

Macquarie University
Department of Biological Sciences

Annual Report 2012



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Photo by Penelope Ajani



**Associate Professor
Mariella Herberstein**

Head of Department.

Welcome from the Head of Department

It is a great pleasure to present the 2012 Department of Biological Sciences Annual Report.

I took over as Head of Department in March 2012 from Professor Lesley Hughes. Lesley's leadership (2009–2012) has skilfully placed the Department of Biological Sciences in a position of teaching and research excellence. Lesley facilitated a successful integration of the Department into the newly established faculty structure at Macquarie University. I am most grateful for Lesley's past and ongoing leadership within the Department.

The year 2012 saw significant changes at Macquarie University. The new Vice Chancellor, Professor Bruce Downton, and the new Executive Dean of the Faculty of Science, Professor Clive Baldock, signalled a fresh approach for the University and the Faculty of Science.

The Department of Biological Sciences had a very successful teaching year in 2012. Our undergraduate enrolments were the highest to date, with more than 5,000 enrolments over three teaching sessions. Our postgraduate enrolment remained steady, at approximately 120 students. A particular highlight was the Department's national teaching award from the Australian Government's Office for Learning and Teaching, awarded to the *Genes to Geosciences Postgraduate Enrichment Program*. University teaching awards were also given to Dr Matthew Bulbert (Outstanding Contribution to Student Learning) and Dr Michelle Power (Teaching Excellence, Early Career).

The Department's 2012 research performance continued to surpass that of previous years in both publication output and research income. In particular, the Department made a very strong contribution to the University's publications in top tier scientific journals. Our overall research performance is reflected in the excellent ERA assessment in 2012, ranking our research as 'above world standards' for biological sciences and 'well above world standards' for environmental sciences. Our large cohort of postgraduate students remains a significant contributor to the Department's teaching and research activities.

The Department's excellent performance in 2012 was facilitated by our professional staff, whose technical and administrative expertise supported all aspects of teaching and research within the Department.

I would like to express my sincere thanks and gratitude to all staff and students in the Department of Biological Sciences who contributed to our ongoing success with great conviction, expertise and enthusiasm.

Associate Professor Mariella Herberstein

Head of Department

History of the Department of Biological Sciences

The School of Biological Sciences, founded in 1964 by Professor Frank Mercer, was set up as a multidisciplinary school that encompassed botany, zoology, biochemistry, ecology, genetics, physiology and later molecular biology and microbiology – disciplines that were typically housed in separate departments in other universities.

Frank Mercer was a visionary and inspirational leader who recognised that: (i) the most important scientific innovation arose at discipline boundaries; (ii) an atmosphere encouraging interdisciplinary collaborations was essential; (iii) quality teaching and research were inextricably linked; and (iv) small group practical/tutorial teaching of science was most effective. The School admitted its first postgraduate students in 1965 and its first undergraduates in 1967.

Professor Mercer's appointment was followed by the recruitment of Professor Fred Milthorpe and Professor Geoff Sharman, both of whom also served terms as elected Heads of School. Professor Sharman was subsequently elected as a Fellow of the Australian Academy of Science. Later Heads included Des Cooper (two terms), Jan Gebicki (two terms), Andy Beattie, Jack Bassett, Jean Joss, Hatch Stokes (two terms), Michael Gillings, David Briscoe, Lesley Hughes and Marie Herberstein (current). The senior staff were ably assisted by other academic staff as well as technical and administrative personnel who embraced Frank's vision

Much of Frank's vision has endured and remains strong today. The School has prospered as a hub of excellent teaching and research, and is also recognised as a harmonious and enjoyable place to work. It has grown into one of the strongest biology units of its size in Australia, with internationally recognised research strengths in many biological disciplines. The School pioneered the external teaching of biology in Australia, one of the first in the world to do so. Several of our current academic staff were trained at Macquarie and returned after spending time at other institutions. Many of our graduates have prospered in Australia and

internationally, and have made successful and lasting contributions across a variety of careers including education, public health, industry and research.

With University restructuring the School of Biological Sciences became a department in the Division of Environmental and Life Sciences, and later in the Faculty of Science. Over the course of these changes, biochemistry, molecular biology and microbiology were transferred into the Department of Chemical and Biomolecular Sciences. Most recently, the Department has been joined by the Palaeobiology Research Group and merged with the Department of Brain, Behaviour and Evolution.

Future of the Department of Biological Sciences

The Department is in an excellent position to further build on its past successes in research and teaching. We are developing a strategic plan that aligns with the University's overall

vision as developed by the Vice Chancellor. Our plan aims to utilise the congenial and creative environment in the Department to generate transformational breakthroughs in research and teaching. We believe that integrating research programs across the different disciplines in biological sciences will yield the most significant insights. The Department plans to further expand its research expertise into genome level analysis and advance collaborations across different levels of biological organisation and a diversity of taxa.



Governance

The Department's organisation is centred on a committee structure consisting of ten committees and an executive group, all of whom deal with the development of strategic directions, policy and implementation.

Academic staff, professional administrative staff, technical staff and higher degree research students are represented on the committees. Committees meet regularly and communicate with the entire Department via electronic updates or during regular Department meetings. The Head of Department produces weekly email newsletters and schedules formal and informal meetings every three to four weeks.

In addition to these formal committees, there are a number of working groups that coordinate equipment, space, timetables, the Millthorpe Memorial Fund and the Greg Mills and Tony Price Bequest Funds. Departmental staff are represented on Faculty and University committees and present updates to the Department at regular intervals. The Head of Department attends regular meetings of the Faculty Advisory Committee and meets with the Executive Dean of the Faculty of Science.



Department Staff

The academic, professional and technical members of staff in the Department of Biological Sciences are all engaged in delivering the core activities of teaching and research excellence.

We are one of the largest departments at Macquarie University and take pride in our collegial and friendly working environment

Head of Department

Associate Professor Marie Elisabeth (Mariella) Herberstein

Professors

Ken Cheng	Lesley Hughes
Michael Gillings	Colin Prentice
Sandy Harrison	

ARC Laureate Fellow & Distinguished Professor

Mark Westoby

Emeritus Professors

Andrew Beattie	Richard Frankham
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Associate Professors

Brian Atwell	David Raftos
Glenn Brock	Adam Stow
Culum Brown	Phil Taylor
Jenny Donald	Martin Whiting
Simon Griffith	Belinda Medlyn
Michelle Leishman	

Senior Lecturers

Drew Allen	Grant Hose
Leanne Armand	Darrell Kemp
Andrew Barron	Michelle Power
Melanie Bishop	Julia Raftos
Jennifer Clarke-Mackessy	Jane Williamson

Lecturers

Katherine Barry (Kate)	David Nipperess
Linda Beaumont	Luke Strotz
Matthew Bulbert	James Valentine
Sham Nair	Stephney Whillier

ARC Future Fellows

John Alroy	Joshua Madin
Matthew Kosnik	Ian Wright

MQ Research Fellows

Caroline Lehmann	Anne Wignall
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ARC DECRA Research Fellows

Daniel Falster	Melanie Zeppel
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Research Fellows

Kelli Anderson	Amanda Ridley
Chris Blackman	Lee Rollins
Julia Cooke	Julieta Rosell
Samuel Collins	Andrew Scafaro
Martin Dekauwe	Enrico Sorato
Allyson Eller	Andrea Stephens
Bradley Evans	Rich Fitzjohn
Stephanie Stuart	Rachael Gallagher
K-Lynn Smith	Sean Gleason
Nikolai Tatarnic	Aaron Harmer
Emma Thompson	Ines Hessler
Wade Tozer	Yan-shih Lin
Liette Vandine	Elizabeth Madin
Mark Wainwarin	Vincent Maire
Elizabeth Wenk	Ross Peacock
Rhys Whitley	Clint Perry
Kevin Willis	Nansi Richards
Peter Wilson	

Executive Officer

Sharyon O'Donnell

Professional Staff

Marie Howitt	Teresa Potalivo
Shirley Lim	Vincenzo Repaci
Laura McMillan	Nansi Richards
Veronica Peralta	Leigh Staas

Technical Staff & Scientific Officers

Craig Angus	Muhammad Masood
Ray Cameron	Paul McCann
Maria Castillo-Pando	Samantha Newton
Sarah Collison	Tarun Rajan
Ray Duell	Sanscha Regtop
Libby Eyre	Jennifer Rowland
Marita Holley	Shannon Smith
Andrew Irvine	Liette Vandine
Pridhee Kapoor	Adam Wilkins
Monika King	Paul Worden
Winnie Man	

Faculty Staff in the Department

Rekha Joshi	Debra Birch
Robby Miller	Nicole Vella
Jenny Minard	

Honorary Associates

Alison Basden	Robert Kooyman
Andrew Baird	Carolyn Michael
Geoffrey Bedford	Ron Oldfield
Jason Bragg	Hannelore Paxton
David Briscoe	Diana Perez-Staples
Donald Butler	Irina Pollard
Bob Creese	Graham Pyke
Herbert Dartnall	Helen Ramsay
Alison Downing	Fiona Scarff
Kevin Downing	Sandra Schuster
Remko Duursma	Patricia Selkirk
Mark Eldridge	Margaret Stuart
Jan Gebiki	Noel Tait
Dinah Hales	Diana Tsoulos
Roger Hiller	Christine Turnbull
Brady Howard	Koa Webster
Jean Joss	Rüdiger Wehner
Debora Kent	Millar Whalley
Jim Kohen	

Learning and Teaching

The Department of Biological Sciences strives to maintain a high quality, dynamic curriculum that captures the latest and most significant scientific discoveries. There is a strong emphasis on research-led teaching, with programs incorporating departmental research and enquiry-based laboratory sessions into the curriculum. The Department implements diverse strategies to maintain the quality of our offerings, at both the unit and program level.

Undergraduate offerings

In 2012 the Department offered 42 undergraduate units (Table 1), which are encompassed in the Department's three majors: Biology; Brain Behaviour and Evolution; and Palaeobiology. These undergraduate units are also core features of the degrees of Biodiversity and Conservation, Medical Science and Marine Science. Biology units contribute to a number of other programs administered within the Faculty of Science, including Biomolecular Sciences, Museum Studies and Chiropractic Science.

The Department of Biological Sciences had 5,143 enrolments in the undergraduate units outlined in Tables 1–3. An average of 406 students were enrolled in the 100-level units (excluding Advanced Biology), 169 in the 200-level units and 54 in the 300-level units.

The 2012 *Evolution Lecture* was delivered in March by Professor Nina Wedell from the University of Exeter in Cornwall, UK. The lecture was given to the students of BIOL114 (Evolution and Biodiversity) with strong participation from academic staff and postgraduate students.



A furry oceanographic observer: fur seals are informing us about physical changes occurring in the ocean and how that affects their food supply. Photo by Robert Harcourt.

Table 1. Undergraduate units offered in Session 1 by the Department of Biological Sciences, 2012.

SESSION 1		
Unit Code	Unit title	Enrolled
BIOL108	Human Biology	954
BIOL114	Evolution and Biodiversity	389
BIOL188	Advanced Biology	4
BBE100	Introduction to Brain, Behaviour and Evolution	450
BIOL206	Genetics	183
BIOL210	Plant Structure and Function	115
BIOL257	Neurophysiology	205
BIOL260	Science of Sex	350
BIOL313	Plants: Cells to Ecosystems	32
BIOL316	Invertebrates: Evolution, Behaviour and Diversity	106
BIOL345	Human Genetics Theory	84
BIOL357	Physiology 1	9
BIOL369	Vertebrate Evolution	111
BIOL373	Marine Ecology	32
BIOL379	Reef Evolution and Dynamics	25
BIOL382	Applied Palaeontology and Biogenic Sediments	36
BIOL388	Advanced Biology	10
BIOL390	Selected Topics in Biodiversity and Conservation	15
BIOL399	Special Interest Topics in Biology	11
BBE303	Independent Research Project in Brain Behavior and Evolution	2
BBE304	Contemporary issues in Brain Behaviour and Evolution	24
BBE305	Animal Communication	70
MAR201	Introduction to Marine Science	37
MAR303	Marine Science Project	7
Total Enrolment		3261

Table 2. Undergraduate units offered in Session 2 by the Department of Biological Sciences, 2012.

