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LIZARD ISLAND
RESEARCH STATION

Australian Museum
6 College Street Sydney NSW 2010 Australia
t +61 2 9320 6000
www.australianmuseum.net.au

LIZARD ISLAND RESEARCH STATION NEWSLETTER 2011

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Directors
Dr Lyle Vail and Dr Anne Hoggett

Lizard Island Research Station
PMB 37
Cairns QLD 4870
Australia

Phone: + 61 (0)7 4060 3977
Fax: + 61 (0)7 4060 3055
Email: lizard@austmus.gov.au
www.australianmuseum.net.au/Lizard-Island-Research-Station

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AUSTRALIAN MUSEUM DIRECTOR'S REPORT

In the 2010 newsletter I wrote about the trends in the type of research that is done at our Station and the need to provide adaptable, leading edge facilities, able to meet changing needs. With an estimated 75% of the world's reefs seriously threatened, we have a massive responsibility to better understand these unique systems. I also alluded to the importance of longer term research to meet the enormous and complex challenges facing coral reefs around the world, including those on our door step.

Long term commitment is a strong characteristic of those who have served to make the Research Station the leading on-reef research facility that it is today. This year marks the conclusion of a collective centenary of commitment of several very significant Lizard Island Research Station contributors. I would like to pay my personal tribute to the remarkable and sustained efforts of those who have been instrumental in the Station's achievements but who have now chosen to follow other paths - Ken Coles AM, the Foundation Chair for the past 18 years; Andrew Green, for 34 years of service on the Foundation as member, Secretary, Treasurer and Public Officer and Lance and Marianne Pearce for their 24 years of dedicated service on the Research Station.

This year also marks the end of the highly successful 30th Anniversary development – a massive overhaul of the Station's infrastructure made possible by the Foundation and campaign leader Charlie Shuetrim AM in particular and, of course, the Research Station staff.

As with coral reefs themselves, turnover creates opportunities. I look forward to working with the new Foundation chair, members and Station staff to ensure we are in a strong position to meet the challenge.

FRANK HOWARTH
Director, Australian Museum

RESEARCH STATION DIRECTORS' COMMENT

Change can be unsettling, perhaps more so when you know that something is about to happen but it hasn't happened yet. This year brought a frisson of uncertainty when key people who have long been associated with LIRS decided to change their roles. In 2012, Lance and Marianne Pearce will retire after almost 24 years as maintenance staff. As well, Ken Coles is stepping back from 18 years of chairing the Lizard Island Reef Research Foundation. Just one of these changes is major, but two in the same year is quite boggling.

All of these people are much more than work colleagues - they are dear friends. With Lance and Marianne, we've had many good times and forged the strong bonds that you only get by facing real challenges together, and there have been plenty of those over the years. Ken's life is very different to ours but he moves gracefully between the two worlds and makes sure that they mix. He gives sage advice and unstinting support and he has the leadership to bring others along with him. All three have worked hard in their different ways to help make LIRS a success. We are privileged to have worked with them for so long.

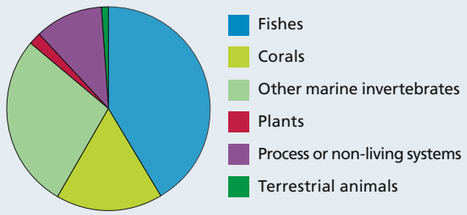
Another looming change is the end of the 30th Anniversary Development in 2012. This has been a major focus for almost ten years. The infrastructure is now in place to keep LIRS productive and relevant into the future. The challenge is to maintain it and to ensure that it continues to be used well. Planning for the next phase at the Station is well under way.

Managing change is the subject of much hot air. We think that change is one of life's spices to be enjoyed. We are pleased that Lance, Marianne and Ken have chosen to change their roles - especially since they will all remain close to LIRS. We wish them well and thank them sincerely for their contributions and their friendship. And we look forward to entering the next phase at LIRS with the stability of Bob and Tania Lamb continuing in their half-time maintenance roles, Ken remaining a trustee on the wonderful LIRRF board, and with new people who have yet to be found filling some very big boots.

ANNE HOGGETT AND LYLE VAIL
Directors, Lizard Island Research Station

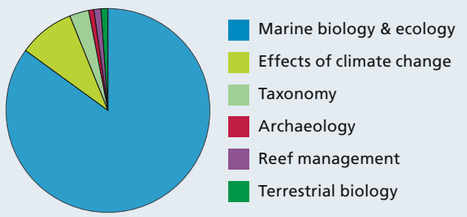
2011 IN SUMMARY

Research usage by senior scientists and research students comprised more than 70% of total visitor usage in 2011 (6392 person nights).



Fishes and marine invertebrates other than corals were the most frequent subjects of research.

Senior scientists and PhD students led nearly 90% of the 103 research projects conducted during 2011.



As usual, marine biology and ecology were the main research areas.

FEATURED RESEARCH

MIXED-UP FISH

Fish behave strangely – and in ways that do not help survival - when living in seawater with the higher levels of carbon dioxide that are predicted to occur this century. This is according to numerous papers published this year based on research conducted at Lizard Island, a few of which are outlined here.

Maud Ferrari and colleagues showed that the larvae of several damelfish species don't avoid predators in a high carbon dioxide environment as well as they usually do (*Global Change Biology,* 2011). In the aquarium, the team found that fish continued to feed and swim much more when exposed to predation risk in an elevated carbon dioxide environment than in normal seawater. To see whether this behaviour is actually as maladaptive as it seems, they did a field experiment. They released tagged fish that had been raised in the aquarium at various carbon dioxide levels onto patch reefs and followed their survival. While about 90% of the individuals that had been raised in normal seawater survived for at least 30 hours, only 30% to 50% of those raised in elevated carbon dioxide water survived for that long.

FEATURED RESEARCH

Another likely maladaptive behaviour in reef fish larvae was found by Paolo Domenici and colleagues. They showed that elevated carbon dioxide affects behavioural lateralisation, which is the decision by a fish to turn to the left or right (*Biology Letters,* 2011). Individual fish that have been raised in high CO_2 water lose their normal tendency to turn a particular way when faced with a choice. Behavioural lateralisation is directly related to brain function through the visual system – by having a tendency to turn a particular way, individual fish can keep a given eye on the environment and make quicker decisions about which way to turn. This research suggests that elevated CO_2 has a direct effect on brain function in larval reef fishes.

Settlement behaviour of larval damselfishes is also affected by elevated carbon dioxide, as shown by Brynn Devine and colleagues (*Coral Reefs,* 2011). Settlement is a critical period in the life of a reef fish, when a larva must choose a permanent home on the reef after its first few weeks of life in open water. Larvae use many environmental cues to detect suitable habitats and to approach them at a time when the risk of being eaten is lowest; smell and vision are both important. The team found that larvae raised in elevated CO_2 water lost the ability to smell their preferred habitat but they were still able to find it when they could see it at close range in aquarium experiments. However, the timing of settlement was very different in high CO_2 water. Instead of settling at the new moon as is normal, larvae mostly settled at full moon when the risk of predation is higher. The researchers think that this shift occurred because with an impaired sense of smell, the larvae needed moonlight to find their preferred habitat by sight alone.

The same group of researchers found that high carbon dioxide levels disrupt the sense of smell in adult reef fishes - an effect that had previously been shown only for larvae - to the extent that their homing ability is badly affected (*Oecologia,* 2011). Homing is an important behaviour for many reef fishes, including cardinalfish which feed at night and rest at home sites during the day. The team held adult cardinalfish in water with various levels of CO_2 for several days then tested in aquaria whether treated fish approached a shoal-mate from its "home" site or a fish from a distant shoal, when they could smell but not see the other two fish. Fish treated in normal seawater spent much more time near their "home" fish while those treated with high CO_2 water showed no preference. Then the team released marked, treated fish 200 m from their home site and found that fish treated with high CO_2 water were 20% to 30% less likely to find their way home than fish treated with normal seawater.

