Australian Museum Lizard Island Research Station
Newsletter 2010



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LIZARD ISLAND
RESEARCH STATION

LIZARD ISLAND RESEARCH STATION NEWSLETTER 2010

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AUSTRALIAN MUSEUM DIRECTOR'S REPORT

As I write this the effects of the Japanese tsunami are still unfolding. Apart from anything else about this terrible event, it shows that very little that is created by humans can stand up to the direct force of the ocean. Also at this time the climate change debate in Australia is getting vigorous again, with substantial misinformation being put about. The Museum's position on climate change is clear. The very substantial balance of scientific evidence shows that human induced climate warming is occurring and that coral reefs will be seriously impacted by the effects of this change.

It is interesting to see just how much research time at Lizard Island is now devoted to climate change and coral reefs, as is shown later in this newsletter. We are now focusing more on the longer term effects of warming, through ocean acidification, as well as the shorter term impacts of more visible effects such as bleaching events.

The trends in the type of research that is done at our Research Station reflect that we are providing adaptable, leading edge facilities, able to meet changing research needs. That we can do this is a tribute to the foresight and management skills of our team at LIRS, led by station Directors Drs Anne Hoggett and Lyle Vail. They skillfully balance the day to day operations of the station with longer term planning and major projects such as the recently and very successfully installed solar power plant. While the station's research contributes to climate change knowledge, we have also reduced our environmental footprint through the use of solar energy.

A big debt of gratitude from the Museum team and Trustees is owed to the Lizard Island Reef Research Foundation for its unstinting and very effective support of the research station. My particular thanks go to Foundation Chair Ken Coles and to 30th Anniversary campaign leader Charlie Shuetrim, with whom we work closely and very enjoyably to make LIRS the wonderful resource it is.

FRANK HOWARTH
Director, Australian Museum

RESEARCH STATION DIRECTORS' REPORT

Epic rainfall during 2010 broke a long and devastating drought across much of Australia. At Lizard Island, the decade leading up to 2010 was the dryest known and it included the three dryest years since records began in 1979. In 2010, more than 2000 mm of rain fell between January and April and the annual total was more than double the long-term average. The big wet has continued into 2011 with catastrophic flooding and a massive category 5 cyclone. Australia is prone to such extremes and the weather is predicted to become even more extreme as more carbon dioxide is released into the atmosphere.

Researchers have been busy studying the direct effects of climate change - elevated temperature and lower pH - on coral reef organisms for some time. It is now clear that the consequences go way beyond coral bleaching and the decreased ability of organisms to build their skeletons. Research outlined on page 4 has found that as seawater becomes more acidic, young reef fish become attracted to the scent of predators rather than being repelled by it. And as corals are degraded, there are cascading effects on other reef organisms due to habitat loss. Lately, some researchers have turned their attention to the potential impacts of severe weather events. Dr Chris Fulton will use his 2011 Yulgilbar Foundation Fellowship to explore how temperature and wave energy influence the timing and persistence of fleshy seaweed patches on reefs (page 8). And PhD student Sandra Binning will use her 2011 Ian Potter Doctoral Fellowship to find out whether fish can adapt to different flow conditions (page 6).

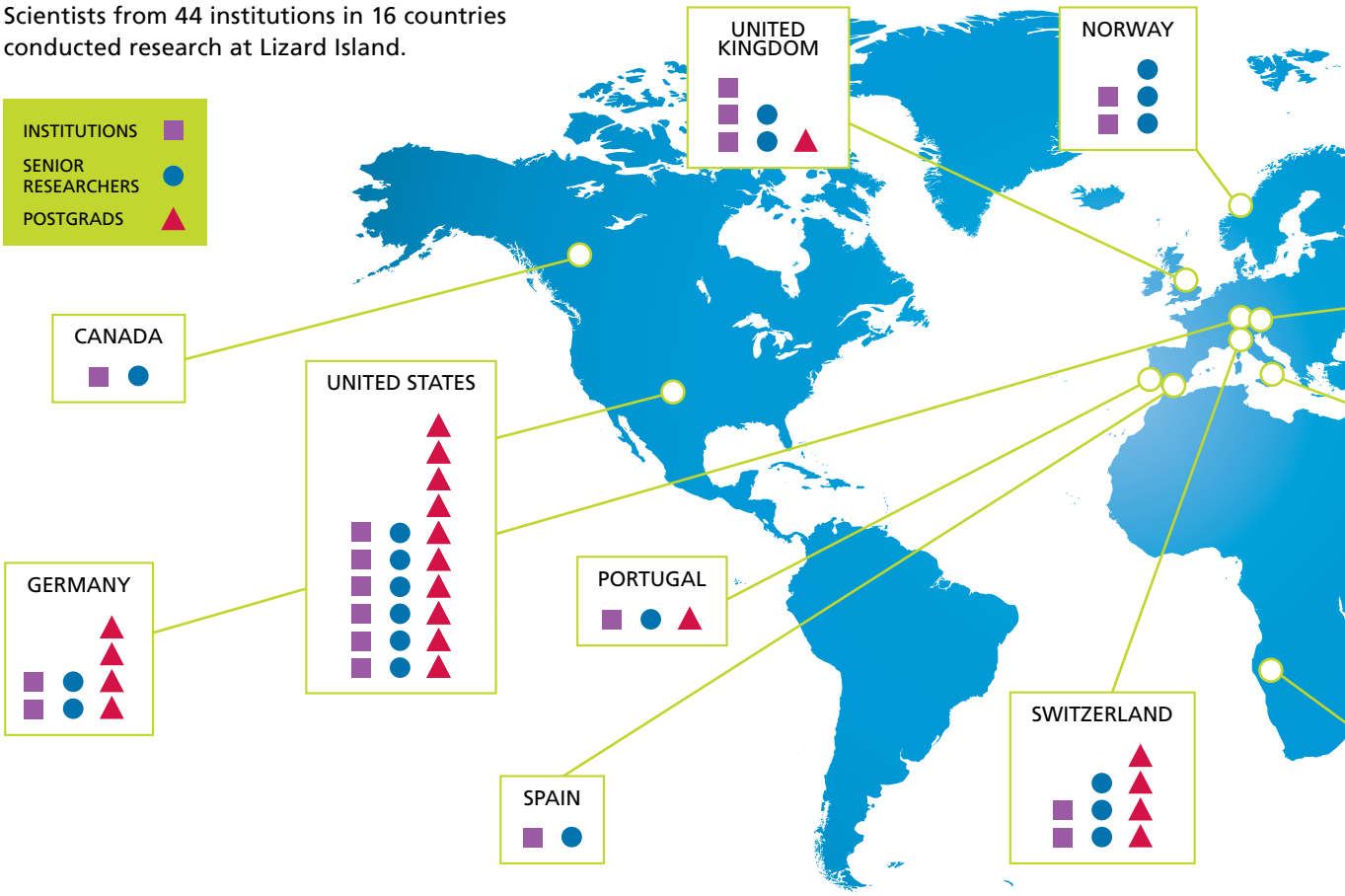
The wet and cloudy conditions this year brought relief from high temperatures during summer,

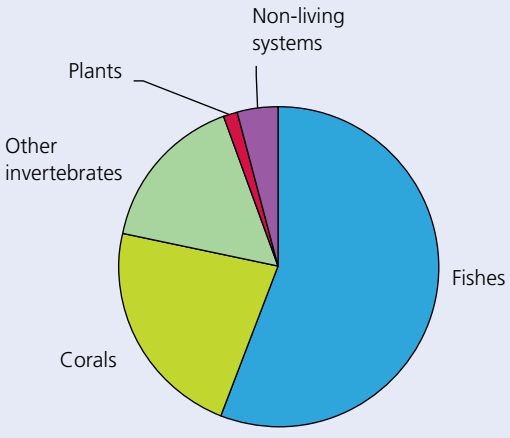
a good thing for the corals. But we need to act if reefs as we know them are to persist into the next century. The Station will soon be reducing its CO_2 emissions substantially: a 30kW solar power system, part of the 30th Anniversary Development, is close to being commissioned. It will reduce by about 60% the emissions that we produce through generating electricity.

