

Report



# **Australian Museum Lizard Island Research Station**

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2019

A diver in full scuba gear is positioned in the center of the frame, surrounded by a dense school of small, silvery fish. The diver is holding a camera and looking towards it. The background is a deep blue-green water with many fish swimming in various directions. The diver's equipment, including a tank, regulator, and lights, is visible. The overall scene is a vibrant underwater ecosystem.

## Lizard Island Research Station 2019 Report

### LIRS Directors

Dr Lyle Vail AM and Dr Anne Hoggett AM

### Lizard Island Research Station

PMB 37

Cairns QLD 4892

Australia

T + 61 (0)7 4060 3977

E [lizard@austmus.gov.au](mailto:lizard@austmus.gov.au)

[australianmuseum.net.au/get-involved/amri/lirs](http://australianmuseum.net.au/get-involved/amri/lirs)

### Australian Museum Research Institute

Dr Rebecca Johnson, Director (to February 2020)

Cameron Slatyer, Acting Director (from February 2020)

T + 61 (0)2 9320 6237

E [Cameron.Slatyer@austmus.gov.au](mailto:Cameron.Slatyer@austmus.gov.au)

The Lizard Island Research Station acknowledges the traditional owners of Jiigurru, the Dingaal people, on whose land the research station is situated.

The Lizard Island Research Station respects elders past and present, and welcomes all who visit the research station.



The Intergovernmental Panel on Climate Change in September 2019 warned that damage to the oceans is accelerating and may be at the point of irreversibility. This places coral reefs at the forefront of risk, with most warm water reefs projected to suffer significant losses of area and local extinctions (IPCC 2019 Special Report on the Ocean and Cryosphere in a Changing Climate).

Australia needs to take action on the Climate Change emergency. In April 2019, a letter to Nature (Hughes et al 2019 Global warming impairs stock-recruitment dynamics of corals) stated that the coral bleaching events of 2016 and 2017 meant the level of larval recruitment of coral, compared to historical levels, declined in 2018 by 89%.

While the reef at Lizard Island has shown promising signs of recovery through 2019, recently there have been new bleaching events.

The alarming implications of the Great Barrier Reef's corals being unable to replenish themselves with projected increased frequency of extreme climate events over the next two decades, are clear.

The Lizard Island Research Station (LIRS) plays a more important role than ever in documenting the changes and challenges facing our irreplaceable natural heritage. LIRS continues to host researchers from around Australia and the world striving to understand the natural world and the many threats faced due to human-induced activity.

In this year, as the news about climate change and impacts on the Great Barrier Reef becomes even more alarming, and our need for action, even more urgent, it is particularly important to thank our dedicated LIRS co-directors Anne Hoggett and Lyle Vail. Their leadership at LIRS provides a guiding hand to the many researchers striving to research and conserve our coral systems.

Thank you as well to the unflagging efforts of the Lizard Island Reef Research Foundation (LIRRF), led by Chair Kate Hayward, for continuing to support the work of the LIRS, and to the visiting researchers, volunteers, donors, Australian Museum Research Institute staff and AM Trust for your support of the AM's LIRS.

**Kim McKay AO**  
**Director & CEO, Australian Museum**



It seems we're facing challenges on many fronts. Our Australian summer was marked by fires which had devastating impact on our communities, landscape and animal life. A novel virus is now threatening global communities and disrupting the status quo and livelihoods at rapid speed. And as our own supporters know, ocean life and coral reefs continue to face ongoing threats from global anthropogenic climate change as well as local stressors such as pollution run-off and plastics.

So, it is with some relief that the level of bleaching around the Lizard Island Group this summer – so far – hasn't reached that of 2016 and 2017. Our fingers are crossed for that to remain the case. While the longer term health and resilience of our coral reefs remains greatly concerning, there are encouraging reports of recovery, as LIRS co-directors Dr Anne Hoggett and Dr Lyle Vail relay in their report which follows.

Since its founding 47 years ago, the Lizard Island Research Station (LIRS) has built a reputation of being one of the best tropical marine stations worldwide. It is a highly productive, extremely efficient, well managed work place where established and early career scientists go to study reefs and their ecosystems. Supporting this research is the primary focus of the Lizard Island Reef Research Foundation (LIRRF). This report gives you a flavour of some of the projects the Foundation plans to support this coming year.

Supporting such vital projects can only happen with the generosity and collaboration of many and I'd like to thank everyone for their support. This includes our Members, Friends and Donors who generously give; the dedicated researchers and their volunteers who assist them; the highly capable and dedicated LIRS co-directors; the staff at the Australian Museum who assist the efforts of our Foundation and my Fellow Trustees for generously volunteering their own time, expertise and funding support.

As a "stop press", I'd like to acknowledge a generous donation from the Minderoo Foundation. It was made in early 2020 and will be outlined in next year's report.

**Kate Hayward**  
**Chair, Lizard Island Reef Research Foundation**

# 2019 in review



The summer of early 2019 was the second in a row with no major environmental disaster for coral reefs at Lizard Island. It has been wonderful to watch the continued growth of many species of corals during the year. Some areas are recovering amazingly quickly. However, the rebound is patchy and other areas have yet to show much regrowth following enormous cumulative damage from cyclones in 2014 and 2015 and coral bleaching in 2016 and 2017.

Average global temperature of the upper few metres of the ocean has increased by about 1.3°C over the past 100 years according to the US National Oceanographic and Atmospheric Administration (NOAA). As well as increasing the strength of cyclones, this underlying increase means that corals are now threatened by bleaching almost every summer. Even before human activities increased global temperature, corals were living near the edge of their maximum thermal tolerance. The summer of 2019/2020 is a clear example of living on the edge. In mid-December 2019, the NOAA coral bleaching outlook for early 2020 was fairly benign for the northern Great Barrier Reef (GBR). Within the space of two months, that outlook has changed markedly due to unseasonably warm conditions in north Queensland. At the time of writing (mid February 2020), we are observing slight to moderate bleaching of many species of corals in shallow, sheltered areas at Lizard Island. The NOAA forecast for the northern GBR has now been elevated to Alert level 1, at which coral bleaching is likely but not necessarily severe enough to lead to coral death. Several research groups are monitoring the situation at Lizard Island but beyond that, in the short term, we can only hope that the heat stress doesn't last for too many more weeks.

Support of LIRS by the LIRRF is critical to the Station's success and survival. Since its inception in 1978, the LIRRF has contributed more than \$13 million to research and research infrastructure. In 2019, the LIRRF funded 19 research projects for a total of more than \$280,000 – four new and three ongoing doctoral fellowships, three new and three ongoing postdoctoral fellowships, and five new and one ongoing research grant. Support for fellowships and grants in 2020 is likely to exceed that level. As well as producing valuable research, the fellowships contribute to research training by allowing young scientists to develop their independent research skills. We thank the many LIRRF donors who enable this research and who provide funding for the infrastructure at LIRS on which it depends.

Scientific research by postgraduates and senior scientists makes up the bulk of activity at LIRS. However, another important component is education for younger students about coral reefs. LIRS has long hosted educational visits for students that are organised by their own university or high school. The opportunity is thus limited to the six to eight institutions that can reasonably be accommodated at LIRS each year – students who don't go to those institutions have no way to participate. In 2019, we were delighted to be able to broaden the field for this opportunity thanks to generous support from the LIRRF.

A funded 9-night trip to LIRS for 16 students and two teachers was planned for April 2020. In 2019, the participants were selected in a competitive process based on academic achievement, a strong interest in marine science, and ability to communicate that enthusiasm. Unfortunately, the Coronavirus pandemic made the trip impossible at that time and it had to be cancelled only weeks before it was due to start.

In late 2019, Dr Rebecca Johnson, Director of the Australian Museum Research Institute, which includes LIRS, was appointed Chief Scientist and Associate Director of Science at the Smithsonian National Museum of Natural History in Washington DC. Rebecca was a strong advocate for LIRS for many years and we thank her for her support and wish her all the best in her challenging new position.

Our sympathies go out to all of those affected by the devastating fires of summer 2019/20. The massive impact on the bush by these fires is not dissimilar to that experienced by corals following mass bleaching events – vast tracts of whole ecosystems were annihilated. The culprit behind these and other environmental disasters is us – humans – by allowing the world to heat up through our carbon emissions.

