Lizard Island Research Station

Report 2023

AUSTRALIAN MUSEUM

Acknowledgements
The Australian Museum acknowledges and pays respect to the Gadigal people and the Dingaal and Ngurrumungu people, as the First Peoples and Custodians of the land and waterways on which the Australian Museum and Lizard Island Research stand.

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Photograph of Kim McKay © Australian Museum.

Photographs of Kate Hayward and the six fellows were provided.

All other photographs by Lyle Vail or Anne Hoggett unless otherwise indicated.

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Kim McKay AO
Director & CEO, Australian Museum

Last year we celebrated the unparalleled achievements of the Australian Museum's (AM) Lizard Island Research Station (LIRS); and this year, we acknowledge another milestone with some regret: the co-directors Dr Anne Hoggett AM and Dr Lyle Vail AM have announced their retirement, having served at the AM station for 34 years.

In her keynote presentation at the Talbot Oration last year, Dr Anne Hoggett reminded us "There is just time to reduce carbon emissions to allow a semblance of reefs as we know them," and the Australian Museum is committed to upholding the legacy of these remarkable scientists. The Australian Museum is embarking on a global search to identify two new marine scientists to take up the role of co-directors to lead the LIRS.

Despite this significant news, the LIRS has not slowed in delivering outstanding work, impactful research and advocacy. Some highlights described in more detail in this report include the completion of the second annual Lizard Island Coral Reef Study Tour group, which brought high achieving students to LIRS. BBC series, *Blue Planet II*, narrated by Sir David Attenborough, also featured footage captured in the waters surrounding Lizard Island by wildlife cinematographer Alex Vail.

We held two 50th anniversary dinners, one in Melbourne and one in Sydney, and the 50th Anniversary infrastructure fundraising project was successfully launched by the LIRRF team who are dedicated to raising the $2million we need for important infrastructure projects at LIRS.

We are indebted to our donors, fundraisers and volunteers, whose efforts impact every part of the LIRS. This vital work would not be possible without the Lizard Island Reef Research Foundation, led by Chair Kate Hayward.

Finally, I would like to acknowledge the support that LIRS receives from Australian Museum Research Institute staff led by Professor Kris Helgen and the AM Trust. Please join me also in acknowledging Professor Frank Talbot AM, a former Director of the Australian Museum, for having the vision to found LIRS 50 years ago.

May 2024

Kate Hayward
Chair, Lizard Island Reef Research Foundation

As I write, widespread bleaching has been reported across areas of the Great Barrier Reef. It's the fifth mass bleaching event in eight years and it is heartbreaking. Areas that had bounced back remarkedly well at Lizard over the past six years are now under stress. Each summer now is a nail biting one and the trajectory is alarming. This is why supporting our marine scientists now is as important as ever. We need to understand how reefs and their ecosystems are being affected, continue to monitor changes, understand adaptability and inform management practices. The Station has supported the continuous collection of data over five decades and continues to play a very important role.

2023 has been a milestone year for the Station, marking 50 years since its founding. Its contribution to coral reef science has been hugely significant, as this report highlights. Coinciding with the Station's 50th anniversary, the Foundation has kicked off a $2 million capital campaign to fund a new laboratory space as well as fund another staff house. We are half way there, thanks to generosity of our supporters.

It will be with great sadness, at the end of this year, that we farewell Station Co-Directors Anne Hoggett and Lyle Vail. After 34 years of exceptional stewardship, Anne and Lyle are retiring. It's hard to adequately acknowledge the enormous influence they've had in shaping the Station to be one of the world's best coral reef research facilities. It's not just the excellent infrastructure that, over three decades, they have helped design, build and maintain. It is not just the care and professionalism they've shown fellow marine scientists, supporting and nurturing many careers. They've created something much, much more - a culture of great collaboration where scientists from institutions worldwide can work together to share ideas and problem solve. They have done this with great passion, respect and humility. They will leave the Station in extremely good stead for their successors. We thank them enormously and wish them every happiness.

May 2024

Lizards Island Research Station (LIRS) is 50 years old

In the last 50 years, LIRS has made a huge contribution to knowledge of coral reefs. It is also a place that engenders loyalty and long-term commitment, and we want to acknowledge the people who have made enormous, enduring contributions to its development.

The inaugural Director, Steve Domm, spent nearly two years organising logistics and preparing basic facilities on the undeveloped site before the first researchers arrived in 1975. Among those who took part in that first research trip were the station's founder Frank Talbot, then Director of the Australian Museum, and AM scientists Pat Hutchings and Penny Berents, all of whom remain involved with LIRS to this day.

The station's second Director, Barry Goldman and his then-wife Lois Wilson, left a wonderful legacy of infrastructure and culture that is the foundation on which the current station is built. Former AM Director Des Griffin was a staunch supporter at a critical stage in the station's development. All LIRS maintenance staff have made important contributions. Lance and Marianne Pearce and Bob and Tania Lamb deserve special mention for their long service: 24 and 15 years respectively. LIRS continues to receive strong support from the Australian Museum, led by Kim McKay (Director and CEO) and Prof Kris Helgen (Chief Scientist and Director of AM Research Institute).

The Lizard Island Reef Research Foundation (LIRRF) was established only five years after LIRS began, providing a firm financial footing for the station and the research it supports – which it has done abundantly. There are too many people involved to mention by name, but we must acknowledge the Foundation's founder, the late Sir John Proud, and its longest-serving Chair, the late Ken Coles. They were visionaries without whom the station would not exist today. David Shannon and then Kate Hayward succeeded Ken as LIRRF Chair and both have been enormously successful in building on that legacy and extending the Foundation's reach. Long-term Trustee Charlie Shuetrim has made an exceptional contribution over decades by creating and maintaining connections, managing the Foundation's financial affairs, and thinking outside the box. We thank them, all LIRRF Trustees past and present, and all donors to the LIRRF for their commitment to the success of LIRS.

After leading LIRS for more than two thirds of its history, we have decided to take the next step in life: we will be handing over to new people in late 2024. We are extremely proud of the station's work and achievements. Thanks to the Foundation's support, its infrastructure is fit for purpose and in great shape. The research facilitated by LIRS is impressive in both quality and quantity. But it's the inclusive and collaborative culture of LIRS that we will miss most. Sunset beers and Saturday night barbeques sound like simple pleasures but they are valuable events at LIRS. They grease the wheels of communication and help to make LIRS an effective, exciting and very pleasant place to work. We wish our successors all the joy that we have had at LIRS.

As noted on page 16, some parts of the reef around Lizard Island continued to recover strongly in 2023. Reefs have clearly shown their resilience in this area, and long may it last! However, disturbances fuelled by carbon pollution are becoming increasingly frequent. Caribbean reefs suffered major losses in the northern summer in 2023, and as we write in early 2024, bleaching is beginning again at Lizard Island. The consequences of the current event remain to be seen, but it's only a matter of time before there is mass death of corals again on the Great Barrier Reef. With no end to carbon pollution in sight, we cannot assume that its resilience will last forever.

Lyle Vail AM and Anne Hoggett AM
Directors, Lizard Island

Fun facts about LIRS over its 50 years:

- Almost all capital development at LIRS has been made possible by philanthropy.
- More than 2,700 scientific publications have been produced from research at LIRS.
- They include at least 218 PhD theses from 15 Australian and 37 overseas universities.
- 133 fellowships and 30 grants have been awarded for research at LIRS thanks to funding from LIRRF.
- More than 130,000 dives and 93,000 boat trips have been logged.
- 256 student groups involving more than 5,000 students have used LIRS as a base for educational trips.
- LIRS operates with only four full-time staff, all on site, as it did in 1990 when usage was at less than half the current level.
- Staff turnover is extremely low: since 1973, there have been only four sets of Directors and, since 1990, there have been only six sets of maintenance staff.
- There have been at least 2,300 of those important Saturday night barbecues.