ANNE HOGGETT AND LYLE VAIL
Directors, Lizard Island Research Station

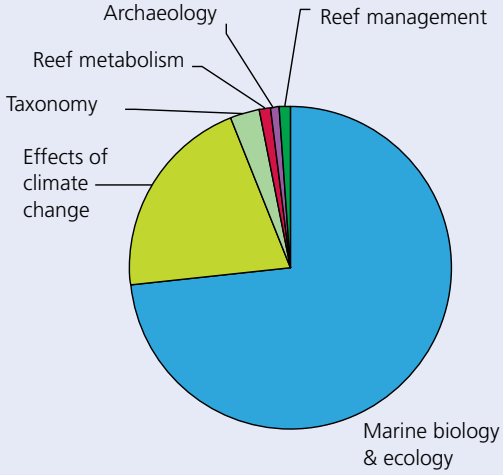
2010 IN SUMMARY

Scientists from 44 institutions in 16 countries conducted research at Lizard Island.

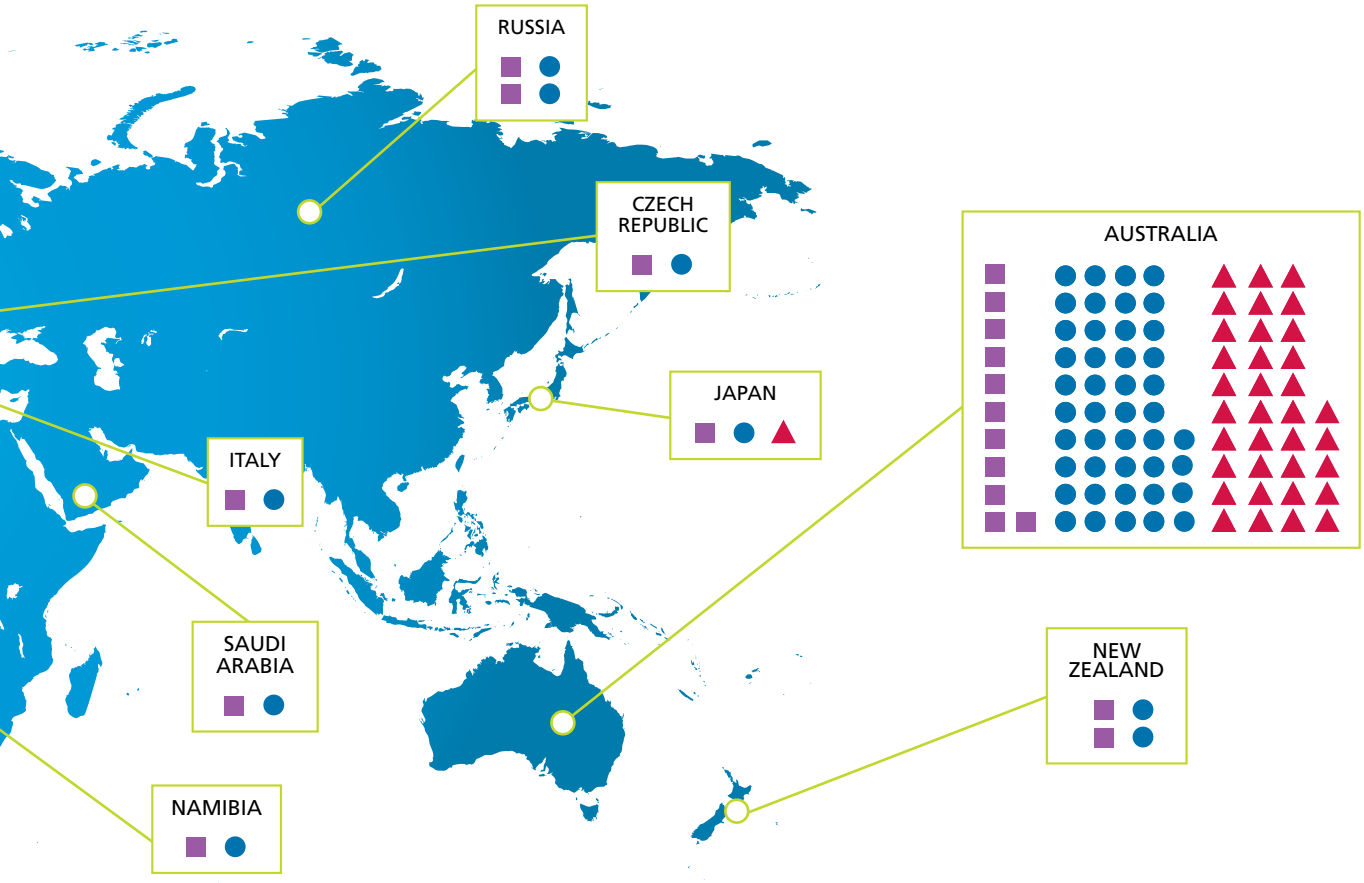


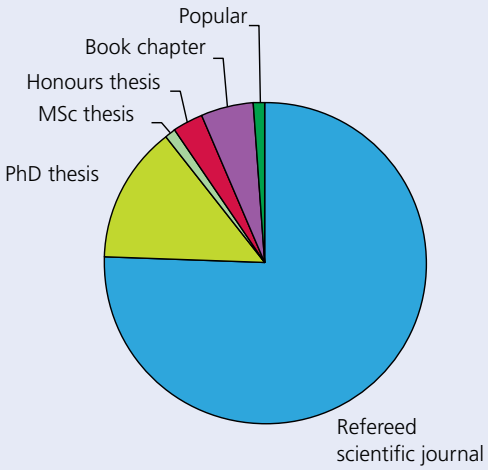


Of the 98 research projects conducted in 2010, fishes and corals were the most frequent subjects.

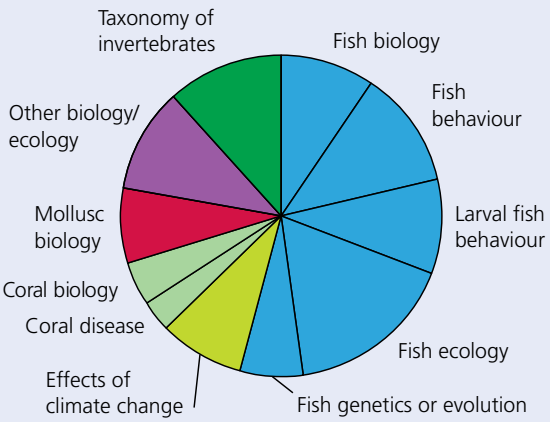


Overwhelmingly, ecology and biology were the main research areas of the projects undertaken in 2010. The effects of climate change on reef organisms was a strong theme.





Of the 94 scientific publications based on research at Lizard Island and recorded in 2010, 13 were PhD theses.



Fish research comprised more than half the subject matter of the publications.

FEATURED PUBLICATIONS

Just two of the 94 publications listed this year (page 20) are featured here to provide a sample of the work conducted at LIRS.

SECRET COMMUNICATIONS

A major theme of ecology is discovering how animals sense their environment and how they use those inputs to find resources and avoid danger. Over the past decade, research at Lizard Island has developed this theme on coral reefs, studying the ways that various animals use sight, smell and hearing.

This year, research at Lizard Island has shown that certain coral reef fish use ultraviolet (UV) vision to tell the difference between their own and other similar species. One species of damselfish may even be able to recognise individuals by their faces, in much the same way that we recognise other people.

As described in *Current Biology* (Siebeck et al., 2010), the experiments involved two damselfish species of similar size and similar yellow body colouration but with different UV facial patterns. Male Ambon damselfish defend their territories from males of the same species, while tolerating intrusion by the other species. The team exposed male Ambon damselfish to males of both species in conditions in which the UV markings could or could not be seen. The territorial reaction differed only when the UV facial patterns could be seen, demonstrating that the patterns are necessary for the fish to discriminate between the species. Additional experiments showed that the fish were reacting to the detailed shape of the UV patterns on the intruder's face and not simply to the UV colour.

Earlier work at Lizard Island by the lead author, Dr Uli Siebeck, had shown that, as with human vision, the eyes of many predatory reef fish species filter out UV light. This means that predators, such as coral trout and wrasses, probably cannot see the UV markings on their damselfish prey. The researchers suggest two good reasons for that. First, blocking UV enhances contrast, which is important for the detection of prey at distance. And second, it protects their retinas from UV damage, which is likely to benefit the much longer-lived predatory species.

Top left: "Do I know you?" Individual damselfish may recognise each other.

The damselfish are thus probably exploiting a "secret communication channel" among themselves, allowing them to recognise and interact with each other while maintaining camouflage from predators.

