



Lizard Island Research Station

Newsletter 2002

Published April 2003

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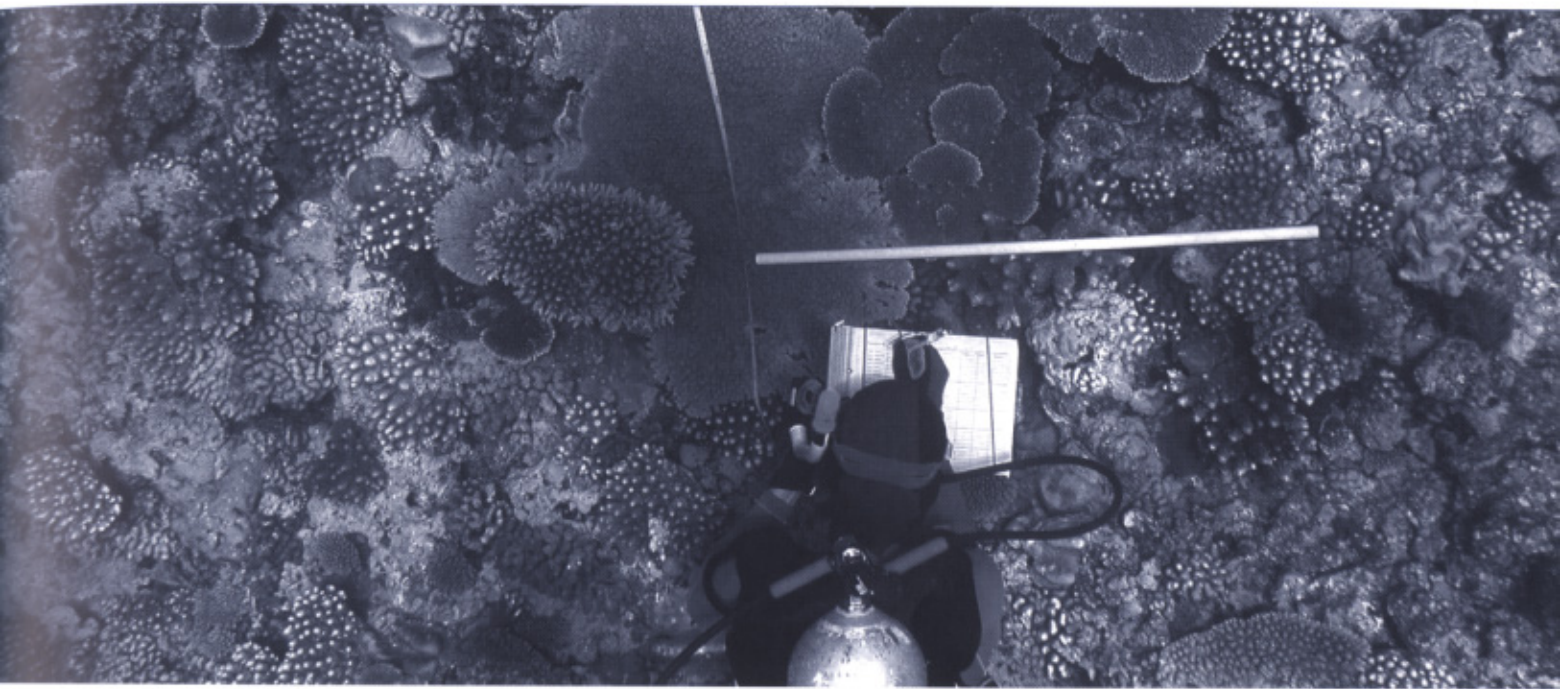


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Artist's impression of the proposed 30th Anniversary Development: new labs, seminar room, computer room, library, office, dive "shop", service areas. **We need to raise \$1.2 million to build it. With your help, we will succeed!**

**Stop Press** (March 2003): The 30th Anniversary Development was officially launched in Sydney on 20 February 2003. Over a third of the fundraising target has already been committed by donors to the Coral Reef and Marine Science Foundation (Kevin Kalkhoven, Dick Eidswick) and the Lizard Island Reef Research Foundation (Charles & Sandy Shuetrim, Ken Coles, Rowena Danziger, Trevor Pearson, Sarah Whyte, Trevor & Geraldine Haworth).



## Lizard Island Research Station Newsletter 2002

This newsletter covers events during 2002.  
Published April 2003.

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



Professor Goran Nilsson measures oxygen consumption in marine animals.

## 30th Anniversary Development

The Lizard Island Research Station will be 30 years old in 2003. To celebrate, the Station plans to embark upon the biggest building program in its history to ensure that it continues to support the best coral reef science into the 21st century.

We need:

- More lab space to accommodate all the projects – since the last laboratory building was constructed in 1991, usage by researchers and students has increased by nearly 50%.
- New lab equipment to allow for more sophisticated kinds of research.
- Additional aquarium space to ease the annual crush in spring and summer.
- A computer room with more computers connected to the internet so that researchers can communicate effectively.
- A seminar room where research seminars, lectures to student groups, and tours for the public can be conducted.
- A bigger library to house more books, journals, reprints and non-print media.
- Space for the Station's large quantity of snorkelling and scuba gear for hire.
- Offices for staff.
- Service areas to cope with freight and laundry for this remote community.

The estimated cost is \$1.2 million and preliminary plans have been drawn. An artists impression of the new facility is shown inside the front cover. Fundraising for the development will be launched jointly by the Lizard Island Reef Research Foundation and the Coral Reef and Marine Science Foundation (CRMSF) in early 2003.

Kevin Kalkhoven pre-empted the official launch and gave a fantastic kick-start to the fundraising in October 2002 when he promised \$333,333 towards the project.

## Developments during 2002

A new **high speed catamaran, *Kirsty K***, is welcomed into the LIRS fleet! The boat was built to our specifications in Cairns and delivered in September 2002. Funding for the vessel was generously provided by Kevin Kalkhoven and the Coral Reef and Marine Science Foundation. Kevin was able to see the boat during his visit to the island in October and the boat is named after his daughter. *Kirsty K* replaces the ageing workhorse *Condor* that has provided excellent service over the past 14 years. *Kirsty K* is similar in size and speed to the older boat but it provides a much smoother ride in rough conditions and is much dryer in the cockpit. It has a combined chart-display GPS and depth sounder unit which makes navigation much easier.

Another new boat acquired in 2002 is a **4.9 metre dinghy, *Pip***. It replaces Number VI which is worn out after more than 15 years of service. The new dinghy was built in Cairns with funds provided by the Lizard Island Reef Research Foundation (LIRRF). Following the recent tradition of naming new dinghies for supporters (such as *Jacque* and *Alison*), the new dinghy is named after Pip Smith. With her husband Dick, Pip has been a strong supporter of the Station over many years.

The Station joined the online world in November 2002 with **broadband satellite** connections. This long-awaited development was provided at the best possible price (zero!) by Telstra as part of its commitment to improving communications in remote areas. The system provides high-speed download and moderate upload speed. This is an enormous improvement on the dial-up connection via radio that was used over the past few years for email but which was not viable for web access.



Michael Berumen studies butterfly fish.

To enable efficient web access for LIRS visitors, a new **computer** was purchased with funds provided by the LIRRF. There are now two computers for visitors to use. The new one is used almost exclusively for internet access and the other is used mainly for manipulation of digital images.

A **display about the Station**, including interactive access to the Station's web site, was commissioned with funds from the LIRRF through a donation from Mr and Mrs Doug Markell. The display is intended for permanent exhibition at the Australian Museum, and it was installed in late 2002.