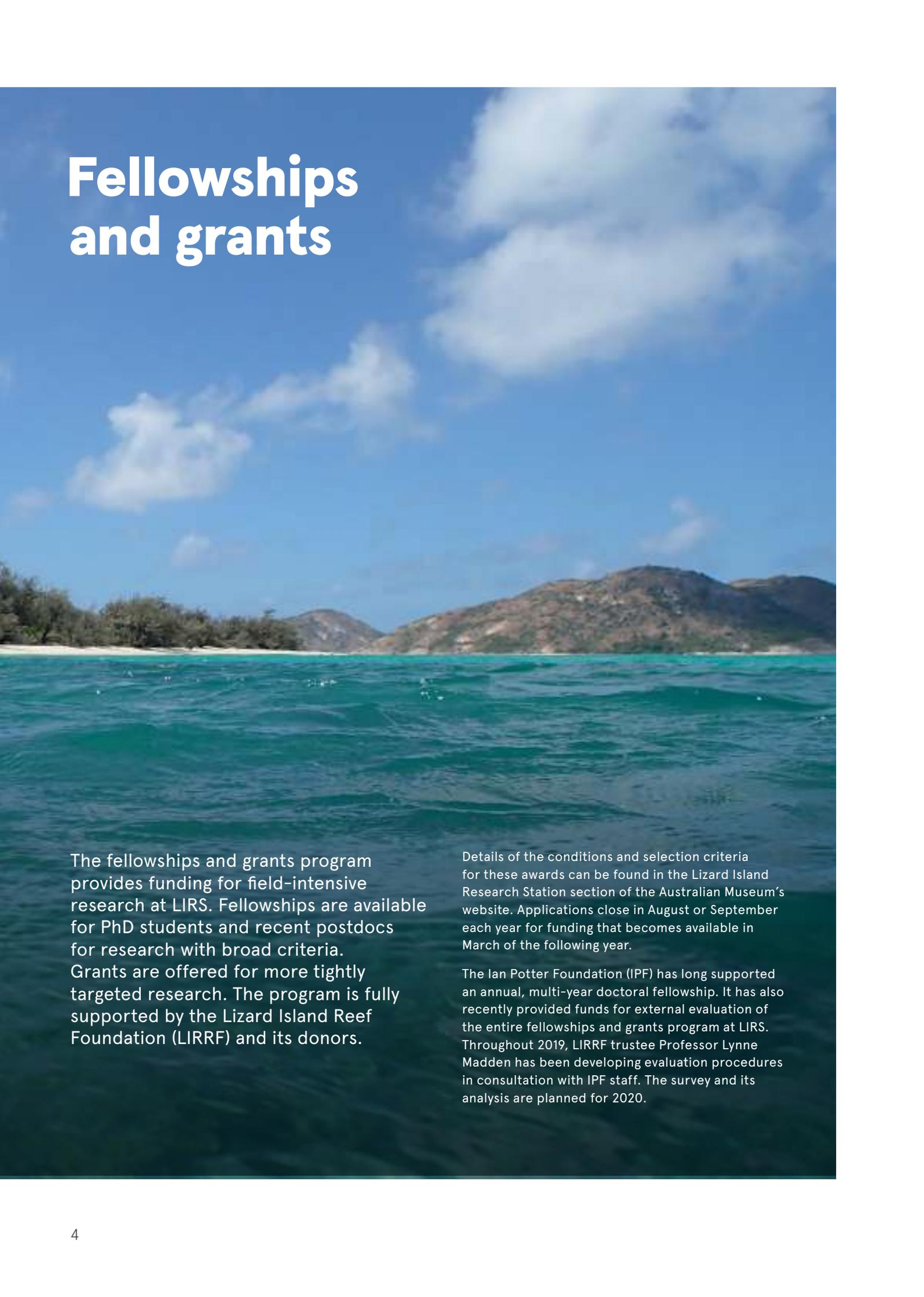
At Lizard Island, we've seen corals rebound strongly since the last major disturbance in 2017 which shows that the ecosystem has the capacity to recover naturally. However, it's looking increasingly likely that there will be another mass bleaching in early 2020, long before that regrowth is mature. If that happens, it will be the third time in five years. How long can coral reefs continue to bounce back under such frequent massive disturbances? It is beyond urgent to reduce carbon emissions globally if we are to have a hope of retaining Earth's amazing natural environments.



**Lyle Vail AM and Anne Hoggett AM  
Directors, Lizard Island Research Station**

**Left** Extraordinary regrowth of coral at North Direction Island in December 2019. This area had been destroyed by cyclones and coral bleaching between 2014 and 2017.

# Fellowships and grants



The fellowships and grants program provides funding for field-intensive research at LIRS. Fellowships are available for PhD students and recent postdocs for research with broad criteria. Grants are offered for more tightly targeted research. The program is fully supported by the Lizard Island Reef Foundation (LIRRF) and its donors.

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 website. Applications close in August or September each year for funding that becomes available in March of the following year.

The Ian Potter Foundation (IPF) has long supported an annual, multi-year doctoral fellowship. It has also recently provided funds for external evaluation of the entire fellowships and grants program at LIRS. Throughout 2019, LIRRF trustee Professor Lynne Madden has been developing evaluation procedures in consultation with IPF staff. The survey and its analysis are planned for 2020.

## Fellowships

Two new fellowships join the program in 2020: the Gough Family Doctoral Fellowship and the Maple-Brown Family Foundation Postdoctoral Fellowship. They have been made possible by the two eponymous families and they are welcome additions to the program.

Six new fellows will commence work in 2020: two PhD students and four early-career scientists. Outlines of their projects can be found below. In addition, funding continues into 2020 for three fellows who are in the second year of their awards.



### Sterling Tebbett

2020 Ian Potter Doctoral Fellow

James Cook University

#### **The functioning of future coral reefs: fishes, sediments and productivity**

Globally, coral reefs have changed profoundly as a result of strengthening anthropogenic stressors, especially climate change. Unfortunately, Lizard Island, on Australia's northern Great Barrier Reef, now epitomises the future many coral reefs face after back-to-back cyclones in 2014 and 2015, and back-to-back coral bleaching events in 2016 and 2017. However, this situation also offers an opportunity to understand how coral reefs can reassemble themselves following such devastating events.

To explore coral recovery at Lizard Island, Sterling will utilise a historical dataset of high-definition photographs spread across Lizard Island. These locations were first photographed immediately prior to the 2016 bleaching event and have been photographed on a regular basis since. He will re-take photographs of the same locations in 2021 and 2022 which will allow him to assess which locations have shown signs of recovery from 2016 to 2022, as well as identify those that have not. Specifically, he will assess how algal turfs, and the sediments bound within them, shape coral reef recovery. To date, evidence suggests that sediment can become trapped in algae turfs allowing them to become overgrown and, in turn, impede coral recovery by limiting the areas available for baby corals. Sterling will also investigate how the groundskeepers on coral reefs, the herbivorous fishes, interact with overgrown algae turfs to clear them of sediment and potentially promote coral recovery.



### Makeely Blandford

2020 Gough Family Doctoral Fellowship

James Cook University

#### **Interactions between fish and coral reefs: the influence of habitat degradation on fish communities**

Habitat degradation can affect coral reef fishes in evolutionarily important ways. For example, widespread coral death can result in some fish dying while other individuals survive. Understanding why some individuals persist on degraded reefs and identifying the underlying mechanisms are critical to predicting the future composition of reef fish communities. Makeely will conduct experiments to determine if the loss of individuals selects for particular traits (physiological, performance or behavioural) and whether survivors modify their behaviours to survive, and if so, whether that altered knowledge is passed on to their offspring.

As well, this project will investigate the mechanisms by which algal-dominated reefs interrupt the sensory information presented to coral reef fishes and identify the specific active components of degraded reefs which prevent fishes from learning and updating predation threats. It is unknown whether survivors of habitat degradation have found a way around this sensory problem, or whether it will affect their persistence in degraded habitats.



### Dr William Feeney

2020 Maple-Brown Family Foundation  
Postdoctoral Fellowship  
Griffith University

#### **Mutualisms in a changing world: does the presence of cleaner wrasses confer resilience to coral reef ecosystems?**

The importance of species interactions as drivers of natural selection was recognized by Charles Darwin. Since then, we have learned that different kinds of interactions affect biodiversity differently. For example, mutualistic interactions such as those between fishes and anemones have been shown to promote the generation of biodiversity through the creation of new niches. Understanding whether mutualisms will break down and pose risks to the involved species, or confer mutual resilience in the face of environmental change is a major question of contemporary importance. Testing this question, however, is notoriously difficult as it requires a rapidly changing environment and long-term data that precedes environmental change.