FISH IN HOT WATER

Research into the impacts of climate change on coral reefs is a "hot" topic for good reason: corals, and hence coral reefs, are uniquely vulnerable to the twin direct effects of rising atmospheric CO_2 – rising temperature and rising ocean acidity. This is because corals can tolerate only a narrow temperature band and need seawater within a particular pH range to form their skeletons. As the oceans become warmer and more acidic, those corals that survive are more vulnerable to the subsequent indirect effects of climate change – rising sea levels and increased storm activity.

Corals are the habitat builders of coral reefs. Appropriately, much research is being done on the impact of climate change on corals and on damage to coral reef habitats. But, aside from habitat effects, how will other reef species fare under predicted future scenarios? Research conducted partly at Lizard Island has shown that rising CO_2 emissions could have a significant impact on the world's fish populations.

An international team of researchers has found that in more acidic seawater, the behaviour of larval reef fishes changes in ways that decrease their chance of survival enormously. The paper in *Proceedings of the National Academy of Sciences* (Munday et al., 2010) describes experiments with larval fish raised in seawater enriched with different levels of CO_2, up to levels predicted for the end of century (850 ppm). To quote from the paper:

Altered behaviour of larvae was detected at 700 ppm CO_2, with many individuals becoming attracted to the smell of predators. At 850 ppm CO_2, the ability to sense predators was completely impaired. Larvae exposed to elevated CO_2 were more active and exhibited riskier behaviour in natural coral-reef habitat. As a result, they had 5–9 times higher mortality from predation than current-day controls, with mortality increasing with CO_2 concentration. Our results show that additional CO_2 absorbed into the ocean will reduce recruitment success and have far-reaching consequences for the sustainability of fish populations.

FELLOWSHIPS

LIZARD ISLAND FELLOWSHIPS PROGRAM

Five Fellowships are currently awarded each year by the Australian Museum to enable field-intensive coral reef research at Lizard Island Research Station. 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 Yulgilbar Foundation.

Details of the conditions and selection criteria 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	Maximum duration	First awarded
Lizard Island Doctoral Fellowship	$24,000	3 years	1984
Ian Potter Doctoral Fellowship at Lizard Island	$24,000	3 years	2006
Isobel Bennett Marine Biology Fellowship	$11,000	1 year	2008
John & Laurine Proud Fellowship	$11,000	1 year	2008
Yulgilbar Foundation Fellowship	$11,000	1 year	2009

Two Yulgilbar Foundation Fellowships were awarded this year, one to an early career postdoctoral researcher and one to a PhD student.

An additional grant was also made for 2011 thanks to funding from Professor Bill Shipley and Jensie Shipley, the Harvard Medical School and the Lizard Island Reef Research Foundation. This donation will enable work by a postdoctoral researcher that will underpin many future studies at Lizard Island.

Top right: Biodiversity is studied by Merrick Ekins and Monika Schlacher of the CReefs team. Photo: Gary Cranitch.

With the additional Yulgilbar Fellowship and the special grant awarded this year, seven new research projects will be supported in 2011 under the fellowships program, as outlined below. Overall, the program has now provided for research at Lizard Island by 45 PhD students and 11 postdoctoral researchers.

F. JOSEPH POLLOCK
2011 Lizard Island Doctoral Fellow
James Cook University and Australian Institute of Marine Science

White syndromes, a virulent group of coral diseases impacting Indo-Pacific coral reefs

The world's coral reefs are undergoing rapid and unprecedented decline. An estimated 27% of the world's reefs have already been lost and if the current pressure continues unabated, nearly 60% could be lost by 2030. A wide range of factors contribute to coral reef decline, including coastal development, overfishing and global climate change. Additionally, coral diseases have recently emerged as an important factor

In the past decade, a virulent group of coral diseases known as White syndromes have impacted reefs throughout the Indian and Pacific Oceans. Between 2001 and 2007, the prevalence of White syndromes increased nearly 20-fold in some regions of the Great Barrier Reef. These diseases primarily affect fast-growing branching and plating hard corals and are indicated by a rapidly spreading white band of tissue loss. The White syndrome lesion radiates across the coral at up to a centimetre per day, leaving behind dead coral skeleton.

Despite the impact of White syndromes on coral reefs, little is known about the specific drivers of these diseases. It is currently unclear if White syndrome cases reported from different regions represent one disease or several that share a common visual appearance. Additionally, a great deal of confusion remains regarding the environmental factors that influence White syndromes. This knowledge gap is a major impediment to the development of management options for minimising the occurrence and impacts of these diseases.

FELLOWSHIPS

Joe will address some of the most pressing questions about White syndromes on the Great Barrier Reef. He will examine the complex relationship between corals, the marine environment and invading pathogens. Central to this work is a highly sensitive assay that he has developed to detect and quantify the bacteria *Vibrio coralliilyticus*, which has been suggested as the causative agent of a number of White syndrome outbreaks. Joe's research will provide a badly needed case study of White syndrome impacts.

SANDRA BINNING
2011 Ian Potter Doctoral Fellow at Lizard Island
Australian National University
Shape up or ship out: can coral reef fish change their shape to suit their environment?

How are widespread species able to thrive in a broad range of environments? Does this wide distribution make them more resilient to environmental change? In the face of uncertain environmental fluctuations in natural systems, the answers to these questions are imperative for natural resource managers worldwide.

Managers of the Great Barrier Reef are concerned that changes in the physical environment may result in catastrophic biodiversity loss as conditions become unsuitable for species in their chosen habitat. However, one phenomenon that may allow species to rapidly adapt to environmental change is phenotypic plasticity, where individuals of the same genotype produce different morphologies, physiological states or behaviours in response to their local environment. Sandra aims to examine how adaptable a range of coral reef fishes are to differences in wave energy, a prominent physical stressor in shallow marine systems that is expected to increase due to climate change.

Wave-induced water motion affects a fish's capacity to swim effectively, which consequently influences its ability to perform daily activities and survive in a given habitat. Among species using primarily their pectoral fins for swimming, fin shape is strongly linked to performance: rounded fins are better adapted for manoeuvring in low-flow areas, whereas tapered fins enable high speed swimming in high flow environments. Preliminary research in some widespread fish species from around Lizard Island has revealed differences in fin shape and swimming performance between individuals of the same species living in different habitats, suggesting that individuals are adapted to local flow conditions.

Sandra's research will build on these ideas using a functional approach to explore morpho-physiological variation in damselfish, wrasses and surgeonfish. She plans to combine behavioural observations, morphological measurements, respirometry and rearing experiments to examine the extent to which coral reef fishes are intraspecifically adapted to their flow environment, and the underlying mechanisms contributing to this variation. Sandra's research will provide insight into the evolution and dominance of pectoral swimming fishes in coral reef systems as well as the possibility for plastic species to respond rapidly to environmental change.

JESSICA STELLA
2011 Yulgilbar Foundation Fellowship for PhD student
James Cook University
Threats to coral-associated invertebrate diversity from climate change

Coral reefs have the highest biodiversity of any marine ecosystem and it is the invertebrates that account for the vast majority of animal species there, with estimates approaching 9 million species. Currently, we know very little about the factors affecting the biodiversity and abundance of reef invertebrates. Many live in close association with branching corals, which provide ideal habitat for small invertebrates because they offer protection from predators, mating sites and settlement cues for larvae. Corals are also a significant food source for some reef invertebrates. In return for these benefits, some invertebrates provide their coral homes with vital ecological services, including clearing of harmful sediments and aggressively protecting them from predators, such as the Crown-of-Thorns Starfish. As some invertebrate species require a coral host for their existence, any decline in coral abundance or health could have dramatic effects on their abundance and diversity.

Corals are currently under threat due to warming oceans and the increased risk of coral bleaching associated with climate change. Branching corals, in particular, are most susceptible to bleaching, which can cause a decline in abundance and/or a deterioration of coral health. The loss of coral habitat has already proved to have devastating effects on many reef fish, yet almost nothing is known about how this may affect the species that rely upon corals and thus what the risk to coral reef biodiversity may be.

Jessica aims to increase our knowledge about the diversity, taxonomy and ecology of invertebrates that associate with live coral. She will investigate the abundance and distribution of invertebrates associated with branching corals and assess how specialised some are to particular coral hosts. She will identify the invertebrates she collects in collaboration with expert taxonomists. Jessica's research will determine which species rely strongly on living coral and how many corals they utilise, thus helping to identify those species most sensitive to habitat loss from frequent bleaching events, and ultimately to assess any potential loss of coral reef biodiversity.