SESSION 2		
Unit Code	Unit title	Enrolled
BIOL115	The Thread of Life	471
BIOL188	Advanced Biology	4
BBE100	Introduction to Brain, Behaviour and Evolution	54
BBE101	Evolution and Human Behavior	117
BIOL208	Animal Structure and Function	185
BIOL227	Ecology	77
BIOL235	Experimental Design and Data Analysis for Biology	64
BIOL247	Systems Physiology	172
BIOL260	Science of Sex	80
BIOL261	Palaeontology	75
BBE200	Animal Behaviour	65
BIOL346	Bioscience Ethics and Reproduction	48
BIOL349	Biodiversity and Conservation	32
BIOL358	Physiology 2	9
BIOL362	Freshwater Ecology	36
BIOL367	Immunobiology	73
BIOL372	Marine Birds and Mammals	34
BIOL376	Advanced Human Physiology	30
BIOL388	Advanced Biology	10
BIOL390	Selected Topics in Biodiversity and Conservation	7
BIOL399	Special Interest Topics in Biology	11
BBE306	Neuroethology	32
MAR303	Marine Science Project	7
Total Enrolment		1693

Table 3. Undergraduate units offered in Session 3 by the Department of Biological Sciences, 2012.

SESSION 3		
Unit Code	Unit title	Enrolled
BIOL260	Science of Sex	100
BIOL245	Tropical Marine Ecosystems	16
BIOL318	Birds of Australia	31
BIOL334	Conservation Genetics	55
BIOL341	Parasitology	52
Total Enrolment		254



1. Undergraduate student Ashleigh Pickering putting the finishing touches on an experiment to understand how the density and spatial arrangement of pneumatophores influences their role in trapping and retaining organic matter. Photo by Alan Baldry.
2. Teaching laboratories. Photo by Ray Duell.



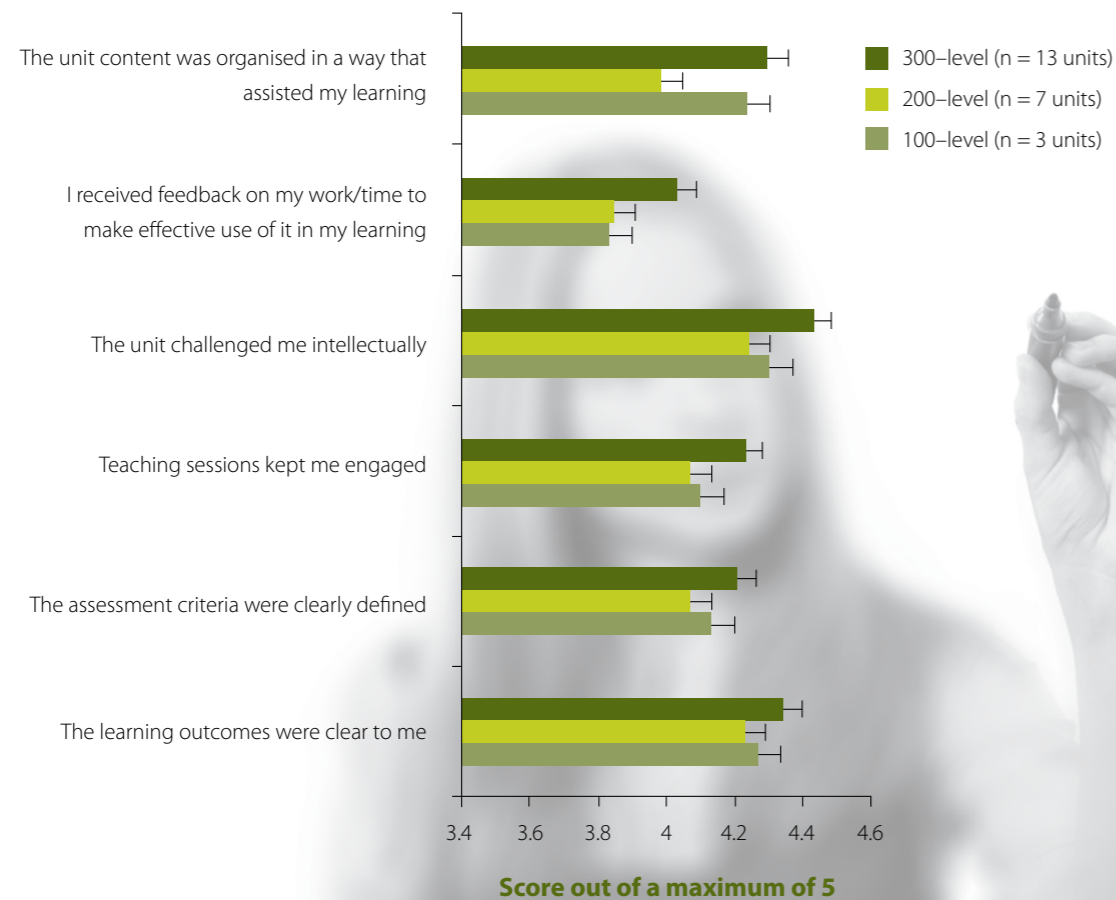
Learning and Teaching

Quality assurance of programs and units

The Department's Curriculum Committee oversees quality assurance of undergraduate learning and teaching within the Department. The Curriculum Committee coordinates and holds regular reviews of units, during which the learning and teaching quality is assessed and feedback is provided to the convener. Quality assurance and enhancement strategies are implemented through regular Curriculum Committee meetings and annual curriculum days involving the whole department.

Student feedback is integral to maintaining the Department's high quality curriculum. The Head of Department reviews student feedback every semester via Learner Evaluation of Unit surveys, and meets with conveners when appropriate to address unit quality. In 2012, student evaluation surveys were performed for 23 biology units, and the Department achieved very high unit evaluation scores. Evaluations results for individual biology units demonstrate a high level of student satisfaction. Examples of student scores are shown in Figure 1. These show responses for clarity of communication of learning outcomes and assessment requirements, intellectual challenge and timely feedback.

FIGURE 1. STUDENT EVALUATIONS OF UNITS OFFERED IN THE DEPARTMENT OF BIOLOGICAL SCIENCES 2012 (AVERAGE \pm STANDARD ERROR).



Learning and teaching initiatives

To ensure that students have a valuable and high quality learning experience, the Department has initiated several learning and teaching initiatives that aim to enhance skills and create an exchange of information and ideas within the learning and teaching forum. These are outlined below.

1. Training of sessional staff (tutors and laboratory demonstrators)

- **Department-based learning and teaching training:** the *Genes to Geosciences Postgraduate Enrichment Program* aims to enrich the development of our PhD students through small, focused teaching modules. These modules provide early career scientists with learning and teaching skills including the development of learning outcomes, how to mark assessments, development of rubrics, engaging student diversity and giving and receiving feedback.
- **Professional development through University workshops:** tutors are further encouraged to develop their skills in learning and teaching through attendance at University courses and workshops such as *Foundations in Learning and Teaching* and *iLearn* training for sessional staff.
- **Establishment of 'super tutors' for large units:** super tutors have previous tutoring experience and are able to take on additional administrative roles and mentor less experienced tutors. Super tutors are often associated with the unit over several years, providing continuity between offerings.

2. Department learning and teaching seminar series

- In 2012 the Department introduced a learning and teaching seminar series. Six interactive seminars addressed topics such as: bringing research into teaching; creative assessment in biology; compressing science units for intensive mode delivery; and experiences with *iLearn*. The seminars fostered discussion and generated many useful ideas to further improve practice among teaching staff.

Teaching laboratories

In 2008 the Department's teaching laboratories were entirely rebuilt to create new, state-of-the-art facilities, each equipped with interactive electronic white boards, audio-visual projection screens and student computer stations. Designed to provide a highly interactive learning environment, the laboratories are also flexible learning spaces. They allow for a high teacher-to-student ratio while catering for a range of student learning needs. With the ability to accommodate 128 students at any one time, the laboratories were used to educate over 2,000 undergraduate students in 2012.

The laboratories give students access to a range of equipment, including microscopes equipped for digital photography, desktop spectrophotometers for biochemical analyses and sophisticated machinery for the extraction and analysis of DNA. In 2012 these laboratories were used to teach subjects ranging from introductory level biology to advanced biochemistry. The flexibility and equipment enable the delivery of a wide diversity of units covering fields such as genetics, biochemistry, marine biology, ecology, zoology and physiology.



1. Michelle Leishman.

2. Arabidopsis flower. Photo by Debra Birch.

3. Tanja Lenz. Photo Debra Birch.

Learning and Teaching

Scholarly activities in learning and teaching

All staff in the Department – academics, sessional staff and technical staff – are actively encouraged to pursue scholarly learning and teaching activities. The Department provides financial support for attendance at external learning and teaching workshops, attendance at national and international higher education conferences as well as travel funding for undergraduates to participate in international programs.

Several of the Department’s academics have been recognised for teaching excellence. A national teaching award from the Australian Government’s Office for Learning and Teaching was awarded to the *Genes to Geosciences Postgraduate Enrichment Program*. Teaching awards have also been received for both group and individual achievements from the Macquarie University Vice Chancellor’s Awards program (Table 4), while learning and teaching grants have been won by Department staff from Macquarie University’s internal grants, the University’s learning and teaching competitive grant scheme and the innovation in scholarship program.

The Department also participates in learning and teaching research endeavours, and in 2012 several staff members were awarded learning and teaching grants to develop innovations in curriculum design and delivery (Table 5).

Table 4. 2012 Learning and Teaching Awards given to staff in the Department of Biological Sciences.

STAFF MEMBER/S	AWARD
Mark Westoby, Wade Tozer, Michael Gillings and Mariella Herberstein	Australian Government Office for Learning and Teaching: Australian Awards for University Teaching – Award for Programs that Enhance Learning (Postgraduate Education)
Matthew Bulbert	Macquarie University Vice Chancellors Award – Citation for Outstanding Contributions to Student Learning
Michelle Power	Macquarie University Vice Chancellors Award – Teaching Excellence Early Career

Table 5. 2012 Learning and Teaching grants awarded to staff in the Department of Biological Sciences.

STAFF MEMBER/S	TITLE	GRANT SCHEME
Culum Brown	Development of Biology Participation Projects in Jordan	Macquarie University PACE International
Abigail Cabrelli and Adam Stow	Enhancing Student Learning Through Film	Macquarie University Learning and Teaching Competitive Grant
Sham Nair	Preparing for Learning: Using Computer Simulations to Activate Prior Learning	Macquarie University Innovation in Scholarship Program



1. BIOL227 field trip. Photo by Matthew Kosnik.
2. MAR201 field trip. Photo by Matthew Kosnik.
3. Photo of Paul Duckett by Siobhan Dennison.

Undergraduate student prizes

The Department of Biological Sciences awards nine prizes for undergraduate students in the areas of botany, genetics, palaeontology, parasitology, zoology and general biological sciences (Table 6). Prizes are awarded to the student who was most proficient in each area. A prize for the most proficient female student in second level biology was also awarded in 2012. Prizes are kindly provided by beneficiaries, federations, scientific supply companies and scientific societies. The Department actively encourages prize donors to participate in the award ceremonies and to attend Departmental lunches and tours, promoting discussion with the Head of Department and prize winners.



Orb web spider.
Photo by James O'Hanlon.

Table 6. 2012 Student awards and prizes awarded to students in the Department of Biological Sciences.