The interactions between the blue-streaked cleaner wrasse, *Labroides dimidiatus*, and its clients comprises an iconic example of an interspecies mutualism. These fishes primarily feed on small crustacean parasites which they glean from the skin of client fishes at a rate of up to 1200 parasites per day. This valuable ecosystem service has resulted in cleaner wrasses recently being recognized as a key species for supporting coral reef biodiversity. Over the past 19 years, Dr Alexandra Grutter (University of Queensland) has been running a globally-unique long-term experiment into the ecological importance of cleaner-client interactions across a series of patch reefs at Lizard Island. Previous work has established that the presence of cleaner wrasses is associated with higher recruitment of juvenile fishes and other work has demonstrated that the presence of fishes provides increased aeration and nutrition to corals, suggesting that by enhancing surrounding fish biodiversity through mutualistic behaviours, cleaner wrasses may play an important role in conferring resilience to coral reefs. William will utilize this long-term data set to investigate whether the presence of cleaner wrasse is associated with changes in the rate of coral recovery since the 2016 bleaching event.



### Dr Stephanie Gardner

2020 Raymond E. Purves Foundation  
Postdoctoral Fellowship  
University of New South Wales

#### **Rise of the turfs: Unlocking the secrets of our changing reefs**

Ecosystems worldwide are being altered due to anthropogenic climate change. In marine ecosystems, one of the most striking impacts of climate change is the tropicalisation of temperate reefs, where warm-water taxa such as tropical fish and reef-building coral shift poleward to waters typically considered temperate, and cool-water species like kelp recede.

Turf algae are dense, multi-species assemblages of filamentous benthic algae that are typically less than 1 cm in height. These communities are found across a broad range of latitudes and are important bio-foulers that are often first to capitalise on ecosystem changes due to their rapid growth rates and apparent tolerance of extremes. Turfs exude a portion of their photosynthates as dissolved organic carbon, which fuels the growth of benthic microbial communities, and enhances nutrient cycling and trophic productivity through the provision of a novel food source for herbivorous fishes.

Stephanie will characterise turf-dominated communities and the biological and environmental factors leading to their success across a latitudinal gradient along Australia's east coast. She hypothesises that turf-associated microbial communities within tropicalized reefs will have lower diversity, abundance and richness compared to coral-dominated reefs, but they will share core bacterial functional groups responsible for roles (such as biofilm formation and nutrient cycling) that contribute to the establishment and success of turfs. Uncovering the mechanisms and key microbial players that allow algal turfs to dominate under future climate scenarios has the potential to transform our understanding of how reefs will persist into the future.



## Dr Christopher Goatley and Dr Simon Brandl

2020 John and Laurine Proud  
Postdoctoral Fellowship

University of New England and University of  
Perpignan (France), respectively

### Function, biodiversity, and distribution of Australia's smallest vertebrates

Reef fishes form integral links in coral reef food webs and support the exceptional productivity of reef ecosystems. To enable efficient management of these valuable ecosystems, it is critical that we develop a clear understanding of the functional roles of individual fish species and communities. In order to achieve this we need a detailed inventory of the identity, diversity, and distribution of fish species on reefs.

Decades of visual surveys have yielded a fairly comprehensive picture of the distribution and abundance of large reef fish species on coral reefs. However, visual surveys are only effective for sampling large, conspicuous species. Remarkably, this overlooks around half of the fishes on coral reefs. The other, 'hidden' half is comprised of cryptobenthic reef fishes (CRFs). Spread across 17 families, CRFs are tiny (<50 mm), camouflaged, highly-abundant species that are strongly associated with the seabed.

It appears that these overlooked fishes may perform important reef functions such as the cycling of energy and nutrients through reef food webs. Due to challenges in studying such tiny fishes, the biodiversity of CRF species and their specific functions are remarkably poorly documented. LIRS probably represents the world's most extensively sampled location with regards to CRF communities.

Nonetheless, in 2018, Chris and Simon performed a pilot study that discovered three new species records for Australia and at least three undescribed species of CRFs.

In this project, Chris and Simon will conduct a quantitative inventory of CRF taxa and their ecological traits on reefs surrounding Lizard Island. Specimens will be contributed to the Australian Museum's fish collection. The project will also provide open-access identification guides through the Lizard Island Field Guide and the Australasian Fishes Project, to facilitate the future monitoring of these enigmatic and critically-important fishes by ecologists, taxonomists and citizen scientists.

## Dr Zegni Triki

2020 Isobel Bennett Marine Biology  
Postdoctoral Fellowship

Stockholm University

### Does brain morphology explain the sex differences in the cognitive abilities of cleaner fish?

Evolutionary theory is based on a simple principle: individuals that are better adapted to ecological challenges survive and reproduce better than individuals that are less well adapted. However, there is little information as to what extent intelligence may promote individual success. There is increasing evidence that cognitive performance varies between individuals of the same species. This performance has been categorised as either 'general intelligence' or 'ecological intelligence'. General intelligence refers to cognitive capacities that can be employed in a variety of contexts, such as the ability to delay gratification. Ecological intelligence is a set of cognitive capacities that allow for solving tasks that are frequently encountered in nature, such as foraging.

The cleaner fish *Labroides dimidiatus* is the perfect species to address the following questions: (i) What type of intelligence is more relevant, general or ecological? and, (ii) How is variation in either of the two types of intelligence linked to brain complexity? Cleaner fish interact with both conspecifics and clients in a complex array of social behaviours including territoriality, partner manipulation, reputation management, punishment, and tactical deception-like behaviour. These behaviours can be flexible given the specifics of a situation.

Cleaner wrasse individuals begin adult life as females. The largest individuals eventually change sex and become males. Cleaner wrasse typically live in harems comprised of one male and several females, allowing the male to have a higher reproductive output with only a minority of females changing sex to become a male. This makes the system ideal to investigate the relationship between individual success, intelligence and brain complexity. Evaluating these fish for their general and ecological intelligence will allow us to disentangle whether they have a general cognitive tool kit, or whether their performance is the outcome of specific ecological knowledge, or maybe they have both types of intelligence.

## Grants

Four new grants have been awarded to commence in 2020 as outlined below. Negotiations are in progress for the award of two additional 2020 grants which are not listed here.

Since 2015, research aimed at mitigating the effects of Crown-of-Thorns Starfish predation on corals has been part of the LIRS grants program. The 21st project in this series is outlined below and the final one will be announced soon. This substantial body of work was funded by a \$500,000 Ian Potter Foundation 50th Anniversary Commemorative Grant to the Lizard Island Reef Research Foundation.

This year, generous funding from the Banyer family (LIRRF Trustee Greer Banyer, husband Jay Banyer and daughters Eve and Erin) allows for continuation of research into the effects of plastic pollution on coral reefs for the next three years. This builds on the original donation for this purpose in 2018 by the Rossi Foundation.

The Charles Warman Foundation also joins the group of funders for research grants. LIRRF Trustee Wendy King and her family were instrumental in obtaining funding for the special grant for eDNA research outlined below, and for another special grant which will be announced soon.

### Dr Daniela Ceccarelli

2020 Special Grant  
Independent researcher

#### **Repeat fish survey at Lizard Island in the wake of multiple disturbances**

The Lizard Island area has suffered major disturbances in four consecutive summers: category 4 cyclones in 2014 and 2015; and severe coral bleaching in 2016 and 2017). Fortunately, simultaneous surveys of both corals and fishes had been carried out before these events, in 2011, at 14 sites around the Lizard Island Group. The corals were surveyed by Dr Zoe Richards (then at the Australian Museum, now Curtin University) and the fishes by Dr Dani Ceccarelli. The LIRRF funded these researchers to repeat the surveys on two occasions after the disturbances, in 2015 and 2017.

Zoe obtained funding elsewhere to repeat the coral surveys again in 2020. This grant was awarded to Dani to allow the fish surveys to be conducted again at the same time to maintain continuity of this important data set.

**Right** A goby about 3 cm long, one of many species of cryptobenthic reef fishes.

### Dione Deaker and Professor Maria Byrne

2020 Crown-of-Thorns Starfish Research Grant  
University of Sydney

#### **Resilience to food scarcity: the development and microbiome of COTS larvae in natural oligotrophic reef conditions**

Pulses in larval survival and settlement success are considered to be the underlying cause of Crown-of-Thorns Starfish (COTS) outbreaks that devastate coral reefs throughout the Indo-Pacific. The causes of such pulses are the subject of much controversy. COTS larvae eat microscopic algae known as phytoplankton. The 'enhanced nutrient' hypothesis suggests that more COTS larvae survive during phytoplankton blooms which are promoted by nutrient run-off from land or upwelling offshore. This implies that COTS larvae are essentially starving during normal conditions. However, COTS larvae typically experience low nutrient conditions and outbreaks can occur far from events that periodically raise nutrient levels. Recent studies revisiting the opposing 'larval-resilience' hypothesis show that COTS larvae are more tolerant of low food abundance than previously thought. A more detailed understanding of the biology of COTS larvae is essential to address and mitigate the factors that drive population outbreaks.