A new **donor acknowledgement board** was installed at the Station in late 2002 with funds from the LIRRF through a donation from Mrs Rowena Danziger. The modular system will enable rapid recognition for new donors.

A **digital projector** was purchased in late 2002 with LIRRF funds through a donation by Mr and Mrs Charles Shuetrim. This greatly enhances the Station's ability to facilitate research seminars and presentations to student groups. As well, Charlie donated a **laptop computer** to the Station during the year. It is used to gather contact data from day visitors and for presentations with the projector.

The Lizard Island Reef Research Foundation also provided funds this year to continue the ongoing replacement schedule for **outboard motors**, to trade in the **4WD vehicle** for a new one, and to purchase a new **photocopier** and a **photo-quality printer**.

## Other fundraising news

Numerous representations were made to the Federal government during 2002 to obtain funding for the Lizard Island Research Station in line with that provided in 2001 for the other major research stations on the Great Barrier Reef. We remain hopeful that a source of government funding will be found. The Station continues to be reliant on its own revenue stream and on support from the Australian Museum and the private sector. During 2002, commitments for major funding were made by the following organisations and individuals:

- The **James N. Kirby Foundation** and **Raymond Kirby** have agreed to fund an upgrade of Kirby House. This visitors' house will have a new commercial kitchen, new floor coverings, a new roof, and it will be repainted. These donations will be made through the Lizard Island Reef Research Foundation.
- The **Raymond E. Purves Foundation** will fund an extension to and upgrade of the Raymond E. Purves Laboratory. A new air-conditioned room will be added to this building, the open-air wet lab will have new benches and floor coverings and the open area will be reorganised. Again, this donation will be made through the Lizard Island Reef Research Foundation.
- The **Australian Museum** has committed funds to replace the roofs of several buildings at the Station. The Museum's support for this essential maintenance project is gratefully acknowledged.

These projects, along with others to be funded by the LIRRF, will be carried out in May and June of 2003.



Kevin Kalkhoven and family visit Lizard Island.

# Doctoral Fellowships

A Lizard Island Doctoral Fellowship is awarded annually to support field-intensive research by an outstanding PhD candidate who will make effective use of the Lizard Island Research Station's facilities. Each new Fellowship is worth up to A\$6,000 per year for up to three years. An additional A\$1,000 per annum may be granted to assist with additional travel costs if the successful applicant is enrolled at a foreign university. Financial support for the Fellowships program in 2002 was provided by the Lizard Island Reef Research Foundation. The Coral Reef and Marine Science Foundation will also contribute to the program in 2003. Information about the 2004 Lizard Island Doctoral Fellowship will be available at [www.lizardisland.net.au](http://www.lizardisland.net.au) by July 2003. Closing date for applications is 1 October 2003.

## Fellowship research during 2002

Justine Becker (2002 Fellow, University of Queensland) spent more than three months at Lizard Island during 2002 conducting her studies into the ecological role of cleaner shrimps on coral reefs. Justine has found seven species of cleaner shrimp in a variety of habitats and recorded shrimp in cleaning associations with 24 species of reef fish. Justine plans additional field trips in 2003 and 2004 when she will determine the effectiveness of cleaner shrimp in removing parasites from client fish.

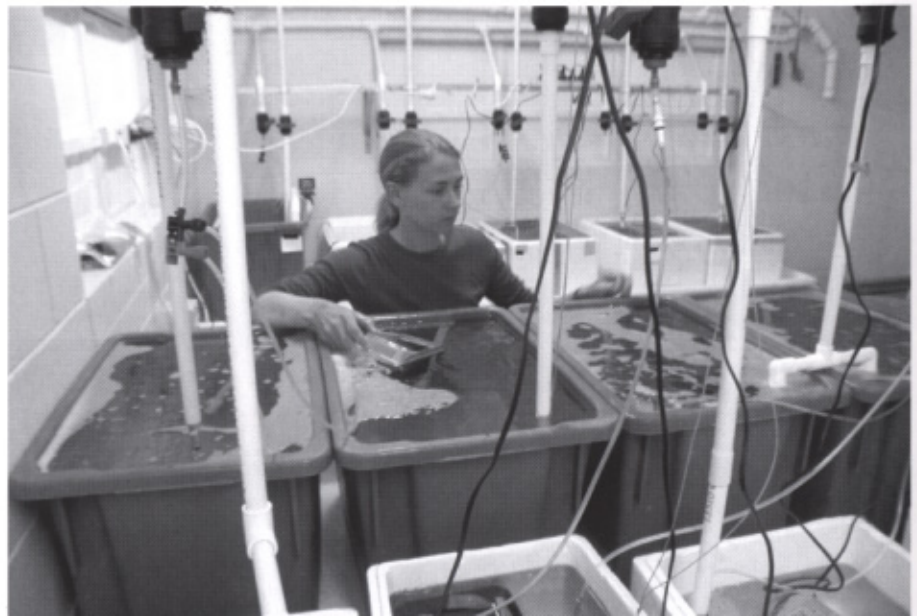
Heather Patterson (joint 2001 Fellow, James Cook University) completed her final PhD field trip to Lizard Island in December 2002. Her study of otolith chemistry is yielding many exciting results. One important find, which corroborates some previous studies, suggests that Lizard Island is an important source of reef fish larvae for other nearby reefs.

## Two Doctoral Fellowships awarded for 2003

We are pleased to announce that Line Bay and Chris Fulton of James Cook University, Townsville were each awarded a 2003 Lizard Island Fellowship. Normally only one new Fellowship is offered each year but, for 2003, funds for two new Fellowships were available through donations by Mr Kevin Kalkhoven and Mr Dan Pettit to the Coral Reef and Marine Science Foundation. Each Fellowship is worth up to \$6,000 per annum for up to three years. We sincerely thank Mr Kalkhoven and Mr Pettit for their generous support. Both Line and Chris are eligible for three years' support starting in 2003.

**Line Bay's** project is entitled "Thermal adaptation and the evolution of species' borders in coral reef fishes". Many species have distinct geographical borders in the absence of any obvious barriers to range expansion. How such borders evolve has long intrigued biologists, since their existence suggests a failure of natural selection to produce adaptations to conditions beyond the edge of the current range.

Line Bay investigates thermal stress in reef fish.





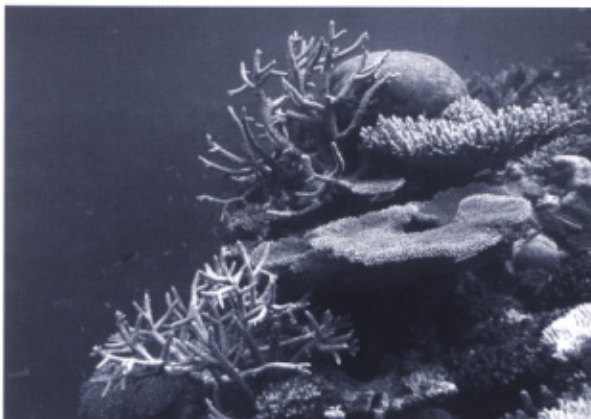
Jason Gedamke and Iain Clarke study minke whale behaviour using acoustic telemetry.

Line will use a molecular approach to investigate the evolution of species borders in some coral reef fishes. In particular, she is interested in the relationship between gene flow and local thermal adaptation. She will estimate the local thermal adaptation of certain species of reef fish by quantifying the expression of a group of stress proteins, the heat shock proteins. These proteins act as protective molecular “chaperones” and are expressed when an organism is subjected to temperatures – both hot and cold – to which they are not well adapted. Lizard Island is significant in the design of Line’s study because it is near the southern border for some fish species and near the northern border for others. This will allow her to examine mechanisms determining both sorts of borders.