All these studies showing that fishes' senses become scrambled in high CO_2 water led to the breakthrough discovery at Lizard Island of the cellular mechanism. Göran Nilsson and colleages found that the transmission of nerve signals in fishes' brains is disrupted (*Nature Climate Change,* January 2012). The story behind this discovery shows science at its best in operation.

Göran is an eminent physiologist from the University of Oslo who has conducted annual research visits to Lizard Island for many years. Through those trips he has developed collaborations with many ecologists and has been working recently with Phil Munday of James Cook University on the effects of climate change. They became increasingly intrigued by the sensory scrambling of reef fish. It is known that fish avoid becoming acidotic in high CO_2 water by shunting bicarbonate, chloride and hydrogen ions, among others, across cell membranes. From his knowledge of neurochemistry, Göran reasoned that this altered ion balance might affect nerve signals because receptors in the brain either transmit or inhibit them depending on the chemical environment. Particularly, the GABA-A neuroreceptor, which is found in all vertebrate and many invertebrate brains, could be affected since it uses chloride and bicarbonate to transmit its signals. Göran thought that the crazy behaviour of fish larvae raised in high CO_2 water might be reversed by treating them with gabazine, a specific antagonist of the GABA-A receptor. The team went to work on a series of experiments to see whether this was the case and the results were immediate and clear – fish reverted to normal behaviour when treated with gabazine. "These were the most exciting experiments of my career," says Göran. The research suggests that the nervous systems of other marine organisms are also likely to be affected by increasing ocean acidity. This adds to the long list of deleterious effects of climate change predicted for coral reefs and other marine systems.

Top right: Göran Nilsson (L) and Phil Munday.

FELLOWSHIPS AND GRANTS

A record eight new fellowships were awarded in 2011 by the Australian Museum for field-intensive research at LIRS. 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, the Yulgilbar Foundation, and the Teakle Foundation.

The Peter Teakle Sustainable Fishing Research Grant was awarded for the first time in 2011. It is fully funded by the Teakle Foundation which is led by Peter Teakle, an Australian businessman and keen game fisherman who is passionate about ensuring that recreational fishing is conducted sustainably.

Details of the conditions and selection criteria for fellowships and grants can be found in the Lizard Island Research Station 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.

	Maximum value	First awarded	Number awarded
Lizard Island Doctoral Fellowship	$24,000	1984	39
Ian Potter Doctoral Fellowship at Lizard Island	$24,000	2006	8
Isobel Bennett Marine Biology Fellowship	$11,000	2008	4
John & Laurine Proud Fellowship	$11,000	2008	5
The Yulgilbar Foundation Fellowship	$11,000	2009	5
Peter Teakle Sustainable Fishing Research Grant	$30,000	2011	1
Special grants	Varies	1998	3
TOTAL			65

OONA LÖNNSTEDT

2012 Ian Potter Doctoral Fellow at Lizard Island

James Cook University

Predator-prey interactions and the importance of sensory cues in a changing world

Little is known of the behavioural interactions between predators and their prey in tropical reef systems despite the importance of predation in promoting and maintaining biodiversity. To be successful, prey must live to pass on their genes to the next generation so they need to detect any potential threats as soon as possible. Predators need to feed to survive and so they need to locate prey and capture it. Recent research has highlighted the crucial roles that visual and particularly chemical cues play in influencing the outcomes of predator-prey interactions, but the balance and relative importance of each sensory system remains unknown.

Climate change threatens to perturb the delicate balance between predators and their prey. Ocean warming and acidification through elevated global CO_2 levels lead to rapid bleaching and often death of the live hard corals that underpin coral reef ecosystems. To predict how reef fish communities respond to changing environmental conditions we need to understand the complex relationships between predators and their prey, and how these may be affected by habitat degradation.

Early results from Oona's research show that a short initial experience with a predator immediately after a fish has settled from the plankton makes the potential prey fish more risk adverse and enhances survival of juveniles by at least 8 times. It also shows that smells - chemical cues - released from injured shoal-mate fishes are masked by coral degradation. This has the potential to dramatically affect the mechanisms by which these small prey fish learn about their predators. A primary aim of Oona's research is to determine to what extent predatory fish utilise the smell of their prey when hunting and particularly, how coral degradation influences the olfactory sense used by various species of predatory reef fish.

DOMINIQUE ROCHE

2012 Ian Potter Doctoral Fellow at Lizard Island

Australian National University

Surf's up! How waves affect predator-prey interactions in coral reef fishes

Predation is a fundamental process in determining the distribution and abundance of organisms in nature. During an encounter with a predator, the difference between life and death for the prey depends both on biological factors (e.g. the ability of both participants to accelerate) and physical factors (e.g. the availability of refuges). While previous research has examined these factors in isolation, we know very little about how biological and physical variables interact to influence the dynamics of predation.

Coral reefs are exceptionally biodiverse ecosystems but also one of the most physically challenging environments inhabited by fishes. Oscillatory water flow from wave action on coral reefs is thought to have destabilising effects on fish behaviours that require shorter bursts of locomotion, such as those that occur during predator-prey interactions. Currently, we do not know how such destabilising forces interfere with the daily activities of coral reef fishes, including vital behaviours such as capturing prey and escaping from predators.

Using a combination of field observations and laboratory experiments, Dom's research will be the first to experimentally evaluate the effects of wave energy on predator-prey interactions in a diverse assemblage of coral reef fishes. His results will enable us to better understand how characteristics of fishes and their environment affect habitat use and population size, and thereby the spatial arrangement of coral reef fish biodiversity.

Top left: Extreme low tides such as this occur on a few days during winter.

Top right: A school of surgeonfishes.

JUSTIN WELSH

2012 Lizard Island Doctoral Fellow

James Cook University

The spatial ecology of coral-reef fishes

Through their feeding activities, herbivorous fishes suppress the growth of macroalgae (fleshy seaweeds) and help reefs remain in a coral-dominated state. Despite the importance of this group of fish, we know little about their movements. Justin's research aims to redress this by quantifying their movement patterns and home ranges.

He will use ultrasonic transmitters and receiver units to do this. Signals from transmitters implanted in fish will be monitored by an array of about 25 acoustic receivers deployed in the Lizard Island lagoon. Movements of individual fish will be monitored by the array for about five months after which data will be downloaded and analyzed to identify patterns in tagged fishes' movements. These long-term monitoring periods will enable identification of an individual fish's home range and provide an understanding of any unusual movements, such as reproductive migrations or schooling events of tagged fish.

Once he has assessed the home range of an individual fish, Justin will identify habitat features within its home range that are essential for the fish's activities, including feeding, resting and mating. By identifying important areas of reef for fish behaviours it will be possible to identify key habitats that must be included within marine reserves in order to optimise their effectiveness.

Justin will also manipulate experimentally the presence of macroalgae on small areas of reef outside a fish's territory to determine whether herbivorous fishes will move out of their normal home range to control algae growth in the experimental plots. Knowing the extent and plasticity of the feeding range of herbivorous fish will help reef managers predict areas of coral reefs that may best be protected from impacts that reduce coral coverage and promote the growth of algae.

FELLOWSHIPS

SHARON WISMER

2012 Lizard Island Doctoral Fellow

University of Neuchâtel

Cognitive flexibility in bluestreak cleaner wrasse: environmental constraints?

Animal cognition refers to the mechanisms involved in learning, memory and decision-making. Recent evidence suggests that other animals are capable of some of the cognitive abilities previously described only in primates. The bluestreak cleaner wrasse is a prime example.