PRIZE	AWARD CATEGORY	RECIPIENT
Australian Federation of Graduate Women NSW (North Shore Branch) Prize	Proficiency by a female student in at least 2 units at 200-level in Biological Sciences	Michelle Vecsei
Brendan Searle Prize	Proficiency in the unit BIOL206 Genetics	Benjamin Brown
Australian Instrument Services Motic-Microscopy Award	Proficiency in the unit BIOL208 Animal Structure and Function	Dianne Dampney
Australian Society for Parasitology Prize	Proficiency in the unit BIOL341 Parasitology	Genevieve Kyi
Bill Cantwell Prize for Biological Sciences	Proficiency in the Biological Sciences Honours program	Marissa Betts
Milthorpe Memorial Prize	Proficiency in a 300-level Plant unit	Jessica Wilks
Mollie Thomson Prize	Proficiency in two 100-level Biological Science units	Carly Maddox
Life Technologies Prize	Outstanding performance in a 300-level Biological Sciences or Chemistry and Molecular Sciences unit	Kimberley Duncan
Australian Field Geology Club Prize	Proficiency in the unit BIOL382 Applied Palaeontology and Biogenic Sediments	Julia Atkinson

Future directions in learning and teaching

Over the past 10 years we have continued our practice of regular curriculum review in order to successfully implement the Department’s long-term learning and teaching strategy. During the next three years we are aiming to further develop a balanced curriculum that delivers program learning outcomes and graduate capabilities for today’s world. Our goal is to keep improving standards and capabilities so that students are well equipped for a variety of career pathways. The introduction of the Master of Research degree in 2013 will require curriculum adaptation to align our undergraduate programs with this new program.

At a local level we will continue to foster the professional development of staff in learning and teaching through a range of new initiatives. We are also aiming to improve our student evaluation scores by running workshops convened by our top teaching staff, with an emphasis on providing valuable and timely feedback to students.



Research

The Department conducts research on a wide range of contemporary biological problems. Researchers collaborate strongly within the Department and Faculty of Science, generating multidisciplinary, innovative research groups.

Department staff have forged strong and successful collaborative research programs with people and organisations around Australia and internationally.

The strength of the Department's research culture has been recognised in the high number of successful external research grants received from government and industry (Table 7). The Department's excellent overall research performance is reflected in the Australian Government's 2012 Excellence in Research for Australia initiative (ERA), ranking biological science research at Macquarie University as "above world standard". The Department also contributed significantly to aspects of environmental sciences research, which was ranked "well above world standards".

Research papers 2012

The number of publications produced by the Department has been increasing over the last five years (Figure 2). In 2012 we averaged over six publications a year per academic staff member. This is particularly impressive because many of our members of staff are early career researchers. For a complete list of publications produced by the Department in 2012, please see pages 38–47. The majority of the Department's publications are in peer-reviewed scientific journals.

The Department generates a significant proportion of the University's high impact research papers and commentaries published in the journals Nature and Science. Over the past five years, staff in the Department of Biological Sciences contributed almost half of the University's research papers (8/18) and more than half of the University's commentaries (8/13) published in Nature and Science. In 2012, two research papers and two commentaries in these journals included staff in the Department of Biological Sciences (authors in bold, on the following page).

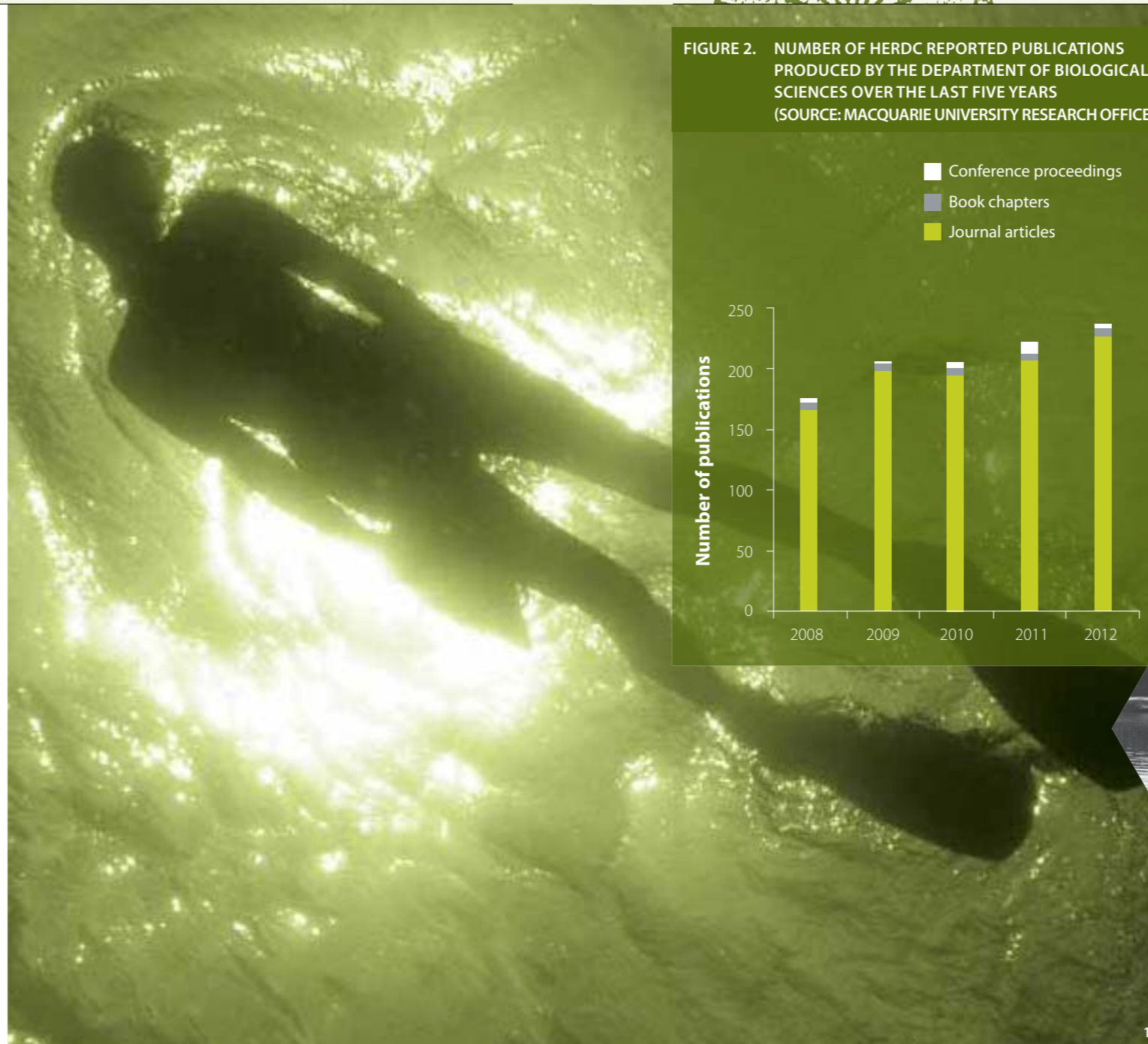
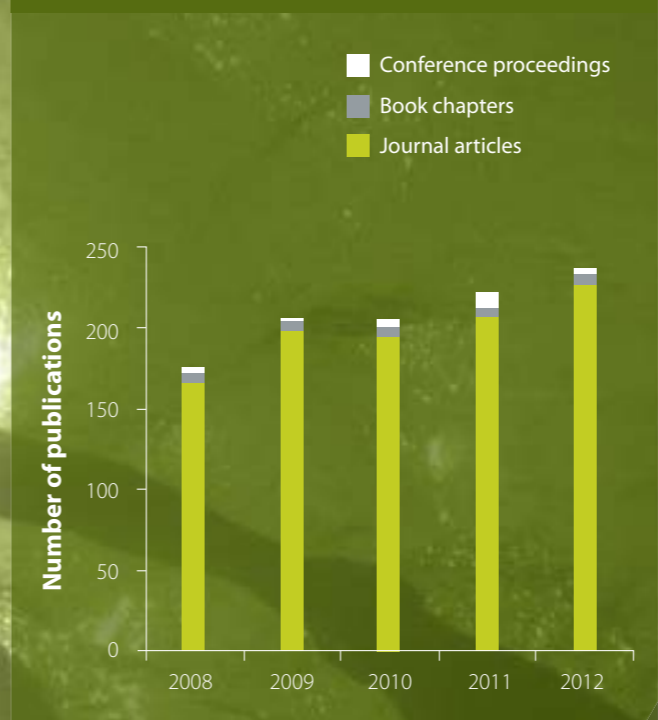


FIGURE 2. NUMBER OF HERDC REPORTED PUBLICATIONS PRODUCED BY THE DEPARTMENT OF BIOLOGICAL SCIENCES OVER THE LAST FIVE YEARS (SOURCE: MACQUARIE UNIVERSITY RESEARCH OFFICE)



Research papers

Choat, B., Jansen, S., Brodrigg, T. J., Cochard, H., Delzon, S., Bhaskar, R., Bucci, T. S., Field, T. S., **Gleason, S. M.**, Hacke, U. G., Jacobsen, A. L., Lens, F., Maherali, H., Martínez-Vilalta, J., Mayr, S., Mencuccini, M., Mitchell, P. J., Nardini, A., Pittermann, J., Pratt, R. B., Sperry, J. S., **Westoby, M.**, **Wright, I. J.** & Zanne, A. E. (2012). Global convergence in the vulnerability of forests to drought. *Nature*, 491, 752-755.

Yvon-Durocher, G., Cesscatti, A., del Giorgio, P.A., Gasol, J.M., Montoya, J.M., Pumpanen, J., Trimmer, M., Staehr, P., Woodward, G., & **Allen, A. P.** (2012). Reconciling differences in the temperature dependence of ecosystem respiration across time scales and ecosystem Types. *Nature*, 487, 472-476.

Commentaries

Barron, A. B., & Brown, M. J. (2012). Science journalism: Let's talk about sex. *Nature*, 488, 151-152.

Herberstein, M. E., & **Kemp, D. J.** (2012). A clearer view from fuzzy images. *Science*, 335, 409-410.



1. Elizabeth Madin in the field. Photo by Joshua Madin.

2. Macquarie University campus. Photo by James O'Hanlon.

3. Art installations in the biology building. Photo by James O'Hanlon.

Research

Research Grants 2012



Table 7. External research grants funded in 2012 (source: Macquarie University Research Office).

PROJECT TITLE	GRANTING BODY	INVESTIGATORS	2012 FUND ALLOCATION
Understanding soft coral population viability in the face of climate change	Great Barrier Reef Marine Park Authority	Marcela Diaz Jaramillo, Dr Josh Madin, Mr Andrew Baird	\$1,000
Extreme reproductive conflict: sexual cannibalism, female deception, and the evolution of male mate choice	Linnean Society NSW	Dr Kate Barry	\$1,400
Extreme reproductive conflict: sexual cannibalism, female deception, and the evolution of male mate choice	Australian Entomological Society	Dr Kate Barry	\$1,625
Fire management planning in world heritage rainforests: quantifying the flammability of rainforest fuels	The Institute of Foresters Australia	Dr Ross Peacock	\$2,000
Colour evolution in orb spiders	Bermuda Institute of Ocean Sciences	Dr Darrell Kemp	\$2,100
Extreme reproductive conflict: sexual cannibalism, female deception, and the evolution of male mate choice	Association for the Study of Animal Behaviour	Dr Kate Barry	\$2,666
Examining the role of a novel generalised susceptibility gene for bipolar disorder and schizophrenia	National Health and Medical Research Council	A/Prof Jennifer Donald, Prof Peter Schofield, Dr Janice Fullerton, Prof Felicity Shannon Weickert	\$3,000
The distribution of the Rufous Scrub-bird (<i>Atrichornis rufescens</i>): is there an influence of climatic variables?	Birdlife Australia	Louise Williams Dr Drew Allen, Dr David Nipperess,	\$3,412
Spatial variation in the biotic resistance of New South Wales estuaries to invasion by <i>Carcinus maenas</i>	NSW Department of Industry and Investment	Dr Melanie Bishop	\$3,500
Evolution of the light harvesting system in cryptophyte algae: protein structure to quantum coherence	Australian Research Council	A/Prof Roger Hiller, Prof Paul Curmi	\$4,000
Phytoplankton patterns in the coastal waters of New South Wales	NSW Food Authority	Penelope Ann Ajani	\$4,666
Building bridges in rice technology: Australia's native rices and Korea's high tech mutants	Commonwealth Department of Foreign Affairs and Trade	A/Prof Brian Atwell	\$4,950
The 2010 Doctoral Fellowship at the Sydney Institute of Marine Sciences (SIMS) - Osmar Luiz	Sydney Institute of Marine Science NSW	Osmar Jose Luiz-Jr, Dr Josh Madin	\$6,000
Method development: joint analysis of amino acid racemization and AMS C14 using a single sample	Australian Institute of Nuclear Science and Engineering	Dr Matthew Kosnik	\$7,657
Like father, like son: is male courtship performance heritable?	Australia and Pacific Science Foundation	Dr Anne Wignall	\$8,930
Integrating silk biomechanics and spider ecology to understand spider web evolution.	Hermon Slade Foundation	Dr Aaron Harmer	\$10,000
Phytoplankton diversity in coastal water of New South Wales, Australia	Department of Sustainability, Environment, Water, Population and Communities	Dr Leanne Armand, Penelope Ann Ajani	\$10,000
Brian Robinson Fellowship	Banksia Environmental Foundation	Dr Melanie Bishop	\$10,000
The biology and fishery of angel sharks and sawsharks in NSW	NSW Department of Industry and Investment	Vincent Raoult, Dr Jane Williamson	\$10,000
Intergovernmental Panel on Climate Change Fifth Assessment report authors: helping to shape a global change solution - an Australian government initiative	Department of Climate Change and Energy Efficiency	Prof Lesley Hughes	\$11,340

Table 7. External research grants funded in 2012 (source: Macquarie University Research Office).