This project addresses the 'larval-resilience' hypothesis. It will investigate the tenacity of COTS larvae during phytoplankton scarcity by growing larvae in the naturally low nutrient reef waters and it will improve on controversial experiments conducted by others in the 1980s and 1990s. The possibility of nutritional benefits derived from the recently characterized microbiome of COTS will also be investigated. This project aims to fill major gaps in knowledge on the fundamental traits in the biology of COTS to provide insights as to how outbreaks occur in reefs disconnected from phytoplankton blooms.



## Dr Frederieke Kroon and Dr Mark Meekan

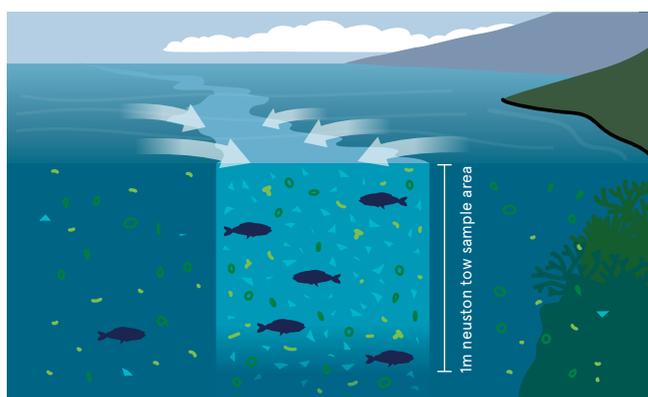
2020 Plastics Pollution Research Grant  
Australian Institute of Marine Science

### The effects of microplastic contamination on mesozooplankton: a unique threat?

Microplastic contamination of the marine environment has been reported globally across habitats including coastlines, the sea surface and water column, and benthic sediments. On the Great Barrier Reef (GBR), microplastics were first reported in surface waters during surveys conducted in 2012. Ingestion of microplastics has since been confirmed for juvenile coral trout and adult lemon damselfish from the GBR, including Lizard Island. In contrast, no studies have been conducted on wild-caught planktonic life stages of coral reef organisms that may be uniquely susceptible to microplastic contamination.

The aim of this study is to determine the susceptibility of mid-sized (0.2 to 20 mm) zooplankton to microplastic contamination. In the first year of the study, Frederieke and Mark will test the hypothesis that both zooplankton and microplastics aggregate in oceanographic features around coral reefs, such as surface slicks, eddies and fronts (see diagram below). If this is the case, then these higher microplastic concentrations may result in higher exposure and ingestion by zooplankton in these features. In the second year, they will test the hypothesis that microplastic ingestion by zooplankton is random (i.e. non-selective), so that zooplankton ingest microplastics in the ratios to which they are exposed.

Overall, their results will clarify the role of physical processes in aggregating zooplankton and microplastics, infer proportional intake of microplastics by zooplankton relative to contamination levels, and document potential selectivity for certain microplastics. Combined with findings from other research conducted by their collaborators, they will be able to determine whether microplastic contamination may have potential flow-on effects on zooplankton condition, growth and settlement onto coral reefs, as well as a transfer of microplastics into the coral reef food web.



## Dr Joseph DiBattista

2020 Special Grant  
Australian Museum

### Innovation in Reef Monitoring – eDNA for Lizard Island

Coral reefs are noted for their high levels of biodiversity and also for the threat that they face from local and global anthropogenic stressors. Traditional methods of assessing coral reef health are coral cover surveys and fish counts. Such surveys are time-consuming and costly, they generate only basic data, and they cannot be done at all under some sea conditions. These limitations mean that it is prohibitive to obtain health data across wide areas and the data obtained at sample sites reflect only a subset of the actual biodiversity present. Thus, the true state of coral reefs is poorly defined. The monitoring and protection of these coral reefs urgently needs a new, rapid, and more spatially and biologically complete methodology to better assess the health of these important ecosystems.

New in our arsenal of research tools is environmental DNA, or eDNA. This enables rapid assessment of the health of coral reefs across a broad range of sites and it monitors biodiversity more accurately than traditional methods. It works like this: animals and plants shed tissue, cells, secretions and excreta into the water. By analysing the DNA present in the water, we can see which species have passed through it or are resident to the surrounding area. This emerging technology provides a fast and inexpensive means to census marine organisms.

This pilot project will analyse seawater samples taken repeatedly at a particular Lizard Island site for eDNA. It will also develop a DNA reference collection from fish specimens in the Australian Museum's frozen tissue bank of those species known to occur at Lizard Island, to match with the eDNA samples. This will provide data that can be used by many future projects and develop methodology that can be used for many applications.

- Phytoplankton
- Zooplankton
- Plastic Fragment
- Larval Fish

**Left** Nearshore slicks accumulate larval fish, zooplankton and microplastics and deliver these into nearshore habitats.

Figure source: Gove et al. (2019) PNAS.

# Lizard Island Reef Research Foundation (LIRRF)

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](http://lirrf.org) for information about the Foundation and the research it supports and to make a donation 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. Our wonderful Members in 2019 are listed on page 24.

## Board changes

New trustees this year are Dr Rod Kefford AM and Mrs Anna Le Deux. Rod has been a leader in education for his entire career having been Headmaster of Wesley College, Perth (1984–1996) and more recently of Barker College, Hornsby (1996–2013). He is also a Trustee of the Australian Museum. Anna is a business person based in Melbourne where she has held various professional roles and is active in volunteer organizations. Her family has had a long association with LIRS and LIRRF. Her parents, the late John Gough AO OBE and Rosemary Gough, have been strong supporters of LIRS for decades. Both Rod and Anna have already become very engaged with the LIRRF and we welcome them to the board.

Melbourne-based Trustee Graham Sherry retired from the board after six years of service. Graham was particularly generous in introducing new people to LIRRF and to expanding support for the Foundation's events held in Melbourne.

### FOUNDER

The late Sir John Proud

### PATRONS

Mr Andrew Green  
Dr Des Griffin AM  
Mr Raymond Kirby AO  
Mrs Jacqueline Loomis  
The Ian Potter Foundation  
Mr Robert Purves AM  
Thyne Reid Foundation  
Prof Frank Talbot AM

### TRUSTEE EMERITUS

Mr Kenneth Coles AM  
Mr James Bildner<sup>1</sup>

### TRUSTEES

Ms Kate Hayward (Chair)  
Mr Charlie Shuetrim AM  
(Chair, Appeal Committee)  
Mr David Armstrong  
Mrs Greer Banyer  
Dr Penny Berents  
Mr Chris Joscelyne  
Dr Rod Kefford AM<sup>2</sup>  
Mrs Wendy King

Mr James Kirby  
Mrs Anna Le Deux<sup>2</sup>  
Prof Lynne Madden  
Ms Kim McKay AO  
Mrs Heather Power  
Mr Robert Purves AM  
Mr David Shannon  
Dr Geoff Shuetrim  
Mr Graham Sherry OAM<sup>3</sup>  
Ms Helen Wellings

<sup>1</sup> Changed role to Emeritus in 2018

<sup>2</sup> New Trustee in 2019

<sup>3</sup> Resigned in 2019

### SCIENCE COMMITTEE

Dr Penny Berents (Chair)  
Mr Charlie Shuetrim AM  
Dr Rebecca Johnson  
Dr Lyle Vail AM  
Dr Anne Hoggett AM  
Prof Lynne Madden

We thank Australian Museum staff Dr Shane Ahyong and Dr Mandy Reid who act as Dr Rebecca Johnson's delegates on the fellowships selection committee.

## Projects and equipment funded by LIRRF in 2019

In the 2019 financial year, the LIRRF contributed a total of \$393,935:

- \$280,572 for research through its fellowships and grants program
- \$44,656 for new outboard motors to support research at LIRS
- \$68,707 for other research operations

## New initiatives for 2020

The LIRRF supported many new initiatives in 2019 that were planned to take place in 2020 and beyond. However, the Coronavirus pandemic of early 2020 has already affected some of these activities.