Cleaner wrasse engage in over 2000 social cleaning interactions with reef fish clients per day, mostly removing parasites. Although a mutualistic relationship, conflict arises as cleaners largely prefer to 'cheat' clients by feeding directly on mucus, which is energetically costly for the client to produce. In order to optimise their preferred food intake across repeated cleaning interactions, cleaner wrasse use Machiavellian intelligence-like behavioural strategies to manipulate, exploit, reconcile and cooperate with their clients. Due to the complex nature of these interactions, cleaner wrasse encounter substantial cognitive demands, which nevertheless differ strongly between sites.

Sharon will investigate the role of ecology in shaping cognitive flexibility in the cleaner wrasse. First, she will cross-release both adult and juvenile cleaner wrasse from simple and complex habitats and assess whether they are able to adapt their strategic behaviour to suit novel environmental conditions. Then she will identify mechanisms which lead to changes in cognition and decision rules. Together, these investigations should allow Sharon to determine whether the behaviour of cleaner wrasse is purely "hardwired" or whether these fish are able to adapt their behaviour to their ecology. The knowledge about whether fish are specifically adapted to micro-ecologies within a larger ecological niche will have important conservation implications. The results may also help inform the growing realisation that many animals that lack large brains may nonetheless manifest advanced cognitive abilities. Finally, the study will provide broader information on the ways in which micro-ecologies can influence an animal's behaviour.

DR VANESSA MESSMER

2012 Isobel Bennett Marine Biology Fellow

ARC Centre of Excellence for Coral Reef Studies

James Cook University

Effects of climate change on reproduction, larval development and population growth of coral trout

Climate change is rapidly emerging as one of the greatest threats to coral-reef ecosystems and reef-associated fishes, with predicted increases in sea surface temperature of 1-4°C by 2100. The most immediate, but indirect impact to reef fishes is and will be habitat degradation, with loss of live coral and the three-dimensional structural complexity of reefs through coral bleaching, storms and erosion and increasing ocean acidification.

Temperature plays a vital role for fishes, as their internal temperature directly reflects what they experience in their environment. Temperature influences the life of a fish in every possible way: it determines the distribution of a species, affects habitat choice and behaviour and influences virtually all cellular, biochemical and physiological processes. A fish therefore thrives under certain environmental conditions, for which it is optimally adapted, but these conditions vary greatly between species and species groups.

Vanessa's research will test the effects of increasing temperatures on the common coral trout (*Plectropomus leopardus*), a large predatory reef fish and the most important fisheries species on the Great Barrier Reef. The project will address the following questions: To what degree are coral trout dependent on live coral, especially during the early stages of its life? How does temperature affect the metabolic rate of coral trout during different stages of its life? Will coral trout be able to cope with the projected increases in temperature? Will temperature affect the capacity of coral trout to capture prey? Results from her research will provide important information on how this commercially important species will be impacted by climate change.

DR ASHLEY FRISCH

2012 John and Laurine Proud Fellow

ARC Centre of Excellence for Coral Reef Studies

James Cook University

Apex predators on coral reefs – Do marine parks need sharks?

Healthy coral reefs provide enormous economic, cultural and environmental benefits to Australia and its near neighbours. Reef sharks, the apex predators of coral reefs, are heavily exploited both in Australia and abroad. This activity threatens the health and resilience of coral reefs and the many livelihoods they sustain. The Great Barrier Reef supports a $5.1 billion tourism industry and opportunities to view reef sharks are a major tourism attraction. Therefore, the need to effectively conserve and manage reef sharks is a high priority.

Ashley's research will identify the importance of reef sharks in maintaining coral reef health by quantifying their ecological role. He and his team will undertake field research at Lizard Island and at numerous nearby reefs. The proximity of the Lizard Island Research Station to multiple-use management zones makes it an ideal location to undertake this type of project.

Describing the ecological role of reef sharks requires an understanding of how reef organisms interact with each other (e.g. via competition and predation) and how energy is transferred through the community. This information is best captured in a food web model that quantifies the strength of each interaction, or the proportion of prey biomass consumed per unit of predator biomass. Ashley's research will evaluate the importance of reef sharks to coral reefs via field observations, diet analyses and stable isotope measurements to develop a parameterized food web that (1) quantitatively describes the trophic relationships between functional groups across gradients of reef shark densities and (2) identifies the "top-down" structuring role of reef sharks. It is anticipated this research will underpin innovative approaches to ecosystem based management of coral reefs.

DR SHELBY TEMPLE

2012 Yulgilbar Foundation Fellow

University of Bristol

See coral reefs in a new light: communication and camouflage in the polarised light dimension

Scientists at the University of Bristol have built a specialised camera that enables them to see an aspect of light that humans are essentially blind to – polarised light. Though humans aren't sensitive to polarised light, many reef dwelling animals are, which means our understanding of reef communities may be limited by our previous oversight in ignoring the polarisation dimension in this environment.

Shelby and a team of researchers from the Ecology of Vision Laboratory at the University of Bristol will use their specialized camera to study how the coral reef environment looks to animals that can see polarised light. The camera enables researchers to measure the polarisation of light. It then converts these polarisation images into false colour images, where different colours represent different polarisations of light.

It is known that many animals can discriminate electric field vector (e-vector) orientation and direction of e-vector spin (circular polarisation) of polarised light. For instance, cephalopods do not possess colour vision at all even though they are some of the most behaviourally complex creatures in the sea. Instead they possess polarisation vision which is more robust to diurnal-, depth- and turbidity-related changes in light intensity and colour. The main objective of Shelby's research will be to quantify the polarisation sensitivity of various reef animals and to characterize polarisation patterns of reef inhabitants relative to their background.

Top left: Apex predator.

Top middle: A cleaner wrasse cleaning the gills of a Bluespotted Coral Trout.

Top right: Light is important on reefs.

FELLOWSHIPS

DR TIMOTHY CLARK[1] (left),
DR STEVEN COOKE[2],
DR VANESSA MESSMER[3],
DR ANDREW TOBIN[4], AND
PROF MORGAN PRATCHETT[3]

2012 Peter Teakle Sustainable Fishing Research Grant

[1] Australian Institute of Marine Science
[2] Carleton University, Canada
[3] ARC Centre of Excellence for Coral Reef Studies, James Cook University
[4] Fishing and Fisheries Research Centre, James Cook University

Interactive effects of climate change and fisheries capture on the physiology and behavior of recreational fisheries species

A fish that is caught and released is often completely exhausted from the encounter, leaving it physiologically compromised (e.g., elevated heart rate and metabolism, elevated blood stress indices) with a depressed capacity for swimming activity. To maximise the likelihood that a fish will survive as intended after release, it is important to understand the stress that fisheries capture imposes on fish, and subsequently determine ways in which recovery can be enhanced prior to release. An additional stressor for fishes is the general warming trend that is occurring in many aquatic environments as a consequence of climate change. Since many tropical fish species live at temperatures approaching their thermal maximum, abnormally warm periods can push fish to their limits.

The inaugural Peter Teakle Sustainable Fishing Research Grant was awarded to a team of five researchers to study these issues. They will investigate the interactive effects of climate change and fisheries capture on key recreational and commercial fisheries species (coral trout, spangled emperor, stripey snapper) that are common in the Lizard Island region. They will use novel bio-logging technology to record heart rate, temperature, depth and 3D acceleration of individual fish. The bio-loggers have proven their utility in a number of temperate fish species and provided groundbreaking results. The stage is now set to utilise the technology to investigate questions relating to tropical fish species.

Almost nothing is known of the interactive effects of temperature and fisheries capture on tropical marine fishes. For example, is a fish more likely to recover quickly and survive if it is caught and released in winter rather than summer? Is post-release survival during summer likely to decrease if temperatures become warmer in future years? This project will quantify the conditions that result in optimal recovery of some species of reef fish, resulting in a set of 'best practices' for handling and recovering fish.