Fellowships and grants

The Lizard Island fellowships and grants program provides funding for field-intensive researchand is fully supported by the Lizard Island Reef Research Foundation (LIRRF) and its donors.

New fellowships are awarded each year to support broad categories of research by PhD students and recent postdocs. Grants are awarded periodically to support more targeted research.

An external evaluation of the fellowships program was conducted this year (see p.14)

In 2023, three doctoral and three postdoctoral Fellowships were awarded that will start in 2024. A new Critical Research Grant was not awarded, although research was carried out during the year supported by three Critical Research Grants awarded between 2020 and 2022.

Donors who support specific awards are listed below. We sincerely thank them for their generous support.

- Lizard Island Reef Research Foundation members and friends
- The Ian Potter Foundation
- The Charles Warman Foundation
- The Gough Family
- The Hermon Slade Raiatea Foundation
- The Maple-Brown Family Foundation
- The estate of Sir John and Lady Proud
- The estate of Chris Joscelyne
- Ian Darling AO and Min Darling
- Sally White OAM
- The Raymond E. Purves Foundation

Details of the conditions and selection criteria for these awards can be found in the Lizard Island Research Station section of the Australian Museum's web site. Applications close in August or September for funding that becomes available in April of the following year.

Fellowships

Since the program's inception in 1984, the LIRRF has supported 133 Fellowships totalling about $1.8 million. The scope of projects supported by Fellowships is intentionally broad enabling applicants to seek support for research within their areas of interest and existing commitments. They are highly competitive and produce excellent research while making an important contribution to research training. The program is unique for its scope and longevity and for the rare support it offers for field work by early career scientists.

Six new fellows will commence their field work in 2024: three PhD students and three recent postdocs. Outlines of their projects can be found on pages 6 – 9.

The value of Fellowships increased substantially in 2023. This reflects the growing requirement by Australian universities for diving by their scientists and students to take place in teams of at least three people. Until recently, it was common to dive at LIRS in two-person teams and the new requirement increases the cost of field work.

Grants

The Lizard Island grants program has supported research within several themes since its inception in 2012. In 2020, the program changed to a single theme with broad scope - critical research. Thirty grants have been awarded since 2012 with a total value of almost $1 million.

Critical Research Grants support coral reef research that is important on a broad scale and has a time-critical element. Unlike the fellowships program, grants are not limited to a particular research demographic - applicants can be at any level within the research community. They are offered irregularly depending on need and the funding available. A new grant was not awarded in 2023.

In 2023, field work was carried out for three Critical Research Grants awarded earlier:

Prof Maria Dornelas (University of St Andrews) and **Prof Joshua Madin** (University of Hawai'i) were awarded a three-year Critical Research Grant in 2020, funded by the Charles Warman Foundation, for a long-term study: *Understanding coral reef recovery from extreme disturbances using 3D maps.* The final field trip under this grant was conducted in late 2023.

The team has extended its valuable time series of annotated 3D maps. The process of recovery is clearly visible in these data. There is substantial increase in coral density at most sites, and the total number of coral colonies increased to 35,000 in 2022 from 11,000 in 2017, and the number of species identified has risen to 303 in 2022 from 120 in 2017. Data for 2023 is not yet available but it's clear that the trajectory continues. Recovery is particularly obvious for *Acropora* corals, which had become exceedingly rare after a series of severe disturbances between 2014 and 2017. However, recovery is very patchy, with some sites faring far better than others.

This important project will continue at Lizard Island thanks to major funding awarded to Prof Dornelas through a European Research Council Grant.

Prof Andrew Baird (James Cook University), **Dr Tom Bridge** and **Dr Peter Cowman** (Museum of Tropical Queensland) and **Prof Joshua Madin** (University of Hawai`i) were awarded the 2022 Critical Research Grant for *Taxonomy of the reef-building corals at Lizard Island*. The grant is funded by donors Sally White and Ian and Min Darling.

The short-term goal of this project is to establish a curated collection of all hard coral species found in the waters surrounding Lizard Island, combined with live photos of the collected specimens and DNA samples. It is critical to do this now, while coral diversity is high as the reef recovers strongly from disturbances. The work of photographing, collecting, preserving, and extracting DNA from corals at Lizard Island was completed in 2023. Analysis of DNA is underway and the coral skeletons will eventually be housed at the Australian Museum. The long-term goal is a robust taxonomy for corals of the Great Barrier Reef and beyond. Taxonomy underpins all biological and ecological research so it's excellent that Lizard Island corals will be included in this broad-scale revision of coral taxonomy.

Prof Morgan Pratchett (James Cook University) was awarded a Critical Research Grant in 2022 for a project designed to quantify size and abundance of Crown-of-Thorns Starfish (COTS) at different places and times in the lead up to renewed population irruptions of this coral-eating starfish on the Great Barrier Reef (GBR).

The research was conducted in late 2022 and early 2023, focusing on the northern GBR from Cairns to Cape Grenville. Results support the suggestion that renewed population irruptions of COTS will affect the GBR in coming years. Indeed, Prof Pratchett's novel methods for detecting and quantifying COTS densities reveal significant and ongoing increases in the abundance of COTS across many reefs in the northern and far northern GBR, including Lizard Island. Notably, there have been marked increases in COTS densities at Lizard Island since 2020, despite ongoing culling at reefs in the region. However, there has been no attempt to cull COTS in the far northern GBR. Given the size, abundance, and reproductive condition of COTS recorded in the Cape Grenville, Princess Charlotte Bay, and Lizard Island regions there is likely to be further substantial settlement and corresponding increases in COTS densities in coming years. This research reveals a critical need for changes to current COTS culling programs if we are to contain impending and future population irruptions of COTS.

Cher Chow

2024 Ian Potter Foundation Doctoral Fellowship

St Andrew's University, Scotland

Biodiversity and productivity in coral reef ecosystems

Coral reefs are among the most productive and biodiverse marine ecosystems but are undergoing high rates of diversity change. Decline in biodiversity following disturbances has been linked with cascading compositional change, reduced reef calcification, and reduced fish productivity. This suggests that that the theory of a positive relationship between biodiversity and productivity applies to coral reefs. However, some studies have found that the abundance of certain key species is more important. Coral reef research currently suffers from a paucity of direct investigations into the functional impacts of biodiversity change. Cher is addressing this knowledge gap with a process-based approach to clarify the consequences of biodiversity trajectories on the functioning of coral reefs, and of similarly complex ecosystems that are under threat.

Cher will build upon on a long-term data set established by her supervisor, Prof Maria Dornelas (University of St Andrews, University of Lisbon) and Prof Joshua Madin (Hawai`i Institute of Marine Biology, University of Hawai`i at Manoa). Her research focuses on quantifying the productivity of reef-building corals and fishes across a biodiversity gradient and then modelling the relationship between productivity with biodiversity. The objectives of the project are to: 1) Measure coral and reef fish productivity, 2) Quantify the relationship between biodiversity and productivity through time; and 3) Identify key species to reef productivity.

This project will be one of the first attempts to directly quantify reef growth and link it back to the coral species generating that growth. Clarifying the role of biodiversity in the functioning of an ecosystem will have important implications in how coral reefs and other similarly complex biomes are managed and utilised.

Kyra Jean Cipolla

2024 Lizard Island Doctoral Fellowship

University of Texas Austin, USA

Scaling-up estimates of cryptobenthic fish communities using structure-from-motion and remote sensing

Coral reefs are one of the most structurally complex and biodiverse ecosystems in the marine environment. However, human impacts have shifted reefs toward less complex ecosystems, which may drastically change reef fish communities. One important yet overlooked group is cryptobenthic reef fishes (CRFs). CRFs are tiny fishes (up to 5 cm long) that live their relatively short lives close to the reef, hiding from predators in holes, and feeding on a range of sources on the reef. In turn, CRFs supply energy to consumers higher on the reef food web. Although there is a lot of ecological research on the links between the reef benthos and larger fish species, the effects of reef shape on small reef-dwellers are poorly known despite their dependence on many benthic habitats and structures. Kyra Jean's research will examine how variations in habitat shape, reef type, and benthic structure affect fish community structure.