- **The Lizard Island Coral Reef Study Tour 2020** was to have taken place in April 2020 but it has been cancelled due to the pandemic. The intention was to make the extraordinary experience of LIRS and coral reefs available to high school students who have a burning interest in marine science and the academic capacity to pursue a scientific career, and to brilliant teachers. The 9-night trip to LIRS was all set to go, with 16 students and two teachers selected through a competitive process during 2019. Hopefully, we will be able to offer an equivalent educational experience when the emergency is over. The program is funded by generous donations to the LIRRF from the James N. Kirby Foundation, the Corella Fund and the Coles Danziger Foundation.
- **Direct support for research** has burgeoned with four substantial donations:
  - The Charles Warman Foundation is funding two research grants, thanks to the involvement of LIRRF Trustee Wendy King.
  - The Maple-Brown family continues its long-term support of LIRRF by funding a new postdoctoral fellowship.
  - The Banyer family is funding a series of grants for research into the effects of plastic pollution on coral reefs, thanks to LIRRF Trustee Greer Banyer, her husband Jay Banyer and their daughters.
  - The Gough family is funding a new doctoral fellowship, carrying on the support provided over many years by the late John Gough AO OBE. His daughter Anna Le Deux became a LIRRF trustee this year and she is joined by her mother and siblings in making this donation.
  - An upgrade of the solar power system at LIRS can now proceed with certainty thanks to a substantial donation for that purpose from the Charles Warman Foundation. The existing stand-alone system is almost ten years old and its large battery bank needs to be replaced soon. Technology has improved enormously in this time and this is an opportunity to improve key parts of the whole system.

## Events

During 2019, the Foundation hosted events in Sydney, Melbourne and – for the first time – in Brisbane for its friends, members and guests. These events are to thank people for their support and to inform them about research at LIRS and the state of the Reef.

On 26 March at the Australian Museum, coral reef fish research was the theme at an early-evening function. Dr Anne Hoggett AM (LIRS), Professor Bill Gladstone (University of Technology Sydney), and PhD student and 2017 Ian Potter Doctoral Fellow Renato Morais (James Cook University) provided different perspectives on coral reef fish research and the outlook for reef fishes. A lively Q&A followed the presentations

On 27 March, Mr Sam Hayward hosted a dinner for Members at the Melbourne Club. Two speakers from the night before also spoke at this event. Renato Morais presented his research into the effects of reef degradation from cyclones and mass coral bleaching on coral reef fish productivity, and Anne Hoggett gave an overview of the station and the state of the reef.

On 16 October, coral reef research and climate change effects were the topics for three speakers at another function at the Australian Museum. Professor Tim Flannery (Australian Museum), Professor Maria Byrne (University of Sydney) and PhD student Martin Hing (University of Wollongong) spoke about the Reef and their research. Dr Penny Berents (Australian Museum) was the moderator for a Q&A session.

The inaugural LIRRF event in Brisbane was held at the Queensland Museum on 19 November. We thank CEO and Director Dr Jim Thompson of the Queensland Museum for enabling this event. It followed a similar format to the Sydney events. The speakers were Dr Anne Hoggett AM (LIRS), Professor Justin Marshall and Dr Derek Sun (both University of Queensland) with Dr Penny Berents (Australian Museum) as moderator for the Q&A.

## Lizard Island Resort

The luxurious Lizard Island Resort provides an exceptional base from which to experience the Great Barrier Reef. Owned and operated by Delaware North, the Resort is a long-term supporter of the Research Station and the Foundation. 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 made a donation of \$1,000 or more in the last 12 months) qualify for a 20% discount on any stay of 3 or more nights at the Resort, except in the last week of October and in the Christmas–New Year period. See [lirrf.org](http://lirrf.org) for information about making a booking.

When you are on the island, please be sure to visit the Research Station to see how your donation is being put to good use. For more information about the Resort, visit [lizardisland.com](http://lizardisland.com).

## Donations

LIRRF operates with very low overhead costs, providing a highly efficient channel for donations to support science on the Reef. Lizard Island Research Station would not exist and could not continue without donor support. Various options for donating are available online at [lirrf.org/donate](http://lirrf.org/donate). All donations of \$2 or more are tax deductible in Australia.

# For the record

## Lizard Island Field Guide

Lizard Island Field Guide (LIFG) is an online guide to the life of Lizard Island, both terrestrial and marine. It now includes more than 2,800 species with photographs and so much other information, an increase of about 300 during the year. This includes 750 of the 1500 known fish species in this area, 250 corals, 580 molluscs, 200 echinoderms, 100 birds and 240 land plants.

Representation of terrestrial invertebrates in LIFG is very poor with only about 100 insect species and 18 spider species currently included. We expect those numbers to increase substantially when last year's LIRRF Postdoctoral Fellow, Dr Darko Cotoras, publishes the results of his 2019 field work into Lizard Island spiders and beetles.

The online guide (<http://lifg.australianmuseum.net.au/Hierarchy.html>) is updated continuously and free mobile applications for both major platforms are updated twice each year. We thank the LIRRF for providing the funds to maintain these sites, to Geoff Shuetrim and the Gaia Guide Association for developing them, to Marianne Pearce who enters much of the background data, and to the many contributors. Anne Hoggett oversees the quality and development of content.

iNaturalist is a citizen science project that enables observations of biodiversity to be shared and identified by its online community of about 1 million people. It is an excellent complementary platform to LIFG. In August 2019, we set up a project within iNaturalist called Lizard Island Life. iNaturalist contributors have helped us to identify many species for LIFG and selected contributions to Lizard Island Life are imported to LIFG to extend its species coverage and to provide additional photos.

## Staff

Dr Lyle Vail AM and Dr Anne Hoggett AM completed 29 years as joint Directors in August 2019.

Marianne Dwyer and John Williamson completed their fourth year as maintenance staff in March 2019.

Lance and Marianne Pearce and, separately, Snow Amos filled in as maintenance staff when Marianne and John were on leave. Renie Amos also helped enormously as a volunteer during the latter period.

## Vale Terry Ford

It is with great sadness that we announce the passing away of Terry Ford on 16 February 2020. Terry, along with his partner Lois Wilson, has been involved in LIRS activities for decades. They operated the Station's live-aboard research vessel *RV Sunbird* for many years during the late 1980s and early 1990s. When *Sunbird* was sold, Terry and Lois visited LIRS almost annually, either as volunteers or as relief staff. Since 2001, they visited on 16 occasions and donated almost two-person years of their time helping with maintenance. In 2005, Terry took over the annual task of inspecting and, where needed replacing, all safety equipment in the Station's 15 research boats. Terry undertook this task enthusiastically despite being massively overqualified as a former Lieutenant Commander of Australian Navy patrol vessels. In the earlier days of his naval career he was a jet fighter test pilot. Whenever possible, Terry would be down at the beach to watch the setting sun. He will always be remembered for his dedication and friendship.

## Volunteers

LIRS relies upon volunteers to help with its maintenance. Our special thanks and acknowledgement in 2019 to 'regulars' Snow and Renie Amos, Sue Lawrence, Kerry Sackett, and Helen and Peter Wodetzki. Thanks also to second-time volunteer Charlie Maling, and new volunteers Genna Davies, Rory Lewis, Blinda McClelland and Ruby Staas.



## Internships

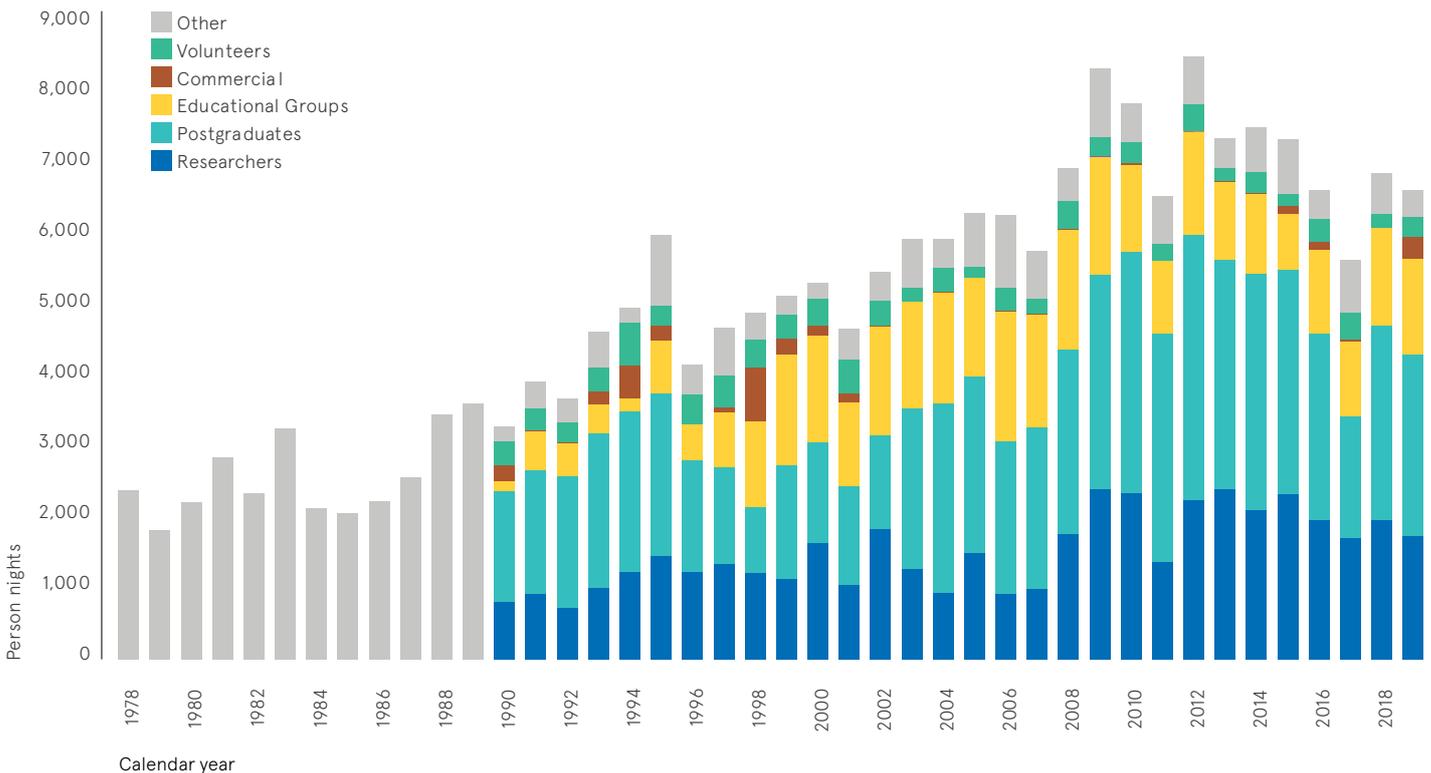
The undergraduate internships program ended in 2019. The final intern was Courtney Hildebrandt of the University of Wollongong who spent nearly a month at LIRS in early 2019. This program gave undergraduate students in relevant courses the opportunity to develop their skills in a research environment. Six students took part in the program over three years after being selected through a highly competitive process. While the program was successful in developing a small number of undergraduates, our focus has returned to supporting postgraduate and postdoctoral research. We thank the LIRRF for the opportunity to trial this program.

