goal of this research is to determine if schooling behavior will be impacted by climate change. Because so little research has been conducted on this topic in coral reef systems, this work will also examine the ecology of schooling behavior, to better understand its role in coral reef systems and more appropriately analyze results related to environmental disturbance. Lauren will use a variety of innovative methods in order to assess how ocean warming and acidification may affect schooling behavior. Her goal is to determine if communication within groups will be affected, how school characteristics may be changed, and consequently what effects this will have on survival. By examining multiple schooling species, this project will also be able to establish species-specific trends in schooling behavior.

Lauren's research will help to ascertain the viability of this critically important behavior in the future and provide fish conservation biologists with novel methods for studying group behaviors and physiology that have traditionally been difficult to quantify.



*Dr Paul York and
Dr Peter Macreadie*

2014 Isobel Bennett Marine Biology Fellows
James Cook University and University of Technology
Sydney (\$11,000 in 2014)

Carbon sequestration capacity of deep water seagrasses won the Great Barrier Reef

Seagrasses are one of the most productive habitats on the planet, providing global ecosystem services such as enhancing fisheries production, cycling nutrients and stabilising coastlines valued in the US\$ trillions per year. Recent research shows that some shallow water seagrass species are among the most powerful carbon sinks in the world. They can bury carbon at a rate 35 times faster than tropical rainforests, and bind it for millennia, making them a potentially powerful tool in mitigating against climate change. However, seagrasses are declining at an alarming rate with a 30% reduction in distribution since World War II.

Queensland contains some of the largest and most diverse seagrass meadows on Earth. Shallow-water seagrasses in this region have received a good deal of attention because they are logistically easy to study and because they occur in areas where there is increased human activity. However Queensland’s deep-water seagrasses have received little attention, despite being ranked among the most extensive on Earth (over 40,000 km²). Whether deep-water seagrass populations provide the same important ecosystem services as their shallow-water counterparts is currently under debate.

At present, information is lacking on the carbon sequestration capacity of seagrasses growing in deep waters. Paul and Peter’s research proposes to link changes in seagrass densities to carbon stock within sediments. Specifically, the project will test how the carbon sequestration capacity of seagrasses varies with water depth and bed persistence. In addition, the team will use carbon fingerprinting techniques to better understand the sources of carbon to deep-water seagrasses, i.e. the relative importance of carbon produced by seagrasses vs. external carbon sources such as macroalgae, phytoplankton, or terrestrial run-off. This will allow determination of how changes in ocean dynamics and land management practices are likely to affect the carbon sequestration capacity of deep-water seagrasses.

Dr Jairo Rivera Posada

2014 John and Laurine Proud Fellow
ARC Centre of Excellence for Coral Reef Studies,
James Cook University (\$11,000 in 2014)

Improvements of the single injection ‘bile salts’ control method for Crown-of-Thorns Starfish and novel perspectives

Outbreaks of coral-eating Crown-of-Thorns Starfish (COTS, *Acanthaster planci*) are one of the most significant biological disturbances on reef ecosystems. On the Great Barrier Reef, coral cover has declined by 50% in the 27 years to 2012 and COTS are thought to be responsible for 42% of that loss. A key strategy to reduce and reverse coral loss is the development of effective control methods to prevent or eradicate ongoing outbreaks. Jairo has been awarded the John and Laurine Proud Fellowship for two years in a row to address this problem.

With the 2013 fellowship, Jairo and co-workers successfully developed and tested a new control method involving injection of oxbile into COTS. This is already greatly enhancing the effectiveness of the ongoing Government-funded COTS control program; only one injection is needed (compared to multiple injections with the former method), most COTS can be injected where they are found, and there are no harmful effects on other reef organisms.

However, strict regulations and import permits are now required when buying oxbile due to concerns about Mad Cow Disease. This extra logistic challenge hampers use of the oxbile method throughout the Indo-Pacific. It is well known that COTS control programs fail mainly due to high cost and long delays in getting the programs underway.

In 2014, Jairo will test a wide range of substances in an attempt to find substitutes for oxbile, including five types of bile salts from different species. He will also test several osmotic stressors as alternative method to control COTS. Sea stars cannot tolerate drastic changes in salt concentration and preliminary results show that COTS can be controlled with a variety of sodium salts, including normal table salt. Lastly, Jairo’s previous work at LIRS progressed our understanding of the bacterial causes of disease in COTS. He will look more closely into bacterial pathogens and disease in COTS in 2014.



Top: The reef flat at Coconut Beach is a great place to collect invertebrates when the tide is very low.



Opposite, left to right: Paul York, Peter Macreadie, Jairo Rivera Posada and Celia Churchill.

Dr Celia Churchill

2014 Coral Reef and Marine Science Foundation Fellow
University of California Santa Barbara (\$11,000 in 2014)

Interactions between a crustacean and an alga: the first marine arthropod with photobionts? (Ostracoda: Philomedidae)

Marine species interact in a variety of ways to gain food and shelter, including endosymbiosis, in which one symbiont lives inside the tissue of another. Several groups of invertebrates, including corals, molluscs, and sponges, are involved in a special kind of endosymbiosis with photosynthetic algae. The symbiotic partners exchange nutrients, allowing them to live in the clear but nutrient-poor shallow waters of the tropics. These endosymbiotic interactions comprise the energetic foundation of coral reefs.

Celia studies members of a diverse class of crustaceans called ostracods, or “seed shrimp.” Although ostracods are common

and can have huge populations, they are very small (1-2 mm long) and thus rarely observed. Lizard Island Research Station has a rich history of ostracod research and an extremely high ostracod diversity, with many species still undescribed. On a recent trip to LIRS with a team of ostracod researchers, Celia found a new species of philomedid ostracod that appears to harbor a green alga within its tissue.

To date, there is no record of a marine arthropod with photosynthetic endosymbionts. Celia’s research will begin to characterize this algal-ostracod relationship by testing whether the ostracod sources energy from the alga. Stable isotope ratios from the new species compared to other closely-related Lizard Island ostracods will show the relative contribution of carbon from primary producers (most philomedids are detritivores), and the relative trophic level. The alga will also be identified by morphology and molecular data from the ostracod transcriptome. This research will provide information on a potentially unique marine species interaction and add to our knowledge of the planet’s biodiversity.



Above: Dr Vicki Nelson

Opposite: PhD student James Foster with apparatus to determine whether fish use polarisation vision to see through veiling light.

Research by Fellows in 2013

Fellowships supported research by 13 scientists during 2013. Key to institutions is on page 20, year of award shown in parentheses.