Recent advances in underwater technology allow scientists to quantify reef geometry using photogrammetry, which is high-resolution, non-invasive, and feasible to implement in the field even in relatively rough conditions. It is very difficult to examine habitat shape of an entire reef. However, aerial imagery from unmanned aerial vehicles offers an exciting, low-cost, remote-sensing platform that provides invaluable monitoring power for reefs at large spatial scales. Kyra Jean plans to combine reef geometry, CRF collections, and aerial imagery of shallow reef areas (<10m deep) to examine how changes in habitat shape will affect reef ecosystem functioning. Kyra Jean's project will enable determination of the community composition of functionally important CRFs and project the habitat architecture of the entire reef system by measuring a fraction of the total area.

Melman Neill

2024 Joint Minderoo Foundation and Lizard Island Reef Research Foundation Doctoral Fellowship

University of Texas Austin, USA

Physiology, life history, and the pace of life: understanding the role of cryptobenthic fishes in coral reef ecosystems

Cryptobenthic reef fishes (CRFs) are a group of tiny species that are easy to ignore as they measure less than 5 centimetres and spend much of their time flitting between crevices and hiding from predators. Nonetheless, CRFs are a major conduit of energy on reefs. They grow rapidly and are consumed by predators at very high rates, channelling considerable amounts of energy from their planktonic food to larger predators.

Melman's research aims to investigate how CRF metabolic rates relate to their community structure and growth. First, he plans to survey CRF communities at sites surrounding Lizard Island with varying levels of wave exposure using a specialized net structure.

Second, he will use respirometry to understand how metabolic rates differ between CRF species. Respirometry involves placing live fishes inside specialized chambers where their respiration is quantified by precisely measuring the oxygen concentration. Oxygen consumption rate is a proxy for metabolic rate, which may vary significantly between species. Finally, he will collect otoliths, or ear stones, from CRFs to determine their growth rates. From this data he will obtain a more holistic understanding of CRF communities.

Melman is the inaugural recipient of the Joint Minderoo Foundation and the Lizard Island Reef Research Foundation Doctoral Fellowship. Consequently, he will conduct his research both at Lizard Island and at Ningaloo Reef. Quantifying CRF functioning at both sites will reveal ecological trends important to future reef conservation efforts.

Above: Researchers from University of Queensland and Queensland Museum study fish parasites at LIRS: (L-R) Dr Nicholas Wee, Dr Scott Cutmore, Dr Terry Miller and Prof Tom Cribb.

Dr Michalis Mihalitsis

2024 Isobel Bennett Marine Biology Fellowship

University of California Davis, USA

Feeding kinematics reveal novel axes of niche partitioning in herbivorous coral reef fishes

Herbivores (plant eaters) are widely known for their crucial roles on coral reefs such as removing significant amounts of algal material from reefs. However, little is known about the morphological and/or behavioural adaptations required by them to bite algae off the sea floor, in an almost weightless environment. Biting as a feeding mode is functionally demanding, requiring a high degree of morphological specialisation. Many herbivorous species conduct an abrupt sideways head flick to detach filamentous algae, while others use a ventral pulling motion.

Michalis' project aims to investigate the feeding kinematics (e.g., reliance on a sideways head flick) of surgeonfish species at different reef habitats, that are also exposed to different current strengths. He will film surgeonfishes feeding in different flow regimes across Lizard Island, with two synchronised cameras from two different planes of view. This method will enable him to capture the motion of feeding from multiple planes of view, and with the help of computer software, capture it in three dimensions. By establishing links between morphology, behaviour, and the influence of environmental factors (i.e., current flow), we can better understand how future reef configurations (i.e., increase in algal turfs), may shape the functional delivery by herbivorous fishes on coral reefs in the Anthropocene.

Dr Mike McWilliam

2024 Maple-Brown Family Foundation Fellowship

James Cook University

The importance of habitat geometry for coral reef productivity

Shallow-water coral reefs are among the most productive of all ecosystems. High rates of productivity can be partly attributed to climatic factors but they can also be enhanced by 'habitat geometry,' including benthic morphology and ecosystem topography. Three-dimensional (3D) habitat complexity is essential for coral reef biodiversity and stability. However, the structural attributes of reef habitats are changing rapidly under human pressures, especially global warming.

Habitat structure can influence reef productivity because of scaling relationships linking organism size, geometry, and metabolism. Early reports attributed high reef productivity to elevated structures and extensive substrate that allow photosynthetic coral and algae to settle and grow. Dense coral thickets can provide highly effective 3D light-traps and act as 'energy generators' for reefs. Changes to habitat geometry under increasing disturbances can theoretically modify the productivity and energy-use of reefs, ultimately affecting biomass accumulation and carbonate accretion.

The main objective of Mike's study is to study the relationship between habitat complexity and primary productivity, and test whether reef patches with a more intricate habitat structure have a higher Gross Primary Productivity (total carbon fixed) and a higher Net Community Production (carbon remaining after the respiration costs of plants, heterotrophs, and decomposers are met). His study will use in situ metabolic chambers and state-of-the-art 3D mapping technology to quantify the predictive role of habitat geometry for carbon fixation across a range of locations and scales.

Dr Sterling Tebbett

2024 John and Laurine Proud Fellowship

James Cook University

The boom-and-bust future of coral reefs in the Anthropocene

Climate change is restructuring the world's coral reefs, with more frequent and severe mass coral bleaching events resulting in widespread coral death. While in some cases coral cover can recover in a matter of years after these disturbances, thanks to fast-growing corals, this recovery is likely to be short-lived. This is because climate change has shortened the amount of time between disturbance events on reefs, and these fast-growing corals are highly sensitive to disturbances, such as coral bleaching. As a result, some reefs may be entering a period of boom-and-bust coral dynamics. Unfortunately, our understanding of what these boom-and-bust cycles mean for the functioning of coral reefs is currently limited. Sterling's research will examine the nature of boom-and-bust coral cover dynamics at Lizard Island, while also examining other key reef organisms, namely algae, that dominate coral reefs during periods of low coral cover.

To explore boom-and-bust coral cover dynamics, he will utilise a dataset of high-definition photographs spread across Lizard Island. These locations were initially photographed immediately prior to the 2016 bleaching event and have been photographed regularly since to track coral loss and recovery. Sterling will continue this sampling to track coral dynamics in high definition around Lizard Island and document any busts in corals that may occur because of the coral bleaching events that appear set to disturb Lizard Island in the future. To offer broader insights into how coral reefs may function during these boom-and-bust coral dynamics, he will also undertake detailed surveys of the short algae that are widespread, but often overlooked, on reefs around Lizard Island during periods of low coral cover. Understanding the composition of these algae, the rate at which they grow, and the factors which shape this growth, is important as some of these algae can play critical roles in the construction of coral reefs.

Lizard Island Reef Research Foundation

Founder

The late Sir John Proud

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Dr Des Griffin AM
Mr Raymond Kirby AO
Mrs Jacqueline Loomis
The Ian Potter Foundation
Mr Robert Purves AM
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[1] New Trustee in 2023

We thank Australian Museum researcher Dr Shane Ahyong for being part of the Selection Committee in 2023 for awarding fellowships and grants, joining Science Committee members Penny Berents, Kris Helgen, Anne Hoggett and Lyle Vail (Chair of Selection Committee). Dr Joey DiBattista resigned from the Australian Museum in 2023 to take up a position at Griffith University. We thank him for his valuable input while a member of the Selection Committee over many years.

The Lizard Island Reef Research Foundation is an independent trust established in 1978 to conduct and support scientific research at LIRS and elsewhere on the Great Barrier Reef.