Currently, we do not know if reef fishes experience thermal stress in the wild and if so, how this differs between seasons, locations and species. Line’s research will significantly increase our understanding, not only of the evolution of species’ borders, but also of how climate change effects coral reef fish communities.

**Chris Fulton’s** project is entitled: “Wave exposure and the structure of reef fish assemblages: the role of swimming performance”. Wave action is generally recognised to play an important role in the survival and success of attached reef organisms such as corals. Such animals need a certain amount of water movement to supply them with nutrients and remove wastes, but too much surge can cause breakage or dislodge them altogether. For mobile organisms such as reef fishes, however, the effect of wave action has been largely overlooked. The traditional view is that fish can move around to avoid the problems associated with wave action that besiege attached organisms. However, recent research on a single family of fishes, the wrasses, has indicated that wave action may also have direct effects on fishes, and ultimately influence where they live on coral reefs.

Chris is investigating the extent to which wave energy and swimming abilities shape the distribution and abundance patterns of several diverse and abundant reef fish families. His study will be the first to quantify wave energy gradients amongst reef habitats and directly compare them to the distribution patterns of some reef fish. This will provide us with a new understanding of how a physical factor as widespread as wave energy can directly affect coral reef fishes, and how this affects where they live on the reef. Such information is invaluable when selecting marine reserve areas for the management and conservation of coral reef ecosystems.



Chris Fulton with plaster balls used to measure wave action.



# Lizard Island Reef Research Foundation

## FOUNDER

Sir John Proud<sup>^</sup>

## PATRONS

Lord Catto of Cairncatto<sup>^</sup>  
Dr Des Griffin AM  
Mr Raymond Kirby AO  
Mr Henry Loomis and Mrs Jacqueline Loomis  
Lady Proud  
Mr Robert Purves  
Mr Charles Warman AM

## TRUSTEES

Mr Kenneth Coles AM (Chairman)  
Mr Andrew Green (Secretary and Treasurer)  
Prof Mike Archer  
Dr Penny Berents  
Mr James Bildner  
Mr Trevor Haworth AM  
Mrs Alison Hayward  
Mr Chris Joscelyne  
Mr Vivian King  
Mr Raymond Kirby AO  
Mr Gordon Moffatt AM  
Mr Bill Page-Hanify AM  
Mr Robert Purves  
Associate Prof Margaret Rose  
Mr Charles Shuetrim  
Ms Julianna Walton  
Mr Charles Warman AM  
<sup>^</sup> deceased

The Lizard Island Reef Research Foundation is an independent trust established to raise funds for the Lizard Island Research Station and to support research on the Great Barrier Reef. Its major commitments are to the Doctoral Fellowships program and to capital developments at Lizard Island. Donations to the Foundation are tax deductible within Australia. More than \$2.2 million has been raised by the Foundation since its inception in 1978. See the inside back cover for Members and Friends of the Foundation in 2002.



In the 2001/02 financial year, the LIRRF contributed \$132,000 to the Station and it has committed additional funds for 2002/03. The developments in 2002 that were made possible by the LIRRF are outlined elsewhere in this newsletter.

## Foundation Members' Dinner

The annual Members' dinner was held on 9 September 2002 at the Wharf Restaurant on Sydney Harbour. The guest speaker was Associate Professor David Bellwood of James Cook University who enthused us with his love of fishes, impressed us with his prodigious knowledge of coral reef science, and entertained us with his stories of fishes' lives and field work. Again, we have Anders Ousback to thank for providing the venue and the wonderful meal. Wine for the dinner was generously donated by Fesq & Company, Shaw & Smith, and Port Philip Estate.

## Melbourne luncheon

Luncheon at the Athenaeum Club in Melbourne is also an annual Foundation Members' event. In 2002, the function was hosted by Ken Coles on 22 April. Dr Penny Berents of the Australian Museum spoke passionately about research at the Station, especially the continuing success of the Lizard Island Doctoral Fellowship program. Penny is a member of the Foundation and has been involved with the Lizard Island Research Station in many capacities since its earliest days.

## Members' prizes

Each year, current members of the Foundation are entered into a draw for two great prizes. One is a four-night stay for two at the Lizard Island Resort with return air fares to Lizard Island from within Australia, and the other is a four-night cruise for two to Lizard Island aboard the Captain Cook Cruises ship *Reef Endeavour* with return air fares to Cairns from within Australia. P&O Australian Resorts and Captain Cook Cruises, respectively, are the generous sponsors of these prizes.

In 2002, Lyle Vail and Anne Hoggett were drawn as winners of the Resort prize, and Penny and Peter Berents won the *Reef Endeavour* cruise. Lyle and Anne already have plenty of time on Lizard Island, so they returned the Resort portion of their prize to the Foundation. The Foundation provided additional airfares and the whole prize was raffled among members and others. The raffle raised about \$8,000 and was won by Louise Berg.

Assoc Prof David Bellwood addresses LIRRF members.



# Coral Reef and Marine Science Foundation

## DIRECTORS

Mr Jim Bildner (President)  
Prof Michael Archer  
Dr Andrew Baker  
Prof Roy Caldwell  
Mr Kenneth Coles AM  
Mr James Duplessie  
Mr Kevin Kalkhoven

The Coral Reef and Marine Science Foundation Inc. was incorporated in the USA in 2001. It aims to provide funding for coral reef research and research infrastructure worldwide. Donations to the Foundation are tax deductible within the USA.

Its first major grant of US\$40,000 was awarded during 2002 to the Lizard Island Research Station. This grant was used to purchase the high speed catamaran *Kirsty K* and to fund the first of three annual payments for the two 2003 Lizard Island Doctoral Fellows. These projects are detailed elsewhere in this newsletter.



Charlie and Sandy Shuetrim,  
Prof Mike Archer and Dr Susan Hand  
at the LIRRF dinner. (Photo: courtesy  
Ken Coles)

## Foundation visitors

Many people associated with the Lizard Island Reef Research Foundation and the Coral Reef and Marine Science Foundation visited the Station during 2002 while staying at the Resort or visiting the island during a *Reef Endeavour* cruise:

- Lord Hugh Griffiths & Baroness Heather Brigstocke
- Antoinette Albert and her daughters Anna and Emily
- Bill Winning and Fiona Playfair
- Ken Coles AM and Rowena Danziger
- Margaret and Rod MacDonald
- Kevin Kalkhoven with Sally Tischler, Lorna and Hal Llewellyn and others
- Doug and Alison Markell
- Christina and John Stitt
- Sir Bruce McPhail (Vice Chairman, P&O International) and Richard Hein (Chairman, P&O Australia) with partners and friends.



Andrew Green and Collette Garnsey  
at the LIRRF dinner. (Photo: courtesy  
Ken Coles)



## For the record...

### Worst ever coral bleaching at Lizard Island

Bleaching occurs when symbiotic algae are expelled from the tissues of corals and some other reef invertebrates in response to environmental stress. Algal cells provide an important source of nutrition for these animals and they are also responsible for much of the living coral's colour. When the number of algal cells within a coral decreases, the coral loses its colour – it “bleaches” – and will eventually starve. If the environmental stress is removed before the coral dies, algae are able to re-enter the coral which then regains both its colour and its major food source.