Lizard Island Doctoral Fellows

F. Joseph Pollock^{1,5} (2011)
Dominique Roche^{1,4} (2012)
Justin Welsh^{1,5} (2012)
Hanne Thoen⁹ (2013)
Fabio Cortes^{9,36} (2013)

Ian Potter Doctoral Fellows

Sandra Binning^{1,4} (2011)
Oona Lonnstedt^{1,5} (2012)
Martina Prazeres^{1,9} (2013)

Isobel Bennett Marine Biology Fellow

Dr Andrew Hoey^{1,4} (2013)

Peter Teakle Sustainable Fishing Research Grant

Dr Timothy Clark², Dr Andrew Tobin^{1,5}, Dr Vanessa Messmer^{1,5} and Prof Morgan Pratchett^{1,5} (2013)

Profile of a former fellow

Dr Vicki Nelson

Vicki Nelson was the 1992 Lizard Island Doctoral Fellow. A Sydney University graduate, she moved to Townsville in 1990 to start her PhD at James Cook University. Her research at LIRS involved repeatedly photographing marked areas on the reef crest at points around Lizard and North Direction Island to look at short term community and population dynamics of reef crest corals. After three years of idyllic field work at LIRS she spent many months in the dark digitising maps of quadrats and following the fates of thousands of coral colonies. Her work suggested that patterns in community structure are strongly related to recruitment dynamics of coral.

Vicki’s career since her time at Lizard Island has spanned a wide range of activities, from training and environmental consultancy in Cambodia, to environmental policy and management in Australia, with detours through postgraduate research administration and executive assistance. She now indulges her twin passions for science and communication in her own writing and editing business focusing on making science accessible and useful for environmental policy-makers and managers and the public.

Lizard Island Reef
Research Foundation

FOUNDER Sir John Proud ¹	TRUSTEES Mr David Shannon (Chairman) Mr Charlie Shuetrim AM (Chairman, Appeal Committee) Dr Penny Berents Mr James Bildner Mr Kenneth Coles AM Mr Paul Connor ³ Ms Belinda Gibson ⁴ Dr Ronnie Harding Mr Trevor Haworth AM ^{3,1} Mr Frank Howarth PSM Mr Chris Joscelyne Mr Vivian King	Mr Raymond Kirby AO Prof Lynne Madden Mrs Fiona Playfair Mrs Heather Power Mr Robert Purves AM Mr Graham Sherry OAM ⁴ Ms Helen Wellings ⁴
PATRONS Mr Andrew Green Dr Des Griffin AM Mr Trevor Haworth AM ¹ Mr Raymond Kirby AO Mrs Jacqueline Loomis The Ian Potter Foundation Mr Robert Purves AM Thyne Reid Foundation Prof Frank Talbot AM		1 Deceased 2 New patron in 2013 3 Retired as Trustee in 2013 4 New Trustee in 2013

LIRS would not be the success it is without the support of the Lizard Island Reef Research Foundation. It has enabled all capital development of the Station since its inception in 1978 either directly through its donors, or indirectly by assisting with applications for funding to the Australian Museum. The LIRRF and its donors also fund the Lizard Island Fellowships program along with an increasing number of other projects.

Projects and equipment funded by the LIRRF in 2013 include:

- The Polychaete Workshop, see page 2
- The online Lizard Island Field Guide (lifg.australianmuseum.net.au)
- New mobile applications based on LIFG for both Android and Apple platforms
- The LIRS Fellowships program, see previous section
- New research dinghy, *L&M*, named for Lance and Marianne Pearce, long-term maintenance staff who retired in 2012
- Satellite tags to record long-distance movements of marlin
- Replace equipment including computers, outboard motors and other boating equipment, and lab equipment including an autoclave and 0.0001g balance
- Internships to assist with the operations of LIRS and to support research





Top left: Archaeologist Dr Sean Ulm and a student at work on the ridge above Mangrove Beach.



Top right: LIRS director Lyle Vail (red shirt) with LIRRF chairman David Shannon (blue shirt), Australian Museum Trustees and guests.



Bottom left: Captain Trevor Howarth AM at Lizard Island in 2001



Bottom right: Long-time supporter Dick Smith dropped in on the 30th anniversary of his first visit to Lizard Island.

Opposite: Katia Nicolet, PhD student and the first LIRS intern, conducts a tour for resort guests.

Board Changes

Captain Trevor Haworth AM has been a long term supporter of LIRS. A Trustee of the LIRRF since 1993, he retired from the board this year. His family company, *Captain Cook Cruises*, operated tourist ships on the Great Barrier Reef for many years. He generously donated trips on *Reef Endeavour* to the LIRRF as prizes and also provided discount travel between Cairns and Lizard Island for LIRS researchers and volunteers. Following his retirement, he accepted an invitation from the Trustees to remain involved as a Patron. Very sadly, as this publication was going to print, we were advised that he had died. Trevor contributed a great deal to our LIRS and the Foundation and he will be sadly missed.

The Australian Museum Trust appoints two Trustees to the LIRRF board. Paul Connor resigned from the LIRRF board during the year due to other commitments for the AM Trust. We thank him for his engagement and interest. We welcomed two new AM Trust appointees members to the LIRRF board in 2013, Belinda Gibson and Helen Wellings.

Members

Members of the Foundation support LIRS by donating \$1,000 or more per year. Life Members donate at least \$100,000 which may be spread over several years. This regular source of funding is essential to the operations and development of LIRS and we thank all of them for their generous support. Please see the inside back cover for this year's Members.

Delaware North Australia Parks and Resorts, operator of the Lizard Island Resort, is a major supporter of the Members program. Each year, the company donates to the LIRRF a 3-night stay for two people at the Resort. Members go into a draw to win this wonderful prize, which the LIRRF supplements by providing airfares within Australia. This year's prize was won by David and Vanessa Shuetrim.

Delaware North Australia Parks and Resorts also offers LIRRF Members a discount of 20% for stays of three or more consecutive nights at the Lizard Island Resort. We thank Delaware North Australia Parks and Resorts for its generous support.



Events

The annual dinner for Members was held on the Terrace at the Australian Museum on 26 September 2013 with about 100 people attending. The guest speaker was Jim Bildner, the only US-based Trustee of the LIRRF. Jim is an Adjunct Lecturer in Public Policy at the Harvard Kennedy School and a Senior Research Fellow at the Hauser Center for Nonprofit Organizations at Harvard University. The focus of his work is the institutional role of philanthropy in solving complex issues in society. He spoke energetically and engagingly on this topic. LIRS Director Anne Hoggett also spoke about challenges facing coral reefs exemplified by experiences on a recent visit to the Coral Triangle, and about the recent Polychaete Workshop.

Taking advantage of Jim Bildner's visit to Sydney, the LIRRF and the Australian Museum Foundation jointly hosted another event on the same day. An invited group of Sydney people with philanthropic interests enjoyed a light lunch while Jim took to the floor and explored the challenges of matching philanthropy with causes followed by an extensive discussion period. We thank Jim for his time and insights at both events.