Go to lirrf.org for information about the Foundation and the research it supports and to donate to its worthy causes. All donations of $2 or more are tax deductible in Australia.

Members donate $1,000 or more in a 12-month period and Friends give a lower amount. Life Members donate at least $100,000 which may be spread over several years. LIRS would not be the place that it is without the support of the LIRRF. Members in 2023 are listed on page 28.

Board changes

The LIRRF Trust Deed requires two LIRRF Trustees to be current Trustees of the Australian Museum Trust. This crossover between boards is beneficial in many ways. Following the retirement of David Armstrong and Rod Kefford from the AM Trust last year, we welcomed two new AM Trustees to the LIRRF board this year.

Distinguished Professor Larissa Behrendt AO is a Eualayai/Gamillaroi woman and the Director of Research and Academic Programs at the Jumbunna Indigenous House of Learning at the University of Technology, Sydney. She is a graduate of the UNSW Law School and has a Masters and SJD from Harvard Law School. She is a Fellow of the Academy of Social Sciences in Australia and a founding member of the Australian Academy of Law. Larissa was appointed to the AM Trust in August 2019.

Jennifer Dalitz is a Business Advisor, Executive Coach, Board Chair, Non-Executive Director of Qudos Bank and iPartners. She brings strategic and operational expertise in line roles and as a management consultant within top tier firms, working predominantly across banking and financial services, professional services, and membership associations. She was appointed to the AM Trust in January 2023 and serves as the Chair of the Australian Museum's Audit & Risk Committee.

Vale

Former LIRRF Trustee Alison Hayward was a long-term Trustee and a substantial donor to LIRRF. Among other generous gifts, she funded 'Alison's Shed' at the Station as part of the 30th Anniversary Development. Her daughter, Kate Hayward, is currently chair of LIRRF.

Gordon Moffatt AM was a long-term LIRRF Trustee whose exceptional generosity spanned many causes, including the LIRRF with his funding of four Life Memberships. His daughter, Heather Power, is a LIRRF Trustee.

Projects and equipment funded by LIRRF in 2023

In the 2023 financial year, the LIRRF contributed a total of **$443,865** in support of research and education.

- **$324,978** for research and education through its fellowships and grants program and for the Coral Reef Study Tour.
- **$17,232** for three outboard motors to support research at LIRS
- **$101,655** for other research operations.

Coral Reef Study Tour

In October 2023, the second annual Lizard Island Coral Reef Study Tour successfully accomplished its goal of enthusing and educating a diverse group of high-achieving students and teachers by providing access to the fantastic facilities and community at LIRS. Like the inaugural tour, this week-long immersive educational program hosted 16 Year 11 Biology students and two Biology teachers from NSW Government schools. Kate Hayward, Chair of LIRRF, also participated in the trip

We thank the Corella Fund for funding this initiative in 2023. It has also generously provided support that ensures the tours in 2024 and 2025 can go ahead. We also thank the Peters Family Foundation for their support for the 2024 and 2025 programs.

Evaluation of Fellowships program

An external evaluation of the Fellowships program was carried out this year. The extensive report provides resounding validation of the program's many benefits. Our thanks go to LIRRF Trustee Lynne Madden for driving the process, to Lynne's colleague Megan Brennan for her invaluable assistance, to The Ian Potter Foundation for providing the funding to enable it, to Lee Ridoutt of Human Capital Alliance for conducting it, and to the many fellows, former fellows and other stakeholders who contributed to the evaluation.

Above: Coral Reef Study Tour participants prepare to head out for a snorkelling session.

Below: Alice Mahoney (left) and Kate Hayward exploring Lizard Island during one of the LIRRF trips in 2023.

Right: Kim McKay, Frank Talbot and Anne Hoggett at the Talbot Oration. Photo: Australian Museum.

Events

In celebration of the Station's 50th Anniversary, the AM and LIRRF held numerous events during 2023.

Screening of *Blue Planet II* footage

In February, we showcased segments from the renowned BBC documentary series, *Blue Planet II,* at the Shark Island Institute in Sydney. Narrated by Sir David Attenborough, these segments feature footage captured in the waters surrounding Lizard Island. It includes footage taken by, and observations with, wildlife cinematographer Alex Vail who grew up on Lizard Island and is the son of LIRS Directors Anne Hoggett and Lyle Vail. Following the viewing, there was an informal discussion with the Australian Museum's Chief Scientist, Prof Kris Helgen, LIRRF Trustee Dr Penny Berents and LIRS Director Dr Anne Hoggett. We thank Ian and Min Darling for allowing us to host this event at the Shark Island Institute and the BBC for providing access to these segments.

Tour of Queensland Museum's Connections *Across the Coral Sea* exhibition

Also in February, this event comprised a tour of the fascinating *Connection across the Coral Sea* exhibition followed by Q&A with Distinguished Professor Sean Ulm (Director of ARC Centre of Excellence for Indigenous and Environmental Histories and Futures) and members of the Walmbaar Aboriginal Corporation: Kenneth McLean (Chairperson), Tanya Yoren and Shailand Deeral-Rosendale. The exhibits include discoveries from the Jiigurru (Lizard Island) Group dated at 6,500 years and pottery previously thought not to exist within these cultures, dated between 2,000 and 3,000 years ago. We thank Dr Jim Thompson (Chief Executive Officer, Queensland Museum), for hosting this event.

Right: Former AM President Sam Mostyn AO chaired the Talbot Oration. Photo: Australian Museum.

Talbot Oration

In June, LIRS Director Dr Anne Hoggett gave the 2023 Talbot Oration, *Coral reefs in hot water,* at the Australian Museum. It explored the plight and importance of Australia's coral reefs, their complex biology and calls on an urgent need for action due to human-induced impacts of climate change. Following Anne's address there was a panel discussion including ichthyologist Dr Joseph DiBattista, AM Manager of Pasifika Collections and Engagement Melissa Malu, and Sam Mostyn AO who chaired the discussion and fielded questions from audience members.

50th Anniversary Dinner in Sydney

The LIRRF dinner in Sydney is an annual event but this year's was special as it celebrated the 50th anniversary of LIRS. Held in the Australian Museum's Hintze Hall on 18 October, more than 200 LIRRF members and supporters attended. There was a full evening of events with a welcome by Kim McKay AO (AM Director & CEO), introduction by Kate Hayward (Chair, LIRRF) and an overview of the value of the Station's work over its 50 years by LIRS Director Dr Lyle Vail AM. LIRRF trustee and Station user since its inception, Dr Penny Berents, introduced four speakers whose research spanned the Station's five decades. They included Dr Pat Hutchings AM, Dr Jeffrey Leis, Dr Alison Green and Prof Andrew Hoey. We thank them for outlining their research and their interesting anecdotes. Prof Kris Helgen (AM Chief Scientist, Director of the Australian Museum Research Institute) presented AMRI Lifetime Achievement Awards to LIRS Station Directors Anne Hoggett AM and Lyle Vail AM.

A silent auction raised $50,000 in support of research and education at LIRS. We thank the following for their generous prizes: Delaware North (Lizard Island Resort); Katherine Gambini and Mark McGovern (Daintree Secrets) and Captain Cook Cruises Fiji (Fiji Expedition Cruises).

50th Anniversary Dinner in Melbourne

An annual dinner for Members in Melbourne was an opportunity for a special celebration of the station's 50th Anniversary. Held on 23 October at the Melbourne Club, Dr Anne Hoggett AM (LIRS Director) presented a version of her Talbot Oration. Other speakers included Kate Hayward (Chair, LIRRF) and Prof Kris Helgen (AM Chief Scientist and Director of AMRI). We thank Sam Hayward for hosting this event for more than 100 supporters.