DR STEFAN WALKER
Isobel Bennett Marine Biology Fellow
James Cook University

The evolution of dominance signalling and signal-receiver behaviour

Individuals communicate to inform each other about aspects of the environment and their own motives and constitution. While we typically think of communication as a human trait, there is ample evidence to demonstrate that many other species can communicate too. Advertising, negotiation, cooperation, collective decision-making and transactional learning are all observed in a wide variety of animals and all require an honest and reliable mode of communication. However, individuals can benefit from providing false information (that is, from being deceptive) and it is often unclear how communication mechanisms remain stable through generations.

Many species of reef fishes live in societies in which some individuals dominate others. Stefan will examine how individuals in such societies communicate information about their dominance, and the conditions under which such signals remain stable through evolutionary time. He will do this by combining game theory with experiments, both on the reef and in the aquarium. Stefan will explore the idea that reef fishes use colour pattern as a signal of dominance, and that signals remain reliable through generations because cheaters are punished for communicating dishonestly. Other studies have emphasised punishment of subordinates by more dominant individuals. Stefan will also examine whether subordinates can pool resources to punish competitively superior, but nonetheless deceptive, dominants.

Theoretically, individuals in social hierarchies can avoid the need for costly competition by signalling dominance honestly. For example, low-rank individuals don't need to fight an unwinnable battle for a high-ranking mate if the certain winner is readily recognisable. By providing knowledge of how signals remain honest, Stefan's research will help us understand how conflict is resolved in animal societies and thus, how social groups remain stable. This provides an understanding of several more general ecological and evolutionary patterns and processes. Moreover, the social punishment hypothesis for dominance signalling provides an explanation for the stability of colour signals through evolutionary time. This research will thus contribute to our understanding of how and why reef fishes have evolved such diverse colour patterns, both within and between species.

Top left: Whitespotted eagle ray.
Top middle: A day at the office.
Top right: Chevron Barracuda.

FELLOWSHIPS

DR TRACY AINSWORTH
2011 John and Laurine Proud Fellow
James Cook University

The contribution of host–microbe interactions to coral physiology within the microbial environment

By interacting with their hosts, microbes are able to influence entire ecosystems. From a microbe's point of view, a single coral colony is a vibrant and dynamic city. Tracy will visit Lizard Island to see the reef from the microbial point view.

The coral host is a complex three-dimensional structure of distinct habitats within which large communities of microbes exist, analogous to the role of enteric microorganisms in humans. There are many ways that microbes may assist the coral host. These include production of antibiotics and probiotics, supply of nutrients and stimulation of the immune system. Through micro-manipulation, Tracy will study the microbial environment and determine why the smallest members of the reef call corals "home". This project will provide critical information about the microbial community and its function in coral reef habitats.

DR CHRIS FULTON
2011 Yulgilbar Foundation Fellow
Australian National University

How does climate influence seaweed patch dynamics on the Great Barrier Reef?

Tropical seaweeds compete with corals for space and light on coral reefs. In some situations, the competitive balance between these two groups can be disturbed such that seaweeds overgrow and permanently smother the corals. While this may suggest that seaweeds are a threat to coral reef ecosystems, large seaweed patches often appear seasonally on healthy coral reefs, where they provide a very important food resource and habitat for other species. The question then, is why do some seaweed patches grow and decay over a natural seasonal cycle, while others persist and smother corals?

Fleshy seaweeds of the genus *Sargassum* start growing rapidly in late spring-early summer on inshore reefs of the Great Barrier Reef, often creating large seaweed-dominated areas that can cover over half of the shallow-water habitat in some locations. While recent research has shown that nutrient levels and grazing by herbivores can influence where these patches arise, the timing and persistence of *Sargassum*-dominated patches is thought to be linked to climatic conditions. Certainly, changes in temperature and wave energy have been linked to the lifespan of seaweeds on rocky shores, where whole sections of seaweed are broken off by breaking waves once certain environmental thresholds are reached.

Chris will explore how temperature and wave energy influence the timing and persistence of Sargassum-dominated patches on the Great Barrier Reef. Using a combination of remote-sensing satellite data and on-reef measurements, he will measure how much wave-driven force is required to break *Sargassum* fronds away from the reef, and how this strength changes according to seasonal fluctuations in water temperature. Chris will use this information to model environmental thresholds to the growth and decay of *Sargassum* patches, which will help us understand and predict how climate change may affect coral-seaweed dynamics on the Great Barrier Reef.

DR SARAH HAMYLTON
2011 Special Grant
University of Wollongong

Modelling coral reef response to environmental change: a geospatial approach

Reef systems underpin human food security, tourism, employment and protection of the shoreline. These benefits are compromised by environmental changes that damage the structure of the reef and the physical processes that maintain them. Rising atmospheric CO_2 concentration is a major systemic change that is inducing coral bleaching and ocean acidification. The development of effective strategies to manage such changes depends on understanding how they will manifest on coral reef systems. Sarah will use a combination of remote sensing and spatial statistical techniques to model the influence of environmental change on coral reefs at Lizard Island.

Satellite images provide a synoptic portrait of Earth's surface by recording numerical information on the sun's reflectance measured from a series of continuous pixels that cover a landscape across a number of spectral bands. Spatial statistical techniques explicitly utilise the location of attributes in space to investigate geographical structures within remotely sensed data.

Simulating the future response of reef systems to environmental change relies on defining the relationships between structural and functional properties of reef systems. Structural properties include the distribution of reef platforms and the composition of their surfaces. Functional properties include mass and energy flows that drive construction, such as calcification. Both structural and functional properties of reef systems exist in patches that can be detected and analysed using remote sensing combined with spatial statistics.

At Lizard Island, Sarah will identify areas of carbonate production and quantify parameters that influence it, such as water depth, water quality and exposure to wave energy. Then she will establish relationships between these structural and functional aspects of the reef system along gradients at the landscape scale. Using satellite imagery of the Lizard Island area, Sarah will generate a structural representation of carbonate producing areas. She will then use established relationships to produce models of how carbonate production might be affected given anticipated environmental change.

PROFILE OF A FORMER FELLOW

PROFESSOR MARK MCCORMICK

Mark McCormick was the Lizard Island Doctoral Fellow for 1989. He moved from New Zealand to do his PhD at James Cook University, which at that time was becoming well established as a world leader in coral reef research. His PhD study at LIRS concerned the influence of life history on the "quality" of larval reef fish.

Mark has continued as a very active researcher with broad interests in reef fish population dynamics. After two postdoctoral research fellowships at JCU, he moved through the academic ranks there and was recently awarded a personal chair. More than 50 students have completed postgraduate degrees under Mark's supervision with another 20 currently underway.

Mark has used LIRS extensively throughout his career and is now one of our major users. He and his team are regular summer visitors, taking up a substantial proportion of the Station's facilities to conduct numerous projects. Mark is an author of more than 115 scientific publications, of which at least 75 are based on work conducted at Lizard Island. In this newsletter alone, Mark is an author of 16 of the 94 listed publications. Two of Mark's PhD students have also been Lizard Island Doctoral Fellows, in 2005 and 2007.

Top middle: Dr Megan Porter's (right) fellowship visit for vision research included two PhD students and international colleagues. Photo courtesy of the team.

Top right: Mark McCormick

RESEARCH BY FELLOWS IN 2010

Fellowships supported research by nine scientists during 2010 (year of award shown in parentheses).

LIZARD ISLAND DOCTORAL FELLOWS	Jacob Johansen, James Cook University (2008) Chris Goatley, James Cook University (2010)
IAN POTTER DOCTORAL FELLOWS	Andrew Hoey, James Cook University (2007) Alicia Crawley, University of Queensland (2009) Darren Coker, James Cook University (2010)
ISOBEL BENNETT MARINE BIOLOGY FELLOW	Dr Megan Porter, University of Maryland Baltimore County (2009)
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 Maud Ferrari, University of California Davis (2010)

30TH ANNIVERSARY DEVELOPMENT

The Lizard Island Reef Research Foundation (LIRRF) and its many supporters enabled this $4.75 million redevelopment of the research station. Implementation began in 2005 and will be complete in 2011. During 2010, the following milestones were reached:

- The maintenance workshop was substantially rebuilt in May on the same footprint as the original building. New storage systems have improved efficiency while ceiling fans and additional windows have improved working conditions. This project was enabled by untied donations to the **LIRRF**.
- The scuba filling system was upgraded at the same time as the workshop. The compressors were rebuilt and moved to reduce noise impacts. They are now connected to an air bank, allowing scuba tanks to be filled at any time. The compressors are now run only when power draw is low, which reduces fuel consumption. This project was also funded by untied donations to the **LIRRF**.
- A new dinghy was purchased during the year, the eighth under this program. It is named *Primrose* in honour of its donor, **Lady Potter.**
- Another new dinghy was ordered in 2010 for delivery in 2011. It will be named *Mary Ida* at the request of its donor, the **John Villiers Trust**.
- The frame for a 30 kW solar power system was constructed in October and the solar array will be installed in early 2011. Two donors have contributed specifically to this project: the **A&K Foundation** and **The Fred P. Archer Trust** managed by **The Trust Company.** Installation of the solar power system has been made possible by deferring some other upgrade projects, as the Federal Government program that would have provided a $200,000 subsidy towards this system was cancelled at short notice in 2009.
- The staged purchase of laboratory equipment continues, funded by the **Raymond E. Purves Foundation** and the **Thyne Reid Foundation**. Items purchased in 2010 include a laboratory oven, chemical storage cabinets, a set of sediment screens, and numerous small items.