The worst episode of coral bleaching ever recorded at Lizard Island – and at many other places on the Great Barrier Reef – occurred during late summer in early 2002. Sea temperature was high and the days were unusually sunny for that time of the year due to drought. Elevated temperature and solar radiation are known risk factors for bleaching events. Bleaching was widespread at Lizard Island and nearby mid-shelf reefs in hard corals, soft corals and anemones. It was most severe in shallow water but some bleached corals were observed to at least 18 metres depth. A large number of soft coral colonies died. The outcome varied for bleached hard coral colonies: some died, some lost part of their living tissue and others recovered. A much lower level of bleaching occurred at nearby outer barrier reefs and most corals appear to have recovered there.

Apart from the 2002 event, bleaching has been observed at Lizard Island only rarely since the Station's inception in 1973. On those earlier occasions, the number of colonies affected was much lower and all colonies appeared to recover. Most of the earlier events were associated with extremely low daytime tides and calm, sunny conditions in winter. Bleaching in response to these stresses appears to be sustainable at Lizard Island.

The 2002 event came hot on the heels of the worst bleaching event ever recorded globally in 1998 and both were attributed to elevated water temperatures. Lizard Island was spared during 1998 but many other places on the Great Barrier Reef have been severely bleached on two occasions in only five years. This is clearly not sustainable in the long term and has led some researchers to predict the demise of coral reefs as we know them within fifty years.

### Research Station features in ABC documentary

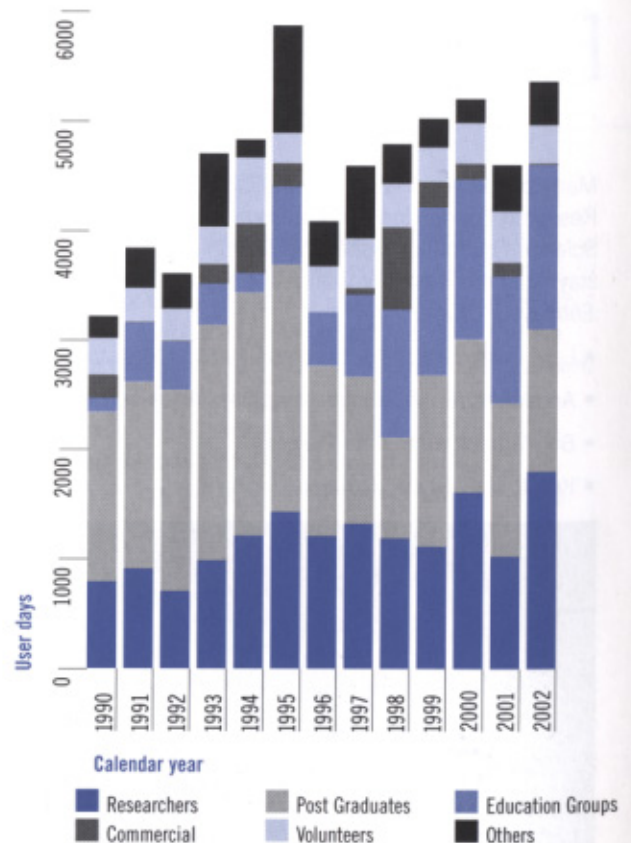
An ABC TV series entitled “Island Life” was screened in Australia in January 2002 and has been broadcast worldwide during the year. The first of six 50-minute episodes featured the Lizard Island Research Station and its workers. The documentary has been very well received and we thank Richard Smith for the excellent program he wrote, filmed and produced. The work of two researchers at the Station also featured in two short segments on the ABC program “Catalyst” during the year.

### Staff

There have been no staff changes during the year. Lyle Vail and Anne Hoggett are continuing as Directors and the two maintenance positions are filled by Lance and Marianne Pearce during summer (September to March) and by Bob and Tania Lamb during winter (March to September). Renie Hood and Snow Amos assisted as volunteers when Anne and Lyle were both off the island in January.

### Usage

The Station achieved record usage by its core user groups during 2002. Researchers, postgraduate students and student groups together accounted for 4,593 user days from a total of 5,340 – volunteers, contractors and official guests make up the difference.



Minke whales are numerous around Lizard Island in winter.



### Bench fees

Users are charged a bench fee that is subsidised by the Australian Museum Trust and the Lizard Island Reef Research Foundation. The fee covers shared, self-catering accommodation, use of a small boat, laboratory and aquarium facilities, and scuba tanks and air fills to qualified divers. The fee changes each year on 1 January to cover costs. Researchers and student groups who are applying for grant funding should include a margin for these annual increases. The fee schedule for 2002 and 2003 is (A\$ including GST, per person per night):

	2002	2003
Researcher	\$93.00	\$95.00
Researcher's assistant	\$81.00	\$83.00
Postgrad student (own project)	\$35.00	\$36.00
Postgrad's assistant	\$31.00	\$32.00
School or university group	\$58.00	\$59.00
Commercial	\$173.00	\$176.00

For individuals staying for 28 consecutive days or longer, a 10% discount applies to the whole of their bench fee. Other costs involved in conducting research or bringing an educational group to the Station are detailed on the Station's web site.

### Volunteer program

The Station's volunteer program is essential to its operations and it provides valuable experiences for the 20 to 30 volunteers accepted each year from the hundreds of applications received. Volunteers give four hours manual work each day and stay for approximately two weeks. The work is maintenance, not research, but many volunteers are recently qualified biologists who are eager to live on a field station, experience the coral reef environment and mix with researchers. Volunteers must pay their own travel expenses and arrange for their own food supplies. To enable volunteers to donate their services, shared accommodation is provided free of charge at the Station. In general, only two volunteers are accepted at any one time on a space available basis. Opportunities are

greatest from mid-February to mid-June and during August and September. More details about the program and an application form are available on the Station's web site.

### Research volunteers

The Station's web site invites interested people to register as volunteers to assist with research. This service has developed in response to numerous enquiries about opportunities for such work from biology students, graduates, divers and others.

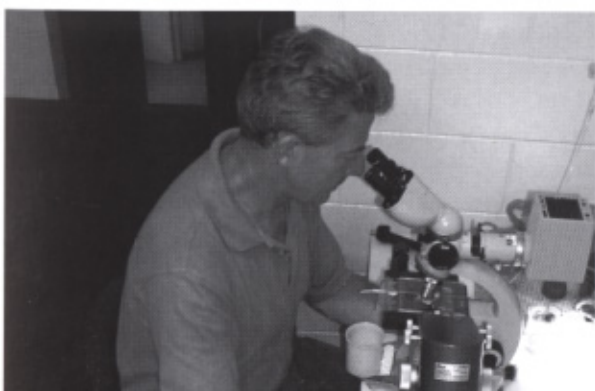
The Station can provide Lizard Island researchers with succinct details of volunteers who are available at the appropriate time. It is then up to the researcher to contact the volunteers and make arrangements independently. The Station does not provide prospective volunteers with any researcher's details. Volunteers must be treated according to the relevant guidelines of the researcher's home institution. Bench fees for volunteer assistants are payable by the researcher to the Station as for any other assistant. There are many well-educated, dive-qualified and enthusiastic volunteers on our register for 2003 – many claim to be good cooks too! The few that we were able to place during 2002 became valuable and effective members of their teams. We hope that more researchers take advantage of this service during 2003.

### Monitoring

The Station continued its monitoring activities during 2002, collecting data on weather parameters, water temperature, crown-of-thorns starfish abundance, and human usage and numbers of potato cod at the Cod Hole. As well, a new program started in February 2002 to monitor the fate of particular coral colonies following the severe coral bleaching event. Photographs of these corals are taken monthly.