Left: Outer reef scene.
Top left: Blue Lagoon at low tide.
Top middle: Sea whip garden.
Top right: Chris Fulton and Mae Noble at work in the aquarium.

PROFILE OF A FORMER FELLOW

DR ALISON GREEN

Alison Green was the 1991 Lizard Island Doctoral Fellow. She did her undergraduate studies at the University of Queensland before moving to Townsville to do her PhD at James Cook University. Her PhD research at LIRS concerned the early life history of wrasses and parrot fishes and their interactions with territorial damselfish that protect patches of macroalgae.

Since completing her PhD, Alison has had an active career in marine science with much of her field work occurring outside Australia. Between 1994 and 1998 she worked in American Samoa and other US Pacific Islands as a coral reef biologist and consultant. During the next five years, she was Director of Science, Technology and Information at the Great Barrier Reef Marine Park Authority in Townsville. Since 2003 she has worked for The Nature Conservancy as a senior marine scientist. Some awards that she has received during her career include: The Nature Conservancy's Asia Pacific Conservation Award for Excellence in Site Conservation Practice: Kimbe Bay, Papua New Guinea and a Fulbright Scholarship.

Alison has extensive expertise in designing networks of marine protected areas. During the last few years she has provided scientific advice and training to field practitioners in over 20 countries in the Western Pacific, Southeast Asia, West Indian Ocean, Latin America and the Caribbean. Currently, she is providing technical assistance for integrating fisheries, biodiversity and climate change objectives into a network of marine protected areas in the Coral Triangle and Micronesia. To learn more about her work and The Nature Conservancy please visit her blog at http://blog.nature.org/author/agreen/

RESEARCH BY FELLOWS IN 2011

Fellowships supported research by nine scientists during 2011 (year of award shown in parentheses).

LIZARD ISLAND DOCTORAL FELLOWS	Jacob Johansen, James Cook University (2010) Chris Goatley, James Cook University (2010) F. Joseph Pollock, James Cook University (2011)
IAN POTTER DOCTORAL FELLOWS	Darren Coker, James Cook University (2010) Sandra Binning, Australian National University (2011)
ISOBEL BENNETT MARINE BIOLOGY FELLOW	Dr Stefan Walker, James Cook University (2011)
JOHN & LAURINE PROUD FELLOWS	Dr Michael Berumen, King Abdullah University of Science and Technology (2009) Dr Nichola Raihani, Zoological Society of London (2010)
YULGILBAR FELLOW	Dr Chris Fulton, Australian National University (2011) Jessica Stella, James Cook University (2011)
SPECIAL GRANT	Dr Sarah Hamylton, University of Wollongong (2011)

30TH ANNIVERSARY DEVELOPMENT

The final major construction project of the 30th Anniversary Development was completed in 2011 when a new solar hybrid power system came online in late February. The 30 KW system comprises an array of 144 solar panels integrated with large battery bank and existing diesel generators. This system reduces the Station's CO_2 emissions due to power generation by about 65%. We thank Andrew Beveridge and Oscar Arteaga of the now-defunct Research Institute for Sustainable Energy for establishing excellent design parameters and LIRS staff member Bob Lamb for detailed planning and careful installation of the solar hardware and switching systems.

The solar power system was funded by targeted donations from **Abercrombie & Kent Philanthropy** and the **Fred P. Archer Trust** (managed by **Trust Company**) with the balance from untied donations for the 30th Anniversary Project with major input from **The Ian Potter Foundation**. Live information about the system, including slideshows, is available at www.sunnyportal.com. Click on "Publicly available plants" and use the search function to find Lizard Island Research Station

The 30th Anniversary Development has now improved virtually every facility at LIRS including accommodation, laboratories, library, computer facilities, aquarium, diving and boating, workshop and power generation. In addition to the solar power system, the following upgrades were completed during 2011:

- *Kirsty K* was extensively refitted using untied donations to the **LIRRF**. This vessel has held up very well over nine years of heavy use and the refit should see it last for a similar amount of time with normal maintenance and motor replacement.
- The ninth new dinghy, *Mary Ida*, went into service. She was purchased with a donation from the **John Villiers Trust**.
- Funding for a tenth new dinghy was donated by the **Trust Company**. It will be ordered and delivered in 2012.
- The Station's most vital vehicle is the tractor. The existing tractor, funded by the **Thyne Reid Foundation** in 2005, was replaced with an identical new one after six years of excellent service using untied donations to the **LIRRF**. Replacing essential items of major equipment periodically enables reliability of operations.
- The **Thyne Reid Foundation** and the **Raymond E. Purves Foundation** have provided substantial funding for the purchase of laboratory and field equipment. This year, funds from the **Thyne Reid Foundation** were used to purchase underwater camera equipment, laboratory balances, an ice machine and other items.
- Transport and storage of petrol for outboard motors was improved with the purchase of four bulk stainless steel fuel containers using untied donations to the LIRRF. Two large containers (946 litres) are barged to Cairns for filling while two smaller ones (477 litres) are used on site for refuelling boats.

LIZARD ISLAND REEF RESEARCH FOUNDATION

FOUNDER
Sir John Proud[1]

PATRONS
Dr Des Griffin AM
Mr Trevor Haworth AM
Mr Raymond Kirby AO
Mr Henry Loomis[1] and Mrs Jacqueline Loomis
The Ian Potter Foundation
Lady Proud[1]
Mr Robert Purves AM
Thyne Reid Foundation
Prof Frank Talbot AM[4]
Dr Charles Warman AM[1]

TRUSTEES
Mr Kenneth Coles AM (Chairman)
Mr Andrew Green (Secretary & Treasurer)
Mr Charlie Shuetrim AM[4] (Chairman, Appeal Committee)
Dr Penny Berents
Mr James Bildner
Mr Paul Connor[2]
Dr Ronnie Harding
Mr Trevor Haworth AM
Mr Frank Howarth
Mr Chris Joscelyne
Mr Vivian King
Mr Raymond Kirby AO
Dr Cindy Pan[3]
Mrs Fiona Playfair
Mrs Heather Power
Mr Robert Purves AM
Mr David Shannon

1 Deceased
2 New Trustee in 2011
3 Retired as a Trustee in 2011
4 Congratulations to Charlie Shuetrim and Frank Talbot on their Medals of the Order of Australia, awarded in January 2011 and 2012, respectively.

Left: Solar power reduces the Station's carbon emissions from generating electricity by 65%.

Top left: Bob Lamb and his team atop the solar array.

Top middle: UQ PhD students Derek Sun and Alyssa Marshell with new boat *Mary Ida*.

Top right: Aquarium experiments in progress by JCU PhD student Matt Mitchell.

The Lizard Island Reef Research Foundation raises funds for the development of LIRS and to support coral reef research. Since its inception in 1978, it has raised almost $9.5 million. Without the support of the LIRRF, the LIRS would not be the world-class coral reef research station that it is today.

KEN COLES RETIRING AS CHAIRMAN

Ken Coles has been Chairman of the Foundation since 1994 and a Trustee since 1991. As noted in the LIRS Director's Comment (page 1), he plans to step down as Chairman next year. Ken has led the LIRRF to many achievements, including:

- Establishing the Members program, which has provided reliable funding for replacement of essential equipment at LIRS over many years and is a framework for special fundraising activities
- Establishing the tradition of annual events for members - a dinner in Sydney and a lunch in Melbourne - to keep them informed and engaged
- Recognising as Patrons those individuals and organisations who have provided exceptional service to the Foundation
- Encouraging development of the fellowships and grants program - the Foundation now supports six new awards each year
- Leading the fundraising effort in the 1990s to replace inadequate staff housing, an initiative that has played a major role in the stability of staff at LIRS
- With Trustee Charlie Shuetrim and the Board, successfully raising more than $5 million for the 30th Anniversary Development
- Maintaining an enthusiastic and effective board of Trustees for nearly two decades
- Providing a valuable legacy by recently establishing the Life Membership program (outlined below) - and by becoming, with his wife Rowena Danziger, one of the inaugural Life Members - that will ensure the ability of LIRS to support excellence in coral reef research into the future.