Top left: New scuba-filling area seen from the beach.
Top centre: Dr Megan Porter in the new dive area.
Top right: *Primrose* in action.
Left: Christmas tree worms.

LIZARD ISLAND REEF RESEARCH FOUNDATION

FOUNDER

Sir John Proud[1]

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Mr Raymond Kirby AO
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The Ian Potter Foundation[2]
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Mrs Fiona Playfair
Mrs Heather Power
Mr Robert Purves AM
Mr David Shannon

1 Deceased
2 New Patrons in 2010
3 Retired as a Trustee in December 2010
4 Congratulations to Charlie on his AM, awarded in January 2011

Top: LIRRF Chairman Ken Coles presents a Patron Certificate to Lady Potter.

Above: The LIRRF enables research by numerous fellows including 2010 Lizard Island Doctoral Fellow Chris Goatley, shown here.

The Lizard Island Reef Research Foundation was established to raise funds for the Lizard Island Research Station and to support research on the Great Barrier Reef. Since its inception in 1978, the Foundation has raised more than $8 million for these purposes. The Foundation is the enabling force behind the 30th Anniversary Development Program and the Lizard Island Fellowships Program.

Ken Coles has been a Trustee of the Foundation since 1991 and Chairman since 1994. He is supported by an active Board of Trustees. Long-term Trustee Bill Page-Hanify stepped down from the Board in 2010. We thank him for his support and input over many years, and wish him well for the future.

NEW PATRONS

Two organisations were elected as Patrons of the LIRRF in 2010. The Trust Deed defines a Patron as "a person who has made a substantial contribution to the affairs of the Foundation which in the opinion of the Trustees warrants that person being elected a Patron of the Foundation". There is no doubt that both new Patrons have contributed enormously to the LIRRF and to the research station.

Announcement of the **The Ian Potter Foundation** as a Patron was made in May at the LIRRF's annual luncheon in Melbourne. The lunch was attended by several Governors of the Foundation and its CEO. The honour was graciously accepted by its Life Governor, Lady Potter AC. Included among the guests were Mr John Gough AO and Prof Tom Healy AO, both Governors of The Ian Potter Foundation, who, with Lady Potter, have provided personal support and valuable advice to the LIRRF.

A donation of $1.5 million by The Ian Potter Foundation to the 30th Anniversary Development was instrumental in obtaining matching funding from the Queensland Government. Together, these contributions ensured that the project could proceed as planned. In recognition of the Foundation's critical support, the central research area at LIRS is now known as The Ian Potter Centre for Tropical Marine Research. The Ian Potter Foundation has also supported training for coral reef research through the Ian Potter Doctoral Fellowship at Lizard Island, now in its sixth year.

To celebrate recognition of the **Thyne Reid Foundation** as a Patron, a function was held at the Australian Museum in July. Among the 40 people attending were several members of the Reid family and the Administrator of the Foundation, Ms Susan Stevensen. Mr Ian Reid, Chairman of the Thyne Reid Foundation, was delighted to accept the honour on its behalf. Ian and his wife, Jill, take great interest in the work of the station and LIRRF.

The Thyne Reid Foundation is a major supporter of the 30th Anniversary Development. It has provided funds for a tractor with hydraulic implements, two boats *(Freya* and *Lili)*, the refurbishment of a building to form three new laboratory rooms (now known as the Thyne Reid Wing) and laboratory equipment.

MEMBERS

Members of the Foundation donate $1000 or more per year. 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 its generous support of this prize. Please see the inside back cover for Members of the Foundation.

Two delightful gatherings are organised each year by LIRRF Chairman Ken Coles to thank members for their support and to keep them and their guests in touch with the work being conducted at Lizard Island. Speakers in recent years have been scientists who have worked at LIRS and they have been very well-received. Anne Hoggett also speaks to pictures of the latest developments that she and Lyle Vail, both Directors of the station, have carried out. Ken is ably assisted by Australian Museum staff, notably Gail McCarthy and Marcela Pacheco.

Thirty people attended the luncheon for members at the Athenaeum Club in Melbourne on 19 May 2010. Rebecca Fox of James Cook University, a current Lizard Island Doctoral Fellow, was the guest speaker. She spoke passionately about coral reefs, her research into the lives of common but little-studied rabbitfish, and the surprising personal journey that led her to reef science.

The dinner in Sydney was attended by 100 people at the Wharf Restaurant on 18 October. The speaker was Professor Justin Marshall of the Queensland Brain Institute at the University of Queensland. Justin has conducted research at Lizard Island for many years and he gave a fascinating presentation on how fish and other animals use colour for communication.

VISITORS

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

John and Barbara Boyle
Ken Coles and Rowena Danziger
James Duplessie and family
John and Margie Goodall
John and Rosemary Gough
Mike and Lou Hamshere
Tom Healy
Fiona and Matthew Playfair
Lady Potter
Bill and Jensie Shipley
Charlie and Sandy Shuetrim

Top left: Rowena Danziger, Ken Coles and Fiona Playfair.
Top right: Retiring Trustee Bill Page-Hanify AM with his wife Barbara.

FOR THE **RECORD**

SENSOR NETWORK INSTALLED AT LIZARD ISLAND

In June and July, a node of the Great Barrier Reef Ocean Observing System sensor network was installed at Lizard Island. The network consists of a base station located at LIRS and four sensor floats and two network poles located in the lagoon. Sensors recording sea temperature, salinity and pressure are located at various depths at each of the floats and network poles. The pole near Bird Island is also fitted with a weather station. Data from the sensors are available on the internet (http://data.aims.gov.au/aimsrtds/faces/latestreadings.xhtml) in near-real time. This information is very useful to the scientists conducting research at LIRS. Other sensors and recording devices can easily be added to the network as required.

BIODIVERSITY OF LIZARD ISLAND

LIRS maintains a database of species known from the Lizard Island area that includes aspects of their biology and ecology such as location, habitat, seasonality and spawning time. It includes animals and plants in marine and terrestrial habitats and is based on collections held at the Australian Museum and the Queensland Herbarium, published reports, collections data provided by visiting scientists, and observations. This work-in-progress commenced in the early 1990s and now includes more than 5000 named species.

Thanks to funding from the Lizard Island Reef Research Foundation, LIRS is also developing a web-based field guide to the animals and plants of Lizard Island. Dr Andy Lewis was contracted to set up the website and provide content for about 200 species of fish and common large invertebrates. Dr Anne Hoggett has provided content for her area of specialty, the echinoderms, bringing the tally to about 300 species so far. Each species has its own page with large-format photographs and notes about its distinguishing features, location on Lizard Island, habitat preferences, biology, ecology and published references. This open-ended project is ready to be expanded to include contributions from visiting scientists to LIRS. This beautifully illustrated resource is already in use at LIRS and we plan to make it available online soon. A mobile app may not be far behind.

Top: Run-off from the land impacts reefs.
Left: One if the sensor network buoys.

FOR THE **RECORD**

EXTRAORDINARY RAINFALL

As in much of Australia, 2010 broke the rainfall record at Lizard Island. Total for the year was 2829 mm, more than double the long-term average of 1318 mm. The island has never been greener.

USAGE

The planned operating capacity of LIRS after completion of the 30th Anniversary Development facilities was intended to be 7000 visitor nights per year, but has been closer to 8000 for each of the past two years. Core usage (researchers, postgraduate students and student groups) in 2010 was 6895 person nights, close to 2009's record level.