The annual luncheon in Melbourne was held at the Athenaeum Club on 8 May 2013. LIRS Director Anne Hoggett spoke to the group about Crown-of-Thorns Starfish damage to the reef and new methods of controlling it, and about the Station's efforts to enhance knowledge of local biodiversity including development of the Lizard Island Field Guide.

Visitors

People associated with the Lizard Island Reef Research Foundation who visited during the year include:

- Colin Bernasconi and Shannon Sweeney
- Paul Connor, Lilian Gehue and family
- Michael Ford, Georgina Haysom and family
- John Gough AO and Rosemary Gough
- Tom Healy AO
- David and Daniela Shannon
- Charlie Shuetrim AM and Sandy Shuetrim
- Geoffrey Shuetrim, Alex Heath and family
- Dick Smith AO
- John and Jacquie Mullen and guests
- Geoff and Kathy Manley, friends of Kevin Kalkhoven
- Allan Myers AO and guests



LIZARD ISLAND RESORT OFFER

We are delighted to announce that Delaware North (owners and operators of Lizard Island Resort) will offer a 20% discount on any room at any time* to members of the Lizard Island Reef Research Foundation. The only condition is that you book for a minimum 3 night stay.

This is a very generous offer to promote the wonderful work being done at Lizard Island Research Station and we are most grateful to Delaware North for their support.

We encourage all members to avail themselves of this very generous offer. A visit to Lizard Island is an exceptional experience, both at the Resort and the Research Station. The Resort consistently makes the Top 10 Hotels of the World list and the Research Station is widely acknowledged as one of the best tropical marine field research stations in the world. What better place is there to visit?

This is also a golden opportunity for our Foundation to attract new members. The discount offered by the Resort more than covers the \$1,000 annual membership donation to Lizard Island Reef Research Foundation and enables these new members to sample for themselves the delights of the Lizard Island Resort and the fascinating work being done at Lizard Island Research Station.



The Lizard Island Group, where you can laze on the beach or snorkel out to the coral reef that surrounds the adjacent headland.



Lizard Island Resort, the northern most resort, located directly on the Great Barrier Reef, offers 24 powdery white beaches and 40 luxurious suites.



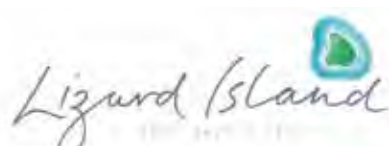
Enjoy secluded picnics on private beaches, five star cuisine and indulgent spa treatments. Sail a catamaran, dive the outer barrier reef or go fishing.

HOW TO BOOK:

Telephone Lizard Island Resort reservations on 1300 863 248 and mention that you are a member of the Lizard Island Reef Research Foundation.

Details of the Resort are on their web site at: www.lizardisland.com.au
If you have any questions re this offer please contact Charlie Shuetrim:
t +61 (0)416 215 251 e cshuetrim@sancha.com.au

* This offer is not available last week in October or Christmas to New Year period.



Top left: New maintenance staff Bruce Stewart and Cassy Thompson

Top right: Microscope technician Allan Ross visits annually to keep LIRS equipment in good shape.



Bottom left: Former staff Bob and Tania Lamb.



Bottom right: The international WormNet II team (page 17) who are assembling a "tree of life" for worms.

For the Record

Bob & Tania Lamb leave LIRS

Bob and Tania Lamb started at LIRS in the early 1990s as volunteers. They were employed temporarily at LIRS several times from 1995 and they became permanent staff members in 1998. They worked for six months each year from then to 2012, spending the remainder of each year working at their home base of Coffs Harbour in NSW or travelling. Bob and Tania were not able to do their normal 6-month rotation in 2013 due to an injury suffered by Tania the year before. Late in 2013, they decided to resign.

As well as being excellent at their jobs, Bob and Tania were hubs of the community with their music, parties and handicrafts. They have many friends from their years at Lizard Island and are sadly missed.

Staff

Lyle Vail and Anne Hoggett completed 23 years as joint directors of LIRS in August 2013.

Kim Demamiel and Stewart Pulbrook filled the maintenance positions from September 2012 to October 2013 and we thank them for their contributions.

Cassy Thompson and Bruce Stewart took on these roles from November 2013 and we welcome them to the team.

Former staff Lance and Marianne Pearce returned twice during the year to assist during staff absences.

Developments

With completion of the 30th Anniversary Development in 2012, few infrastructure developments were needed in 2013. All new equipment this year replaced existing items, including a new dinghy named *L&M*, several computers, several outboard motors and lab equipment including an autoclave and a balance.

Substantial progress was made towards our goal of making Lizard Island a hub of known biodiversity. The online Lizard Island Field Guide (lifg.australianmuseum.net.au) continued to improve and new mobile applications for it were released for both Android and Apple platforms thanks to Geoff Shuetrim and the Gaia Guide Association. As well, LIRS hosted a workshop that will produce at least 20 scientific papers documenting the polychaete (bristle worm) fauna of the area (see page 2).

An internship program (see below) was also implemented this year to assist with LIRS operations including maintenance and development of the Lizard Island Field Guide.

The LIRRF provided funding for all these purchases and projects.

Bench Fees

Per person per night, Including GST	2013	2014
Researcher	\$128.00	\$131.00
Researcher's assistant	\$113.00	\$116.00
Postgrad student (own project)	\$50.00	\$51.00
Postgrad's assistant	\$45.00	\$46.00
School or university group	\$80.50	\$82.50



Interns

LIRS established an internship program in 2013. It provides extended access to field and aquarium facilities for postgraduate students who provide 12 hours assistance each week to LIRS staff. Interns stay for three months and do not pay bench fees. Interns must have a project that can be done effectively without an assistant for most of the time. Please contact LIRS for further information about this program. The program has got off to an excellent start and clearly benefits both LIRS and the students. Interns during 2013 were Katia Nicolet (PhD student, James Cook University), Oona Lonnstedt (PhD student, James Cook University) and Julius Piercy (PhD student, University of Essex).

Volunteers

The volunteer program is essential to the Station's operations, especially maintenance. Several people have provided wonderful assistance as volunteers every year for many years. Renie Amos, Snow Amos, Lois Wilson and Terry Ford take on large maintenance projects each year and we have come to rely

upon them. Margaret Hoggett has acted as the station's archivist for several years, scanning old photos and putting albums into order. Other volunteers who assisted maintenance staff during 2013 are: Fay Adams, Devin Ingersoll, Brendan Nedelec, Jack Randall, Bailey Rehnberg and Jennifer Zadkovitch. Our sincere thanks goes to all volunteers.