Ken will remain a valued Trustee of the Foundation and this will assist with an orderly transition to a new Chairman in 2012. We sincerely thank Ken for his outstanding tenure as Chairman.

BOARD CHANGES

The Australian Museum Trust generally appoints three of its board members as Trustees of the LIRRF. Dr Cindy Pan ably filled one of these positions until she retired from both boards in 2011 and we thank her for her support. We also welcome the new AM Trust representative, Paul Connor.

LIFE MEMBERS

The LIRRF established a new fundraising initiative this year to address the increasing maintenance needs of LIRS now that the 30th Anniversary Development is almost complete. The goal is to establish a substantial capital fund that will provide income to maintain LIRS into the future. Life Members make a minimum donation of $100,000 which can be spread over several years.

Peter Teakle became the inaugural Life Member in 2011. Peter has been involved with marlin fishing at Lizard Island for many years. As the owner of several large boats, he understands the necessity of maintaining such assets and the challenges of doing that in a marine environment. He also recognises the importance of LIRS in facilitating research that underpins environmental conservation, hence his generous donation.

As well as becoming a Life Member, Peter has provided $30,000 though his Teakle Foundation for the inaugural Peter Teakle Sustainable Fishing Research Grant to be awarded by the Australian Museum. The grant was first advertised in 2011 and research will commence in 2012. Additional information is provided on page 8.

Three couples who are long-term supporters of the LIRRF have also become Life Members, getting the program off to a wonderful start. They are Ken Coles and Rowena Danziger, Robert and Susan Maple-Brown, and Vivian and Wendy King. We thank them for their generous support.

MEMBERS

Members support LIRS by donating $1000 or more per year to the LIRRF. They go into a draw to win a three-night holiday for two at the Lizard Island Resort, including airfares within Australia. We thank the owner

of the resort, Delaware North Corporation, for contributing this fantastic prize. Please see the inside back cover for Members of the Foundation.

The 2011 luncheon for Members was held at the Athenaeum Club in Melbourne on 18 May with 30 people attending. The invited speaker, Professor Justin Marshall of the Queensland Brain Institute at the University of Queensland, has conducted research at Lizard Island over many years. Justin gave a fascinating presentation about how marine animals use colour for communication.

The annual Members' dinner was held at the Wharf Restaurant in Sydney on 14 September with 85 people attending. The guest speaker was Rebecca Fox, a PhD student at James Cook University and a current Lizard Island Doctoral Fellow. She spoke about her research at Lizard Island on the enigmatic rabbitfishes and also related her unusual path into marine science. Having completed an economics and politics degree, Rebecca worked for former UK Chancellor Gordon Brown until a visit to a remote coral reef moved her so much that she decided to change careers.

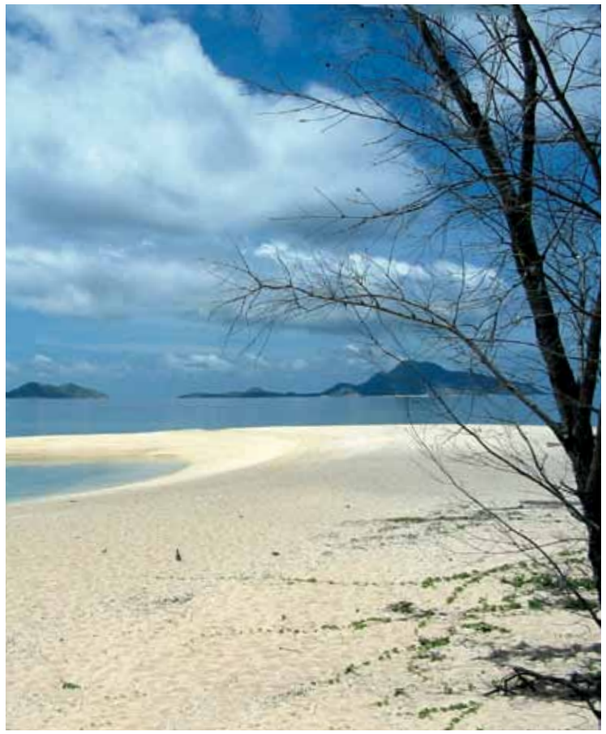
VISITORS

People associated with the Lizard Island Reef Research Foundation who visited during the year include Philip and Sylvia Hartog and their three daughters, Liz Loxton and her daughter, Peter and Nina Teakle and friends, Geoff and Elisabeth Haddy, Robert and Sarah McKay, and Lou and Mike Hamshere.

WHAT COMES NEXT?

We conducted an online survey in 2011 to find out how successfully LIRS meets the needs of its users and to inform planning for the next phase in the Station's development. The survey was advertised through relevant Australian scientific societies and internationally through Coral-List. There were 67 responses that were overwhelmingly positive about how the Station is currently performing. A full analysis of survey results can be found on the Lizard Island Research Station website under The Next Phase.

Ideas raised by the survey respondents are being considered during development of a new plan for LIRS in early 2012. However, it is clear that maintenance and incremental development of facilities will remain the priority. We thank everyone who took part in the survey for their time and interest in helping to improve LIRS.



LANCE & MARIANNE PEARCE TO RETIRE

Lance and Marianne have been valued maintenance staff at LIRS since August 1988. They worked at LIRS year-round until 1998 when their tropical fruit orchard near Innisfail had grown to a stage that it needed more of their attention. Since then, they have worked at LIRS for six months each year and spent the other six months at the farm and travelling. They have decided to retire in 2012, making it nearly 24 years at LIRS - a duration that may well be a record for staff at any island research station.

They have been a key pillar of this small community on a small island for a very long time. They are clever, hard-working, dependable, generous and kind and their time here has been much more than working a job, it's been living a life. We wish them many happy adventures as well as some peace and quiet - as they say, you can never have too many sunsets. We'll miss them terribly.

USAGE

Usage in 2011 was 6392 visitor nights, slightly lower than last year but still near the planned operating capacity of 7000 visitor nights. Core usage (researchers, postgraduate students and student groups) was 5496 visitor nights.

BENCH FEES

Per person per night, Including GST	2011	2012
Researcher	$119.50	$124.00
Researcher's assistant	$106.00	$110.00
Postgrad student (own project)	$47.00	$48.50
Postgrad's assistant	$42.50	$43.50
School or university group	$75.00	$78.00
Commercial	$216.00	$233.00

Far left: Peter and Nina Teakle.
Left: Lizard Island from North Direction Island.
Top: Lance and Marianne Pearce.

FOR THE **RECORD**

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 11am 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.

VOLUNTEERS

Volunteers provide valuable assistance with maintenance and other projects. Our sincere thanks goes to the following people for their help during 2011: Renie Amos, Snow Amos, Caroline Broughton, Kim Edgerton, Myriam Estrabaut, Julian Foerster, Terry Ford, Angela Goerlich, Wil Hendrikx, Rebecca Hill, Christian Hoffmann, Rob Leech, Nicolas Lemore, Angus Peters, Geoff Stearns, Lois Wilson, Helen Wodetzki, Peter Wodetzki.

In addition, we thank those who provided their specialist services to LIRS on a voluntary basis. Charlie Makray again provided first aid training for all staff and Allan Ross again serviced the Station's numerous microscopes. Michael Sladek provided training in the shipping of dangerous goods to four staff members.