PROJECT TITLE	GRANTING BODY	INVESTIGATORS	2012 FUND ALLOCATION
The biology of environmental stress: Genetic and physiological adaptation in Sydney rock oysters with prolonged exposure to contaminants	Sydney Institute of Marine Science NSW	Aroon Ramesh Melwani, A/Prof David Raftos	\$12,500
Frayed at the edges? Integrating evolutionary genetics into the study of species distributional limits	Australian Research Council	Dr Darrell Kemp, Dr Carla Sgro	\$12,577
Sex, symbiosis and 'she-males': Probing the bizarre reproductive manipulations imposed by bacterial endosymbionts upon Australian butterflies	Australia and Pacific Science Foundation	Dr Darrell Jon Kemp, Dr Kate Barry, Dr Markus Riegler	\$13,200
Forest ecosystem water use: Does species diversity matter?	Australian Research Council	A/Prof David Ellsworth, Dr Belinda Medlyn,	\$13,415
Wild shark social networks: Impacts of human intervention	Sea World Research and Rescue Foundation Inc	Dr Culum Brown, Dr Tristan Guttridge, Joanna Wiszniewski	\$14,000
It's not all peachy: what is the adaptive role of colour change in frogs?	Australia and Pacific Science Foundation	Dr Matthew Bulbert	\$14,500
Extreme reproductive conflict: sexual cannibalism, female deception, and the evolution of male mate choice	Hermon Slade Foundation	Dr Kate Barry	\$16,181
Assessing male influence on population structure in the Australian sea lion	Sea World Research and Rescue Foundation Inc	Dr Adam Stow, Heidi Ahonen	\$16,400
DEMO-TRAITS -Tree demography, function traits and climate change	European Commission	Prof Mark Westoby, Dr Benoit Courbaud	\$19,200
Management of coastal lakes to minimise invasion	Australian Research Council	Dr Melanie Bishop, Dr Melinda Coleman, Dr Timothy Glasby, Dr Brendan Kelaher	\$20,000
Acid test for the capacity of estuaries to adapt to climate change?	NSW Environmental Trust	Dr Melanie Bishop MJ, A/Prof David Raftos, Dr Valter Amaral	\$20,000
Improving the heat tolerance of rice through wild rice germplasm	Bayer CropScience	A/Prof Brian Atwell	\$20,407
Research project on the analysis of thermotolerance of photosynthesis, especially of rubisco activase, in wild rice species - Bridge Funding	Bayer CropScience	A/Prof Brian Atwell, Andrew Peter Scafaro	\$24,000
Understanding colony collapse: a social analysis of honey bee colony failure	Hermon Slade Foundation	Dr Andrew Barron	\$25,184
Development of a DNA microarray to identify markers of disease in pearl oysters (<i>Pinctada maxima</i>) and to assess overall oyster health.	Fisheries Research and Development Corporation	A/Prof David Raftos, Dr Sham Nair SV, Dr Brian Jones, Dr Melanie Crockford	\$26,000
Knowing what you don't know: analyzing the biology of metacognition and uncertainty in a simple model system	Life Sciences Research Foundation	Dr Clint Perry, Dr Andrew Barron	\$27,500
Disentangling the factors mediating marine trophic cascades over a latitudinal gradient in Australia	National Science Foundation (NSF)	Dr Elizabeth Madin	\$30,000
Contract in relation to the services of Professor Lesley Hughes to act as Climate Commissioner	Department of Climate Change and Energy Efficiency	Prof Lesley Hughes	\$35,455

Research

Research Grants 2012



Table 7. External research grants funded in 2012 (source: Macquarie University Research Office).

PROJECT TITLE	GRANTING BODY	INVESTIGATORS	2012 FUND ALLOCATION
Testing the diversity-function paradigm for the provision of clean water in aquifers	Australian Research Council	Dr Grant Hose, Prof John Ellis, Dr Adam Stow, Prof Hartmut Arndt, Dr David Nipperess	\$39,000
Taking fruit fly MAT to new levels of efficacy	Horticulture Australia Ltd	A/Prof Phil Taylor, Dr Samuel Collins, Dr Ian Jamie, Mr Bernie Charles Dominiak, Mr Andrew Jessup, Dr Peter Crisp, Dr Hainan Gu	\$44,000
Diversity and evolution of Australian alpine grasshoppers (Orthoptera: Acrididae: Oxyninae: Praxibulini)	Department of Sustainability, Environment, Water, Population and Communities	A/Prof Marie Herberstein, Dr Hojun Song	\$45,000
Support for Face Experiments	U.S. Department of Energy	Dr Belinda Medlyn	\$50,000
Climate change research: Can Sydney rock oysters adapt to chronic multigenerational exposure to ocean acidification and temperature?	Australian Research Council	Dr Laura Parker, Dr Wayne O'Connor, Dr Pauline Ross, A/Prof David Raftos, Prof Hans Pörtner	\$50,000
Development of a test to quantify irradiation damage in Fruit Flies	South Australian Research and Development Institute (SARDI)	A/Prof Phillip Taylor	\$56,491
Development of a low cost, global-scale remote monitoring for MPAs	World Wildlife Fund (WWF)	Dr Elizabeth Madin	\$59,743
Wildlife conservation: altering host-parasite interactions and impacts to biodiversity and ecology	Australian Research Council	Dr Michelle Power, A/Prof Michael R Gillings, Dr Mark Eldridge, Dr Deborah Ashworth	\$60,000
Environmental proteomics: A new, more reliable method of measuring the effects of chemical pollution on Australia's coastal ecosystems.	Australian Research Council	Dr Gavin Birch, A/Prof David Raftos, A/Prof Ross Coleman, Dr Paul Haynes, Dr Richard Hynes	\$60,000
Molecular memory: how DNA methylation contributes to spatial memory	National Health and Medical Research Council	Prof Ryszard Maleszka, Dr Jennifer L Cornish, Dr Andrew Barron	\$65,000
To be cooperative or selfish: individual decisions in a model society	Australian Research Council	A/Prof Simon Griffith, Dr Andrew Russell, Prof Scott Edwards	\$65,000
More than mud: how will disruption of soft-sediments threaten coastal biodiversity?	Australian Research Council	Dr Melanie Bishop	\$80,000
Putting adaptation into vegetation models: towards a predictive theory of trait diversity and stand structure	Australian Research Council	Mr Daniel Falster, Prof Hanna Kokko, Dr S Joseph Wright	\$95,000
Primary production in space and time	Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education	Prof Colin Prentice, Alfredo Huete, Sara Mikaloff-Flotcher, Dr Helen Cleugh	\$97,500
A framework and tool box for assessing and monitoring swamp condition and ecosystem health	SEWPAC/ANU	Dr Grant Hose, Dr Kirstie Fryirs, Prof David Keith	\$99,577
Adapting to climate change: Does enhanced metabolism provide heritable protection against ocean acidification and increasing temperature in oysters?	Australian Research Council	A/Prof David Raftos, A/Prof Paul Haynes, Wayne O'Connor, Ms Laura Maree Parker, A/Prof Pauline Ross, Hans Portner	\$100,000
Elevated carbon dioxide (CO2) effects on vegetation: repairing the disconnect between experiments and models	Australian Research Council	Dr Belinda Medlyn, Dr Michelle Leishman, Prof Sune Linder, Dr Richard Norby, Professor Ram Oren	\$100,000

Table 7. External research grants funded in 2012 (source: Macquarie University Research Office).

PROJECT TITLE	GRANTING BODY	INVESTIGATORS	2012 FUND ALLOCATION
Fossils, rocks and early Cambrian clocks: Calibrating body plan assembly and lineage splits in ancestral animals from Gondwana	Australian Research Council	A/Prof Glenn Brock, Dr John Paterson	\$100,000
How does your garden grow? Scaling functional traits to whole-plant growth	Australian Research Council	Dr Ian Wright, Lucas Cernusak, Dr Caroline Lehmann, Ross Peacock,	\$115,000
Shifting rainfall from spring to autumn: tree growth and water use under climate change	Australian Research Council	Dr Melanie Zeppel	\$125,000
Mate choice near and far: Genetic compatibility, sexual selection, and speciation in Australian grass finches	Australian Research Council	A/Prof Simon Griffith	\$140,000
Next generation vegetation model based on functional traits	Australian Research Council	Prof Colin Prentice, Dr Ian Wright	\$140,000
Integrating biomechanics and ecology: moving from an individual- to population-level understanding of the effects of environmental change	Australian Research Council	Dr Josh Madin	\$147,536
Evolution of intelligence in small brains: how to navigate the messy natural outdoors smartly	Australian Research Council	Dr Ken Cheng, Prof Rudiger Wehner	\$150,000
Quantifying the effects of western colonisation on Great Barrier Reef molluscan communities	Australian Research Council	Dr Matthew Kosnik	\$171,600
Towards a trait-based ecology: new directions in leaf economics research	Australian Research Council	Dr Ian Wright	\$196,798
Quantifying the tree of life's diversity with the paleobiology database	Australian Research Council	Dr John Alroy	\$197,200
Understanding and predicting southward range expansions of corals	Environmental Trust NSW	Dr Josh Madin	\$199,129
Quantitative reconstructions of Australian climates since the last interglacial	Australian Research Council	Prof Sandy Harrison	\$200,000
Ecosystem Modelling And Scaling infrasTructure (e-MAST) - Terrestrial Ecosystem Research Network (TERN) project	Department of Education, Employment and Workplace Relations (DEEWR)	Prof Colin Prentice, Prof Brendan Mackey, Dr Helen Cleugh, Dr Simon Ferrier, Damian Barrett, Prof Lindsay Botten, Prof Stephen Williams, Dr Barry Brook	\$376,000
Evolutionary ecology of vegetation	Australian Research Council	Prof Mark Westoby	\$582,045
Single cell genomics	Australian Research Council Linkage Infrastructure and Equipment Fund	Prof Ian Paulsen, Prof Marc Wilkins, Prof Nicolle Packer, Prof Claire Wade, Prof Peter Waterhouse, Prof Rodney Scott, Prof Ian W Dawes, Prof Ricardo Cavicchioli, A/Prof Robert Willows, A/Prof Cynthia Whitchurch, Prof Ian Charles, Prof Harold Stokes, Prof Michael Gillings, Dr Dayong Jin, A/Prof Neville Firth	\$654,000

Research

Australian Research Council grants: 2012 outcomes (for 2013 funding)

Members of the Department of Biological Sciences are indicated in bold, below.

DP130103839 **Gillings, Prof Michael R**; Charles, Prof Ian G.

Evolution and ecology of integron gene cassettes: exploring the protein universe.

Total: \$360,000

Bacteria rapidly adapt to new conditions by sharing diverse genes via lateral genetic transfer, best illustrated by the spread of antibiotic resistance. This study will characterise mobile genes, discovering new gene families and proteins, and will expand existing knowledge of bacterial evolution.

DP130100418 **Griffith, A/Prof Simon C**; Rollins, Dr Lee A; Burke, Prof Terence A.