The postgraduate internships program provides access to field and aquarium facilities for PhD students who assist LIRS staff for 12 hours per week for at least three consecutive months in lieu of paying bench fees. Few students have projects that meet our requirements for this program and unfortunately none were able to take up the opportunity during 2019.

## Bench fees

Per person per night, Including GST	2019	2020
Researcher	\$ 148.50	\$ 150.00
Researcher's assistant	\$ 132.00	\$ 134.00
Postgrad student (own project)	\$ 57.50	\$ 58.50
Postgrad's assistant	\$ 52.50	\$ 53.50
School or university group	\$ 94.50	\$ 96.00
Media	\$223.00	\$226.00
Commercial	\$279.00	\$283.00

**Below left** New Caledonian Maskrays (*Neotrygon trigonoides*) are common at Lizard Island.



# Visitors in 2019

## Institutions

### Australian

- 1 ARC Centre of Excellence for Coral Reef Studies
- 2 Australian National University
- 3 Curtin University
- 4 Griffith University
- 5 James Cook University
- 6 Macquarie University
- 7 Monash University
- 7a Queensland Museum
- 8 Queensland University of Technology
- 9 Southern Cross University
- 10 University of Adelaide
- 11 University of New England
- 12 University of Queensland
- 13 University of Sydney
- 14 University of Tasmania
- 14a University of Western Australia
- 15 University of Wollongong

### International

- 16 Arkansas State University (USA)
- 17 Bar Ilan University (Israel)
- 18 California Academy of Sciences (USA)
- 19 Carnegie Institution (USA)
- 20 Hawaii Institute of Marine Biology (USA)
- 21 Hawaii Pacific University (USA)
- 22 Monterey Bay Aquarium Research Institute (USA)
- 23 National Oceanic and Atmospheric Administration (USA)
- 24 Nova Southeastern University (USA)
- 25 School for International Training (USA)
- 26 Silliman University (Philippines)
- 27 University of Auckland (New Zealand)
- 28 University of Aveiro (Portugal)
- 29 University of Bristol (United Kingdom)
- 30 University of Copenhagen (Denmark)
- 31 University of Exeter (United Kingdom)
- 32 University of Lisbon (Portugal)
- 33 University of Maryland Baltimore County (USA)
- 34 University of Neuchâtel (Switzerland)
- 35 University of Oslo (Norway)
- 36 University of Otago (New Zealand)
- 37 University of Saskatchewan (Canada)
- 38 University of St Andrews (United Kingdom)

Scientists from 40 institutions in 12 countries conducted 87 research projects in 2019 comprising 54 senior scientists or postdocs, 33 PhD candidates, 8 MSc candidates, 2 Honours candidates and 9 undergraduate research students. The researchers are listed here with their project titles and institutional affiliations.

A school of Blackfin Barracuda  
(*Sphyraena genie*) at Lizard Island

Opposite XXXX

## Senior scientists and postdocs

### Bridie Allan<sup>36</sup>

- 1) Interactions of temperature and microplastics on coral reef fish behaviour
- 2) The effect of temperature stress and microplastic pollution on escape behaviour of coral reef fish

### Cassy Thompson as field leader for Kristen Anderson King<sup>1,9</sup>

Recovery of coral growth rates and reef carbonate budget after severe bleaching events at Lizard Island

### Rohan Brooker<sup>6</sup>

Camouflage on coral reefs

### Kristen Brown<sup>1,12</sup>

Reef recovery in the aftermath of mass coral bleaching

### Sally Carson<sup>36</sup>

Science education, communication and community engagement in relation to marine science research

### Lucille Chapuis<sup>31</sup>

Mitigating the impact of motorboat noise on tropical reef fishes

### Doug Chivers and Maud Ferrari<sup>37</sup>

The impact of habitat degradation on predator-prey interactions

### Wen-Sung Chung<sup>12</sup>

Polarisation body patterns of cuttlefish

### Kendall Clements<sup>27</sup>

Nutritional ecology and demography of parrotfishes

### Fabio Cortesi as field leader for Cynthia Rignios<sup>1,12</sup>

Crown-of-Thorns Starfish population genetics

### Darko Cotoras<sup>18</sup>

Exploring the arachnid and coleopteran diversity of the Lizard Island Group

### Graeme Cumming<sup>1,9</sup> and Brad Congdon<sup>9</sup>

Predicting movement responses of marine organisms to a changing world

### Joseph DiBattista<sup>3</sup>

eDNA and fish barcoding at Lizard Island

### Jennifer Donelson<sup>1,9</sup>

Behavioural thermoregulation of coral reef fish



### Jason Doyle<sup>2</sup>

Further develop COTS eDNA tools with a view to operationalisation as part of an early-warning system

### Will Feeney<sup>7</sup>, Alexandra Grutter<sup>12</sup> and Paul Sikkel<sup>16</sup>

Long-term effects of cleaner fish on coral reef communities

### Christopher Fulton<sup>4</sup>, John Fleng Steffensen<sup>30</sup> and Keith Korsmeyer<sup>21</sup>

Ecophysiology of reef fish locomotion in dynamic flows

### Jason Gedamke<sup>23</sup>

Dwarf Minke Whale song - potential changes over 20 years

### Andrew Hoey<sup>1,9</sup> and Andrew Baird<sup>1,9</sup>

Post-bleaching recovery of coral populations

### Fredereike Kroon<sup>2</sup>

Fish predation on Crown-of-Thorns Starfish

### Sjannie Lefevre Nilsson<sup>34</sup> and Göran Nilsson<sup>35</sup>

Effect of hypoxia and temperature on heart rate and oxygen uptake in jumping snails

### Joshua Madin<sup>20</sup>, Maria Dornelas<sup>38</sup> and Andrew Baird<sup>1,9</sup>

Reef records monitoring

### Justin Marshall<sup>12</sup>

Stomatopod polarisation vision and anemonefish vision

### Mark McCormick<sup>1,9</sup>

- 1) Monitoring of fish and corals around Lizard Island
- 2) Marine plastics effect on anti-predator behaviour of *Strombus* and *Conus*

### Mark McCormick<sup>1,9</sup> and Bridie Allan<sup>36</sup>

Microplastics affect fish survival

### Mark Meekan<sup>2</sup> and Jennifer Kelley<sup>14a</sup>

Soundscape of Lizard Island waters and fish behaviour relating to light and turbidity

### Samuel Powell<sup>12</sup>

Measuring polarization of the visual environment of the Great Barrier Reef

### Morgan Pratchett<sup>1,9</sup>, Andrew Hoey<sup>1,9</sup> and Vanessa Messmer<sup>1,9</sup>

Assessing non-outbreak densities of Crown-of-Thorns Starfish

### Steve Purcell<sup>11</sup>

Movement and growth of sea cucumbers

### Yuichiro Takeshita<sup>22</sup>, Tyler Cyronak<sup>24</sup>, Ken Caldeira<sup>19</sup>, Manoela Romano<sup>19</sup>, David Koweek<sup>19</sup> and Kenny Wolfe<sup>1,12</sup>

Lizard Island Metabolism in Transition (LIMITS)

### Zegni Triki<sup>34</sup>

Is there variation in cognitive performance between female and male cleaners?