Special visitors at LIRS

Several visits by special interest groups took place during the year. A group of Australian Museum Trustees visited in July, led by Prof Kris Helgen and other senior AM staff. Other trips were made by three groups of LIRRF Trustees and supporters. Trustee Anna Le Deux led the trip in June trip while LIRRF Chair Kate Hayward led trips in July and September. In addition, LIRRF Trustee Greer Banyer and her family visited in July. During these trips, participants snorkelled on the Reef, took part in discussions with the Station Directors and met with researchers.

50th Anniversary infrastructure projects

In this 50th Anniversary year, the LIRRF began an ambitious fundraising campaign for two new buildings that are needed to carry LIRS forward into the future. With a fundraising target of $2 million we are well on the way with pledges and donations currently received of approximately $1.2 million.

- A new air-conditioned laboratory is needed to provide adequate space for current usage levels, especially during the busy summer period. It will accommodate up to eight researchers. Funding for this project is already assured thanks to a wonderful donation from Rowena Danziger AM. It will be called *"Anne Hoggett and Lyle Vail Laboratory given in Memory of Ken Coles by his wife Rowena Danziger."*

- An additional staff house is needed to allow for greater flexibility in filling staff positions. Since 1990, LIRS has operated with only four full-time staff. During that period, capacity has increased by nearly 50% (from 25 to 37 visitor places) and usage is 2.6 times higher (from 3,200 to up to 8,000 visitor nights per year). Several contributions to this project have been made by generous donors, including the Thyne Reid Foundation, and fundraising continues.

The Sapphire Project

The Sapphire Project was founded in the US by Susan Rockefeller to promote sustainability and ocean conservation. Last year, LIRS was a beneficiary of the substantial funds raised at the inaugural Australian Sapphire Dinner in Sydney. This year, we were pleased to welcome Susan and David Rockefeller and Ryan Gollan (Co-chair Sapphire Committee) who made a flying visit to LIRS to see the facility and the Reef, and to learn more about our activities.

Lizard Island Resort

The five star Lizard Island Resort provides an exceptional base from which to experience the Great Barrier Reef. Delaware North, operator of the Resort, is a long-term supporter of LIRS and of LIRRF.

Each year Delaware North donates to LIRRF a generous three-night stay at the Resort for two people that includes return transfers by light aircraft from Cairns, accommodation, meals, beverages and more. This wonderful package is used to raise funds.

In addition, current LIRRF Members (i.e., those who have donated $1,000 or more in the last 12 months) qualify for a 20% discount on a stay of 3 or more nights at the Resort with some date restriction. See lirrf.org for information about making a booking at the Resorts.

Donations

LIRRF operates with very low overhead costs, and it provides a highly efficient channel for donations to support science on the Great Barrier Reef. LIRS would not exist and could not continue without donor support. Various options for donating are available online at lirrf.org/donate. All donations of $2 or more are tax deductible in Australia.

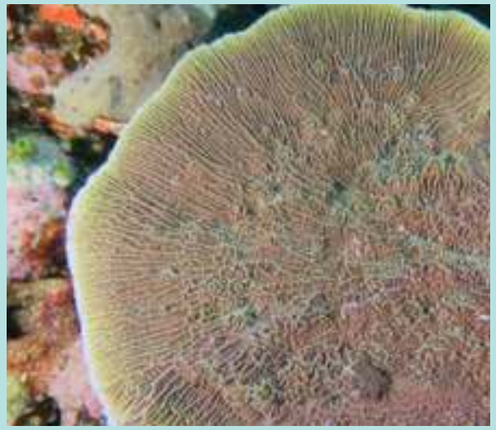
For the record

Reef health

An unseasonal run of weeks of calm, clear conditions from late March 2023 caused water temperature to increase at a time when it normally begins to decline. This led to a bleaching event in April that was mild, patchy and shortlived, with virtually no coral mortality observed. Even so, this is the fourth year in a row that bleaching has occurred in this area. Since the catastrophic bleaching in 2016, there have been only two years without a bleaching event (2018 and 2019). Despite this, the local reefs continue to recover well, especially around the perimeter of the Lizard Island Group (but not yet in the lagoon) and at other reefs nearby.

With high coral cover at Lizard Island, the coral spawning in 2023 was spectacular. The main nights for this event were 29 and 30 November.

Cyclone Jasper had our attention in mid-December. It crossed the coast near Port Douglas and initially caused no damage at Lizard. However, after it crossed the coast, it moved west as a low-pressure system which caused strong NW winds resulting in damage to some plate and staghorn corals at exposed sites.



Staff

Dr Lyle Vail AM and Dr Anne Hoggett AM completed 33 years as joint Directors in August 2023.

Arthur Davie and Ruth Carr will have completed three years as Maintenance Officer and Accommodation Officer, respectively, in January 2024.

Snow Amos filled in for Arthur when Arthur and Ruth were off the island in January 2023. Renie Amos assisted during that period as a volunteer.

Grace Frank and Dr Alex Vail filled in for Lyle and Anne when both were off the island in March/April 2023. Grace also filled in during a short absence by Lyle and Anne in October.

Long-term former staff member Marianne Pearce was employed during May 2023 to assist Anne while Lyle was off the island.

Above: Right: At the 50th Anniversary dinner at the Australian Museum (left to right): Lyle Vail, Pat Hutchings, Jeff Leis, Anne Hoggett, Penny Berents, Andrew Hoey and Alison Green.

Volunteers

Volunteers are vital for LIRS operations. With diverse backgrounds and skills, they help maintain the facilities and grounds to a high standard. Their reward is to know that they are helping to facilitate important coral reef research while becoming valued members of this small community. Our wonderful volunteers in 2023 are listed on page 22.

Lizard Island Field Guide

Lizard Island Field Guide (LIFG, http://lifg.australianmuseum.net.au/Hierarchy.html) is an online guide to the life of Lizard Island, terrestrial and marine. At year's end, it included 3440 species with photographs and other information. This is an increase of only 30 species during the year, the slowest rate of growth to date. A plateau has been reached as most of the easily photographed species have now been entered. The background database of species recorded from the area rose by the same number, to finish 2023 with 7940 species names excluding known synonyms. There is still a long way to go to capture images of rare and hard to photograph species.

In late 2023, the LIFG website required security upgrades that are ongoing in early 2024. Updates to the site will continue when that process is complete. There are several exciting new entries to be added when that is possible. We thank LIRRF Trustee Geoffrey Shuetrim and the LIRRF for their ongoing support for this initiative.