The danger within: assessing the threats to an endangered finch from genetic incompatibility, limited dispersal and effective population size.

Total: \$315,000

The Gouldian finch has declined dramatically over the past half century and remains one of Australia's most threatened birds. This project will use some cutting edge genetic techniques to understand some of the processes that undermine the species' recovery and our ability to monitor current populations.

DP130100417 **Griffith, A/Prof Simon C**; Buchanan, A/Prof Katherine L; Rowe, Dr Melissa.

Reproductive plasticity and climate change: insights from an opportunistic breeder.

Total: \$435,000

Across the globe, birds are struggling to optimise their reproductive timing and investment in a changing and unpredictable climate. This project will use the highly adaptable and opportunistic Australian zebra finch to develop an understanding of how birds tailor their behaviour and physiology to breed across a range of conditions.



DP130102998 **Whiting, A/Prof Martin J**; Byrne, Prof Richard W.

Evolution of cognition and sociality in vertebrates.

Total: \$262,000

This project aims to understand better the selective forces shaping cognition and sociality in animals and to determine if 'social intelligence' theory, which predicts more sophisticated cognition as species become increasingly social, provides a general explanation for the evolution of intelligence.

IC130100009 Haynes, Prof Paul A; Packer, Prof Nicolle H; Nevalainen, Prof Helena K; Paulsen, Prof Ian T; Willows, A/Prof Robert D; **Raftos, Prof David A**; Molloy, A/Prof Mark P; Te'o, Dr Valentino S; **Atwell, A/Prof Brian J**; O'Connor, Dr Wayne A; Quail, Dr Kenneth J; Hobba, Dr Graham D; Ball, Dr Malcolm S.

A molecular technology platform for enabling the next revolution in the food industry.

Total: \$2,100,000

Society needs new approaches for solving the difficulties of providing enough food for the future. This training centre will train young scientists in the application of applying molecular analysis skills to solve specific problems that the food industry faces in the whole process of taking food production from "field to fork".

LE130100019 Doblin, Dr Martina A; Seymour, Dr Justin R; Ralph, Prof Peter J; Vigneswaran, Prof Saravanamuthu; Whitchurch, A/Prof Cynthia B; Suthers, Prof Iain M; Steinberg, Prof Peter D; Brown, Dr Mark V; Ferrari, Dr Belinda C; Murray, Dr Shauna A; Paulsen, Prof Ian T; Ostrowski, Dr Martin L; **Armand, Dr Leanne K**; Waite, Prof Anya M; Hallegraef, Prof Gustaaf M; Bolch, Dr Christopher J.

A transportable containerised laboratory for rapid cell sorting and high-resolution bioimaging of living aquatic microbes in field locations.

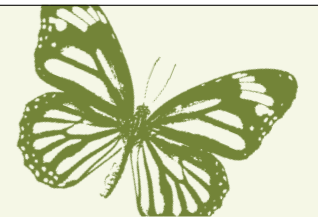
Total: \$580,000

This project will deliver a transportable, unique laboratory for the rapid isolation and high-resolution analysis of living microbes immediately after sampling from the sea or waterways. It will be the first of its kind in Australia and deliver new knowledge of the role of these organisms in their natural habitats.



1. Veronica Peralta.
Photo by Leanne Armand.
2. Julia Cooke.
3. Student in the field.

Academic Staff Profiles



Andrew Allen – Senior Lecturer

I am a theoretical ecologist whose research interests lie at the interface of organismal physiology and community and ecosystem ecology. I have worked on mathematical models to describe a range of biological phenomena including broad-scale biodiversity gradients, rates of DNA evolution, and nutrient cycles in organisms and ecosystems. My current entails developing and testing a new class of biodiversity models that relate contemporary biodiversity to speciation-extinction dynamics in the fossil record and ecologically induced changes in population abundance through time. This work aims to provide a better understanding of how environmental changes, including those induced by human activities, influence the numbers of species present in ecosystems.

John Alroy – Future Fellow

My main research focus is on diversity curves, speciation, and extinction. Will I ever see the light at the end of the Phanerozoic? I develop methods to estimate these abstract numerical things and then apply said methods over and over again to Cenozoic North American mammals and Phanerozoic marine invertebrates.

Leanne Armand – Senior Lecturer

I have a strong interest in the distribution of individual species related to the physical oceanic environment, and the subsequent preservation of this environmental relationship in the fossil record. I use the records of fossil diatoms in deep sea cores between Australia and Antarctica to estimate past climatic conditions, such as sea ice extent and sea surface temperatures over the last glacial cycle (~240,000 yr). My recent

focus is on the living diatom community of the Southern Ocean near Heard and Kerguelen Islands where I has contributed knowledge to the understanding of diatom community responses and the export of their carbon to the seafloor as a result of their population explosion under the annual, naturally iron-stimulated, spring bloom.

Brian Atwell – Associate Professor

I investigate the biology of plant growth and mechanisms of tolerance to abiotic stress. Areas of interest include growth, development and canopy architecture of Australian native rice species (*Oryza* spp.) and the tolerance of *Oryza* species to a range of abiotic stresses such as heat, drought, salinity and anoxia. I am also working on the physiology and biochemistry of cereal grains with a view to improving the technology of milling. A second major strand is the biochemical control of carbon allocation and release as volatile organic emissions, using diverse eucalypts as a model species.

Andrew Barron – Senior Lecturer

My research explores the neurobiology of major behavioural systems such as memory, reinforcement and stress from a comparative and evolutionary perspective. Most of our research is with honey bees, and current major projects include: the neuromolecular basis of drug abuse and addiction, the role of epigenetic systems in long term memory and a sociobiological analysis of honey bee colony collapse disorder.

Katherine (Kate) Barry – Lecturer

I am interested in the ecology and evolution of sexual reproduction, but my specific area of interest lies in the evolutionary outcome of

reproductive conflict between the sexes. My research focuses on the evolution of mating strategies, sexual signalling and mate choice (both pre and post-copulatory). The majority of my research has focused on praying mantid mating systems, where I am particularly interested in the evolution of sexual cannibalism and its effect on male mate choice and reproductive success.

Andy Beattie – Emeritus Professor

Until recently I was the Director for the Commonwealth Key Centre for Biodiversity and Bioresources with research in the exploration of invertebrate and microbial diversity. Currently my main interests are the evolutionary ecology of antimicrobials, interactions between arthropods and microorganisms and the role of microbes in the evolution of sociality. I am also interested in conservation especially with reference to the economic valuation of biodiversity.

Linda Beaumont – Lecturer

My research focuses on the biological impacts of climate change. Much of my research involves the use of niche-based models to assess potential future changes to species distributions. At present I am exploring ways of incorporating multiple climate change scenarios to assess the influence of between- and within-climate model variability on projections of species distributions. The ultimate aim of this cross-discipline project is to produce probability distribution functions indicating the likelihood of species range shifts. This project is being conducted with colleagues at the University of New South Wales, James Cook University and Joseph Fourier University (Grenoble, France).

Melanie Bishop – Senior Lecturer

My research investigates natural and human-mediated processes that control coastal biodiversity and its important ecosystem functions. I use manipulative field experiments to investigate effects of global and local change, often producing results that could not have been predicted using theoretical or modeling approaches.

Glenn A. Brock – Associate Professor

My research activities focus on elucidating the evolution, phylogeny, biodiversity, ecology and biostratigraphy of the earliest (stem group) members of the three major supergroups of bilaterian animals (Ecdysozoa, Spiralia and Deuterostomia) that arose during the Cambrian Explosion. I study exceptionally preserved macro- and microfossils from a variety of localities in Australasia. I am particularly interested in the phylogenetic, ecological and biostratigraphic significance of early Cambrian "Small Shelly Fossils". I am part of a research team excavating, investigating and conserving the globally important lower Cambrian Emu Bay Shale deposit containing fossils of exceptional preservation, evolutionary significance and vital natural heritage.

Culum Brown – Associate Professor

I am primarily interested in Behavioural Ecology particularly predator avoidance behaviour, personality and cognition fishes. In addition to this theoretical work, I have interests in applied research in conservation biology and fisheries management. My research often takes a comparative approach in an effort to understand how natural selection has shaped the brains and behaviour of animals in the context of their natural environment.

Ken Cheng – Professor

My research crosses mechanistic, functional and evolutionary questions in the study of animal behaviour. A central theme of my research concerns how animals process information. Dealing with information is crucial for many important behaviours in an animal's life, including choosing a mate, avoiding predators, and finding food. The range of species I

have studied include humans, rats, pigeons, chickadees, Clark's nutcrackers, desert ants, and honeybees. A large part of my research has concentrated on how animals deal with space and time. I have collaborations with a number of researchers around the world.

Jennifer Clarke – Wallace Fellow

My lab group focuses on the form and function of animal communication and its application in conservation - particularly in highly social species (elk, bison, coatis, ptarmigan, wolves, dingoes, flying-foxes, and Tasmanian devils). Understanding animal communication not only sheds light on critical aspects of a species' evolution and biology but it can also be an invaluable tool to aid in conservation, management, and species' preservation. Our lab studies aspects of alarm calling, food calling, acoustic signatures, contact calls and the role of vocalisations in social transmission of information - with conservation applications.

Richard Frankham – Emeritus Professor

My research focuses on conservation and evolutionary genetics. I investigate selective sweeps in captive populations and evolution in weeds. My research allows me to predict the risk of outbreeding depression and the cost of inbreeding. I have completed the 2nd edition of Introduction to Conservation Genetics in collaboration with Jonathan Ballou and David Briscoe.

Michael Gillings – Professor

The unifying theme of research in my laboratory is the investigation of genetic diversity using DNA markers and sequence analysis. Over the past 10 years we have worked on viruses, bacteria, fungi, plants, invertebrates, sharks, bony fish, birds and mammals. We have developed a range of molecular methods for rapidly assessing genetic and functional diversity in genomic DNA and in DNA extracted directly from environmental samples (metagenomic DNA).

Simon Griffith – Associate Professor

My research investigates the many sources of variation that determine the differential reproductive fitness of individuals in populations

and focuses on birds which, as a group, are very amenable to these questions due to their accessibility for life-history research focused on elements of behaviour and physiology. We study a range of species in both the field and laboratory and have established particularly good opportunities for research with both the zebra finch and Gouldian finch. The issues that we are currently investigating include plasticity in responses to climatic variation, the evolution of cooperative behaviour, personality and social behaviour, genetic structuring within populations and alternative reproductive tactics.

Sandy Harrison – Professor

I am a palaeoclimatologist, with a special interest in how climate changes affect the land-surface, terrestrial biosphere and hydrological processes, and how changes in these components of the Earth system, in turn, feedback to or modulate regional climates. My work involves the development and use of numerical models in conjunction with observations to understand the mechanisms of climate change. I use continental to global scale syntheses of palaeoenvironmental observations to document and quantify regional changes during the Late Quaternary. I use numerical models of the terrestrial biosphere, which couple hydrological processes, vegetation dynamics and disturbance, in conjunction with outputs from state-of-the-art climate models, to explore how climate changes are registered at a regional scale.

Mariella Herberstein – Associate Professor & Head of Department

I investigate the behavioural ecology of invertebrates including spiders and insects within an evolutionary framework. I am interested in establishing spiders as significant models in behavioural and evolutionary research, deceptive signals in spiders and orchids, and the mating behaviour and sexual selection in spiders and insects.

Grant Hose – Senior Lecturer

My research interest is the ecology and ecotoxicology of river and groundwater ecosystems. My background is in bio-assessment and the use of invertebrate

Academic Staff Profiles



communities to reflect water quality and health of freshwater environments. Mostly now I work on groundwater ecosystems, their function and how they respond to contamination, but I remain interested and actively researching pesticide, metal and other contaminants on rivers, ponds and streams.

Lesley Hughes – Professor

My work concerns the impacts of climate change, especially on terrestrial species and ecosystems. I am particularly interested in how conservation strategies can be developed to increase the resilience and adaptive capacity of ecosystems to climate threats. I am also interested in climate change communication, especially in how communication strategies need to be tailored for scientists, policy makers and the general public.