### Noa Truskanov<sup>34</sup>

Social learning in juvenile cleaner fish

### Sean Ulm<sup>9</sup>, Ian McNiven<sup>10</sup>, Ariana Lambrides<sup>9</sup>, Christian Reepmeyer<sup>9</sup> and Ben Gunn<sup>8</sup>

Lizard Island Archaeological Project

Above PhD student Isla Keesje Davidson and assistant at work in the Lizard Island lagoon

## Postgraduate research students

### **Melisande Aellen**<sup>34</sup>

General intelligence in cleaner fish? (PhD)

### **Olivia Arnold**<sup>9</sup>

Lizard Island Archaeological Project (MSc)

### **Jessica Bellworthy**<sup>17</sup>

How do local thermal regimes and reproductive timings impact coral planulae plasticity? (PhD)

### **Makeely Blandford**<sup>1,9</sup>

Interactions between fish and coral reefs: the influence of habitat degradation on fish communities. (PhD)

### **Nader Boutros**<sup>13</sup>

Spatial surveys of reef fish and their habitat (PhD)

### **Viviana Brambilla**<sup>38</sup>

Coral reefs and niche construction: quantifying patterns (PhD)

### **Claudio Brandao**<sup>28</sup>

Chasing *Symbiodinium*: the endolithic niche of *Symbiodinium* on Lizard Island (PhD)

### **Weili Chan**<sup>12</sup>

Chemical ecology of nudibranchs (PhD)

### **Alice Chou**<sup>35</sup> with supervisor

#### **Thomas Cronin**<sup>35</sup>

Neural organization of the central brain in adult and larval stomatopods (PhD)

### **Amy Coughlan**<sup>14</sup>

The global importance of benthic pelagic coupling for coastal reef functioning (PhD)

### **Yasmin Emery**<sup>34</sup> with supervisor

#### **Redouan Bshary**<sup>34</sup>

Learning mechanisms underlying cognitive performance in mutualistic interactions: from biological markets to social learning (PhD)

### **Tim Gordon**<sup>31</sup>

Soundscapes as symptoms and mechanisms of ecosystem change (PhD)

### **Alexia Graba-Landry**<sup>1,9</sup>

The effect of increasing temperature to seaweed-fish interactions on coral reefs (PhD)



### **Naomi Green**<sup>12</sup>

How different is different? The design and function of highly contrasting colour patterns in animals (PhD)

### **Kelly Hannan**<sup>1,9</sup>

Physiological effects of elevated pCO<sub>2</sub> on fishes employing different swimming modes (PhD)

### **Helen Holmlund**<sup>4</sup>

How does drought affect the water relations of the mangrove fern *Acrostichum speciosum*? (PhD)

### **Isla Keesje Davidson**<sup>29</sup>

Multi-modal communication in reef fish under changing behavioural contexts and environments (PhD)

### **Brad Lamont**<sup>36</sup>

The effect of plastic and CAC exposure on growth and physiology of recruit *Pomacentrus amboinensis* (MSc)

### **Lauren Linnenlucke**<sup>9</sup>

Lizard Island Archaeological Project (PhD)

### **Jake Lowe**<sup>9</sup>

Effects of no-take marine reserve protection on abundance, demography and life history characteristics of large-bodied wrasses of the GBR and Philippines (PhD)

### **Caitlin Maling**<sup>13</sup>

Fish song (poetry) (PhD)

### **Millie Mannering**<sup>36</sup>

The impacts of microplastic consumption on predation rate and predator selectivity on coral reef fish (MSc)

### **Samuel Matchette**<sup>29</sup>

How the presence of water caustics impacts the detection of moving objects by a coral reef fish (PhD)

### **Michalis Mihalitsis**<sup>1,9</sup>

Association of fish body size and shape to the benthos (PhD)

### **Laurie Mitchell**<sup>12</sup>

The role of ultraviolet signalling in anemonefishes (Amphiprioninae) (PhD)

### **Claire Moad**<sup>9</sup>

The effect of habitat degradation on the interrelationships between morphology, performance and behaviour of coral reef fishes (Hons)

### **Teresa Morrell**<sup>36</sup>

Effect of plasticisers on triplefin fish (MSc)

### **Georgina Nicholson**<sup>27</sup>

Diet and bioerosion in Indo-Pacific parrotfishes (MSc)

### **Jose Paula**<sup>32</sup>

Cleaning interactions in a changing world: bioecological responses of cleaning mutualisms to ocean warming and acidification (PhD)

**Matthew Nicholson**<sup>16</sup>

Ectoparasite consumption by diurnal fishes (PhD)

**Marina Santana**<sup>2,9</sup>

Assessing the ecological risks of plastic pollution to coral reef environment (PhD)

**Gabriela Scata**<sup>12</sup>

Octopus brain and social behaviour (PhD)

**Mary Shodipo**<sup>26</sup>

Training in gnathiid sampling methodology (MSc)

**Mathias Soerensen**<sup>21</sup>

Pectoral fin shape effect on swimming kinematics and behaviour during turning in a wave induced water flow (MSc)

**Pietro Storelli**<sup>3,4</sup>

Cooperation and conflict in couples of cleaner wrasse (MSc)

**Amy Streets**<sup>12</sup>

Structure and function of the optic lamina in stomatopods (PhD)

**Robert Streit**<sup>1,9</sup>

Heterogeneity of feeding by herbivorous fishes (PhD)

**Sterling Tebbett**<sup>1,9</sup>

The functioning of transitioning coral reef: fishes, sediments and productivity (PhD)

**Laura Velasquez**<sup>1,9</sup>

Effects of elevated temperature and boat noise on predator-prey interactions (PhD)

**Hong Vo**<sup>12</sup>

Mantis shrimp vision (PhD)

**Jing-Wen Wang**<sup>12</sup>

Electrophysiology studies of the visual neurons in stomatopods (PhD)

**Erin Watson**<sup>12</sup>

How colour pattern characteristics impact the detection of objects by a coral reef fish (Hons)

**Emma Weschke**<sup>29</sup>

Diel investigations into the effects of daytime motorboat noise on nocturnal tropical coral reef fishes (PhD)

## Undergraduate research students

**Jeremy Goodsnyder**<sup>25</sup>

Behavior of populations of rabbitfish (*Siganus doliatus*) on outfront and Loomis Reefs of Lizard Island

**Alison Hammond**<sup>11</sup>

Movement of *Thelenota anax*

**Grace Hinrichs**<sup>25</sup>

The effect of climatic disturbances on coral reef metabolic processes

**Jillian Lessing**<sup>25</sup>

Examining the effects of planulae variation on growth rate and settlement

**Ansley Levine**<sup>25</sup>

The effects of water temperature and habitat quality on the behavior of barred rabbitfish (*Siganus doliatus*) on the Great Barrier Reef

**Thomas McCambridge**<sup>25</sup>

The effects of habitat degradation on the factors influencing reef fish survival

**John McCormack**<sup>25</sup>

A survey of beetle diversity (order Coleoptera) on Lizard Island

**Luka Meyers**<sup>11</sup>

Movement of *Stichopus vastus*

**Sarah Orth**<sup>25</sup>

*Siganus doliatus*: pairing behavioral analysis off Lizard Island, Australia

## Education groups

**Barker College**

Led by Tim Binet, Sarah Cormio and Virginia Ellis

**Geelong College**

Four groups led by Rhonda Browne, Dana Dear, Justine Dyson, Sam Macintosh, Mark Nurnaitis, Benjamin Robbins, Marita Seaton, Emma Withers and Reef Ecotours staff

**ISF Academy Hong Kong**

Led by Jo-Ann Seow and Reef Ecotours staff

**RMIT University**

Led by Jeff Shimeta, Nathan Bott, and David Heathcote

**School for International Training**

Two groups led by Tony Cummings, Vanessa Messmer, David Sellars and Jack Grant

**Wenona School**

Led by Alisha Thompson, Jodie Webster, Ana Vila-Concejo and Elizabeth Nash

## Other visitors

**Australian Museum**

- Staff recognition award winner Dr Stephen Keable

**Lizard Island Reef Research Foundation**

- Chair Kate Hayward with supporters Percy and Nicola Ellis, Mary Hayward and Ian Dungey, Paul Slade, Allison Haworth and Michael West
- Trustee Greer Banyer with husband Jay Banyer and daughters Eve and Erin
- Rossi Foundation representatives Danielle and Christian Helms

**Undergraduate intern**

- Courtney Hildebrandt, University of Wollongong

**Media**

- Associated Press, Sam McNeil
- Reuters, Lucas Jackson and Maurice Tamman
- Plimsoll Productions, documentary film crew
- Sealight Pictures, documentary film crew
- Lisa Bigelow, author

**First aid training**

- Charlie Makray and Julie Armour

**Australian Institute of Marine Science**

- GBROOS maintenance team

**Contractors**

- Allan Ross, microscope service
- Essential Air Solutions, refrigeration works
- Telstra, antenna installation
- BME NQ, boat painting

**Above Left** Honours student Millie Mannering at work in the aquarium.

# Publications



Anemonefishes *Amphiprion percula* in anemone *Heteractis magnifica* at Lizard Island

In 2019, 88 publications based on work carried out at LIRS were received into the collection as listed below. There are now more than 2,380 LIRS publications.