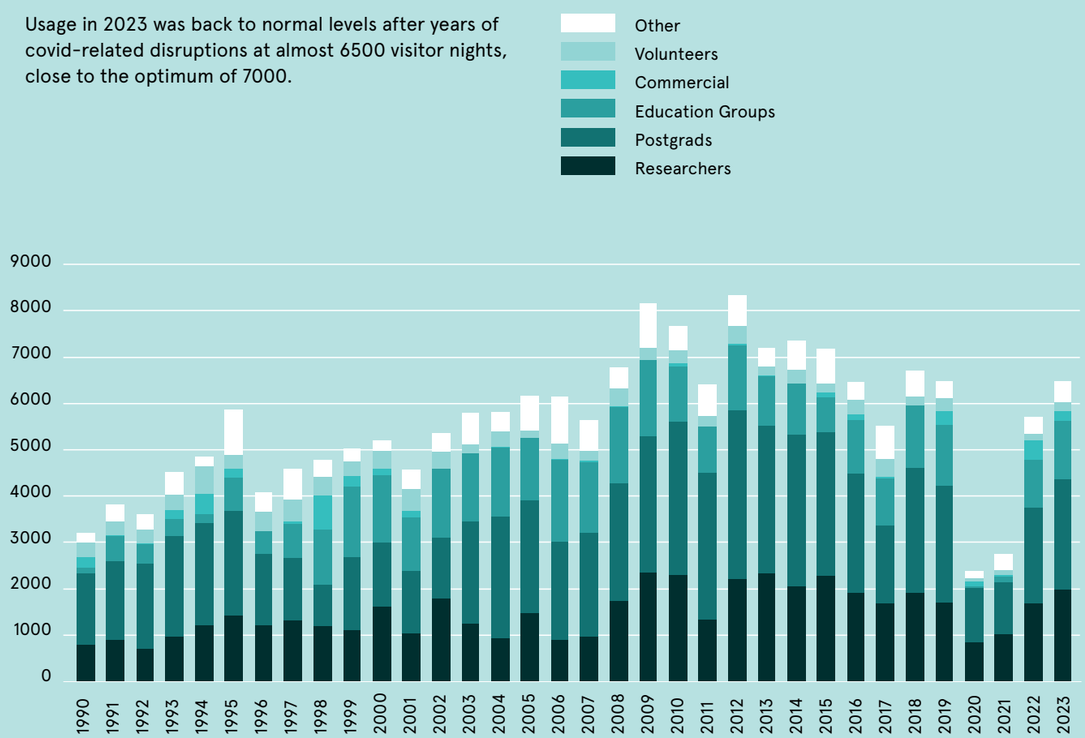
Bench fees

Per person per night, including GST	2022	2023
Researcher	$158.00	$166.00
Researcher's assistant	$142.00	$149.00
Postgrad student (own project)	$61.00	$64.00
Postgrad's assistant	$56.00	$59.00
School or university group	$101.00	$106.00
Media	$238.00	$250.00
Commercial	$298.00	$313.00

Above: Cuttlefish are often seen at Lizard Island.

Usage

Usage in 2023 was back to normal levels after years of covid-related disruptions at almost 6500 visitor nights, close to the optimum of 7000.



Visitors in 2023

Scientists from 35 institutions in 13 countries conducted 83 research projects in 2023. Of these, 26 were led by senior scientists or postdocs, 36 by PhD candidates, 13 by MSc candidates, 1 by an Honours candidate and 7 by undergraduate research students. The researchers are listed here with project titles and institutional affiliations.

Institutions

Australian

1. Australian Institute of Marine Science
3. James Cook University
4. Monash University
5. Murdoch University
6. Queensland Museum
7. Queensland University of Technology
8. Southern Cross University
9. University of Melbourne
10. University of Queensland
11. University of Tasmania
12. University of Western Australia

International

13. Charles University, Czech Republic
14. Idaho State University, USA
15. Max-Planck Institute for Behavioural Physiology, Germany
16. Nencki Institute of Experimental Biology, Poland
17. Osaka Metropolitan University, Japan
18. School for International Training, USA
19. Senckenberg Institute and Museum, Germany
20. The Natural History Museum, UK
21. University of Amsterdam, Netherlands
22. University of Bristol, UK
23. University of California Santa Barbara, USA
24. University of Exeter, UK
25. University of Hawai`i, USA
26. University of Konstanz, Germany
27. University of Lausanne, Switzerland
28. University of Lisbon, Portugal
29. University of Neuchatel, Switzerland
30. University of Oslo, Norway
31. University of Otago, New Zealand
32. University of Saskatchewan, Canada
33. University of Southampton, UK
34. University of St Andrews, UK
35. University of Texas Austin, USA

Senior scientists and postdoctoral researchers

Michelle Achlatis[21]
Nutrient sharing between photosynthetic symbionts and their sponge host: implications for coral reef productivity across oceans

Bridie Allan[31]
The effect of microplastics and oil exposure on coral reef fish

Pawel Bogusjewski[15] **and Redouan Bshary**[29]
Learning and memory in cleaner wrasse *Labroides dimidiatus,* introducing automatized experimentation

Rohan Brooker[1]**, Mark Meekan**[1]**, Miles Parsons**[1]**, Steve Simpson**[22]**, Sophie Nedelec**[24] **and others**
Reef Song: an ecosystem-based approach to enhancing reef recovery and resilience

Neal Cantin[1]
Bleaching processes

Karen Cheney[10]
The function of blue colouration in *Linckia laevigata* sea stars

Wen-Sung Chung[10]
Visual sensitivity of the diurnal reef octopus

Darko Cotoras[19]
Exploring the Chelicerata and ostracod diversity of the islands from the Great Barrier Reef

Adam Crane[32]
The influence of environmentally-relevant stressors on spatial and social cognition of coral reef fish

Scott Cutmore[6]**, Tom Cribb**[10]**, Terry Miller**[6]**, Storm Martin**[5]**, Rod Bray**[20]**, Tim Littlemore**[20]**, Nicholas Wee**[4] **and Deland Kritsky**[14]
Platyhelminth parasites of tropical reef fishes

Maria Dornelas[34]**, Josh Madin**[25] **and Viviana Brambilla**[28]
Understanding coral reef recovery from extreme disturbances using 3D maps

Matthew Dunbabin[7]
CoralBots for benthos classification, impact, and restoration assessment

Peter Harrison[8]**, Marine Gouezo**[8] **and others**
Moving corals RRAP coral larval restoration

Christopher Hemingson[35] **as field leader for Simon Brandl**[35] **and Chris Goatley**[33]
Function, biodiversity, and distribution of Australia's smallest vertebrates

Andrew Hoey[3]
Resilience of coral- and macroalgal-dominated habitats to multiple disturbances

Andrew Hoey[3]
Differential recovery of coral- and macroalgal-dominated areas following repeated disturbances

Ariana Lambrides[3]
10,000 years of Indigenous fisheries informs future Great Barrier Reef

Mark Meekan[1]
Ultra-high resolution of past tropical cyclone records reconstructed from giant clams

Pavel Nemec[13]
Factors shaping brain cellular composition in ray-finned fishes: implications for the evolution of vertebrate brain processing capacity

Sjannie Nilsson and Goran Nilsson[30]
Jumping snail physiology and behaviour

Todd Oakley[23]
Exploring ostracod diversity

Alexandra Ordonez Alvarez[8]
Reef-based research exploring the role of crustose coralline algae species on coral larvae settlement and survival for coral larval restoration purposes

Morgan Pratchett[3]**, Sterling Tebbett**[3]**, Deborah Burn**[3] **and Scott Ling**[11]
Quantifying predation rates on Crown-of-Thorns Starfish relative to fisheries management zones and corresponding differences in abundance of putative predators

Zoe Richards[2]
Biodiversity of Lizard Island revisited

Eduardo Sampaio[15]
Collective motion, hierarchical organization, and partner regulation in heterogeneous groups

Nina Schiettekatte[25]
Linking structural complexity with biodiversity and ecosystem functions

Tiffany Sih[4]
Fish diets

Sam Swan as field leader for David Bellwood JCU
Reef function

Zegni Triki[29]
The neural correlates underpinning cognitive differences between male and female cleaner fish

Zegni Triki[29]
The impact of cleaner fish presence on a resident client fish cognition and brain morphology

Sean Ulm[3] **and Ian McNiven**[4]
Lizard Island archaeological project

Sven Uthicke[1] **and Jason Doyle**[1]
eDNA detection of Crown-of-Thorns Starfish

Research students

Mahsa Alidoostsalimi[9]
Holocene ENSO activity and its influence on seasonal shellfish gathering practices of the Aboriginal people on Lizard Island, Great Barrier Reef: clues from short-lived marine gastropod shells (PhD)

Marine Amann[29]
Impacts of (a) growth rate and (b) a climatic event on cognition and brain development in the cleaner fish *Labroides dimidiatus* (PhD)

Gabriel Anderson[18]
Coral recruitment on live giant clam shells as compared to surrounding habitat (Undergraduate)

Helen Armstrong[5]
Taxonomy and biodiversity of the Cryptogonimidae (Trematoda) parasitic in fishes (PhD)

Juan Carlos Azofeifa Solano[2]
Decoding coral reef soundscapes of Lizard Island (PhD)

Kevin Bairos-Novak[3]
Demographic and evolutionary responses of reef-building corals to climate change (PhD)

Teresa Bednarek[12]
Effects of fish-coral interactions on coral holobiont ecology and physiology (PhD)