Darrell Kemp – Senior Lecturer

I am broadly interested in the evolution and ecology of sexual reproduction. My research blends quantitative genetics, developmental biology, physiology and behavioural ecology and addresses questions relating to the evolution of mating strategies, contest behaviour, mate choice and sexual signalling. I choose model organisms appropriate to answering these questions, and have worked particularly with butterflies, wasps, flies and guppies. I use a range of observational and experimental methods designed to test theoretical hypotheses, and incorporate quantitative genetics and interdisciplinary conceptual perspectives (i.e., life history perspectives of sexual selection) to illuminate the evolution of sexual traits and behaviours.

Matthew Kosnik – Future Fellow

I am interested in the interplay between ecological and evolutionary processes, and more specifically I am investigating the effect of western colonisation on Australian ecosystems. I use sedimentary records to provide historical context to modern marine ecosystems, and I am actively working to move from writing the obituaries for lost systems to understanding how we have impacted these systems. As a result of my main research interests, I am also actively working to understand the preservation

biological remains in sedimentary records, sediment mixing and the preservation of sedimentary time-series, and the idiosyncrasies of palaeobiological assemblages.

Michelle Leishman – Associate Professor

My main areas of research are plant functional traits and ecological strategies of plants. My current research focuses on understanding the success of invasive plants, predicting the success and impact of invasive plants with climate change and developing sustainable vegetation restoration methods. There are a number of active research programs in the lab, including:

Comparison of traits of invasive exotic species in their original and novel ranges, responses of invasive exotic plants to elevated CO₂, predicting exotic species distribution with climate change, the role of soil biota in plant invasions, restoration of riparian vegetation and relating plant volatile organic compound emissions to functional traits.

Joshua Madin – Senior Lecturer

I am a quantitative ecologist interested in a wide range of ecological questions. Broadly speaking, my two primary research interests are in coral reef ecology and ecological informatics. However, I have explored questions in a range of other fields, including paleoecology, reef fish biogeography, and macroecology. My recent coral reef research focuses on understanding and predicting reef coral dislodgement and the consequences of hydrodynamic disturbances (e.g., cyclones) on community structure. This work draws on approaches in near-shore oceanography, hydrodynamics, biomechanics and statistics. Given the many large and diverse data sets that I work with, I have also become involved with several informatics projects focused on developing tools for finding, integrating and analysing multiple (often large) data sets more effectively, making it easier to include cross-disciplinary information in addressing complex ecological questions.

Belinda Medlyn – Associate Professor

My research focuses on how plants, especially forests, respond to increasing atmospheric carbon dioxide (CO₂) and climate change.

I work at the interface between experiments and models: my aim is to develop better models of how ecosystem productivity, water use and species composition will be affected by global change, and to do so I work closely with a number of experimental teams world-wide to test and improve ecosystem models. I use data analysis techniques to synthesise and interpret experimental results, and I use simulation models to extrapolate from experimental data to predict long-term changes in ecosystem function.

David Nipperess – Lecturer

I have broad interests in community ecology, biogeography and conservation biology. My current research centres on the development of new methods of measuring biodiversity that incorporate information on the evolutionary relationships of organisms. I am applying these novel methods to research in biodiversity assessment, community ecology, biogeographical classification and conservation planning.

Colin Prentice – Professor

I study the global land biosphere and its interactions with climate, especially the scaling up from plant and microbial processes to land-atmosphere exchanges of water, carbon dioxide and trace gases. My research now focuses on the “next generation” of ecosystem and land surface models, incorporating new developments in ecology and ecophysiology including optimal allocation theory and plant hydraulics, and on the quantification of land-atmosphere feedbacks using various data sources and models.

David Raftos – Associate Professor

My research group studies the effects of environmental stress on marine invertebrates at the cellular and molecular levels. We are particularly interested in the effects of chemical pollution, elevated temperature and ocean acidification on disease susceptibility. Most of our work is on oysters, and so we have developed extensive research collaborations with state government agencies and the Australian aquaculture industry.

Michelle Power – Senior Lecturer

My broad research interests are in the area of host-parasite interactions and using this association to identify human impacts in fragile ecosystems. Within this framework my research extends to questions encompassing co-evolution, adaptation, diversity, taxonomy and epidemiology. My group's research targets a range of parasites including protozoa and nematodes, and diverse hosts (rock wallaby, Australian sea lion and grasshoppers).

Adam Stow – Associate Professor

My work broadly covers the fields of behavioural ecology, evolutionary biology and conservation genetics. Some of the topics I work on are mating systems and reproductive character displacement, genetic erosion in declining species, gene flow in human impacted environments and refugium during climate change. My research group develops and applies field and molecular based approaches and work on a range of vertebrate and invertebrate animals in marine and terrestrial environments.

Luke Strotz – Lecturer

My research focuses on how Foraminifera can be used to address a range of fundamental questions in biology and the geosciences. This focus has allowed me to pursue research interests across a broad range of disciplines including taxonomy, geomorphology, palaeoecology, tsunami research, macroevolution, and physiology. My most recent research looks to understand macroevolutionary dynamics, using Foraminifera as model organisms. With their excellent fossil record and the increasing availability of modern genetic evidence, Foraminifera represent one of the best taxonomic groups for explaining the unknowns of species formation and evolution generally.

Phil Taylor – Associate Professor

My research is based on terrestrial invertebrates as convenient and tractable models for a wide diversity of ultimate (evolutionary) and proximate (mechanistic) questions of why animals behave as they do. Current work focuses on reproductive and nutritional biology of Queensland fruit flies (*Bactrocera tryoni*,

aka ‘Q-fly’), flexible predatory strategies of *Stenolemus* assassin bugs and communication, assessment and decision-making of jumping spiders. In addition to addressing questions of basic Behavioural Biology, we have a parallel interest in applying the concepts and techniques of Behavioural Biology to current issues of environmentally benign pest management.

Julia Raftos – Senior Lecturer

My current interest is in the anti-oxidant systems in the human red blood cell and at present my studies center on the antioxidant glutathione. Red blood cells are especially vulnerable to oxidative damage because of their role in oxygen transport. Every day up to 3% of the haemoglobin in the red cell is oxidised and this process releases oxygen radicals that have the potential to react with cell proteins and lipids producing a cascade of events that can disrupt the function of critical cell constituents. Without a nucleus the red blood cell cannot replace these damaged components. These cells are also exposed to oxidants that are released into the blood by activated cells of the immune system and from sites of inflammation. As red blood cells circulated through all tissues and organs their anti-oxidant systems have a significant function in maintaining the redox state of the whole body.

Mark Westoby – Distinguished Professor, ARC Laureate Fellow

Understanding and predicting from evolutionary principles the physiognomy and traits of vegetation. Structure and chemistry of plant tissues has decisive influence on geochemical, hydrological and habitat functions in terrestrial ecosystems. Field research is along an East Australian Transect from Tasmania to North Queensland, and also across rainfall gradients. Theoretical research builds models of the competition process and how it gives rise to strategy mixtures in vegetation.

Martin Whiting – Associate Professor

Research in my lab is broadly focused on behavioural and evolutionary ecology, for which we use lizards as a model system. We work on the following general themes: (1) sensory

ecology; (2) visual and chemical signals in lizards and their interaction; (3) colour signals and constraints (hormones, immunocompetence) to signalling; (4) whole organism maximal performance (bite force, sprint speed, endurance, metabolic rate) and performance-based signals; and (5) social organisation and sexual selection, mating systems and alternate reproductive tactics. More recently, a major focus is testing the social intelligence hypothesis for the evolution of large brain size and intelligence using the lizard genus *Egernia* as a model system.

Jane Williamson – Senior Lecturer

My research focuses on life-history aspects of marine organisms, particularly the relative effects of recruitment versus post-recruitment processes on the demography of marine herbivores. My current interests are diverse and can be broadly categorised into the following areas: effects of climate-induced changes on early life stages of marine invertebrates, the ecology and behaviour of marine organisms, and conservation of endangered species. Past projects include: chemical cues as mediators for the demography of marine herbivores, sustainable aquaculture of edible sea urchins, the effects of elevated nutrients on marine algae and corals, epifaunal composition of marine algae, and effects of natural disturbances on the community structure of soft-bottom macro-invertebrates.

Ian Wright – Future Fellow

In my lab group we investigate the functional ecology and ecological strategies of plants - the “how and why” of differences among species in their structural, chemical and physiological traits - and the implications of this variation for ecosystem-scale processes. In some studies we investigate the detailed anatomical and physiological underpinnings of variation in functional traits; in others we quantify trait relationships (and influences of climate and soils) at regional to global scales. Through collaboration with a range of research groups we work towards incorporating this knowledge in global vegetation and primary production models.

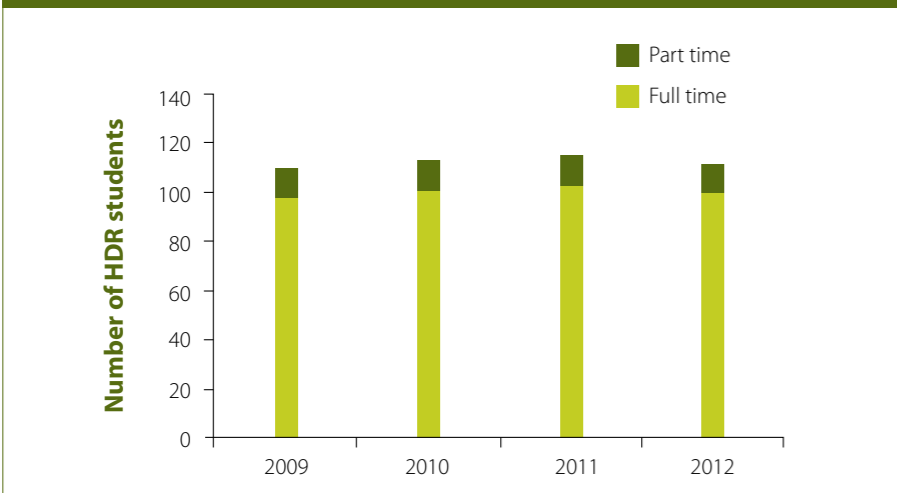
Higher Degree Research Students



The Department of Biological Sciences has a consistent enrolment of 100–120 higher degree research (HDR) students in any given year (Figure 3). The Department carries one of the highest HDR enrolment in the Faculty of Science as well as the University. In 2012, the average number of HDR students per principal supervisor was 3.0.

In addition to pursuing their own research projects, our postgraduate students actively participate in departmental activities such as tutoring and teaching, seminar series, committees and social events. The highlight of the academic year is the HDR conference, usually held in November. The HDR students present a progress seminar followed by individual interviews with a review panel. In 2012, more than 65 seminars were presented over three days, followed by a celebration lunch for the entire Department. From 2013 we will hold an additional mini-conference in February for students who are unable to participate in the November conference because of fieldwork or other commitments.

FIGURE 3. NUMBER OF HDR STUDENTS ENROLLED IN THE DEPARTMENT OF BIOLOGICAL SCIENCES 2009–2012.



Genes to Geosciences Research Enrichment Program

A central support structure for our HDR students is the Genes to Geosciences Research Enrichment Program. The program offers master classes to laboratory groups affiliated with the research centre. In 2012, HDR students were able to choose from 16 different master classes ranging from technical and generic skills to soft skills and a range of scientific topics.

Grants, prizes and commendations

Our postgraduate research students continue to attract external funds and awards in recognition of their research. Congratulations to our Honours, Masters and PhD Students who received grants, awards and commendations in 2012.



1. Rob Harcourt and team attaching a satellite linked CTD logger to an fur seal on Montague Island. Photo by Robert Harcourt.
2. Clifford Garside sampling in the field. Photo by Brett Howard.
3. Field research on One Tree Island. Photo by Matthew Kosnik.

Table 8. Student Awards and Grants.