Top left: 2010 was a stormy year.

Top middle: Santa's helpers tow the "sled" on Christmas morning.

Top right: PhD student Pim Bongaerts and assistant at work on the outer reef.

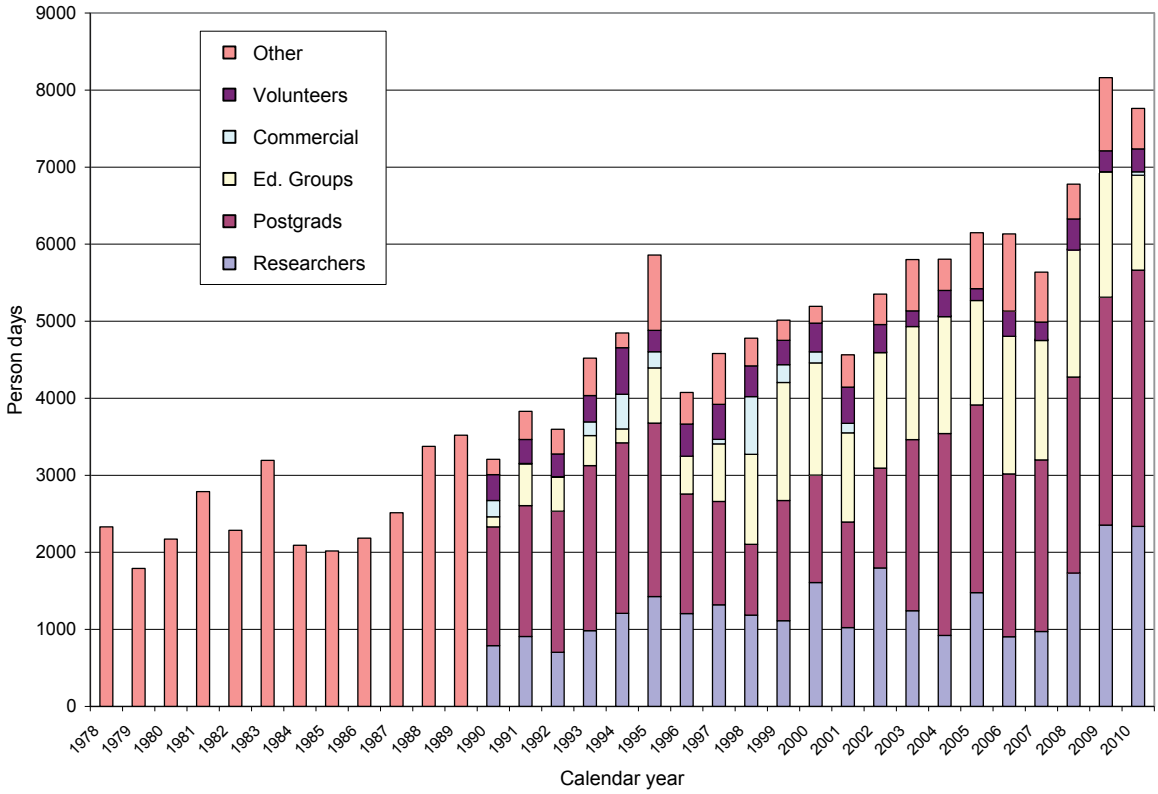
BENCH FEES

Per person per night, including GST	2010	2011
Researcher	$115.00	$119.50
Researcher's assistant	$102.00	$106.00
Postgrad. student (own project)	$45.00	$47.00
Postgrad's assistant	$40.00	$42.00
School or university group	$72.00	$75.00
Commercial	$216.00	$224.00

STAFF

There were no changes to the 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).

Additional staff are needed to cope with the increased workload caused by the development program and increasing usage. Temporary and casual staff employed during 2010 were Snow Amos, Matthew Mitchell, Tane Sinclair-Taylor and Alex Vail.



NEW VIDEO ABOUT LIRS

A new15-minute video presentation about work at LIRS was launched in July 2010. It is used almost daily to explain our work to island visitors. It was directed by independent science communicator Russell Kelley, written by LIRS directors Lyle Vail and Anne Hoggett, filmed by several contributors including Digital Dimensions, Russell and Lyle, and narrated by Anne. We thank Russell and Digital Dimensions for providing this assistance free of charge. The LIRRF generously provided the funds for post-production that was done by Digital Dimensions.

SOCIAL NETWORKING

LIRS has entered the social networking scene with a blog "Life at Lizard" on the Australian Museum website, a Facebook page, and a Twitter account.

Above: Part of a page by Andy Lewis from the Lizard Island Field Guide.

Right: Lyle Vail with a sick Green Turtle that was successfully rehabilitated in Cairns and returned to Lizard Island.

TOURS

Tours of LIRS are conducted for resort guests on Monday mornings. A tour for other island guests, mainly campers and yachties, is conducted between May and October at 11 am on Mondays. 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

The following people provided valuable volunteer assistance with maintenance of the station in 2010: Travis Aitken, Charmaine Alford, Snow and Renie Amos, Terry Ford, Franziska Guendert, Brittany Keeling, Kyle Lalonde, Laura Lefevre, Nick Noyes, Michael Palmer, Amelia Randall, Yarema Reshitnyk, David Selby, Adam Walters, James Wells, Maureen and Les Wilson, and Lois Wilson. As well, we thank two professionals who continue to provide their services to LIRS on a voluntary basis: Charlie Makray for First Aid training and Allan Ross for microscope service. Our sincere thanks go to all volunteers for their help in making the station run efficiently.

VISITORS IN 2010

SCIENTISTS

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

NADIA AURISCH and **TANE SINCLAIR-TAYLOR** (field leaders for **ALEXANDRA GRUTTER**),
University of Queensland
Investigation of cleaner fish functions and mutualism on host fish and fish parasite populations

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

SONIA BEJARANO CHAVARRO,
University of Queensland
Quantifying the effect of cleaner fish removal on grazing intensity on patch reefs

MICHAEL BERUMEN,
King Abdullah University of Science and Technology
1) Nutritional ecology of butterflyfishes
2) Self-recruitment, resources and fitness in a pelagic spawning fish

ROY CALDWELL,
University of California Berkeley
Stomatopod behaviour

JULIAN CALEY, Australian Institute of Marine Science
ROB ADLARD,
Queensland Museum
LYNDA AVERY, Museum Victoria
GARETH BELTON, assisted by
MARIA MARKLUND,
University of Adelaide
IAN BEVERIDGE,
University of Melbourne
PHIL BOCK, Museum Victoria
CHAD BUXTON, Museum of Tropical Queensland (PhD student)
MARIA CORRALES CAPA,
Australian Museum

ZDENEK DURIS,
University of Ostrava
MERRICK EKINS,
Queensland Museum
TAKUMA FUJII (PhD student),
University of the Ryukyus
ABBY FUSARO,
Ocean Genome Legacy
FRED GURGEL,
University of Adelaide
PAT HUTCHINGS,
Australian Museum
VIACHESLAV IVANENKO,
Moscow State University
IVAN MARIN, A.N. Severtzov Institute of Ecology and Evolution
TERRENCE MILLER,
Queensland Museum
JAMES REIMER,
University of the Ryukyus
MONIKA SCHLACHER,
Queensland Museum
CHARLOTTE WATSON,
Northern Territory Museum
CReefs – Census of Marine Life

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

SEAN CONNOLLY,
James Cook University
Biodiversity of coral assemblages

TOM CRONIN, University of Maryland Baltimore County
Vision and signals in fishes and stomatopods

MARIA DORNELAS,
James Cook University
Explaining coral species abundances: linking morphology to demography

SIMON DUNN,
University of Queensland
The effect of future ocean acidification upon the physiology of hermatypic corals

GRAHAM EDGAR,
University of Tasmania
A biodiversity baseline for the northern Great Barrier Reef using Reef Life Survey protocols

MATTHEW FELGATE,
University of Auckland
JIM SPECHT, Australian Museum
WAL AMBROSE,
Australian National University
HANS BADER,
Archaeology Solutions Pty Ltd
Distribution, abundance and diversity of the Lapita cultural complex on the GBR coastline of Australia

MAUD FERRARI,
University of California Davis
DOUG CHIVERS,
University of Saskatchewan
The effect of ocean acidification on predator-prey interactions

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

CRISTINA LINARES,
University of Barcelona
Understanding the competitive dominance of tabular corals

ELIZABETH MADIN,
University of Technology Sydney
ROBERT WARNER, University of California Santa Barbara
Indirect effects of cleaner wrasses