VISIT BY MUSEUM TRUSTEES

In early August, three Australian Museum Trustees - Ronnie Harding, David Sherley and Paul Connor - visited LIRS to see the facilities, meet researchers and learn about future plans. Ronnie and Paul are also Trustees of the LIRRF. They were accompanied by Brian Lassig (the Museum's Assistant Director, Research & Collections). Later in the year, Australian Museum Trustee Michael Chaaya and his wife Michelle visited the Station during their stay at the Resort. We thank the Trustees and Brian for taking the time to visit the Station.

Top: Australian Museum Trustees David Sherley and Ronnie Harding.

STAFF

There were no changes to permanent staff during the year. Lyle Vail and Anne Hoggett continued as Directors, and the maintenance positions continued to be shared on six-month rotation between Lance and Marianne Pearce (in summer) and Bob and Tania Lamb (in winter). However, the search will soon begin for new maintenance staff to take Lance and Marianne's positions starting in September 2012.

Temporary and casual staff employed during 2011 were Julian Foerster and Tane Sinclair-Taylor.

VISITORS IN 2011

SCIENTISTS

ROB ADLARD
Queensland Museum
Endoparasites of coral reef fishes

TROND AMUNDSEN
Norwegian University of Science and Technology
Coral reef fish coloration: sexual selection, diversity and speciation

ANDREW BAIRD
James Cook University
Testing the adaptive capacity of corals to climate change: a demographic approach

REDOUAN BSHARY
University of Neuchâtel
Cooperative and cognitive aspects of cleaning symbiosis

KAREN BURKE DA SILVA
JOHN EDWARDS, **JEANNE YOUNG**
Flinders University
Anemone distribution and toxicity analysis

ROY CALDWELL
University of California Berkeley
Stomatopod behaviour

KAREN CHENEY
University of Queensland
Evolution of aposematic (warning) colouration in marine opisthobranchs

KAREN CHENEY, **JUSTIN MARSHALL**
University of Queensland
How did coral trout get its spots?

TSYR-HUEI CHIOU
University of Queensland
Electrophysiology of vision in stomatopods

KENDALL CLEMENTS
University of Auckland
ESTHER ANGERT
Cornell University
HOWARD CHOAT
James Cook University
LINDSEY WHITE
Auckland University of Technology
The role of hindgut symbionts in protein uptake and recycling in marine herbivorous fishes

SEAN CONNOLLY
James Cook University
Biodiversity of coral assemblages

TOM CRONIN University of Maryland Baltimore County
Properties of natural polarized light fields in air and water

BERNIE DEGNAN, **SANDIE DEGNAN**
University of Queensland
Ecological and evolutionary genomics of marine invertebrates

MARIA DORNELAS
University of St Andrews
Explaining coral species abundances: linking morphology to demography

EIVIND UNDHEIM as field leader for
BRYAN FRY
University of Queensland
Molecular evolution of cephalopod venom proteins

CHRISTOPHER FULTON
Australian National University
MARTIAL DEPCZYNSKI Australian Institute of Marine Science
THOMAS WERNBERG
University of Western Australia
How does climate influence seaweed patch dynamics on the Great Barrier Reef?

CHRISTOPHER FULTON
Australian National University
Energetics of locomotion in coral reef fishes

VIKTOR GRUEV
Washington University St Louis
Underwater CCD polarization sensor

SARAH HAMYLTON
VALERIE HARWOOD
COLIN WOODROFFE
University of Wollongong
CHRIS ROELFSEMA
University of Queensland
Modelling the influence of sea level rise on reef accretion at Lizard Island

TOM HOLMES WA Department of Environment and Conservation
Identity of predators of juvenile coral reef fish

MIA HOOGENBOOM
SEAN CONNOLLY
James Cook University
Metabolic scaling in reef corals

MARTIN HOW
University of Queensland
Polarising vision and behaviour in stomatopods

GEIR JOHNSEN
Norwegian University of Science and Technology
Underwater hyperspectral imaging of coral habitats

FREDERIEKE KROON CSIRO
GBR endocrine disruption

JEFF LEIS Australian Museum
CLAIRE PARIS University of Miami
KERSTIN FRITSCHES
ULI SIEBECK
University of Queensland
Orientation in fish larvae

EIVIND UNDHEIM as field leader for
RICHARD LEWIS
University of Queensland
Investigation of toxins from the superfamily Conacea

VIMOKSALEHI LUKOSCHEK
James Cook University
Seascape genetics of broadcast spawning reef building corals

MARCELA DIAZ as field leader for
JOSHUA MADIN
Macquarie University
Hydrodynamic disturbances on coral reefs

JUSTIN MARSHALL
University of Queensland
Polarised light underwater

JUSTIN MARSHALL
University of Queensland
Stomatopod vision and signals

MARK MCCORMICK
James Cook University
Annual fish census at six sites at Lizard Island

VISITORS IN 2011

MARK MEEKAN Australian Institute of Marine Science
Aging study of giant clams

ROBYNNE MILLS
University of Sydney
Recording Aboriginal sites on Lizard Island

GÖRAN NILSSON
JONATHAN STECYK
University of Oslo
Physiological effects of high temperature and carbon dioxide on reef fish

LUCIE PENIN
University of Perpignan
Influence of post-settlement events on coral population dynamics

MEGAN PORTER University of Maryland Baltimore County
Developmental genetics of stomatopod vision

MORGAN PRATCHETT
James Cook University
Impact of herbivorous fish on coral recruit survival

NICHOLA RAIHANI
Institute of Zoology, Zoological Society of London
Mechanisms promoting cooperation in cleaning mutualism

ZOE RICHARDS Australian Museum
Manage ecosystems, monitor species

NICK ROBERTS, SHELBY TEMPLE
University of Bristol
JUSTIN MARSHALL
University of Queensland
Polarised vision in fish and cephalopods

MEGAN SAUNDERS
JAVIER LEON
TOM BALDOCK
CHRIS BROWN
DAVID CALLAGHAN
University of Queensland
Effect of waves and currents on seagrass distribution and productivity

SHAWN SMITH Australian Institute of Marine Science
Census of Marine Life CReefs

MARTA SOARES Instituto Superior de Psicologia Lisbon
Role of exogenously administered steroid hormones on individual behavioural decisions in cleaner fish

DENNIS STANLEY University of Western Australia
Recovery of oceanographic glider

STEFAN WALKER, VANESSA MESSMER James Cook University
The evolution of badges of status and signal-receiver behaviour

ALLISON PALEY as field leader for **BETTE WILLIS** James Cook University
Ecological significance of coral disease on the Great Barrier Reef

Top left: Talisa Kath with coral trout.

Top middle: Double-spotted Queenfish at the outer reef.

Top right: UK researcher Nick Roberts studies polarised vision.

Middle: Looking east over Lizard Head to North and South Direction Islands.

RESEARCH STUDENTS

SANDRA BINNING
Australian National University
Shape up or ship out: can coral reef fish change their shape to suit their environment? (PhD)

SHANE BLOWES
James Cook University
Competition and coexistence in the butterflyfish community (PhD)

LILLY BOJARSKI
University of Auckland
Microbial nitrogen fixation in the hindgut of marine herbivorous fishes (PhD)

MICHAEL BOK University of Maryland Baltimore County
UV vision in mantis shrimp (PhD)

HARRIET BOOTH
School for International Training
The effects of coral stressing on the feeding preferences of *Acanthaster planci* (undergraduate)

YOLAND BOSIGER
James Cook University
Investigating temporal foraging patterns of coral reef predators and their effect on prey (Hons)

CHRISTOPH BRAUN
University of Queensland
UV-induced DNA damage and UV avoidance (PhD)

ROHAN BROOKER
James Cook University
Behavioural responses to coral bleaching by a coral-feeding fish (PhD)

SONIA CARDOSO Instituto Superior de Psicologia Lisbon
Role of the neurohormone arginine vasotocin on cleanerfish conspecific related behaviour (PhD)

CONOR CHAMP
University of Queensland
Colour vision thresholds in marine fish (PhD)