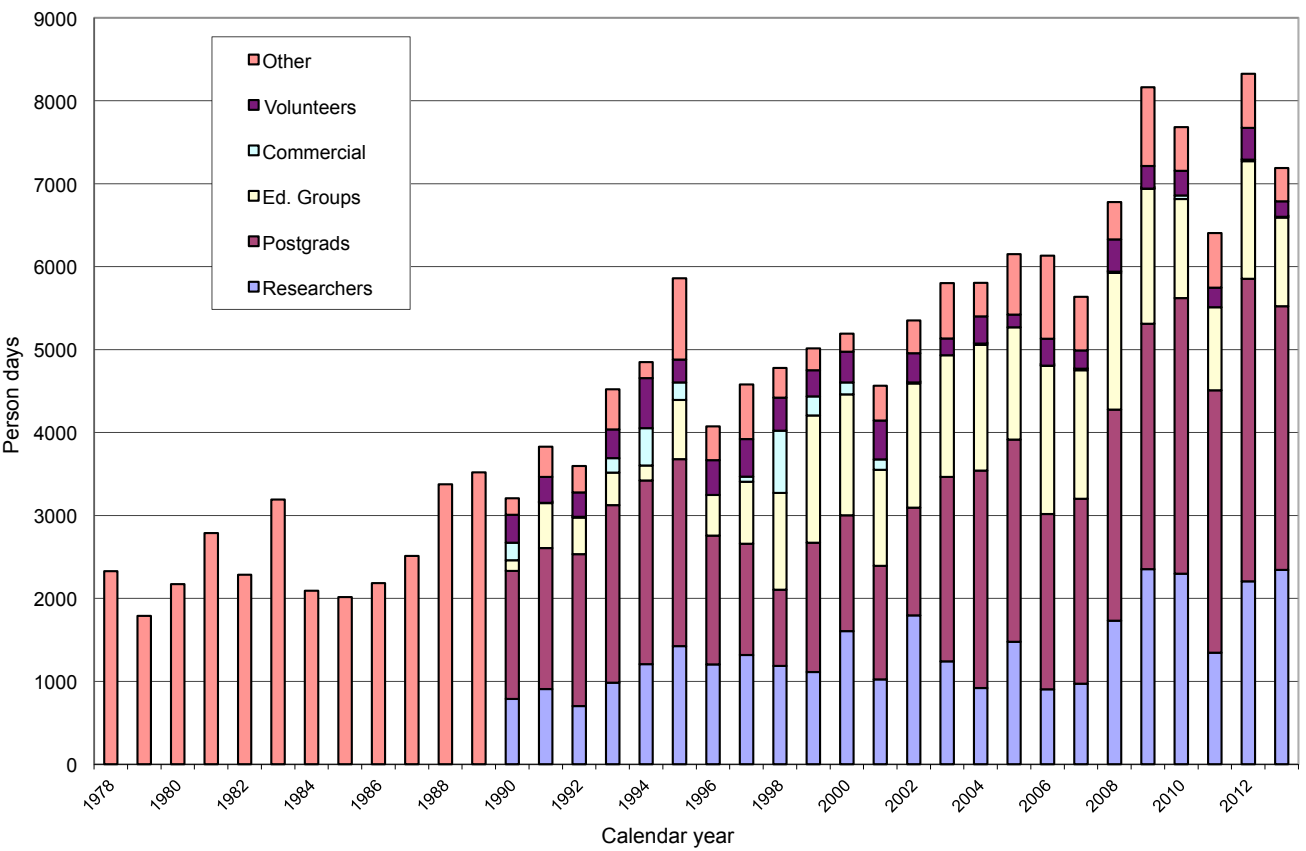
In addition, we thank Charlie Makray who continues to provide first aid training for all LIRS staff, tailored to our needs, on a voluntary basis.

Tours

Tours of LIRS are conducted for resort guests on Monday mornings. A tour for other island visitors, mainly campers and yachties, is conducted between May and October at 11 am on Mondays. Additional booked tours are given throughout the year to resort guests and passengers on cruise ships. At other times, visitors are welcome to call into the station to view the Sir John Proud Aquarium and courtyard displays but guided tours are not available.

Opposite: Low tide in the Lizard Island lagoon, 23 July 2013

Usage





Above: Polychaete workshop participants Maria Capa and Alexander Semenov.
Photo: Guillermo Diaz-Pulido

Right: More polychaete workshop participants, Maite Aguado, Anna Murray and Joana Zanol.



Visitors in 2013

171 scientists from 56 institutions in 11 countries conducted 123 research projects at Lizard Island in 2013. Of these, 99 were senior scientists or postdocs, 51 were PhD candidates, 3 were MSc candidates, 7 were Honours candidates and 11 students conducted research for undergraduate theses. The researchers are listed here with their project titles and institutional affiliations.

Senior Scientists and Postdocs

Trond Amundsen²³

Coral reef fish coloration: sexual selection, diversity and speciation

Conxita Avila³⁵

Diversity and chemical ecology of opisthobranchs

Andrew Baird^{1,5}

Sean Connolly^{1,5}

Maria Dornelas⁵⁴

Joshua Madin⁶

Coral demography

Redouan Bshary⁴⁸

Cooperative and cognitive aspects of cleaning symbiosis

Roy Caldwell³⁸

Stomatopod behaviour

Doug Chivers⁵²

Maud Ferrari⁵²

The importance of neophobia to predator-prey dynamics

Celia Churchill³⁹

Emily Ellis³⁹

Todd Oakley³⁹

Alannah Pique³⁹

Eye evolution in sarsiellonid ostracods (Crustacea: Ostracoda)

Timothy Clark²

Andrew Hoey^{1,5}

Vanessa Messmer^{1,5}

Andrew Tobin⁵

Vulnerability and survival of fish released following fisheries encounters: towards lower post-release predation and more sustainable catch-and-release fishing

Kendall Clements³⁴

Lindsey White¹⁵

Esther Anger¹⁷

Howard Choat⁵

The role of hindgut symbionts in protein uptake and recycling in marine herbivorous fishes

Thomas Cribb⁹

Rod Bray²²

Terrence Miller⁹

Transversotrematid trematodes of GBR fishes

Tom Cronin⁴⁵

Properties of natural polarized light fields in air and water

Cecile Dang⁹

Perkinsosis in bivalves from Queensland

Ashley Frisch^{1,5}

Apex predators on coral reefs: do marine parks need sharks?