NAME	GRANTING BODY	AWARD TYPE
Paulo Momigliano	Sea World Research and Rescue Foundation	\$16,000 research funding
Shannon Smith	Roads and Maritime Services	\$100,000 research funding
Scott Fabricant	Linnean Society of NSW	Joyce Vickery Research Fund
Laurie-Anne Keller	Australian Geographic	Seed Grant
Aroon Melwani	Sydney Institute of Marine Sciences	Thyne Reid Doctoral Fellowship
Lun-Hsien Chang	SAS Research Institute	SAS post-graduate research fellowship
Thomas White	Australian Geographic	Seed Grant
Nola Hancock	Australian Federation of Graduate Women	NSW Education Trust Prize
Alex Bush	Australian Limnological Society Conference	Student Prize- 1st place
Paul Duckett	Genetics Society of Australia Conference	Student Prize- Runner Up
James Lawson	Australia and New Zealand Geomorphology Group Conference	Oral presentation – Commendation
Andrew Scarfaro	Biomolecular Frontiers Research Centre	Student peer reviewed paper prize
Miya Warrington	Two-minute thesis competition	Finalist
James O’Hanlon	International Society for Behavioral Ecology	Travel Grant and Student Poster Prize (1st place)
	Australasian Entomological Society Conference	Student Prize - 2nd place
	MQ Postgraduate Research Fund	Travel grant
Raelene Giffney	MQ Postgraduate Research Fund	Travel grant
Clifford Garside	MQ Postgraduate Research Fund	Travel grant and DVC commendation
Naila Even	International Union for the Study of Social Insects	Travel grant
	MQ Postgraduate Research Fund	Travel grant
Siobhan Dennison	Barbara Rice Memorial Fund (MQ)	Field research proposal award
	Linnean Society of NSW	Joyce Vickery Research Fund
	MQ Postgraduate Research Fund	Travel Grant
Heather Baldwin	Barbara Rice Memorial Fund (MQ)	Field research award
Dalila Rendon	Barbara Rice Memorial Fund (MQ)	Field research award
	Linnean Society of NSW	Joyce Vickery Research Fund
Maria Asmyhr	Barbara Rice Memorial Fund (MQ)	Runner up



Higher Degree Research Students



Table 9. List of HDR students who completed in 2012 (source: Faculty of Science)

NAME	THESIS
Amaral Ana (PhD):	Insights into the evolutionary relationships within the Delphininae, with focus on the <i>Genus Delphinus</i> : A multi-locus, multi-disciplinary approach.
Ali Ashehad (PhD):	Modelling elevated carbon dioxide impacts on plant competition.
Catherine Choung (PhD):	Ecotoxicological assessment of the impacts of a herbicide-insecticide mixture on freshwater ecosystems.
Peter Cuneo (PhD):	The ecology and management of invasive African Olive (<i>Olea europaea ssp. cuspidata</i>) in south west Sydney, Australia.
Matthew Dowle (PhD):	A comparison of two species of bandicoots (<i>Perameles nasuta</i> & <i>Isoodon obesulus</i>) influenced by urbanisation: population characteristics, genetic diversity, public perceptions, stress and parasites.
Louise Duncan (PhD):	Isolation and characterization of lymphoid surface markers in marsupials.
Benjamin Fanson (PhD):	Insights from a nutrient-explicit approach for understanding the cost of reproduction in the Queensland fruit fly, <i>Bactrocera tryoni</i> .
Kerinne Harvey (PhD):	Why do plants become invasive? The role of phylogeny, herbivores and time.
Stephen Hoggard (PhD):	The evolution of sociality and antimicrobial defences in paper wasps.
Rhiannon Kuchel (PhD):	The effects of environmental stressors on immunological activity in <i>Pinctada imbricate</i> .
Katherine McClellan (PhD):	The responses of Australian butterflies to climate change.
Andrea Nicastro (PhD):	How pre-existing stressors determine climate impacts.
Marisa Nordenstahl (PhD):	The adaptive significance of leaf size variation along temperature gradients in Australian rainforests.
Marianne Peso (PhD):	The function of queen and brood pheromones in honey bee social organisation.
Andrew Scafaro (PhD):	Gaining insight into mechanisms of plant thermotolerance through Australian wild rice.
Patrick Schultheiss (PhD):	Foraging ecology of the Australian desert ant <i>Melophorus bagoti</i> .
Enrico Sorato (PhD):	Ecological effects and social correlates of group-living in the chestnut-crowned babbler (<i>Pomatostomus ruficeps</i>).
Juliet Suich (PhD):	Growth & modelled carbon gain in cultivated and wild Australian rice species under elevated CO2.
Emma Louise Thompson (PhD):	Proteomic analysis of metal contamination in Sydney Rock Oysters (<i>Saccostrea glomerata</i>).
Tiina Tosens (PhD):	Anatomical influences on mesophyll conductance.
Emma Wilkie (PhD):	Ecological impact of QX disease and its management strategies.
Antoine Wystrach (PhD):	Visual navigation in ants.
Daniel Zurek (PhD):	The function of the anterior lateral eyes in the modular visual system of jumping spiders (Araneae, Salticidae).



Technical Staff and Scientific Officers

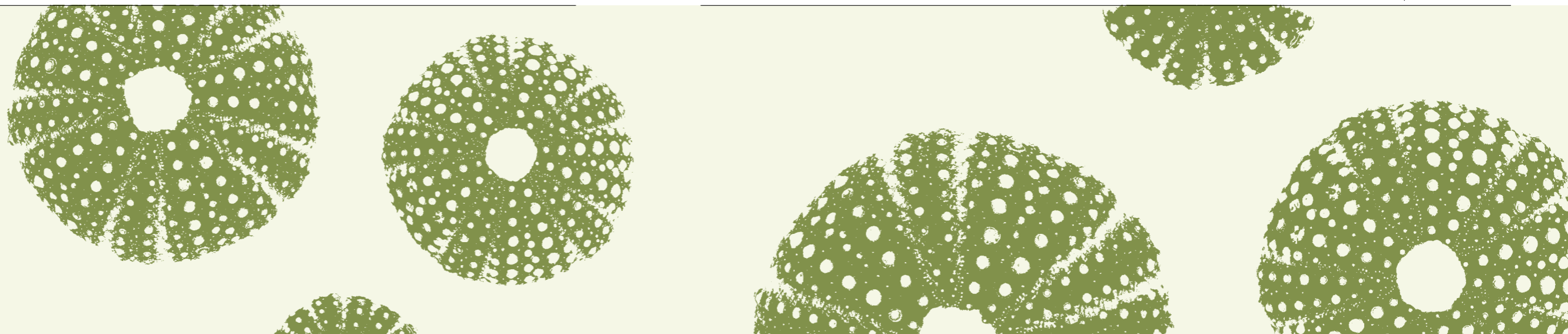
A team of 20 dedicated technical staff provides extensive support for our teaching and research activities.

Technical staff actively support teaching by collecting and managing teaching materials, including the collection and husbandry of live organisms, maintenance of the teaching laboratories and extraction and analysis of DNA. Our highly skilled technicians make it possible for the Department to provide students with a fully interactive education that equips them with real world skills and hands on experience in conducting scientific experiments.

Technical staff further support our academics by ensuring that the technical components of the Department's research facilities are maintained to high standards. This involves the storage and handling of chemicals and research specimens, as well as maintenance of facilities including glasshouses, research aquaria, museum collections, microscopy equipment, molecular laboratories, quarantine and DNA sequencing facilities. The staff are also actively involved in supporting laboratory-based research and terrestrial and aquatic fieldwork, and are a driving force in providing our staff and students with a safe and responsible workplace.



Facilities



Teaching laboratories

The Department's teaching laboratories provide students with a world-class, modern and highly interactive environment. All are fitted with the latest digital technology, including digital microscopes and cameras that allow students to project high-resolution images onto their computer screens and share discoveries with others in the class.



Acid leaching facility

The acid leaching facility is a key resource for chemical processing and preparation of fossil and geologic materials used for teaching and research. Used by the Department of Biological Sciences as well as other departments in the Faculty of Science, the acid leaching facility underwent a \$500,000+ refurbishment in 2012 to create a state-of-the-art specialist facility that ranks amongst the best in the Southern Hemisphere.

Plant growth facilities

The University's large-scale plant growth facility was built in 1999 and houses a wide range of experimental programs. It provides a basis for undergraduate and postgraduate biology teaching and research, and is an important resource for many national and international collaborative projects. Facilities include 14 glasshouses, 14 growth cabinets, research laboratories and the Downing Herbarium. Temperature- and CO₂-controlled glasshouses hold a range of climate change experiments. The facility is scheduled for a significant upgrade as part of the Department's strategic research plan.



1. Teaching laboratories. Photo by Ray Duell.
2. Crab spider in *Asystasia* flower. Photo by James O'Hanlon.
3. Photo by James O'Hanlon.

Sydney Institute of Marine Science (SIMS)

New facilities at the Sydney Institute of Marine Science – of which Macquarie is one of four contributing partner universities – were commissioned in March 2012 and became operational in May 2012. These facilities have been fully refurbished using over \$23 million in funding from the Australian Government's Education Investment Fund (EIF) scheme, the NSW Government's Science Leveraging Fund and the Ian Potter Foundation. The Department of Biological Sciences was a major recipient of awards and grants that contributed to this funding.

The refurbished facilities are extensive and include: a state-of-the-art research aquarium with PC2 containment and environmental control capabilities; PC2 research laboratories for cell biology, molecular biology and microbiology; PC1 research laboratories for ecology, field biology and geosciences; modern teaching laboratories; and administration, accommodation and conference facilities.

The new SIMS facilities are currently being used by eight Macquarie HDR students and two postdoctoral research fellows, as well as academic staff from the Department of Biological Sciences who are working on a range of ARC and other federal and state government grants. In addition, the Institute houses the NSW node of the National Collaborative Research Infrastructure Strategy (NCRIS)-funded Australian Integrated Marine Observing System, which has received in excess of \$100 million in federal infrastructure funding. A major component of the IMOS node is administered by staff from the Department of Biological Sciences. SIMS is also the focus for Macquarie's new Master of Marine Science and Management degree.

Seawater Facilities

Operating since August 2004, the Seawater Facility supports academic research and undergraduate teaching in the Faculty of Science, giving students the opportunity to get a closer look at living examples of marine plants and invertebrate animals from the Sydney Harbour region. The facility is used by the University's marine scientists and collaborative partners to conduct controlled experiments and to temporarily house marine specimens. The facility is scheduled for a significant refurbishment and relocation in 2013.

University Fauna Park Animal Facility

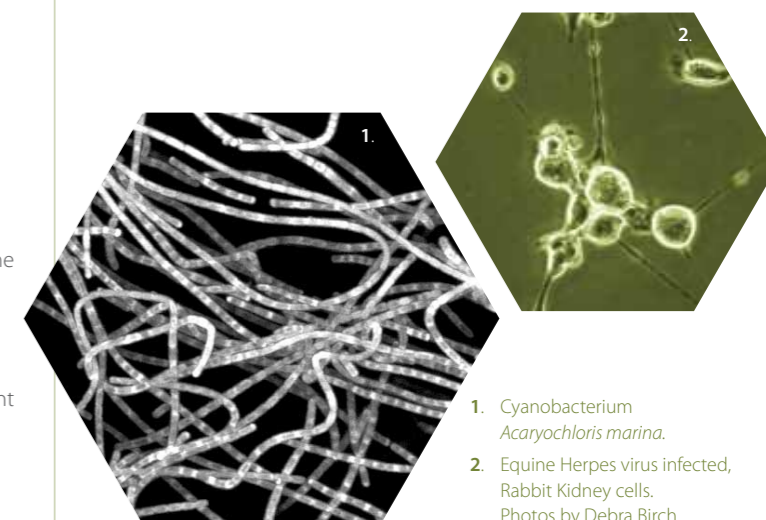
The University's Fauna Park is a unique environment that stretches over 11 hectares, one-third of which is protected Sydney Turpentine Ironbark Forest. The park is committed to non-intrusive research, such that vertebrates (birds, fish, reptiles) and invertebrates (bees, flies, spiders) are observed in their natural settings, with minimal disruption, to determine how evolution has affected brain development and behaviour. Research has a strong focus on conservation and environmental protection. The Fauna Park is also used for research into water ecology and the competitive abilities of native trees.