DARREN COKER
James Cook University
Effects of coral bleaching on coral-dwelling fishes (PhD)

ANDREW COLE
James Cook University
Effect of chronic fish predation on reef building corals (PhD)

FABIO CORTESI
University of Basel
Colour adaptation in *Pseudochromis fuscus* (PhD)

ALICIA CRAWLEY
University of Queensland
Assessing the risk of ocean acidification for the Great Barrier Reef (PhD)

CHRISTOPHER CVITANOVIC
Australian National University
Ecological energetics of butterflyfishes (PhD)

STEVE DOO
University of Sydney
Calcium carbonate production of benthic foraminifera (undergraduate)

KATE FELLER University of Maryland Baltimore County
Visual pigments of stomatopod crustacean larvae (PhD)

REBECCA FOX James Cook University
Ecosystem function of rabbitfishes - movement patterns of *Siganus lineatus* (PhD)

CHRISTOPHER GOATLEY
James Cook University
The ecological role of sediments on coral reefs (PhD)

HOLLY HEINIGER
University of Queensland
Identification and diversity of Myxosporean parasites in apogonids (PhD)

MARISSA HENDERSON
School for International Training
Fluid composition of the reproductive organs of the sea slugs *Siphopteron quadrispinosum* and *S. pohnpei* (undergraduate)

LESLIE HILLMAN
School for International Training
Predation pressure as a factor in social monogamy of mantis shrimp, *Pullosquilla thomassini* (undergraduate)

JACOB JOHANSEN
James Cook University
Energetics of habitat choice in planktivorous coral reef fishes (PhD)

KATE JOHNSON
University of Auckland
Ultrastructure and function of the hindgut in marine herbivorous fishes (PhD)

JAMES KERRY
James Cook University
An investigation of coral morphology and fish association (Hons)

JOLEAH LAMB
James Cook University
Impacts of tourism on coral disease prevalence (PhD)

ROLANDA LANGE
University of Tuebingen
Precopuatory stabbing in a hermaphroditic sea slug; Sexual reciprocity and traumatic mating in hermaphrodite sea slugs (PhD)

CAYNE LAYTON
Australian National University
What are the costs of locomotion during daily foraging in coral reef fish? (Hons)

LIBBY LIGGINS
University of Queensland
Spatial & temporal patterns of coral reef connectivity (PhD)

JOHN LLEWELYN
James Cook University
Behavioural responses of varanid lizards (goannas) to cane toads (PhD)

VISITORS IN 2011

OONA LÖNNSTEDT
James Cook University
Predator-prey interactions and the importance of sensory cues in a changing world (PhD)

RACHEL MANASSA
James Cook University
Social learning as an anti-predator response in coral reef fish (PhD)

IAN MCLEOD
James Cook University
Effects of climate change on the connectivity of coral reef fish populations (PhD)

SELENA MCMILLAN
University of Auckland
Protein uptake in marine herbivorous fishes (PhD)

MATHEW MITCHELL
James Cook University
Effects of flow on antipredator responses (PhD)

ALEXANDRA NAHM University of Maryland Baltimore County
Opsins in extraocular photoreceptors (PhD)

JESSICA PINK
Australian National University
Is there behavioural modality in the swimming and foraging behaviour of coral reef fishes? (Hons)

ANA PINTO
University of Neuchâtel
Coordination abilities in cleaner wrasse pairs (PhD)

F. JOSEPH POLLOCK
James Cook University
Understanding White Syndrome in the Indo-Pacific (PhD)

VERENA REICHEL
University of Tuebingen
Comparative analysis of *Siphopteron* mating strategies and their genital morphology (PhD)

Top: PhD student Rolanda Lange and Johanna Werminghausen in the lab.

DOMINIQUE ROCHE
Australian National University
The bio-physical coupling of predator-prey interactions in coral reef fishes (PhD)

SEBASTIAN SCHMIDT-ROACH
University of Tasmania
Linking life history to reproduction structure in corals (PhD)

MAX SCHWEINSBERG
Ruhr-University Bochum
Intracolonial genetic variation in corals (PhD)

MEGAN SHERMAN
School for International Training
The effect of predator influence on color change in two distinct morphs of the marine fish *Pseudochromis fuscus* (undergraduate)

JESSICA STELLA
James Cook University
Diversity of coral ectosymbionts (PhD)

SEBASTIAN STRIEWSKI
Ruhr-University Bochum
The impact of ocean acidification on the reproduction and growth of scleractinian corals (PhD)

DEREK SUN
University of Queensland
The ecological effects of parasites in fish after settlement (PhD)

HANNE THOEN
University of Queensland
Colour vision in mantis shrimp (PhD)

MELANIE TRAPON
James Cook University
Impact of herbivorous fish on coral recruit survival (PhD)

ALEX VAIL
University of Cambridge
Cooperative hunting between groupers, moray eels and octopus (PhD)

AMELIA WENGER
James Cook University
The effects of sedimentation on damselfish (PhD)

MEGHAN WERFT
School for International Training
Foraging ecology of sand perch, *Parapercis cylindrica* (undergraduate)

JOHANNA WERMINGHAUSEN
University of Tuebingen
Coolidge effect - how partner identity influences the sexual motivation of hermaphroditic sea slugs (MSc)

JAMES WHITE
James Cook University
Role of predation pressure in establishment of behavioural syndromes (MAppSc)

SHARON WISMER
University of Neuchâtel
Generalisation in adult cleaner wrasse (PhD)

ERIKA WOOLSEY
James Cook University
Reefs on the edge (PhD)

MOLLY WRIGHT
University of California Berkeley
The effects of environment and demography on social and genetic monogamy and biparental care in the lysiosquilloid stomatopods (PhD)

STUDENT GROUPS

Barker College
Led by Tim Binet

Brighton Grammar School
Group 1 led by Dr Dani Ceccarelli
Group 2 led by Dr Andrew Lewis

Geelong College Preparatory School
Led by Dr Andrew Lewis

RMIT University
Led by Assoc Prof Gale Spring and Dr Jeff Shimeta

School for International Training
Two groups led by Tony Cummings

Trinity Anglican School
Led by Rachel Elphick

PUBLICATIONS

In 2011, a record 129 publications based on work carried out at LIRS were received into the collection. There are now more than 1500 LIRS publications.

1. Aguado, M.T., G. San Martin and M.E. Sidall, 2011. Systematics and evolution of syllids (Annelida: Syllidae). *Cladistics, 27:* 1-17.

2. Ang, T.Z. and A. Manica, 2011. Effect of the presence of subordinates on dominant female behaviour and fitness in hjierarchies of the dwarf angelfish *Centropyge bicolor. Ethology, 117:* 1111-1119.

3. Anker, A., 2010. New findings of rare or little-known alpheid shrimp genera (Crustacea, Decapoda) in Moorea, French Polynesia. *Zootaxa, 2403:* 23-41.

4. Anker, A. 2011. Four new infaunal decapod crustaceans (Caridea: Alpheidae and Gebiidea: Axianassidae) from Lizard Island, Australia, one of them also occurring in Moorea, French Polynesia. *Zootaxa, 2734:* 1-22.

5. Anonymous, 2011. Young fish like noisy neighbours; 'Reefs with added noise always attracted more fish'. UnderwaterTimes, http://www.underwatertimes.com/news.php?article_id=12653480109.

6. Baumann, H. and M. Gagliano, 2011. Changing otolith/fish size ratios during settlement in two tropical damselfishes. *Helgoland Marine Research*, doi: 10.1007/s10152-011-0255-2.

7. Bay, L.K. and J.M. Caley, 2011. Greater genetic diversity in spatially restricted coral reef fishes suggests secondary contact among differentiated lineages. *Diversity, 3:* 483-502.