### Tours

Tours of the Station for Resort guests are conducted on Mondays and Fridays from 9.30 to 11 am. A tour for other island visitors, mainly campers and yachties, is conducted from 11 am to 12.30 pm on Mondays only. The tours are popular and an effective means of communicating the research being done at the Station. A special tour was conducted for members of the CRC Reef Research board in November 2002. Tours for other groups with a special interest in the Research Station were also given occasionally during the year.



Prof David Vaney investigates retinal anatomy of damselfish.

# Research Projects and Participants

The following research projects were carried out during 2002. Project leaders who are postgraduate students are indicated with an asterisk (\*).

## **Seagrass photosynthesis and productivity and the effect of depth (November)**

Dr Len McKenzie (Northern Fisheries Centre, Australia) assisted by Dr Stuart Campbell and Simon Kerville

## **Ecology of crustose coralline algae: interactions with scleractinian corals (November/ December)**

\*Lindsay Harrington (James Cook University, Australia) assisted by Antony Lamby, Harry Harrington, Sally Ingleton, Greg Suosaari and Chico Birrell

## **Distribution of the seagrass *Halophila tricosta* in shallow reef lagoons and flats (December)**

Assoc Prof Margaret Greenway (Griffith University, Australia) assisted by Dr Peter Pollard and accompanied by Louise and Julian Pollard

## **Large-scale patterns of coral demography on the Great Barrier Reef (January)**

Morgan Pratchett (James Cook University, Australia) assisted by Abbi McDonald and Vanessa Messmer

## **Fluorescent properties of coral reef invertebrates (May/June)**

Dr Vincent Pieribone (Yale University, USA) assisted by Julia Tsai, David Gruber, Maxim Gorbunov, H.T. Kao and Earthwatch volunteers (Team 1: George Aiken, Jeffrey Sidor, Pat Williamson, Elita Pastra-Landis, Margaret Bierworth, Richard Morris, Adam Cherson, Mark Kivimaki, Nancy Leite; Team 2: Claudia Seldon, Caroline Bain, Marian Bayley, Emma Bentton, Geoffrey Chaiken, Mark Copley, Dana Eckstein, Haley Lewis, Richard Morris, Madeline Nadworny, Celeste Nadworny, Sandra Percell; Team 3: Dana Osterholz, Kathleen Cain, Katherine Coehlo, Bill Coehlo, Donald Lewis, Garrett Mitchel, Monica Lee, Lisa Warden, Gail Cohen, Sandford Cohen, John Osterholz, Geoffrey Chaikin

## **Coral disease surveys (July)**

Dr Bette Willis (James Cook University, Australia) assisted by Adam Pharaoh, Elizabeth Dinsdale and Cathie Page

## **The structural integrity and distribution of reef corals in the hydrodynamic environment (August/ September)**

\*Joshua Madin (James Cook University, Australia) assisted by Michael Berumen and Maria Dornelas

## **Chemical inducers for coral larval settlement and their application in ecotoxicology (November/ December)**

Dr Andrew Negri and Dr Andrew Heyward (Australian Institute of Marine Science) assisted by Claudia Vollhardt and Prudence McKenzie

## **Monitoring coral bleaching with colour charts (October/ November)**

Dr Uli Siebeck (University of Queensland, Australia)

## **Reproductive strategies in the needle coral *Seriatopora hystrix* (December)**

\*Elke Maier (University of Munich, Germany) assisted by Dr Ralph Tollrian, Jens Bohn, Christoph Haacke and Christian Laforsch and accompanied by Susi, Lea and Lenny Tollrian

## **Life cycle of trematode parasites of the cleaner wrasse *Labroides dimidiatus* (January/ February, April/ May)**

\*Conor Jones (University of Queensland, Australia) assisted by Dr Lexa Grutter and Justine Becker

## **Community structure of parasites in wrasses (July/ August)**

\*Gabriela Muñoz (University of Queensland, Australia)

## **Helmith parasites of fishes of the Great Barrier Reef (July/ August)**

Dr Tom Cribb (University of Queensland, Australia)

## **Haploporid trematodes of acanthurid fishes (July/ August)**

\*Bart MacKenzie (University of Queensland, Australia)

## **Opecoelids and lethinids (July/ August)**

\*Jonathon Yantsch (University of Queensland, Australia)

## **Survey of the digenean fauna of the Blennidae (July/ August)**

\*Ashley Roberts Thompson (University of Queensland, Australia)

## **Taxonomy, phylogeny and coevolution of the Sanguinicolidae in Australian waters (July/ August)**

\*Matthew Nolan (University of Queensland, Australia)

## **The Bucephalidae system on the Great Barrier Reef (July/ August)**

\*Nathan Bott (University of Queensland, Australia)

## **Distribution and abundance of *Spirobranchus giganteus* (April)**

\*Morgan Peterman (School for International Training, USA)

## **Follow-up study of 1987 giant clam census (April)**

\*Daniel Bruggers (School for International Training, USA)

## **Long-term monitoring of giant clam populations (May)**

Dr David Phillips (independent researcher, UK), assisted by Jackie Robinson

## **Comparative anatomy of northern Great Barrier Reef gastrochaenid bivalves (June/ July)**

Dr Joseph Carter (University of North Carolina at Chapel Hill, USA)

## **Phylogeny of nudibranchs (July)**

Prof Dr Heike Waegle (University of Bochum, Germany) accompanied by Ricky and Leonard Waegle

## **Radiation of aeolid nudibranchs (July/ August/ September)**

\*Ingo Burghardt (University of Bochum, Germany)

## **Systematics and phylogeny of doridoidean nudibranchs (July)**

\*Gillianne Brodie (James Cook University, Australia)

## **Orientation to underwater sound by larval and postlarval crustaceans and fish (January)**

Dr Andrew Jeffs (National Institute of Water & Atmospheric Research, New Zealand) and Dr John Montgomery (University of Auckland, New Zealand)

Assoc Prof Bette Willis and  
Liz Dinsdale study diseased corals.



**Does the cleaner shrimp/ fish mutualism fit a biological market? (October/ November)**

\*Justine Becker (University of Queensland, Australia) assisted by Conor Jones, Rob Jacob and Heidy Parks and accompanied by Elaine Becker

**Importance of cleaner shrimp on coral reefs (October/ November)**

\*Katie Schleit (School for International Training, USA)

**Systematics and phylogeny of isopod crustaceans (July)**

Dr Wolfgang Waegle (University of Bochum, Germany)

**Functions of sound production in stomatopods (August)**

Dr Sheila Patek (University of California, Berkeley, USA) and Dr Stim Wilcox (Binghamton University, USA) assisted by Charlie Nunn

**Monogamous mating systems in stomatopods (August)**

Prof Roy Caldwell (University of California, Berkeley, USA)

**Polarized light signaling in stomatopod crustaceans (August)**

Dr Tom Cronin and \*Chiou Tsy-Huei (University of Maryland, Baltimore, USA)

**Stomatopod vision and signals (August)**

Dr Justin Marshall (University of Queensland, Australia) assisted by Kylie Jennings

**Colour vision and signaling in stomatopods (August/ September)**

\*Alex Cheroske (University of Maryland, USA)

**Hawk moths and butterflies of Lizard Island (December)**

Rob Lachlan (Australian Museum) accompanied by Debbie, Emma and Tiffany Lachlan

**Growth and allometry of shallow water crinoids (January)**

Paul Detwiler (San Diego State University, USA) assisted by Ralph Alquezar

**Crinoid development and metamorphosis (February)**

\*Margaret Pizer (Duke University, USA)