Nicholas Graham^{1,5}

Ecology of novel coral reef ecosystems

Andrew Hoey^{1,5}

Latitudinal & seasonal variation in the functional impact of reef fishes

Morgan Pratchett^{1,5}

Andrew Hoey^{1,5}

Jacob Johansen^{1,5}

Macroalgal driven feedbacks on coral reefs

Mia Hoogenboom⁵

Metabolic scaling with polyp and colony size for reef corals

Martin How⁹

Polarising vision and behaviour in stomatopods

Pat Hutchings³

Yanan Sun (Phd Student)^{3,6}

Elena Kupriyanova³

Maria Teresa Aguado³⁰

Tom Alvestad²⁹

Nataliya Budaeva³²

Maria Capa²⁰

Chris Glasby⁸

Karin Meissner²⁵

Anna Murray³

Joao Nogueira⁵¹

Julio Parapar³³

Vasily Radashevskiy¹⁸

Alexander Semenov⁵⁵

Joana Zanol³¹

Anna Zhadan¹⁹

Polychaete taxonomy workshop

Shaun Killen⁴³

Exploring the links between personality and metabolism

Floriana Lai⁵⁰

Goran Nilsson⁵⁰

Effect of high CO₂ on temperature preference on coral reef fish

Sjannie Lefevre Nilsson⁵⁰

Goran Nilsson⁵⁰

Temperature and high-CO₂ effects in the Humpbacked Conch, *Gibberulus gibberulus*

Jeff Leis³

Uli Siebeck⁹

Claire Paris⁴⁷

Orientation in the pelagic environment

Justin Marshall⁹

Karen Carleton⁴⁶

Yakir Gagnon⁹

Polarisation vision

David McCartt¹⁷

Recording bird sounds

Eva McClure

as field leader for

Alexandra Grutter⁹

Does the infection rate of gnathiids onto fish vary with cleaner presence or between day and night?

Eva McClure

as field leader for

Libby Liggins⁹

Speciation in chitons

Eva McClure

as field leader for

Alexandra Grutter⁹

The role of parasites and cleaning behaviour in coral reef fish recruitment

Mark McCormick^{1,5}

Metabolic predictors of fish behaviour

Mark McCormick^{1,5}

Monitoring fish abundance and diversity in relation to habitat

Mark Mccormick^{1,5}

Mark Meekan^{1,2}

Mathew Mitchell^{1,5}

Influence of boat sound and elevated CO₂ on fish settlement and survival

Damhnait Mchugh¹⁷

Frank Anderson²⁶

Kenneth Halanych¹⁴

Nancy Schult¹⁷

Anja Schulze²⁸

Torsten Struck⁵⁶

Charlotte Watson⁸

Sandy Richter (Phd Student)⁴⁴

Anne Wiegert (Phd Student)⁴⁴

WormNet II: assembling the annelid tree of life

Vanessa Messmer^{1,5}

Andrew Hoey^{1,5}

Effects of climate change on coral trout

Goran Nilsson⁵⁰

Metabolic and behavioural effects of high carbon dioxide

Helen Nilsson Skold²³

Understanding coral ageing

Megan Porter⁵³

Evolution of colour signals in mantis shrimp

Morgan Pratchett^{1,5}

Vanessa Messmer^{1,5}

Jacob Johansen^{1,5}

Initiation and spread of outbreaks of Crown-of-Thorns Starfish on the GBR

Jairo Rivera Posada⁵

Morgan Pratchett^{1,5}

Crown-of-Thorns Starfish control

Michael Rasheed⁵

Katie Chartrand⁵

Paul Leeson⁵

Mark Leith⁵

Cath Mccormack⁵

Skye Mckenna⁵

Verena Schrameyer¹¹

Ross Thomas⁵

Seagrass monitoring

Nick Roberts³⁷

Seeing the reef in a new light: polarization imaging of the reef and its inhabitants

Albert Ros⁴⁸

Do coral reef fish without access to cleaner fish invest more in immune protection?

Jodie Rummer^{1,5}

Temperature and metabolism in a high performance, schooling coral reef fish

Rafael Sarda²¹

Diversity and chemical ecology of polychaetes

Ursula Shepherd⁴⁹

Maren Ziegler

Diversity of symbionts in marine invertebrates and sediments

Stephen Simpson⁴²

Impacts of boat noise on coral reef fish

Josephine Starrs¹⁰

Leon Cmielewski¹²

Sentinel: a media art installation

Sara Stieb^{9,36}

The comparison of the freshwater cichlid and marine reef fish visual system

Shelby Temple³⁷

Polarised vision in fish and cephalopods

Gergely Torda

as field leader for

Bette Willis^{1,5}

Ecological significance of coral disease on the Great Barrier Reef

Sean Ulm⁵

Ian McNiven⁷

Lizard Island Archaeological Project: Mangrove Beach headland midden

Sue-Ann Watson^{1,5}

Philip Munday^{1,5}

Effects of global climate change on marine organisms

Joanna Werminghausen

as field leader for

Alexandra Grutter⁹

What happens to reefs without cleaner fish?

Marian Wong¹³

Social behaviour of coral gobies

Left and middle: Tubeworms that have been removed from their tubes. The long narrow feeding tentacles are normally all that is exposed.
Photos: Alexander Semenov

Far right: Vasily Radashevskiy collecting worms in sediment during the polychaete workshop.



Postgraduate Research Students

Samantha Aird⁵
Assessing late Holocene human predation on *Trochus* and *Tridacna* on Lizard Island, Northeastern Australia (Honours)

Bridie Allan⁵
Ontogenetic shifts in lateralization (PhD)

Kristen Anderson⁵
Effects of environmental change on the growth rates of branching corals (PhD)

Sandra Binning^{1,4}
Can coral reef fish change their shape to suit their environment? (PhD)

Shane Blowes⁵
Competition and coexistence in the butterflyfish community (PhD)

April Boaden^{1,5}
Influence of predation and competition on growth and otolith microstructure of prey (PhD)

Lilly Bojarski³⁴
Microbial nitrogen fixation in the hindgut of marine herbivorous fishes (PhD)

Michael Bok⁴⁵
UV vision in mantis shrimp (PhD)

Simon Brandl^{1,5}
Feeding of herbivorous fishes on cryptic surfaces (PhD)

Christoph Braun⁹
UV-induced DNA damage and UV avoidance (PhD)

Rohan Brooker⁵
Chemical crypsis in reef fish (PhD)

Jordan Casey^{1,5}
The role of territorial grazer behaviour and community structure in coral reef trophic dynamics (PhD)

Katy Corkill⁵
Is fish shape density dependent? (Honours)

Fabio Cortesi^{9,36}
Being brown or yellow: ecological and molecular base for colour adaptation in *Pseudochromis fuscus* (PhD)

Ilse Daly³⁷
The visual system of stomatopods (PhD)

Lindsey Dougherty³⁸
Mechanisms, ultrastructure and behavioural function of flashing in *Ctenoides ales* ‘disco clams’ (PhD)

James Foster³⁷
Do fish use polarization to see through veiling light? (PhD)

Simon Gingins⁴⁸
Adaptations to cleaning mutualism: a comparative approach (PhD)

Sophie Holles³⁷
Effects of chronic/ repeated boat noise on *Acanthochromis polyacanthus* (PhD)

Tom Hata²⁷
Flow and settlement of coral larvae (PhD)