JOSHUA MADIN,
Macquarie University
Hydrodynamic disturbances on coral reefs

GAY MARSDEN (field leader for **ALEXANDRA GRUTTER**),
University of Queensland
Long-term effect of cleaner fish presence on fish herbivory rates

MARTIN HOW,
University of Queensland
Polarising vision and behaviour in stomatopods

CATHERINE LOVELOCK and **RUTH REEF,** University of Queensland, and
MARILYN BALL and **NELE SCHMITZ,**
Australian National University
Environmental constraints on mangrove performance

JUSTIN MARSHALL,
University of Queensland
Vision and signals in fishes and stomatopods

MARK MCCORMICK,
James Cook University

1) Predatory ecology of *Pseudochromus fuscus*

2) Annual fish census at six sites at Lizard Island

MARK MCCORMICK,
James Cook University
MARK MEEKAN, Australian Institute of Marine Science
PAOLO DOMENICI, Consiglio Nazionale delle Ricerche
Impact of acidification on fish survival

PHIL MUNDAY,
James Cook University
GORAN NILSSON,
University of Oslo
Effects of ocean acidification on behaviour of reef fishes

CAIT NEWPORT (field leader for **ALEXANDRA GRUTTER**),
University of Queensland
Effects of parasites on juvenile reef fish

LUCIE PENIN,
James Cook University
Post-settlement events influence on coral population dynamics

DAVID PHILLIPS,
Independent researcher
Long-term monitoring of giant clam populations

MEGAN PORTER, University of Maryland Baltimore County
Characterisation of visual ecology and diversity of stomatopod larvae

STEVE PURCELL,
National Marine Science Centre
Development of novel tagging and marking methods to study movement, growth and age of holothurians

NICHOLA RAIHANI,
Institute of Zoology, Zoological Society of London
The evolution of punishment and cooperation in nature

STEPHEN RINTOUL, CSIRO Marine & Atmospheric Research
Carbonate chemistry of the Lizard Island lagoon

NICK ROBERTS, University of Bristol
Seeing the world in a different light: polarisation vision in reef fish and stomatopods

ALBERT ROS,
University of Neuchatel
Hormone correlates of social behaviour: does social androgen modulation differ in intra- and interspecific contexts?

YUI SATO (field leader for **BETTE WILLIS**), James Cook University
Ecological significance of coral disease on the Great Barrier Reef

MARTA SOARES, Instituto Superior de Psicologia Lisbon
Comparison of the brain's distribution of the arginine vasotocin among species varying in their cooperative behaviour

DENNIS SPRENGER,
University of Tuebingen
STEFAN WALKER,
James Cook University
The effect of sex change on fish personality

SHELBY TEMPLE,
University of Queensland
Polarised vision in fish, cephalopods and crustaceans

RALPH TOLLRIAN,
Ruhr University Bochum
The impact of ocean acidification on the reproduction and growth of scleractinian corals

Top left: Cuttlefish.
Top middle: LIRS mooring basin.
Top right: Titan Triggerfish with wrasses.

POSTGRADUATE STUDENTS

(showing level of candidature)

BRIDIE ALLAN,
James Cook University
The effects of acidification on predator/prey interactions (MSc)

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)

PIM BONGAERTS,
University of Queensland
Intra reef genetic connectivity of Pocilloporidae (PhD)

ROHAN BROOKER,
James Cook University
Effect of diet on corallivore condition and reproduction (PhD)

PIP COHEN, James Cook University
Evaluation of protection zones – case studies in Australia and the Solomon Islands (PhD)

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

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

INGRID CRIPPS,
James Cook University
The effect of ocean acidification on the predator–prey interactions in reef fish (Hons)

JACLYN DAVIES,
James Cook University
Climate change impacts through changes in topographic complexity (MSc)

VISITORS IN 2010

ALIZEE DERENDINGER,
University of Neuchatel
Hormonal correlates of interspecific social behaviour (MSc)

BRYNN DEVINE,
James Cook University
Effects of ocean acidification on homing behaviour in cardinalfishes (MSc)

DANIELLE DIXSON,
James Cook University
Determining the cause of ocean acidification effects on behaviour of reef fishes: pH or CO_2? (PhD)

KATE FELLER, University of Maryland Baltimore County
Oculae camouflage of stomatopod larvae (PhD)

JUSTINE GARCIA, Emory University
Immune capabilities of *Heteroxenia* and *Phyllodesmium lizardensis* during development and establishment of *Symbiodinium* (PhD)

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

SIOBHAN HEATWOLE,
Australian National University
Behavioural flexibility as a phenotypic response to environmental change by coral reef fishes (Hons)

ANDREW HOEY,
James Cook University
Fish–algal interactions: the role of herbivory in structuring algal communities across an exposure gradient (PhD)

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

ROLANDA LANGE,
University of Tuebingen
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)

CARINE LEFEVRE,
James Cook University
Ecology of cryptobenthic fishes on the Great Barrier Reef (PhD)

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

DOMINIQUE MCCOWAN,
James Cook University
Evolution, adaptation and acclimatisation: the vulnerability of scleractinian corals to mass bleaching events (PhD)

MATHEW MITCHELL,
James Cook University
Chemical cues: the role of chemical alarm cues in coral reef fish (PhD)

CRYSTAL NELIGH,
James Cook University
The effect of temperature on predator–prey behaviour (MSc)

AMIRA PARKER,
University of Queensland
Secret communication using ultraviolet patterns in reef fish (PhD)

ANA PINTO,
University of Neuchatel
Interspecific social competence and audience effects in cleaner wrasses, *Labroides dimidiatus* (PhD)

CHIARA PISAPIA,
James Cook University
Effect of coral bleaching on feeding behaviour in butterflyfishes (MSc)

F. JOSEPH POLLOCK,
James Cook University
Prevalence and progression of White Syndrome (PhD)

CECILIA VILLACORTA RATH,
James Cook University
Environmental determinants of growth & mortality of reef fishes in the GBR (MSc)

VERENA REICHEL,
University of Tubingen
Comparative analysis of *Siphopteron* mating strategies and their genital morphology (MSc)

DOMINIQUE ROCHE,
Australian National University
Predator–prey interactions among coral reef fishes: the role of swimming behaviour, performance and environmental flaws (PhD)

ROSAELLA SHEB'A,
Australian National University
Niche segregation in coral reef damselfishes (Hons)

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
Ecological role of parasites in fish after settlement (PhD)

GERGELY TORDA,
James Cook University
Ecological connectivity in pocilloporid corals: implications for their recovery from perturbations and adaptation to climate change (PhD)

MELANIE TRAPON,
James Cook University
1) Spatial variation in abundance, growth and post-settlement mortality of juvenile corals along the Great Barrier Reef (MSc)
2) Impact of herbivorous fish on coral recruit survival (PhD)

ALEX VAIL,
University of Cambridge
Cooperative hunting (PhD)

JEROEN VAN DE WATER,
James Cook University
Molecular mechanisms of coral immunity and the influence of environmental factors on coral immunity (PhD)

PHILIPPE VULLIOUD,
University of Neuchatel
Hormone correlates of social behaviour: does social androgen modulation differ in intra- and interspecific contexts? (MSc)

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

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

JAMES WHITE,
James Cook University
Predatory ecology of Moon Wrasse (MAppSci)

NICOLA WILLSON,
James Cook University
Body condition methods – a comparison of *Acanthochromis* across reefs (MSc)

SHARON WISMER,
University of Zurich
The effect of age class and habitat on cleaner wrasse behaviour (MSc)

UNDERGRADUATE STUDENTS

JULIE CARPENTER,
School for International Training
Effects of size and aggression on sex-change in a hermaphroditic coral reef fish, *Parapercis cylindrica*

ERIN EASTWOOD,
School for International Training
Species discrimination by *Pomacentrus amboinensis* using ultraviolet facial patterns

CAMERON HOLLAND,
School for International Training
Coral bleaching and its effect on the fecundity of the coral crab *Trapezia cymodoce*

SHANNON ODELL,
School for International Training
Secondary predator attractants of naïve *Pseudochromis fuscus*

REBECCA SHOPIRO,
School for International Training
Identifying Apogonidae from larval to juvenile phases based on morphological differences

MEGAN WELCH,
School for International Training
How pH changes fish behaviour

CAROLYN GROVES,
School for International Training
Partner novelty and reproductive fitness in the simultaneously hermaphoditic sea slug *Chelidonura sandrana*

STUDENT GROUPS

University of Maryland
Led by Prof. Reid Compton

Trinity Anglican School
Led by Rachel Elphick

Brighton Grammar School
Led by Dr Andrew Lewis

Ascham School
Led by Edward Sze-Tu

Barker College
Led by Tim Binet

Haileybury College
Led by Dr Andrew Lewis

World Learning
Led by Dr Tony Cummings

RMIT University
Led by Assoc. Prof. Gale Spring

School for International Training
Led by Dr Jack Grant

Top left: PhD student Gergely Torda at work.