**Phylogeny of Crinoidea (October/ November)**

Dr Greg Rouse (South Australian Museum) assisted by Dr Uli Siebeck

**Evolution of gamete characteristics in the brittlestar genus *Macrophiothrix* (December 2001/ January 2002)**

Dr Bob Podolsky (University of North Carolina at Chapel Hill, USA) assisted by Lucy Haycock and Elizabeth Hawkins

**Plasticity of larval skeletal growth in response to food conditions in ophiuroids (December 2001/ January 2002)**

\*Justin McAlister (University of North Carolina at Chapel Hill, USA)

**Egg size, larval ecology and development in the brittlestar genus *Macrophiothrix* (January/ February)**

\*Jon Allen (University of North Carolina at Chapel Hill, USA)

**Extraction of sperm attractant chemicals from brittlestar eggs (February)**

Dr Richard Miller (Temple University, USA) assisted by Cathy Hopkins and Dr Johanna Mader

**The effect of stress on damselfish offspring (November 2001 to February 2002, November 2002 to February 2003)**

Dr Mark McCormick (James Cook University, Australia) assisted by Shawn Smith, Johan Larson, Charlotte Berkstrom and Tom Holmes

**Are pre-settlement reef fish attracted to reef sounds? (January)**

\*Steve Simpson (University of York, UK) and Dr Mark Meekan (Australian Institute of Marine Science) assisted by Vanessa Messmer

**Colour polymorphism, sex allocation and mating systems in the family Pseudochromidae (January)**

\*Peter Eyre (James Cook University, Australia) assisted by Rika Eyre

**Condition and persistence of coral reef fish recruits (January)**

Ralph Alquezar (for Dr David Booth University of Technology Sydney, Australia) assisted by Paul Detwiler

**Ultraviolet cues and mate choice in reef fish (January/ March)**

Dr Sara Ostlund-Nilsson (University of Queensland, Australia) assisted by Prof Goran Nilsson

**Effect of isopods on mate choice in cardinalfish (January/ March)**

\*Lynda Curtis (University of Queensland, Australia) assisted by Prof Goran Nilsson

**Long-term effect of cleaners on gnathiid isopods (January/ February, June)**

Dr Alexandra Grutter (University of Queensland, Australia) assisted by Conor Jones and Mark Johnson

**Predator-prey interactions in coral reef fish communities (February)**

\*Ameer Abdulla (James Cook University, Australia) assisted by Kristin Sherwood

**Cleaner fish food preferences (March)**

Dr Lexa Grutter (University of Queensland, Australia)

**Demography and biogeography of coral reef fishes (March)**

Prof Howard Choat (James Cook University, Australia) and Dr Ross Robertson (Smithsonian Tropical Research Institute, Panama)

**Growth patterns and reproductive biology of surgeonfishes; a geographical analysis (March)**

\*Elisabeth Laman Trip (James Cook University, Australia)

**Geographic variation in size at age of the family Labridae: a contribution to life history theory (March)**

\*John Ackerman (James Cook University, Australia)

**Growth demography and stock structure of north Queensland reef sharks (March)**

\*Will Robbins (James Cook University, Australia)

**Vision and colour perception in elasmobranchs (March)**

\*Tom Lisney (University of Queensland, Australia)

Ascham School students get ready for snorkel trip.



**Experiments on partner control theory in cleaner fish (March/ April)**

Dr Redouan Bshary (University of Cambridge, UK)

**Effects of cleaners on large mobile fish (March/ April/ December)**

Dr Lexa Grutter (University of Queensland, Australia) assisted by Christine Fury

**Experiments on partner control theory in cleaner fish (March/ April)**

Dr Redouan Bshary (University of Cambridge, UK)

**Survey of coral reef fish for blood parasites and their possible vectors (March/ April, October)**

Dr Alexandra Grutter (University of Queensland, Australia), Dr Nico Smit (Kingston University, UK) and Dr Armand Kuris (University of California at Santa Barbara, USA) assisted by Christine Fury

**Bi-directional sex change in coral-dwelling gobies (April)**

Dr Phil Munday (James Cook University, Australia) assisted by Vanessa Messmer

**Hormones mediating bi-directional sex change in coral reef fishes (May/ June, July)**

Dr Phil Munday (James Cook University, Australia) and Dr Frederieke Kroon (NSW Fisheries, Australia) assisted by Dr David Westcott and Katherine Munday

**Life histories of and coral impacts on chaetodontids (June, September)**

\*Michael Berumen (James Cook University, Australia) assisted by Holly Boyett and Stephanie Edwards

**Fish vision and signals (August)**

Dr Justin Marshall (University of Queensland, Australia) assisted by Kylie Jennings

**The role of colour in social interaction in wrasse (August, October/ November)**

\*Samantha Waller (University of Queensland, Australia)

**Ultraviolet communication in *Pomacentrus amboinensis* (August)**

Dr Uli Siebeck (University of Queensland, Australia)

**Effects of line fishing – visual surveys of coral trout (October)**

Dr Tony Ayling (Consultant to CRC Reef, Australia) assisted by Gabriel Codina and Chris Ryan and accompanied by Emma Ryan

**Mutual sexual selection and the evolution of reef fish colours (October)**

Prof Trond Amundsen (Norwegian University of Science and Technology) and Dr Elisabet Forsgren (Goteborg University, Sweden) assisted by Heidi Parks and accompanied by Erik Amundsen

**Reproduction and regional variation in growth of the red bass, *Lutjanus bohar* (October)**

\*Ross Marriott (James Cook University, Australia) assisted by Peter Wruck

**Sexual plasticity in a coral dwelling goby, *Gobiodon histrio* (October)**

\*JP Hobbs (James Cook University, Australia) assisted by Sebastian Hobbs

**Thermal adaptation and the evolution of species' borders in coral reef fishes (October)**

Ashley Frisch as field leader for \*Line Bay (James Cook University, Australia)

**Isopod infection in apogonid fishes (October/ November)**

Dr Sara Ostlund Nilsson (University of Queensland, Australia)

**UV colouration and sexual selection in apogonid fishes (October/ November)**

Dr Sara Ostlund Nilsson (University of Queensland, Australia)

**The effects of large isopod parasites on cardinalfish (October/ November)**

\*Ryan White (School for International Training, USA)

**Colour vision of reef fish and behaviour (October/ November)**

Dr Uli Siebeck (University of Queensland, Australia) assisted by Dr Greg Rouse

**Respiration in coral reef fishes (October/ November)**

Prof Goran Nilsson (University of Oslo, Norway)

**Retinal anatomy of *Pomacentrus amboinensis* (October/ November)**

Prof David Vaney (University of Queensland, Australia) and Prof Reto Weiler (University of Oldenburg, Germany) assisted by Dr Greg Rouse and Dr Uli Siebeck and accompanied by Astrid and Simon Weiler

**Sensory cues for homing in cardinalfishes (November)**

Prof Kjell Doving (University of Oslo, Norway) and Prof Ole Stabell (Agder University College, Norway)

**Ultraviolet communication in *Pomacentrus amboinensis* (November)**

\*Lien Ly (School for International Training, USA)

**Environmental modulation of hormone behaviour interactions in spiny and staghorn damselfishes (November/ December)**

Prof Ned Pankhurst (University of Tasmania, Australia) assisted by Dr Tish Pankhurst, Dr Harry King and Quinn Fitzgibbon

**Isotopes, early life history, and potential self-recruitment of coral reef fishes (December)**

\*Heather Patterson (James Cook University, Australia) assisted by Ian Carlson and Prof Mike Kingsford

**Connectivity of reef fish assemblages (December)**

Prof Mike Kingsford (James Cook University, Australia) assisted by Heather Patterson and Ian Carlson

Barker College students learn about marine life.