Kate Johnson³⁴
Ultrastructure and function of the hindgut in marine herbivorous fishes (PhD)

James Kerry⁵
Role of canopy structures in the ecology of large reef fishes (PhD)

Michael Kramer^{1,5}
Trophic importance of crustacea on coral reefs (PhD)

Iris Krehahn⁵
Influence of topography on Predator-prey dynamics in reef fish (Masters)

Govinda Lienart⁵
Temperature effect on predator-prey interactions (PhD)

Oona Lonnstedt⁵
Predator-prey interactions and the importance of sensory cues in a changing world (PhD)

Storm Martin⁹
Taxonomy and bigeography of the trematode genus *Hamacreadium* in tropical fishes (Honours)

Georgia McGee⁵
Influence of a warming climate on the aerobic metabolism and predator defence strategies of pufferfish (Honours)

Gabrielle Miller⁵
Carbon dioxide effects on mollusc response to fish predators (PhD)

Lauren Nadler^{1,5}
Effect of temperature on the efficiency of schooling behaviour in coral reef fish (PhD)

Cait Newport⁹
Object recognition in fish (PhD)

Katia Nicolet⁵
Coral disease dynamics on the Great Barrier Reef (PhD)

Jess Nowicki^{1,5}
Effects of environmental correlates on foraging ecology of Sand Perch (PhD)

Jack O’Connor^{3,11}
Orientation strategies of larval fish in the pelagic environment (PhD)

Maria del Mar Palacios^{1,5}
Interactions among coral reef fish predators (PhD)

Pedro Pereira^{1,5}
Coral gobies competition (PhD)

Genevieve Phillips⁹
The function of reef fish colour patterns: how did the coral trout get its spots? (PhD)



Far left: Green turtles are common at Lizard Island.

Left: Beautiful coral community at an unnamed midshelf reef SE of Lizard Island

Julius Piercy⁴¹
Effect of reef soundscapes and anthropogenic noise on larval recruitment (PhD)

Ana Pinto *as field leader for* **Sharon Wismer**⁴⁸
Ontogeny of cognition in bluestreak cleaner wrasse, *Labroides dimidiatus* (PhD)

Chiara Pisapia^{1,5}
Intraspecific variation in coral colony condition (PhD)

F. Joseph Pollock^{1,5}
Understanding white syndrome in the Indo-Pacific (PhD)

Davina Poulos^{1,5}
Prior residency effects and the dynamics of fish communities in a changing environment (PhD)

Martina de Freitas Prazeres^{1,9}
Benthic foraminifera as a tool for detecting environmental and ecological changes on the GBR (PhD)

Justin Rizzari^{1,5}
Indirect effects of predators on coral reef trophic ecology (PhD)

Dominique Roche^{1,4}
Gill parasites of coral reef fishes (Monogenea) (PhD)

Dominique Roche^{1,4}
Bio-physical interactions and predator-prey relationships in coral reef fishes (PhD)

Emily Searle⁹
Monorchiidae of haemulids on the Great Barrier Reef (Honours)

Tara Stephens⁵
Mortality estimation of herbivorous coral reef fish using direct telemetry methods (Honours)

Elizabeth Stone⁴⁹
Genetic diversity of *Symbiodinium* in a number of invertebrate hosts and communities at Lizard Island (Honours)

Derek Sun⁹
The role of parasites and cleaning behaviour in coral reef fish recruitment (PhD)

Rachel Templin⁹
Parallel vs convergent processing in the polarisation vision system in the stomatopod (PhD)

Hanne Thoen⁹
Colour vision in mantis shrimp (PhD)

Zegni Triki⁴⁸
Effects of hormones on mutualistic cleaning interactions in parasitized client reef fish (Masters)

Alex Vail⁴⁰
Cooperative hunting between groupers, moray eels and octopus (PhD)

Mathew Vickers⁵
Microclimate use and behavioural thermoregulation of reptiles (PhD)

Naohisa Wada²
Understanding coral bacterial aggregates (Masters)

Justin Welsh^{1,5}
Spatial ecology of coral reef fishes (PhD)

James White^{1,5}
Short term consistency in fish behaviour (PhD)

Anne Winters *with supervisor* **Karen Cheney**⁹
Evolution of chemical defence and visual warning signals in opisthobranch molluscs (PhD)

Undergraduate Research Students

Amy Adams⁴⁹
Diversity of *Symbiodinium* in invertebrate host species

Rosstin Ahmadian⁴⁹
Development stages in the nudibranch *Phyllodesmium lizardensis*

Rebecca Choi²⁴
Lateralization changes in ontogenetic stages of coral reef damselfishes

Jennifer Fields²⁴
Effects of ocean acidification on mollusc behavior

Lian Guo²⁴
Exploring a novel method of controlling Crown-of-Thorns Starfish: lethal effects of oxbile and impacts on surrounding coral reef organisms

Elizabeth Kubacki²⁴
Indirect benefits of high-coral cover for benthic invertebrate feeding butterflyfish *Chaetodon auriga* and *Chaetodon vagabundus*

Dominic Medina⁴⁹
Bacterial diversity in several invertebrate taxa at Lizard Island

Matthew Norstad²⁴
Disease dynamics: interactions of the coral-eating *Drupella* and *Chaetodon plebeius* with black band disease on the Great Barrier Reef.

Leanne Pearl²⁴
How does boat noise affect behaviour and community structure of *Acanthochromis polyacanthus*?

Jillian Sweeney⁴⁹
Glucose and lipids in xenid corals under different light regimes

Clara Weston²⁴
A novel method for controlling Crown-of-Thorns Starfish populations using oxbile and oxgall solutions

INSTITUTIONS		
Australian		
1	ARC Centre of Excellence for Coral Reef Studies	18 Institute of Marine Biology, Vladivostok, Russia
2	Australian Institute of Marine Science	19 Lomonosov Moscow State University, Russia
3	Australian Museum	20 Museum of Natural History and Archaeology, NUST, Norway
4	Australian National University	21 National Council of Research, Spain
5	James Cook University	22 Natural History Museum London, UK
6	Macquarie University	23 Norwegian University of Science and Technology
7	Monash University	24 School for International Training, USA
8	Museum and Art Gallery of the Northern Territory	25 Senkenberg Institute and Museum, University of Hamburg, Germany
9	University of Queensland	26 Southern Illinois University, USA
10	University of Sydney	27 Stanford University, USA
11	University of Technology Sydney	28 Texas A&M University, USA
12	University of Western Sydney	29 UniMiljo, Norway
13	University of Wollongong	30 Universidad Autónoma de Madrid, Spain
International		
14	Auburn University, USA	31 Universidade Federal do Rio de Janeiro, Brazil
15	Auckland University of Technology, New Zealand	32 University Museum of Bergen, Norway
16	Colgate University, USA	33 University of A Coruña, Spain
17	Cornell University, USA	34 University of Auckland, New Zealand
		35 University of Barcelona, Spain
		36 University of Basel, Switzerland
		37 University of Bristol, UK
		38 University of California Berkeley, USA
		39 University of California Santa Barbara, USA
		40 University of Cambridge, UK
		41 University of Essex, UK
		42 University of Exeter, UK
		43 University of Glasgow, UK
		44 University of Leipzig, Germany
		45 University of Maryland Baltimore County, USA
		46 University of Maryland College Park, USA
		47 University of Miami, USA
		48 University of Neuchatel, Switzerland
		49 University of New Mexico, USA
		50 University of Oslo, Norway
		51 University of Sao Paulo, Brazil
		52 University of Saskatchewan, Canada
		53 University of South Dakota, USA
		54 University of St Andrews, UK
		55 White Sea Biological Station of Lomonosov Moscow State University, Russia
		56 Zoological Research Museum Bonn, Germany