8. Bellwood, D.R. and J.H. Choat, 2011. Dangerous demographics: the lack of juvenile humphead parrotfishes *Bolbometopon muricatum* on the Great Barrier Reef. *Coral Reefs, 30:* 549-554.

9. Beninde, J., 2011. Sex in a sea slug: is it all about copulation duration? Diploma thesis, University of Tuebingen.

10. Berumen, M.L., E.D.L. Trip, M.S. Pratchett and J.H. Choat, 2011. Differences in demographic traits of four butterflyfish species between two reefs of the Great Barrier Reef separated by 1,200 km. *Coral Reefs*, doi: 10.1007/s00338-011-0838-z.

11. Beukers-Stewart, B., J. Beukers-Stewart and G.P. Jones, 2011. Behavioural and developmental responses of predatory coral reef fish to variation in the abundance of prey. *Coral Reefs, 30:* 855-864.

12. Binning, S.A. and C.J. Fulton, 2011. Non-lethal measurement of pectoral fin aspect ratio in coral-reef fishes. *Journal of Fish Biology, 79:* 812-818.

13. Bonaldo, R.M., 2011. The ecosystem role of parrotfishes on coral reefs. PhD thesis, James Cook University.

14. Bonaldo, R.M. and D.R. Bellwood, 2011. Spatial variation in the effects of grazing on epilithic algal turfs on the Great Barrier Reef, Australia. *Coral Reefs, 30:* 381-390.

15. Bonaldo, R.M., J.P. Krajewsky and D.R. Bellwood, 2011. Relative impact of parrotfish grazing scars on massive *Porites* corals at Lizard Island, Great Barrier Reef. *Marine Ecology Progress Series, 423:* 223-233.

16. Bongaerts, P., 2011. Bathymetric patterns of genetic variation in the coral-algal symbiosis. PhD thesis, University of Queensland, Brisbane.

17. Bongaerts, P., C. Riginos, K. Hay, M.J.H. van Oppen, O. Hoegh-Guldberg and S. Dove, 2011. Adaptive divergence in a scleractinian coral: physiological adaptation of *Seriatopora hystrix* to shallow and deep reef habitats. *BMC Evolutionary Biology, 11:* 303.

18. Booth, D.J. and K. Parkinson, 2011. Pelagic larval duration is similar across 23 degrees of latitude for two species of butterflyfish (Chaetodontidae) in eastern Australia. *Coral Reefs,* doi: 10.1007/s00338-011-0815-6.

19. Bosiger, Y. 2011. Predator-prey interactions and the effect of daily temporal predation risk on coral reef fish behaviour. Honours thesis, James Cook University.

20. Bray, R.A., T.H. Cribb and J.-L. Justine, 2010. *Multitestis* Manter 1931 (Digenea: Lepocreadiidae) in ephippid and chaetodontid fishes (Perciformes) in the south-western Pacific Ocean and the Indian Ocean off Western Australia. *Zootaxa, 2427:* 36-46.

21. Brooker, R.M., P.L. Munday and G.P. Jones, 2011. Coral obligate filefish masquerades as a branching coral. *Coral Reefs, 30:* 803.

22. Bruce, A.J., 1988. Further records of the hymenocerine shrimp *Phyllognatia sinplex* Fujino (Crustacea: Decapoda). *The Beagle, 5:* 101-104.

23. Bruce, N.L. and C. Sidabalok, 2011. The genus *Lanocira* Hansen, 1890 (Corallanidae: Isopoda: Crustacea) in tropical Australian waters. *Zootaxa, 2793:* 23-34.

24. Bshary, R., R.F. Oliveira and A.S. Grutter, 2011. Short-term variation in the level of cooperation in the cleaner wrasse *Labroides dimidiatus*: implications for the role of potential stressors. *Ethology, 117:* 246-253.

PUBLICATIONS

25. Burger, M.A.A. and R.D. Adlard, 2011. Low host specificity in the Kudoidae (Myxosporea: Multivalvulida) including seventeen new host records for *Kudoa thalassomi*. *Folia Parasitologica 58:* 1-16.

26. Chambers, C.B., 2002. Gastro-intestinal digeneans of acanthurid fishes: diversity and host-parasite interactions. PhD thesis, University of Queensland.

27. Cheney, K.L., 2011. Cleaner wrasse mimics inflict higher costs on their models when they are more aggressive towards signal receivers. *Biology Letters*, doi: 10.1098/rsbl.2011.0687.

28. Chiou, T.-H., N.J. Marshall, R.L. Caldwell and T.W. Cronin, 2011. Changes in light-reflecting properties of signalling appendages alter mate choice behaviour in a stomatopod crustacean *Haptosquilla trispinosa*. *Marine and Freshwater Behaviour and Physiology, 44:* 1-11.

29. Chong-Seng, K.M., A.J. Cole, M.S. Pratchett and B.L. Willis, 2011. Selective feeding by coral reef fishes on coral lesions associated with brown band and black band disease. *Coral Reefs, 30:* 473-484.

30. Clague, G., C. Newport and A.S. Grutter, 2011. Intraspecific cleaning behaviour of adult cleaner wrasse, *Labroides dimidiatus* (Perciformes: Labridae). *Marine Biodiversity Records*, doi: 10.1017/s175526721100056X, 4: e56 (3 pages).

31. Clague, G., K.L. Cheney, A.W. Goldizen, M.I. Waldie and A.S. Grutter, 2011. Long-term cleaner fish presence affects growth of a coral reef fish. *Biology Letters*, doi: 10.1098/rsbl.2011.0458.

32. Cole, A.J. and M.S. Pratchett, 2011. Effects of juvenile coral-feeding butterflyfishes on host corals. *Coral Reefs, doi:* 10.1007/s00338-011-0746-2.

33. Cole, A.J., R.J. Lawton, S.K. Wilson and M.S. Pratchett, 2011. Consumption of tabular acroporid corals by reef fishes: a comparison with plant-herbivore interactions. *Functional Ecology*, doi: 10.1111/j.1365-2435.2011.01935.x.

34. Cole, K.S., 2010. Gonad development in hermaphroditic gobies. Chapter 6 in "Reproduction and sexuality in marine fishes. K.S. Cole (Ed.). University of California Press, Berkeley.

35. Cole, K.S., 2010. Gonad morphology in hermaphroditic gobies. Chapter 5 in "Reproduction and sexuality in marine fishes. K.S. Cole (Ed.). University of California Press, Berkeley.

36. Cole, K.S., 2011. Patterns of reproductive morphology in the genus Gobiodon (Teleostei: Gobiidae). *Environmental Biology of Fishes, 92:* 323-335.

37. Cripps, I.L., P.L. Munday and M.I. McCormick, 2011. Ocean acidification affects prey detection by a predatory reef fish. *PLoS One, 6(7):*e22736 (1-6).

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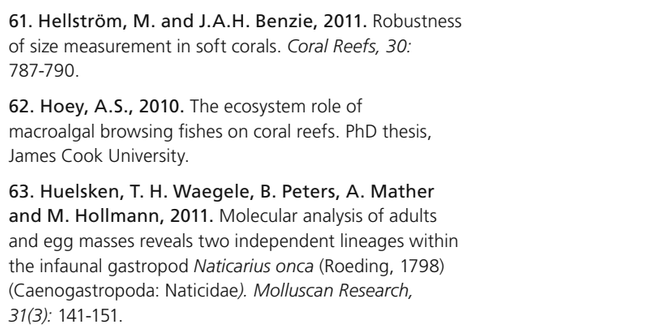

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Top left: PhD student Fabio Cortesi and Eva McClure at work in the aquarium.

Right: Jeff Leis (centre) with Ricardo and Claire Paris.

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Top middle: Part of the Blue Lagoon.

Top right: PhD student Jessica Stella (right), Harriet Booth (centre) and Fernanda di Faria sort samples.

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