Diane Berger[29]
How client features and the weather affect service quality in cleaner fish *Labroides dimidiatus* (MSc)

Leonore Bonin[29]
How do cleaner wrasses become reef naturalists? (PhD)

Casey Bowden[3]
Water flow ecology: how reef structure and water flow shape the world of fishes (PhD)

Mats Brentebraten[3]
Cross-shelf differences in diet and body condition of a common herbivorous fish on the northern Great Barrier Reef (MSc)

Ilha Byrne[10]
Population genetics of the coral *Seriatopora hystrix* across a latitudinal and environmental gradient (PhD)

Josie Chandler[3]
In situ feeding rates of Crown-of-Thorns Starfish and fate of prey corals (PhD)

Cher Chow[34]
Biodiversity and productivity relationships in coral reef ecosystems (PhD)

Evie Croxford[22]
Investigating the influence of reef soundscapes on diurnal and nocturnal reef fish assemblages and larval fish settlement (MSc)

Amber Cumpstone[22]
Acoustic conditioning and anchoring (MSc)

Aneesa Delpachitra[31]
Testing the recovery rates of coral reef fish following exposure to low doses of microplastics and crude oil (MSc)

Francesco Dionigi[13]
Brain size and neuron numbers in selected coral reef fish (PhD)

Alex Dobson[22]
Can acoustic conditioning and anchoring increase survivorship of juvenile coral reef fish? (MSc)

Bohao Dong[9] **with supervisor Amy Prendergast**[9]
Using giant clam shell geochemistry to understand past environmental change and human-environment interaction in the South Pacific (PhD)

Eric Fakan[3]
Impact of habitat quality on the survival and fitness of coral reef fishes (PhD)

Lucy Fitzgerald[27]
Convergent evolution of stripe patterns in clownfishes and damselfishes (PhD)

Garrett Fundakowski[34]
Tracking 3D size and shape changes in stony corals (PhD)

Alberto Garcia Jiminez[27]
The evolution of anemonefishes from the GBR (PhD)

Alan Gojanovic[12]
Breaking the bottleneck: methods for enhancing post-settlement survival in coral reef fishes (PhD)

Alisa Griesinger[26]
Evolution of brain size in coral reef fishes (MSc)

Lauren Hasson[8]
Juvenile coral survival (MSc)

Bret Hatzinger[18]
Effects of lifetime cleaner wrasse (*Labroides dimidiatus*) exposure on endoparasite communities at Lizard Island, Great Barrier Reef (Undergraduate)

Martin Hebert[29]
Impact of environmental perturbations on cleaner fish cognition (MSc)

Sara Heim[27]
Clownfish and damselfish skin mucus molecular profiling (PhD)

David Juszkiewicz[2]
Taxonomy of the coral genus *Porites* (PhD)

Michael Kneppers[3]
Millennial-scale variability in Lizard Island Group mollusc exploitation (PhD)

Taiga Kobayashi[17]
Metacognition with cleaner fish? (PhD)

Christina Langley[8]
Coral larval response to fouling in rearing pools (PhD)

Corentin Lebet[29]
To what extent do male and female cleaner fish differ in their cognitive abilities across a battery of cognitive tests? (MSc)

Cailey Maclaurin[3]
Investigating people-reef interactions across the Mid-to-Late Holocene using morphometric analysis of top shell (*Rochia nilotica*), Jiigurru (Lizard Island Group), northeast Australia (Hons)

Lucas Mendes[29]
Long term memory of cleaner fishes (MSc)

Juliano Morais[3]
Coral recovery dynamics on post-bleach coral reefs (PhD)

Tristan Moss[18]
Anemonefish occupation and specialization in comparison to distribution of anemone species surrounding Lizard Island (Undergraduate)

Serena (Ya) Mou[7]
Reconfigurable robots for scaling reef restoration (PhD)

Grace Mumford[18]
Linking the bite rates of Chaetodontidae with the structural complexity of reefs surrounding Lizard Island (Undergraduate)

Letizia Pessina[29] **with supervisor Redouan Bshary**[29]
Life history of cleaner fishes (PhD)

Matthew Rose[11]
Reef ecosystem functions and phase shifts (PhD)

Paula Ruiz[11]
Stability of sediment-trapping turf communities (PhD)

Carl Santiago[10]
Host sharing and territorial aggression in anemonefishes: investigation the formation of mixed species groups around Lizard Island, Great Barrier Reef (PhD)

Gayatri Singla[18]
Six years post-disturbance coral reef composition at Lizard Island (Undergraduate)

Abigail Shaughnessy[10]
Seasonal visual function in Pomacentridae (PhD)

Ryan Snyder[18]
Living in island paradise: Yellow-spotted Goannas (*Varanus panoptes*) flourish in the unique habitats of Lizard Island National Park (Undergraduate)

Jasper Stead[10]
Seasonal and sexual variation in anemone fish brains and behaviour (PhD)

Midori Stark[15]
Analyzing the influence of habitat complexity on group dynamics in multi species hunting associations (Undergraduate)

Emily Washington[3]
Coral life-history trade-offs (PhD)

Arthur Vittet[29]
Reef fish preferences when interacting with cleaner wrasse (MSc)

Chelsea Waters[8]
Developing and scaling deployment, settlement and monitoring of wild cultured larvae for reef restoration (PhD)

Madeleine Weir[34]
To what degree of accuracy can we use photomosaics in algal benthic community studies? (MSc)

Emma Weschke[22]
The influence of coral cover and lunar phase on the nighttime ecology of nocturnal reef fishes (PhD)

Education groups

Barker College

- Led by Tim Binet, Sarah Cormio and Kirsten Prior

Emmanuel Anglican College

- Led by Justine Jacob, Daniela Pyne, Paul Pryor and Mason Brenton

Geelong College

- First group led by Cristiana Damiano, Erin O'Brien, Kevin Jess and Cleo Bailey
- Second group led by Andy Lewis, Cristiana Damiano, Naomi Longa, Cortney Holloway and Dean Alchin

Lizard Island Coral Reef Study Tour

- Led by Andy Lewis, Cristina Damiano and Naomi Longa and accompanied by LIRRF Chair Kate Hayward

RMIT University

- Led by Jeff Shimeta, Nathan Bott and Kathryn Hassell

School for International Training

- Two groups led by Tony Cummings, Vanessa Messmer and Zali Hock

Reconnoitre for possible future student group

- Rachel Elphick and Riley Charles

Other visitors

Australian Museum

- Kristofer Helgen (Chief Scientist and Director, Australian Museum Research Institute), Amanda Farrar (Director, Public Affairs and Development, Australian Museum), Jacinta Spurrett (Director, Marketing, Communications and Partnerships, Australian Museum), Brian Hartzer (President, Australian Museum Trust), David Feetham (Chair, Australian Museum Foundation) and Australian Museum Trustees Shirley Alexander, Jennifer Bott and Jennifer Dalitz accompanied by Georgina Hartzer and Caroline Feetham
- Abram Powell (Media producer, Australian Museum)

Lizard Island Reef Research Foundation

- LIRRF Trustee Anna Le Deux with Tony Le Deux, Sarah Hatherley, Fred Kininmonth, Laura Kininmonth, Victoria Lane, Rhett Purves, Anna Wijsmann, Eleanor Purves and Lisa Sullivan
- LIRRF Chair Kate Hayward and Trustee Lynne Madden with Jan Aldenhoven, Zena Dinesen, Bill Hayward, Charlie Puchala, Peter Sainsbury, Lee Ridoutt and Patricia Ridoutt
- LIRRF Chair Kate Hayward and Trustees Penny Berents, Charlie Shuetrim and Geoff Shuetrim, with Peter Berents, Alice Mahoney, Elizabeth Salkeld and Sandy Shuetrim
- LIRRF Trustee Greer Banyer with Jay, Eve and Erin Banyer