Top: Catch-and-release fishing can have better outcomes: Andrew Hoey, Andrew Tobin and Vanessa Messmer have a Peter Teakle Sustainable Fishing Grant to work out how.

Above: Mark Meekan with larval fish, the subject of many research projects.

Opposite: Lizard Island lagoon from Lizard Head. Photo: Anna Murray

Student Groups

Brighton Grammar School
Led by Peter Whitehead, James Gerstman and Reef Ecotours staff

School for International Training
Two groups led by Tony Cummings and Darren Coker

RMIT University
Led by Jeff Shimeta, Gale Spring and Richard Wylie

Geelong College Preparatory School
Led by Benjamin Robbins, Marita Seaton and Reef Ecotours staff

Ascham School
Led by Edward Sze-Tu, Patricia Huary and Reef Ecotours staff

Barker College
Led by Tim Binet, Sarah Cormio and Amy Mackay

Other Visitors

ABC Documentary
Hakim Abdelkhalek
Cyril Paquier
Marie Roman

Australian Museum Trustees
Catherine Livingstone AO
Paul Connor
Merlin Crossley
Karina Kelly
Kim McKay
Led by Brian Lassig (Assistant Director, Science and Learning)

Australian Museum Staff
Paul Flemons
Rebecca Johnson

Australian Museum Members
Noreen Armstrong
Marlen Dyne
Anne Measday
John Offord
Jane Parker
Andrew Ross
Sarah Seldon
Denzil Seldon
Led by Ian Morris OAM, Giorgia Palmeri (Odyssey Travel) and Daniela Ceccarelli (Reef Ecotours)

GBR Ocean Observing System Development Australian Institute of Marine Science
Ray Boyes
Scott Gardner
Shaun Hahn

Microscope Maintenance
Allan Ross

Publications

In 2013, 140 publications based on work carried out at LIRS were received into the collection. There are now more than 1750 LIRS publications.

1. Allan, B.J.M., P. Domenici, M.I. McCormick, S.-A. Watson and P.L. Munday, 2013. Elevated CO₂ affects predator-prey interactions through altered performance. *PLoS One*, 8(3): e58520. doi:10.1371/journal.pone.058520.

2. Anthes, N., J. Werminghausen and R. Lange, 2013. Large donors transfer more sperm, but depletion is faster in a promiscuous hermaphrodite. *Behavioural Ecology and Sociobiology*, doi: 10.1007/s00265-013-1662-y.

3. Bandaranayake, W.M. and A. Des Rocher, 1999. Role of secondary metabolites and pigments in the epidermal tissues, ripe ovaries, viscera, gut contents and diet of the sea cucumber *Holothuria atra*. *Marine Biology*, 133: 163-169.

4. Beckmann, C. and P.A. Biro, 2013. On the validity of a single (boldness) assay in personality research. *Ethology*, 119: 937-947.

5. Binning, S.A., D.G. Roche and C.J. Fulton, 2013. Localised intraspecific variation in the swimming phenotype of a coral reef fish across different wave exposures. *Oecologia*, doi: 10.1007/s00442-013-2794-5.

6. Blowes, S.A., M.S. Pratchett and S.R. Connolly, 2013. Heterospecific aggression and dominance in a guild of coral-feeding fishes: the roles of dietary ecology and phylogeny. *The American Naturalist*, 182: 157-168.

7. Borsa, P., I.S. Arlyza, W.-J. Chen, J.-D. Durand, M.G. Meekan and K.N. Shen, 2013. Resurrection of New Caledonian maskray *Neotrygon trigonoides* (Myliobatoidei: Dasyatidae) from synonymy with *N. kuhlii*, based on cytochrome-oxidase I gene sequences and spotting patterns. *Comptes Rendus Biologies*, 336: 221-232.

8. Bott, N.J., T.L. Miller and T.H. Cribb, 2013. Bucephalidae (Platyhelminthes: Digenea) of *Plectropomus* (Serranidae: Epinephelinae) in the tropical Pacific. *Parasitology Research*, 112: 2561-2584.

9. Brandl, S.J. and D.R. Bellwood, 2013. Morphology, sociality, and ecology: can morphology predict pairing behavior in coral reef fishes? *Coral Reefs*, 32: 835-846.

10. Brandl, S.J., A.S. Hoey and D.R. Bellwood, 2013. Micro-topography mediates interactions between corals, algae, and herbivorous fishes on coral reefs. *Coral Reefs*, doi: 10.1007/s00338-013-1110-5.

11. Brooker, R.M., 2013. Habitat preferences of a corallivorous reef fish: predation risk versus food quality. *Coral Reefs*, 32: 613-622.

12. Brooker, R.M., G.P. Jones and P.L. Munday, 2013. Within-colony feeding selectivity by a corallivorous reef fish: foraging to maximize reward? *Ecology and Evolution*, 3(12): 4109-4118.

13. Bryant, L.M., 2013. Cryptic diversity and evolutionary relationships among Australian closed-forest *Melomys* (Rodentia: Muridae) and related Australo-Papuan mosaic-tailed rats. PhD thesis, Queensland University of Technology.

14. Camacho-García, Y.E., E. Ornelas-Gatdula, T.M. Gosliner and Á. Valdés, 2013. Phylogeny of the family Aglajidae (Pilsbry, 1895) (Heterobranchia: Cephalaspidea) inferred from mtDNA and nDNA. *Molecular Phylogenetics and Evolution*, dx.doi.org/10.1016/j.jmpev.2013.11.010.

Right: Hanne Thoen presents some of her work to LIRS researchers.



Far right: Prof. Morgan Pratchett dissecting Crown-of-Thorns Starfish in the Purves Lab at LIRS.



15. Ceccarelli, D.M., M.J. Emslie and A.R. Lewis, 2013. Farming versatility by *Pomacentrus wardi*. *Marine and Freshwater Research*, 64: 558-561.