- 1. Allen, J.D., E.L. Richardson, D. Deaker, A. Agüera and M. Byrne, 2019.** Larval cloning in the crown-of-thorns sea star, a keystone coral predator. *Marine Ecology Progress Series*, 609: 271-276.
- 2. Alvarez Noriega, M., 2019.** Competition and coexistence of reef-corals. PhD thesis, James Cook University.
- 3. Arroyo, F.A., T.E. Pawlowska, J.H. Choat, K.D. Clements and E.R. Angert, 2019.** Recombination contributes to population diversification in the polyploid intestinal symbiont *Epulopiscium* sp. type B. *The ISME Journal*, 13: 1084-1097.
- 4. Bandel, K., 2006.** Families of the Cerithioidea and related superfamilies (Palaeo-Caenogastropoda; Mollusca) from the Triassic to the Recent characterized by protoconch morphology – including the description of new taxa. *Paläontologie, Stratigraphie, Fazies* (14), *Freiberger Forschungshefte, C 511*: 59-138.
- 5. Branconi, R., J.G. Garner, P.M. Buston and M.Y.L. Wong, 2019.** A new non-invasive technique for temporarily tagging coral reef fishes. *Copeia*, 107(1): 85-91.
- 6. Branconi, R., M.Y.L. Wong and P.M. Buston, 2019.** Comparison of efficiency of direct observations by scuba diver and indirect observations via video camera for measuring reef-fish behaviour. *Journal of Fish Biology*, 94(3): 489-497.
- 7. Brandl, S.J., L. Tornabene, C.H.R. Goatley, J.M. Casey, R.A. Morais, I.M. Cote, C.C. Baldwin, V. Parravicini, N.M.D. Schiettekatte and D.R. Bellwood, 2019.** Demographic dynamics of the smallest marine vertebrates fuel coral-reef ecosystem functioning. *Science*, 10.1126/science.aav3384.
- 8. Bray, R.A., S.C. Cutmore and T.H. Cribb, 2019.** An anomalous phylogenetic position for *Deraiotrema platacis* Machida, 1982 (*Lepocreadiidae*) from *Platax pinnatus* on the Great Barrier Reef. *Diversity*, 11:104.
- 9. Cardoso, S.C.C., 2015.** The role of neuropeptides on the modulation of mutualistic behaviour of the Indo-Pacific Cleaner Wrasse (*Labroides dimidiatus*). PhD thesis, Universidade do Algarve.
- 10. Chase, T.J. and M.O. Hoogenboom, 2019.** Differential occupation of available coral hosts by coral-dwelling damselfish (Pomacentridae) on Australia's Great Barrier Reef. *Diversity*, 2019, 11: 219.
- 11. Cheney, K.L., N.F. Green, A.P. Vibert, M. Vorobyev, N.J. Marshall, D.C. Osorio and J.A. Endler, 2019.** An Ishihara-style test of animal colour vision. *Journal of Experimental Biology*, 222: jeb189787.
- 12. Chisholm, J.R.M., 1988** Photosynthesis, calcification and photoadaptation in reef-building crustose coralline algae on the Great Barrier Reef. PhD thesis, James Cook University.
- 13. Chivers, D.P., M.I. McCormick, E.P. Fakan, R.P. Barry, J.W. Edmiston and M.C.O. Ferrari, 2019.** Coral degradation alters predator odour signatures and influences prey learning and survival. *Proceedings of the Royal Society B*, 286: 20190562.
- 14. Clements, M., K. Wolfe, K. Schwartz and M. Byrne, 2019.** Forever fissiparous: asexual propagation and stable demography in a tropical and geographically isolated asterinid sea star. *Marine Biology*, 166: 69.
- 15. Cowan, Z.-L., 2017.** Predation on the early life stages of crown-of-thorns starfish (*Acanthaster cf. solaris*). PhD thesis, James Cook University.
- 16. Cribb, T.H., P.A. Chapman, S.C. Cutmore and D.C. Huston, 2019.** Pronocephaloid cercariae (Platyhelminthes: Trematoda) from gastropods of the Queensland coast, Australia. *Journal of Helminthology*, 94, e105: 1-10.
- 17. DeCarlo, T.M., H.B. Harrison, L. Gajdzik, D. Alaguada, R. Rodolfo-Metalpa, J. D'Olivo, G. Liu, D. Patalwala and M.T. McCulloch, 2019.** Acclimatization of massive reef-building corals to consecutive heatwaves. *Proceedings of the Royal Society B*, 286: 20190235.
- 18. Dittmann, I.L., D. Cuadrado, M.T. Aguado, C. Noreña and B. Egger, 2019.** Polyclad phylogeny persists to be problematic. *Organisms Diversity and Evolution*, 19:585-608.
- 19. Duong, B., S.P. Blomberg, T.H. Cribb, P.F. Cowman, A.M. Kuris, M.I. McCormick, R.R. Warner, D. Sun and A.S. Grutter, 2019.** Parasites of coral reef fish larvae: its role in the pelagic larval stage. *Coral Reefs*, <https://doi.org/10.1007/s00338-019-01766-z>.
- 20. Fakan, E.P. and M.I. McCormick, 2019.** Boat noise affects the early life history of two damselfishes. *Marine Pollution Bulletin*, 141: 493-500.
- 21. Feller, K., D. Wilby, G. Jacucci, S. Vignolini, J. Mantell, T.J. Wardill, T.W. Cronin and N.W. Roberts, 2019.** Long-wavelength reflecting filters found in the larval retinas of one mantis shrimp family (Nannosquillidae). *Current Biology*, 29: 3101-3108.
- 22. Ferrari, M.C.O., D.T. Warren, M.I. McCormick and D.P. Chivers, 2019.** The cost of carryover effects in a changing environment: context-dependent benefits of a behavioural phenotype in a coral reef fish. *Animal Behaviour*, 49: 1-5.
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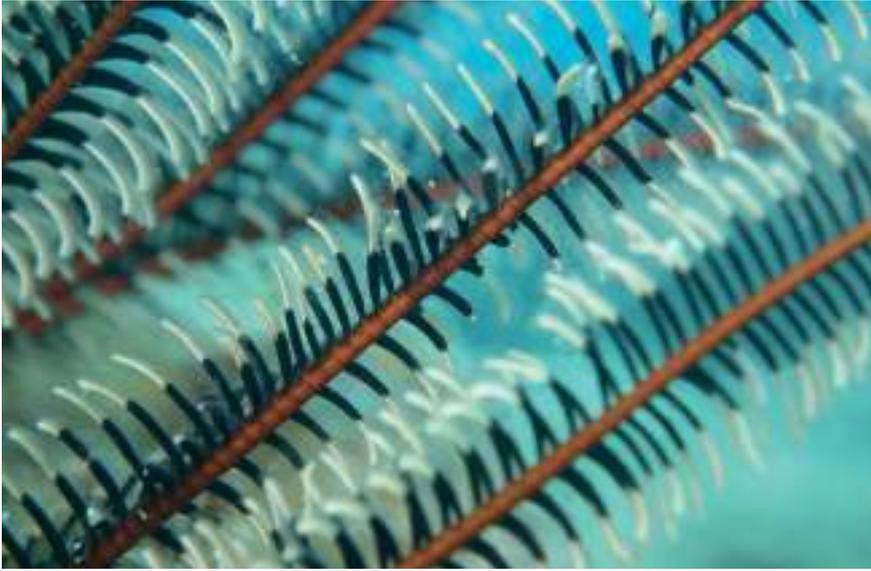
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