**Demography and life history traits of some serranid fishes: implications for fisheries and conservation management (December)**

\*Rachel Pears (James Cook University, Australia) assisted by Russell Kelley

**Seabird genetics (February)**

Dr Emma Gyuris (James Cook University, Australia) assisted by Dr Barry Goldman and accompanied by Ayla Gyuris

**Localization and tracking of dwarf minke whales (June/ July/ August)**

\*Jason Gedamke (University of California at Santa Cruz, USA) assisted by Iain Clarke, Jenna Rumney and Fleur O'Neill

**University group (March)**

Students of the School for International Training, USA led by Dr Jack Grant, Anna Estes and Dr Andy Lewis assisted by Chris Harriss and Russell Butler

**School group (April)**

Students of Geelong College Preparatory School (Australia) led by Stuart McCallum, Julie Fagan and Chris Mitchell

**University group (April/ May)**

Students of the University of Guelph (Canada) led by Prof Paul Hebert and Prof Jim Ballantyne assisted by Jeremy Dewaard, Ainsley Little and Graham Nancekivell

**University group (June)**

Students of Merrimack College (USA) led by Prof Larry Kelts and Dr Andrew Lewis, assisted by Mike Emslie and Dave Williamson, and accompanied by Dr Joe Jacquet

**School group (July)**

Students of Ascham School (Australia) led by Andrew Powell, Jane Valentine, Emma Manners and Edward Sze-Zu

**University group – RMIT University (July)**

Students of RMIT University (Australia) led by Dr Brian Leonard and Associate Prof Gale Spring (RMIT University, Australia)

**University group (August)**

Students of University of Maryland at College Park (USA) led by Peggy Wolf and Dr Bill Higgins and assisted by Wendy Higgins

**TAFE group (August)**

Students of Tropical North Institute of TAFE (Australia) led by Tom Collis

**School group (September/ October)**

Students of Barker College (Australia) led by Tim Binet, David Giltrap and Miriam Broadhurst

**University group (October)**

Students of School for International Training (USA) led by Dr Tony Cummings and Dr Andrew Lewis and assisted by John Brown

**Filming segments for ABC program "Catalyst"**

Dr Richard Smith (ABC TV, Australia)

**Lizard Island Reef Research Foundation visits**

Andrew Green, Colette Garnsey, Tom Green, Alice Green and Michael Jeffreys (April)

Geoff, Jill, Madeline and Angus Brunsdon (April)

Sandy Purves, Owen Jones, Huw Jones and Bryn Jones (July)

Gail McCarthy and Tammy McCarthy (September)

Dr Des Griffin and Dr Janette Griffin (October)

Charlie Shuetrim, Sandy Shuetrim, Geoff Shuetrim, Alex Heath, David Shuetrim and Jane Shuetrim (November)

**Special interest visits**

Prof John Pringle (University of North Carolina at Chapel Hill, USA) accompanied by Beverly Mitchell, Rob and Elizabeth Pringle (July)

Prof Jonathon Erez (Hebrew University of Jerusalem, Israel) accompanied by Miriam and Yair Erez (July)

Prof Mike Kingsford and Kari Arbouin (James Cook University, Australia) (August)

Prof Lewis Walpert (University College London, UK) accompanied by Alison Hawkes (September)

Dr Kelly Burnett (Pacific Northwest Research Center, USA) accompanied by Sean McGinty (September)

Terry Johnston, Karyn Nina Olson and Julie Hoey (Queensland Department of Primary Industries, Australia) (November)

Telstra technicians (November)

Charlie Makray (First Aid Training Services, Australia) and Julie Armour (January, September, December)

**Volunteers**

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Justin Andersen

Levi Byres

Sophie Clayton

Garrett Donnelly

Jackie Fleischer

Alicia Garrigues

Annabelle Gourlay

Felicity Hayward

Catherine Helleux

Libby Hicks

Sebastian Hobbs

Glen Holmes

Renie Hood

Tom Lisney

Johanna Mader

Julia Morton

Richard Murray

Amanda O'Malley

Alice Phillips

Ulrich Poerschmann

Allan Ross

Melanie Schori

Alex Syriatowicz

Chloe Warren

Marian Wong

David Young

# Publications

The following publications based on work carried out at the Research Station were received into the Station's collection this year. As well as recently published works, it includes some that were published some time ago but were accessed into the collection only this year. The collection now totals nearly 800 publications. All visiting researchers are urged to send two copies of papers resulting from work at Lizard Island to be included in this collection.

**Baird, A.H., 2001.** The ecology of coral larvae: settlement patterns, habitat selection and the length of the larval phase. PhD thesis, James Cook University.

**Bansemmer, C., A.S. Grutter and R. Poulin, 2002.** Geographic variation in the behaviour of the cleaner fish *Labroides dimidiatus* (Labridae). *Ethology*, 108: 353-366.

**Bay, L.K., G.P. Jones and M.I. McCormick, 2001.** Habitat selection and aggression as determinants of spatial segregation among damselfish on a coral reef. *Coral Reefs*, 20: 289-298.

**Berumen, M.L., 2000.** Influence of diet and habitat on the condition of butterflyfish. MSc thesis, James Cook University.

**Braleay, R.D. and F. Muir, 1995.** The case history of a large natural cohort of the giant clam *Tridacna gigas* (Fam. Tridacnidae) and the implications for re-stocking depauperate reefs with maricultured giant clams. *Asian Fisheries Science*, 8: 229-237.

**Bray, S.L., 2001.** Geography and the co-variation of life-history traits in the damselfish, *Pomacentrus moluccensis*. Honours thesis, James Cook University, Townsville.

**Bshary, R. and A.S. Grutter, 2002.** Parasite distribution on client reef fish determines cleaner fish foraging patterns. *Marine Ecology Progress Series*, 235: 217-222.

**Bshary, R. and A.S. Grutter, 2002.** Experimental evidence that partner choice is a driving force in the payoff distribution among cooperators or mutualists: the cleaner fish case. *Ecology Letters*, 5: 130-136.

**Bshary, R. and A.S. Grutter, 2002.** Asymmetric cheating opportunities and partner control in a cleaner fish mutualism. *Animal Behaviour*, 63: 547-555.

**Chen, L.-S., 2002.** Post-settlement diet shift of *Chlorurus sordidus* and *Scarus schlegelii* (Pisces: Scaridae). *Zoological Studies*, 41: 47-58.

**Choat, J.H., K.D. Clements and W.D. Robbins, 2002.** The trophic status of herbivorous fishes on coral reefs. *Marine Biology*, 140:613-623.

**Crook, A.C., 1997.** Determinants of the physiological colour patterns of juvenile parrotfish, *Chlorurus sordidus*. *Animal Behaviour*, 53: 1251-1261.

**Crook, A.C., 1999.** A quantitative analysis of the relationship between interspecific encounters, schooling behaviour and colouration in juvenile parrotfish (family Scaridae). *Marine and Freshwater Behaviour and Physiology*, 33: 1-19.

**Crossman, D.J., J.H. Choat, K.D. Clements, T. Hardy and J. McConochie, 2001.** Detritus as food for grazing fishes on coral reefs. *Limnology and Oceanography*, 46: 1596-1605.

**De Almeida Leone, P., J. Redburn, J.N.A. Hooper and R.J. Quinn, 2000.** Polyoxygenated *Dysidea* sterols that inhibit the binding of [1125] IL-8 to the human recombinant IL-8 receptor Type A. *Journal of Natural Products*, 63: 694-697.