16. Cheney, K.L., C. Newport, E.C. McClure and N.J. Marshall, 2013. Colour vision and response bias in a coral reef fish. *Journal of Experimental Biology*, 216: 2967-2973.

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18. Chivers, D.P., D.L. Dixon, J.R. White, M.I. McCormick and M.C.O. Ferrari, 2013. Degradation of chemical alarm cues and assessment of risk throughout the day. *Ecology and Evolution*, 3(11): 3925-3934.

19. Chivers, D.P., M.I. McCormick, G.E. Nilsson, P.L. Munday, S.-A. Watson, M.G. Meekan, M.D. Mitchell, K.C. Corkill and M.O. Ferrari, 2013. Impaired learning of predators and lower prey survival under elevated CO₂: a consequence of neurotransmitter interference. *Global Change Biology*, doi: 10.1111/gcb.12291.

20. Cisternas, P., T.D. O’Hara and M. Byrne, 2013. An ornate fertilisation envelope is characteristic of some *Ophiocoma* species. Echinoderms in a Changing World, Johnson (ed.), Taylor & Francis Group, London, pp. 229-231.

21. Couturier, C.S., J.A.W. Stecyk, J.L. Rummer, P.L. Munday and G.E. Nilsson, 2013. Species-specific effects of near-future CO₂ on the respiratory performance of two tropical prey fish and their predator. *Comparative Biochemistry and Physiology, Part A*, 166: 482-489.

22. Crawley, N.E., 2013. The global impacts of climate change on fish. PhD thesis, Brunel University.

23. Cribb, B.W. and I.D. Whittington, 2004. Anterior adhesive areas and adjacent secretions in the parasitic flatworms *Decacotyle lymmae* and *D. tetrakordyle* (Monogenea: Monocotylidae) from the gills of stingrays. *Invertebrate Biology* 123(1): 68-77.

24. Cronin, T.W. and R.L. Caldwell, 2002. Tuning of photoreceptor function in three mantis shrimp species that inhabit a range of depths. II. Filter pigments. *Journal of Comparative Physiology A*, 188: 187-197.

25. Cronin, T.W., N.J. Marshall and R.L Caldwell, 1994. The intrarhabdomal filters in the retinas of mantis shrimps. *Vision Research*, 34(3): 279-291.

26. Cronin, T.W., N.J. MarshallI, C.A. Quinn and C.A. King, 1994. Ultraviolet photoreception in mantis shrimp. *Vision Research*, 34 (11): 1443- 1452.

27. Cronin, T.W., R.L. Caldwell and J. Marshall, 2006. Learning in stomatopod crustaceans. *International Journal of Comparative Psychology*, 19: 297-317.

28. Cronin, T.W., R.L. Caldwell and M.V. Erdmann, 2002. Tuning of photoreceptor function in three mantis shrimp species that inhabit a range of depths. I. Visual pigments. *Journal of Comparative Physiology A*, 188: 179-186.

29. Cumming, R.L., 2009. Case study: impact of *Drupella* spp. on reef-building corals of the Great Barrier Reef. Great Barrier Reef Marine Park Authority Research Publication 97.

30. Curtis, L.M., 2010. Haemogregarine blood parasites in triggerfish and surgeonfish: distribution, transmission and

implications for their host fish. PhD thesis, University of Queensland.

31. Curtis, L.M., A.S. Grutter, N.J. Smit and A.J. Davies, 2013. *Gnathia aureamaculosa*, a likely definitive host of *Hemogregarina balistapi* and potential vector for *Hemogregarina bigemina* between fishes of the Great Barrier Reef, Australia. *International Journal for Parasitology*, <http://dx.doi.org/10.1016/j.ijpara.2012.11.012>.

32. Cutmore, S.C., T.L. Miller, S.S. Curran, M.B. Bennett and T.H. Cribb, 2013. Phylogenetic relationships of the Gorgoderidae (Platyhelminthes: Trematoda), including the proposal of a new subfamily (Degeneriinae n. subfam.). *Parasitology Research*, 112:3063–3074.

33. Diaz, P.E., R.A. Bray and T.H. Cribb, 2013. *Paradiscogaster flindersi* and *P. oxleyi* n. sp. (Digenea: Faustulidae): overlapping host and geographical distributions in corallivore chaetodontid fishes in the tropical Indo-west Pacific. *Systematic Parasitology*, 86: 87-99.

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35. Duchene D., S.O. Klanten, P.L. Munday, J. Herler and L. van Herwerden, 2013. Phylogenetic evidence for recent diversification of obligate coral-dwelling gobies compared with their host corals. *Molecular Phylogenetics and Evolution*, 69: 123-132.

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Far left: Gorgonians occur in shallow water in some parts of the Lizard Island lagoon.

Left: Andrew Baird and Maria Dornelas collect spawn from corals placed in buckets for the annual event.

of Enchytraeidae (Annelida, Clitellata). *Molecular Phylogenetics and Evolution*, 57: 849-858.

38. Fautin, D.G. and D.R. Smith, 1997. Clonality as a taxonomic character of actinian species. *Proceedings of the 8th International Coral Reef Symposium*, 2: 1609-1612.

39. Feller, K.D., T.W. Cronin, S.T. Ah Yong and M.L. Porter, 2013. Morphological and molecular description of the late-stage larvae of *Alima* Leach, 1817 (Crustacea: Stomatopoda) from Lizard Island, Australia. *Zootaxa*, 3722 (1): 22-32.

40. Fox, R.J., 2012. The trophic and spatial ecology of rabbitfishes (Perciformes, Siganidae) on coral reefs. PhD thesis, James Cook University.

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44. Gagliano, M., W.C. Dunlap, R. de Nys and M. Depczynski, 2009. Ockham’s razor gone blunt: coenzymeQ adaptation and redox balance in tropical reef fishes. *Biology Letters*, 5: 360-363.

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cooperation in a cleaner wrasse mutualism. *Proceedings of the Royal Society B*, 280: 20130553.

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Right: Soft corals in the genus *Dendronephthya* are common at Lizard Island.

Far right: Crown-of-Thorns Starfish reached outbreak proportions at Lizard Island in 2011 and they are still present in large numbers.



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Far left: Batfish (*Platax teira*) at Lizard Island.

Left: Despite Crown-of-Thorns Starfish outbreaks, storms and other impacts, there is still plenty of healthy reef at Lizard Island.

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Right: Lance and Marianne Pearce with their namesake.

Far right: A new method of controlling Crown-of-Thorns Starfish was trialled at Lizard Island thanks to a John & Laurine Proud Fellowship won by Jairo Rivera Posada.



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Far left: Sean Connolly works into the night to process coral spawn samples.

Left: Katy Corkill (left) and Lauren Hughes at work in the Purves Lab.

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