Top middle: Many-lined Sweetlips.

Top right: One of the two *Macquarie* boats.

OTHER VISITORS

Lizard Island Reef Research Foundation
Charlie and Sandy Shuetrim
John and Rosemary Gough
Tom Healy
Lady Potter
Bill and Jensie Shipley
John and Barbara Boyle
Zoli Florian

Construction works
Aaro Raappana, Graeme Davis, Ben Bauer, Beau Petersen, Jono Zangrande, Max Bryant and others (Max Bryant Constructions)

Filming for LIRS video production
Russell Kelley and Rachel Pears

Filming for documentary *The Great Barrier Reef*
James Bricknell, Rachel Butler, Mary Clark, Richard Fitzpatrick, Monty Halls, Bess Manley, Cam McGrath, Rory McGuinness and Nikki Melton (BBC and Digital Dimensions)

Lizard Island Park management
Alan Clackson, Pat Kirby, Richard Lindeman, Hayley McDowell, Simeon Migliaranza, Mick Parks, David Sherwell and Eddie Wyman (Queensland Parks and Wildlife Service)

Refrigeration mechanics
Ashley and Simon Lawson

Installation of Lizard Island node of GBR Ocean Observing System
Scott Bainbridge, Damien Eggeling, Geoff Page, Ray Boyes and Paul Nicolle (Australian Institute of Marine Science)

Installation of temporary tide gauge
Rafe Pennington (Maritime Safety Queensland)

First Aid training
Charlie Makray and Julie Armour

Microscope service
Allan Ross

PUBLICATIONS

Ninety-four publications based on work carried out at LIRS were received into the collection during the year. The collection now comprises more than 1370 publications.

1. Abdulla, A., 2004. Predator-prey interactions in coral reef fish: the implications of predation risk on the behaviour and growth of prey. PhD thesis, James Cook University.

2. Ang, T.Z., 2010. Social conflict resolution in groups of the angelfish *Centropyge bicolor.* PhD thesis, University of Cambridge.

3. Ang, T.Z. and A. Manica, 2010. Aggression, segregation and stability in a dominance hierarchy. *Proceedings of the Royal Society B, 277*:1337-1343.

4. Ang, T.Z. and A. Manica, 2010. Unavoidable limits on group size in a body size-based linear hierarchy. *Behavioural Ecology,* doi:10.1093/beheco/arq062.

5. Ang, T.Z. and A. Manica, 2010. Benefits and costs of dominance in the angelfish *Centropyge bicolor. Ethology, 116:* 1-11.

6. Barnett, L.J., T.L. Miller and T.H. Cribb, 2010. Two new *Stephanostomum*-like cercariae (Digenea: Acanthocolpidae) from *Nassarius dorsatus* and *N. olivaceus* (Gastropoda: Nassariidae) in central Queensland, Australia. *Zootaxa, 2445:* 35-52.

7. Bellwood, D.R., S. Klanten, P.F. Cowman, M.S. Pratchett, N. Konow and L. van Herwerden, 2009. Evolutionary history of the butterflyfishes (f: Chaetodontidae) and the rise of coral feeding fishes. *Journal of Evolutionary Biology,* doi 10.1111/j.1420-9101.2009.01904.x

8. Biro, P.A., C. Beckmann and J.A. Sharp, 2010. Small within-day increases in temperature affects boldness and alters personality in coral reef fish. *Proceedings of the Royal Society B, 277:* 71-77.

9. Bonaldo, R.M and D.R. Bellwood, 2010. Parrotfish predation on massive *Porites* on the Great Barrier Reef. *Coral Reefs,* doi 10.1007/s00338-010-0669-3

10. Bongaerts, P., C. Riginos, T. Ridgway, E. Sampayo, M. J. H. van Oppen, N. Englebert, F. Vermeulen and O. Hoegh-Guldberg, 2010. Genetic divergence across habitats in the widespread coral *Seriatopora hystrix* and its associated *Symbiodinium. PLoS One, 5*: e10871.

11. Bott, N.J., 2006. Bivalves and the Bucephalidae: a parasitic system on the Great Barrier Reef. PhD thesis, University of Queensland.

12. Bray, R.A., T.H. Cribb and J.-L. Justine, 2010. *Diploproctodaeum* spp. (Digenea, Lepocreadiidae) in Australian and New Caledonian waters including two new species from Tetraodontiformes and new records of related species. *Acta Parasitologica, 55:* 313-326.

13. Bruce, N.L., 2009. A new genus and new species of Sphaeromatidae (Crustacea: Isopoda) from the Great Barrier Reef, Australia. *Memoirs of Museum Victoria, 66:* 35-42.

14. Burger, M.A.A. and R.D. Adlard, 2010. Four new species of *Kudoa* Meglitsch, 1947 (Myxosporea: Multivalvulida) from Australia with recommendations for species descriptions in the Kudoidae. *Parasitology, 137*: 793-814.

15. Burger, M.A.A. and R.D. Adlard, 2010. Phenotypic variation in a significant spore character in *Kudoa* (Myxosporea: Multivalvulida) species infecting brain tissue. *Parasitology, 137:* 1759-1772.

16. Byrne, M., F. Rowe and S. Uthicke, 2010. Molecular taxonomy, phylogeny and evolution in the family Stichopodidae (Aspidochirota: Holothuroidea) based on COI and 16S mitochondrial DNA. *Molecular Phylogenetics and Evolution,* doi: 10.1016/j.ympev.2010.04.013.

17. Capa, M. and A. Murray, 2009. Review of the genus *Megalomma* (Polychaeta: Sabellidae) in Australia with description of three new species, new records and notes on certain features with phylogenetic implications. *Records of the Australian Museum, 61:* 201-224.

18. Cheney, K.L., 2010. Multiple selective pressures apply to a coral reef fish mimic: a case of Batesian-aggressive mimicry. *Proceedings of the Royal Society B,* doi 10.1098/rspb.2009.2218.

19. Clague, G.E., 2009. The long-term effects of cleaner fish presence on ectoparasites, condition and growth of coral reef fish. Honours thesis, University of Queensland.

20. Cole, A.J., K.M. Chong-Seng, M.S. Pratchett and G.P. Jones, 2009. Coral-feeding fishes slow progression of black-band disease. *Coral Reefs,* doi 10.1007/s00338-009-0519-3.

21. Cole, A.J., R.J. Lawton, M.S. Pratchett and S.K. Wilson, 2010. Chronic coral consumption by butterflyfishes. *Coral Reefs,* doi 1007/s00338-010-0674-6.

Top left: Dr Ralph Tollrian.
Top right: Coral Rabbitfish.
Right: Calm days are cherished by researchers.

22. Cortesi, F. and K.L. Cheney, 2010. Conspicuousness is correlated with toxicity in marine opisthobranchs. *Journal of Evolutionary Biology, 23:* 1509-1518.

23. Eckes, M., 2009. The ecological function of fish mucus. PhD thesis, University of Queensland.

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Top left: PhD student Oona Lonnstedt at the aquarium.
Top right: 2010 Ian Potter Doctoral Fellow Darren Coker.
Right: A school of Fusiliers.

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Top: PhD student Wander Godhino records coral dimensions on the outer reef crest for Dr Josh Madin.

Bottom: Reef flat at South Island.

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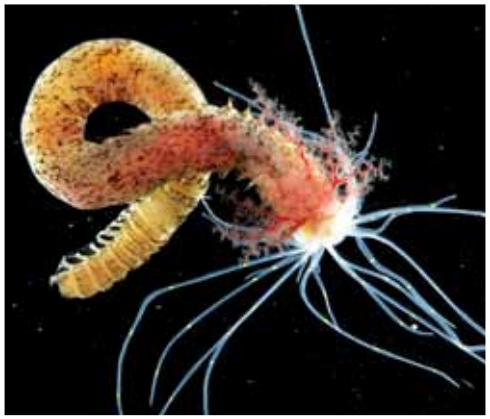


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