**Fisher, R. and D.R. Bellwood, 2002.** A light trap design for stratum-specific sampling of reef fish larvae. *Journal of Experimental Marine Biology and Ecology*, 269: 27-37.

**Fulton, C.J. and D.R. Bellwood, 2002.** Patterns of foraging in labrid fishes. *Marine Ecology Progress Series*, 226: 135-142.

**Fulton, C.J. and D.R. Bellwood, 2002.** Ontogenetic habitat use in labrid fishes: an ecomorphological perspective. *Marine Ecology Progress Series*, 236: 255-262.

**Gedamke, J., D.P. Costa and A. Dunstan, 2001.** Localization and visual verification of a complex minke whale vocalization. *Journal of the Acoustical Society of America*, 109: 3038-3047.

**Goggin, C.L., 1996.** Effect of *Perkinsus olsenii* (Protozoa, Apicomplexa) on the weight of *Tridacna crocea* (Mollusca, Bivalvia) from Lizard Island, Great Barrier Reef. *Aquaculture*, 141: 25-30.

**Grutter, A.S., 2001.** Parasite infection rather than tactile stimulation is the proximate cause of cleaning behaviour in reef fish. *Proceedings of the Royal Society London B* 268: 1361-1365.

**Grutter, A.S. and R.J.G. Lester, 2002.** Cleaner fish *Labroides dimidiatus* reduce 'temporary' parasitic corallanid isopods on the coral reef fish *Hemigymnus melapterus*. *Marine Ecology Progress Series*, 234: 247-255.

**Grutter, A.S., H. McCallum and R.J.G. Lester, 2002.** Optimising cleaning behaviour: minimising the cost and maximising ectoparasite removal. *Marine Ecology Progress Series*, 234: 257-264.

**Gust, N., J.H. Choat and J.L. Ackerman, 2002.** Demographic plasticity in tropical reef fishes. *Marine Biology*, 140:1039-1051.

**Hayward, P.J., 2001.** The identity of two species of cyphonautes larvae (Bryozoa: Cheilostomata) from Lizard Island, Great Barrier Reef, Australia. *Journal of the Marine Biological Association of the United Kingdom*, 81: 995-999.

**Kerrigan, B.A., 1996.** Temporal patterns in size and condition at settlement in two tropical reef fishes (Pomacentridae: *Pomacentrus amboinensis* and *P. nagasakiensis*). *Marine Ecology Progress Series*, 135: 27-41.

**Kritzer, J.P., 2001.** Patterns of spatial variation in the population biology of a coral reef fish and implications for metapopulation dynamics. PhD thesis, James Cook University.

**Kritzer, J.P., 2002.** Stock structure, mortality and growth of the decorated goby, *Istigobius decoratus* (Gobiidae) at Lizard Island, Great Barrier Reef. *Environmental Biology of Fishes*, 63: 211-216.

**Kritzer, J., 2002.** Variation in the population biology of stripey bass *Lutjanus carponotatus* within and between two island groups on the Great Barrier Reef. *Marine Ecology Progress Series*, 243:191-207.



Anne Hoggett gives snorkel briefing to Barker College students and staff.



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- Lange, A., T. Heinzeller and U. Welsch, 1995.** Carbohydrate-histochemistry on the ovary of *Tropometra afra* (Echinodermata: Crinoidea). Pp 299-304 in "Echinoderm Research 1995", Smith & Campbell (eds). Balkema, Rotterdam.
- Larson, H.K., 2002.** A new genus of small coral-reef goby (Teleostei:Gobiidae) from the Indo-west Pacific, with discussion of its relationships. *The Beagle, Records of the Museums and Art Galleries of the Northern Territory*, 18: 63-71.
- Leis, J.M. and B.M. Carson-Ewart, 2002.** In situ settlement behaviour of damselfish (Pomacentridae) larvae. *Journal of Fish Biology*, 61: 325-346.
- Leis, J.M., B.M. Carson-Ewart and D.H. Cato, 2002.** Sound detection in situ by the larvae of a coral-reef damselfish (Pomacentridae). *Marine Ecology Progress Series*, 232: 259-268.
- Leis, J.M., B.M. Carson-Ewart and J. Webley, 2002.** Settlement behaviour of coral-reef fish larvae at subsurface artificial-reef moorings. *Marine and Freshwater Research*, 53: 319-327.
- Lowry, J.K. and H.E. Stoddart, 2002.** The Amaryllididae of Australia (Crustacea: Amphipoda: Lysianassoidea). *Records of the Australian Museum*, 54: 129-214.
- Maida, M., P.W. Sammarco, J.C. Coll, 2001.** Effects of soft corals on scleractinian coral recruitment. II: Allelopathy, spat survivorship and reef community structure. *Marine Ecology*, 22: 397-414.
- Marnane, M.J., 2001.** The trophic role of cardinalfishes (family Apogonidae) on coral reefs. PhD thesis, James Cook University, Australia.
- McCormick, M.I., 1994.** Comparison of field methods for measuring surface topography and their associations with a tropical reef fish assemblage. *Marine Ecology Progress Series*, 112: 87-96.
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- Munday, P.L., 2002.** Does habitat availability determine geographical-scale abundances of coral-dwelling fishes? *Coral Reefs*, 21: 105-116.
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- Robertson, D.R., 1996.** Egg size in relation to fertilization dynamics in free-spawning tropical reef fishes. *Oecologia*, 108: 95-104.
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- Uthicke, S., 2001.** Nutrient regeneration by abundant coral reef holothurians. *Journal of Experimental Marine Biology and Ecology*, 265: 153-170.
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- Webster, M.S., 2002.** Role of predators in the early post-settlement demography of coral-reef fishes. *Oecologia*, 131: 52-60.
- Webster, M.S. and G.R. Almany, 2002.** Positive indirect effects in a coral reef fish community. *Ecology Letters*, 5: 549-557.
- Wilson, S.K., 2001.** An investigation into the trophic nature of small reef fish from the tribe Salariini, family Blenniidae. PhD thesis, James Cook University, Australia.
- Woerheide, G., J.N.A. Hooper and B.M. Degnan, 2002.** Phylogeography of western Pacific *Leucetta 'chagoensis'* (Porifera: Calcarea) from ribosomal DNA sequences: implications for population history and conservation of the Great Barrier Reef World Heritage Area (Australia). *Molecular Ecology*, 11: 1753-1768.
- Zeller, D.C., 2002.** Tidal current orientation of *Plectropomus leopardus* (Serranidae). *Coral Reefs*, 21: 183-187.

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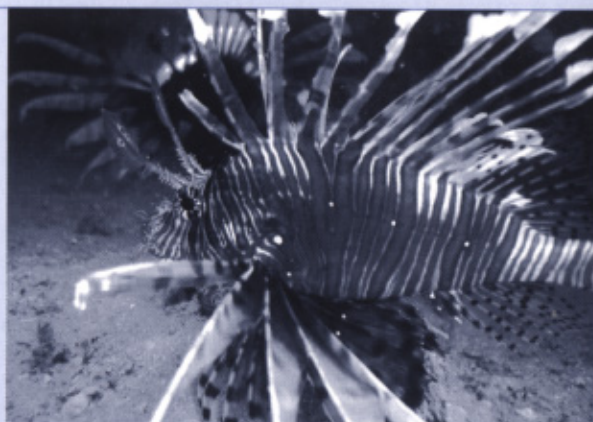


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