Media

- BBC Natural History Unit documentary filming team: Kent Holmes, Berenice Mathieu, Katy Moorhead, Natalie Turner-Blackman and Alex Vail
- GEO Magazine photographic team: Lars Abromeit, Jurgen Freund and Stella Freund

Minderoo Exmouth Research Laboratory

- Kate Kiefer and Nikki De Campe

Australian Institute of Marine Science

- GBROOS maintenance team: Scott Gardner and John Mahoney

First Aid Training

- Charlie Makray and Julie Armour

Queensland Parks and Wildlife Service

- National Park maintenance: Lachlan Bassani, Katie Brampton, Hayley McDowell, Michael Solinas, Aurora Spicer, Joman Tomasello and Hamon Williams

Contractors

- Allan Ross, microscope maintenance
- Cairns Roofing Contractors
- Stratford Painting Contractors

Volunteers

- Renie Amos
- Michael Bennell
- Nicole Carey
- Callan Dawson
- Ann Dunn
- Simon Dunn
- Emily Fewster
- Ian Hardie
- Merran Hughes
- Karsten Jarke
- Peter Sloan
- Vicki Sloan

Publications

In 2023, 73 publications based on work carried out at LIRS were received into the collection as listed below. There are now more than 2,700 LIRS publications.

1. Alavi-Yeganeh, M.S., J. Ghasemzadeh, S. Kouhi and J.-D. Durand, 2023. The squaretail mullet *Ellochelon vaigiensis* (Quoy & Gaimard, 1825) a complex of cryptic species? *Contributions to Zoology,* 2023: 1–17.

2. Álvarez-Noriega, M., J.S. Madin, A.H. Baird, M. Dornelas and S.R. Connolly, 2023. Disturbance-induced changes in population size structure promote coral biodiversity. *American Naturalist*, 202(5): 604-615.

3. Anyosa, S., J. Eidsvik and O. Pizarro, 2023. Adaptive spatial designs minimizing the integrated Bernoulli variance in spatial logistic regression models - with an application to benthic habitat mapping. *Computational Statistics and Data Analysis,* 179: 107643.

4. Asunsolo-Rivera, A., E. Lester, T. Langlois, B.Vaughan, M.I. McCormick, S.D. Simpson and M.G. Meekan, 2023. Behaviour of mesopredatory coral reef fishes in response to threats from sharks and humans. *Scientific Reports,* 13: 6714.

5. Baeza, J.A., S. Prakash, P. Frolová, Z. Ďuriš and A. Anker, 2023. Unweaving a hard taxonomic knot in coral reef dwellers: integrative systematics reveals two parallel cryptic species complexes in 'marbled' shrimps of the genus *Saron* Thallwitz 1891 (Caridea: Hippolytidae). *Coral Reefs*, 42: 157-179.

6. Bairos-Novak, K., 2023. Demographic and evolutionary responses of reef-building corals to climate change. PhD thesis, James Cook University.

7. Bergstrom, E., J. Lahnstein, H. Collins, T.M. Page, V. Bulone and G. Diaz-Pulido, 2023. Cell wall organic matrix composition and biomineralization across reef-building coralline algae under global change. *Journal of Phycology*, 59: 111-125.

8. Blandford, M.I., K.B. Hillcoat, M.S. Pratchett and A.S. Hoey, 2023. Effects of habitat fragmentation on the recruitment and early post-settlement survival of coral reef fishes. *Marine Environmental Research*, 183: 105798.

9. Bonin, L. and R. Bshary, 2023. In the absence of extensive initial training, cleaner wrasse *Labroides dimidiatus* fail a transitive inference task. *PLOS One*, doi.org/10.1371/journal.pone.0287402.

10. Braley, R., 2023. A population study of giant clams (Tridacninae) on the Great Barrier Reef over three-decades. *Molluscan Research*, doi: 10.1080/13235818.2023.2214156.

11. Bray, R.A., S.C. Cutmore and T.H. Cribb, 2023. Proposal of a new genus, *Doorochen* (Digenea: Lepocreadioidea), for reef-inhabiting members of the genus *Postlepidapedon* Zdzitowiecki, 1993. *Parasitology International*, 93: 102710.

12. Brown, K.T., A. Genin, M.A. Mello-Athayde, E. Bergstrom, A. Campili, A. Chai, S.G. Dove, M. Ho, D. Rowel, E. Sampayo and V. Radice, 2023. Predation domes: In-situ field assays to measure predatory behaviours by fish. *Ecology and Evolution*, 13: e10798.

13. Byrne, M., D.J. Deaker, M. Gibbs, P. Selvakumaraswamy and M. Clements, 2023. Juvenile waiting stage crown-of-thorns sea stars are resilient in heatwave conditions that bleach and kill corals. *Global Change Biology*, doi: 10.1111/gcb.16946.

14. Cannon, S.E., S.D. Donner, A. Liu, P.C. González Espinosa, A.H. Baird, J.K. Baum, A.G. Bauman, M. Beger, C.E. Benkwitt, M.J. Birt, Y. Chancerelle, J.E. Cinner, N.L. Crane, V. Denis, M. Depczynski, N. Fadli and many others, 2023. Macroalgae exhibit diverse responses to human disturbances on coral reefs. *Global Change Biology*, 29: 3318-3330.

15. Chandler, J.F., D. Burn, C.F. Caballes, P.C. Doll, S.L.T. Kwong, B.J. Lang, K.I. Pacey and M.S. Pratchett, 2023. Increasing densities of Pacific crown-of-thorns starfish (*Acanthaster cf. solaris*) at Lizard Island, northern Great Barrier Reef, using a novel survey method. *Scientific Reports*, 13: 19306

16. Chow, C.F.Y., C. Bolton, N. Boutros, V. Brambilla, L. Fontoura, A.S. Hoey, J.S. Madin, O. Pizarro, D. Torres-Pulliza, R.M. Woods, K.J.A. Zawada, M. Barbosa and M. Dornelas, 2023. Coral settlement and recruitment are negatively related to reef fish trait diversity. *Coral Reefs*, 42: 519-533.

17. Chung, W.-S., A. Lopez-Galan, N.D. Kurniawan and N.J. Marshall, 2023. The brain structure and the neural network features of the diurnal cuttlefish *Sepia plangon*. *iScience*, 26: 105846.

18. Collins, W.P., D.R. Bellwood and R.A. Morais, 2023. Small coral reef fishes with large ecological footprints. *Coral Reefs*, doi.org/10.1007/s00338-023-02384-6.

19. Corner, R.D., T.H. Cribb and S.C. Cutmore, 2023. Rich but morphologically problematic: an integrative approach to taxonomic resolution of the genus *Neospirorchis* (Trematoda: Schistosomatoidea). *International Journal for Parasitology*, 53(7): 363-380.

20. Cortesi, F., V. Tettamanti and F. de Busseroles, 2023. The visual ecology of anemonefishes. Chapter 9 *in*: Evolution, Development and Ecology of Anemonefishes: Model organisms for Marine Science. V. Laudet and T. Ravasi (eds.), CRC Press, Abingdon, UK, pp. 87-94.

21. Cutmore, S.C., R.D. Corner and T.H. Cribb, 2023. Morphological constraint obscures richness: a mitochondrial exploration of cryptic richness in *Transversotrema* (Trematoda: Transversotrematidae). *International Journal for Parasitology*, 53: 595-635.

22. de León, G. P.-P., B. Solórzano-García, D.C. Huston, B. Mendoza-Garfias, J. Cabañas-Granillo, S.C. Cutmore and T.H. Cribb, 2023. Molecular species delimitation of marine trematodes over wide geographical ranges: *Schikhobalotrema* spp. (Digenea: Haplosplanchnidae) in needlefishes (Belonidae) from the Pacific Ocean and Gulf of Mexico. *Parasitology*, 1–13, doi: 10.1017/S0031182023001245.

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