Microscopy

The Department's microscopy unit specialises in modern light microscopy, electron microscopy, confocal microscopy, histology and digital image capture. Training and instruction is provided by staff who have experience in a wide range of specimen preparation techniques.

Museum

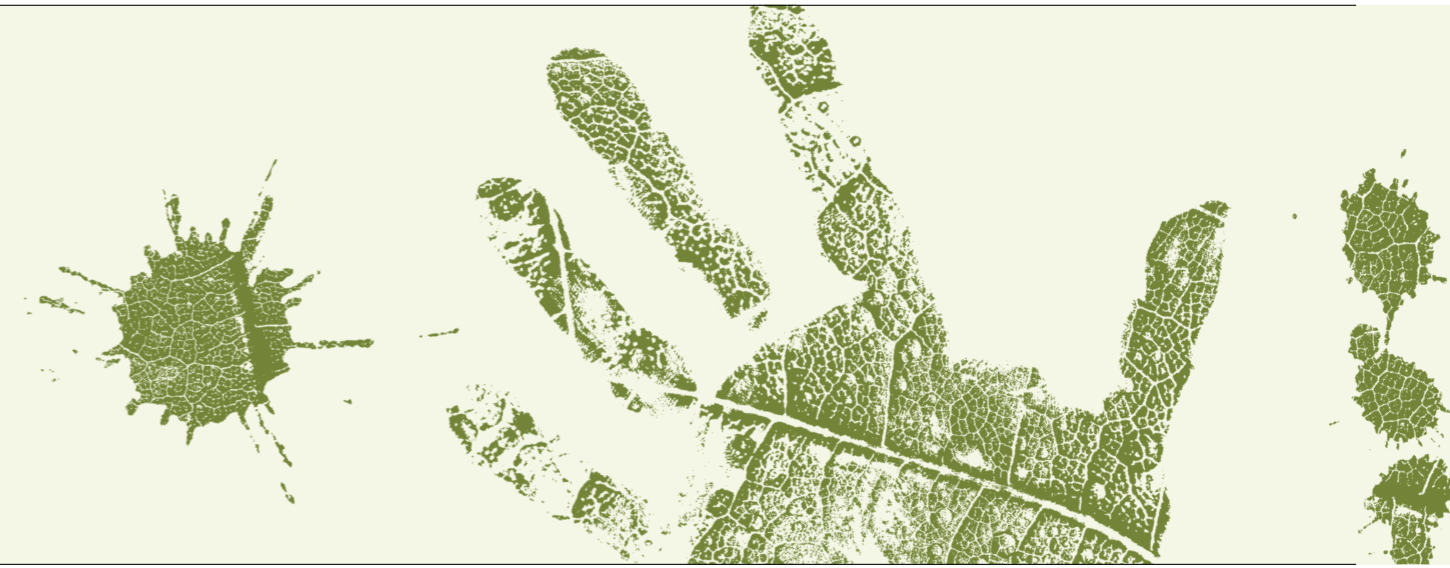
The Department houses the Biological Sciences Museum, which contains a huge range of specimens centred on Australian fauna. The collections are comprehensive and are regularly visited by university students and researchers, school groups, overseas visitors and media organisations.



1. Cyanobacterium *Acaryochloris marina*.
2. Equine Herpes virus infected, Rabbit Kidney cells. Photos by Debra Birch.

Outreach Activities

The Department of Biological Sciences is strongly committed to actively sharing and promoting science and research with the community.



Avenues for media outreach range from public community lectures and radio interviews to working alongside the public in scientific and monitoring programs. Throughout 2012 research on topics as diverse as cuttlefish mating behaviour, cane toad cognition and the evolution of bacteria have been covered by news outlets including Reuters, New Scientist, ABC News and the Sydney Morning Herald. Staff and postgraduate research students have featured heavily in popular science programs on TV, YouTube and radio, including appearances on Q&A, Sky and Channel 7 news programs, Catalyst, TEDx, The Wire, ABC Drive and 2SER 107.3 FM radio. Professor Michael Gillings gives regular interviews on ABC's 702 Sunday Show where he explains popular concepts to the public. Recent topics included: "How evolution generates complexity in the absence of design", "The brain in love", "Why humans don't have pouches" and "Why are people right-handed". Increasingly, science communication is occurring through new online publications and our researchers continue to feature in leading science communication outlets such as Phys.org, Crikey.com.au, Wired Science (<http://www.wired.com/>) and The Conversation (<http://theconversation.com/au>).

The Department works actively with schools in NSW and provides input into the NSW school curriculum. Academics gave many public lectures in 2012, including a keynote address by Professor Lesley Hughes during National Science Week in August. Each year the Department hosts an extensive array of high school students through programs such as the Science and Engineering Challenge, Science Unleashed, Biodiversity in the City and Macquarie Molecular Experience. Members of the Department visit a large number of high schools each year to present lectures and workshops and participate in career days. Staff also work with high school students at external educational facilities such as Land's Edge on Sydney Harbour and the Turning the Pages Environmental Program. Staff are also involved in the Scientists in Schools program.

Staff in the Department of Biological Sciences are active participants in Macquarie University's Open Day, which was held on September 8, 2012. Staff share aspects of their research with the public through a range of media including exhibits, posters and lectures and promote active, hands-on participation where possible.

The Department has a strong commitment to furthering collaborations and partnerships with Aboriginal and Torres Strait Islander students, and underprivileged and regional groups within the community. In 2012 the Department supported campus visits from indigenous high school students as part of the University's Refugee Monitoring Program, and students from disruptive schooling backgrounds through Macquarie's LEAP program. Staff and postgraduate students organised outreach activities specifically targeted at Aboriginal and Torres Strait Islander students, including students from Chifley College in Mt Druitt. In addition, members of the Department travelled to regional areas to give talks and implement monitoring and teaching programs.



1. Field research on One Tree Island. Photo by Matthew Kosnik.
2. The Malaysian orchid mantis. Photo by James O'Hanlon.

External Boards and Services

In 2012, academic staff from the Department of Biological Sciences contributed to the scientific and broader community through active participation in national and international scientific committees, working groups and advisory boards.

At the international level, staff contributed to working groups of the following organisations:

- Intergovernmental Panel on Climate Change
- UNESCO's Bioethics and Education committees
- IUCN Red List of Ecosystems Technical Advisory Committee
- International Scientific Advisory Committee Ocean Tracking Network.

At the national level, staff provided expert advice to a number of organisations including:

- Australian Research Council's College of Experts
- ARC Laureate Fellowship Selection Panel
- Climate Commission
- Wentworth Group of Concerned Scientists
- Land Sector Carbon and Biodiversity Board
- Climate Scientists Australia
- Australian Academy of Science
- National Marine Mammal Scientific Committee
- Australian Animal Tagging and Monitoring System Integrated Marine Observing System.

In addition, a number of staff served as councillors for a range of professional organisations including the Australian Flora Foundation and the Australian Marine Sciences Association. Several staff members contributed to the organisation of national research bodies such as the Terrestrial Biodiversity Adaptation Research Network, the National Climate Change Adaptation Research Facility and the TERN Executive Advisory Committee.

The Department's academic staff contributed to review panels for international funding bodies such as the U.S. National Science Foundation, served on editorial boards of a wide range of international journals including the Journal of Ecology, Journal of Animal Ecology, Animal Behaviour, PLoS ONE, International Journal of Biodiversity, Animal Cognition, Frontiers in Comparative Psychology, Journal of Experimental Psychology, Animal Behavior, Behavioral Ecology and Sociobiology, AoB Plants, ISRN Zoology, and the Journal of Comparative Psychology, Learning and Motivation.



Members of staff served as chairs of the NSW Scientific Committee and the NSW Fisheries Scientific Committee, as well as serving on a range of advisory boards including:

- Scientific Advisory Committee for Sydney Institute of Marine Science
- Education Committee of the Australian Society of Fish Biologists
- Royal Botanic Gardens & Domain Trust
- NSW Office of Environment & Heritage Climate Change Advisory Panel
- Marine Fauna Advisory Committee.

1. Crossing the Simpson Desert to get to the next field site. Photo by Paul Duckett.

Research Centre Reports

Two of Macquarie University's research centres – Genes to Geoscience Research Centre and Climate Futures – are largely based in the Department of Biological Sciences and have strong links with other departments in the Faculty of Science and across the University.

Genes to Geoscience Research Centre

A four-way fusion is emerging among comparative genomics, functional ecology, earth system science and the informatics needed to bring them together. New high-impact research questions are emerging, and it is against this background that the Genes to Geoscience Research Centre aims to nurture forward-looking research ideas. The Centre is made up of a federation of 33 independent laboratories spread across several departments: Biological Sciences, Environment and Geography, Earth and Planetary Sciences, Chemistry and Biomolecular Sciences, and Brain Behaviour and Evolution. The Centre's activities are designed to complement those of contributing departments and individual laboratories.

During 2012, ten speakers visited Macquarie for the Genes to Geoscience seminar series. Sixteen masterclasses were held for postgraduates and postdoctoral fellows as part of the Genes to Geoscience Research Enrichment Program. Ten of these classes were new in 2012. Eight working groups also discussed the following topics: Marine Invasions and Temperature Adaptation; Colour and Colour-Sensing; Dansgaard-Oeschger Cycles and Rapid Climate Change; Growth Rates and Leaf Size; Bee Behaviour and Neurobiology; Cognition; and Eliminating Childhood Lead Toxicity. The flagship Genes to Geoscience outlook meeting included four distinguished visiting speakers as well as nine Macquarie laboratory leaders. Discussions over two days targeted future research possibilities and we are confident that fresh collaborations will result.



1. Trapping skinks. Photo by Martin Whiting.



2. Paul Duckett sampling geckos in desert. Photo by Craig Angus.

Climate Futures

Climate Futures is a multidisciplinary research centre that includes members from all four faculties, with significant representation from the Department of Biological Sciences (including the co-director). During 2012, Climate Futures members were awarded \$7,944,075 for climate-related research, produced 60 journal articles and supervised 73 postgraduate students undertaking climate or environmental research. Throughout the year the Centre ran seven seminars, six workshops, three roundtable discussions and two public lectures. The Centre is focused on three main areas of expansion: building external industry and government linkages; education through the development of the Master of Climate Change, a multi-disciplinary program developed by 25 researchers from across the university; and communication and outreach.

A key aim of the Centre is to engage with government and industry partners to develop long term research projects and educational initiatives, building capacity across Macquarie University and beyond. In 2012, the Centre fostered external industry and government links through a series of focused workshops aligned with the main research themes of the Centre. The workshops focused on several key areas: strengthening current research; projects and partnerships; identifying research gaps with government, non-government and industry partners; and generating new knowledge across traditional boundaries that will have the potential for enhancing the integration of research, policy and practice needs. Postgraduate students are always encouraged to participate in these activities so that they can engage with external partners.

The Centre's workshops and outreach program attracted attendees from 28 government agencies, seven not-for-profit organisations, 23 corporate bodies and 12 universities. Climate Futures continued to focus on lifting our internal and external profile by promoting the expertise of its members and potential for collaborative research.

Financial Statements 2012

RESEARCH INCOME	2011	2012
AINSE	\$14,800	\$7,400
ARC Discovery Early Career Research Award		\$253,078
ARC Discovery Projects	\$1,313,206	\$1,610,475
ARC Future Fellows	\$689,928	\$830,960
ARC Laureate Fellow	\$577,303	\$626,704
ARC Linkage International		\$-6,686
ARC Linkage Projects	\$178,911	\$129,892
Australian Antarctic Division	\$52,060	
CSIRO		\$17,000
National Taxonomy Research Grant		\$45,000
NCCARF	\$200,000	\$76,150
NHMRC Project Grants	\$79,000	\$71,000
Rural Industries Research Development	\$90,992	\$51,375
Commonwealth Other	\$166,581	\$230,320
Local Government	\$4,619	\$2,310
State Government	\$292,565	\$132,413
Australian Contracts	\$63,151	\$119,638
Donations, Bequests, Foundations	\$178,430	\$85,997
International Funding Category A	\$10,011	\$84,932
International Funding Category B		\$67,708
Total	\$3,911,557	\$4,435,666

Income Statement for the year ended 31 December 2012

	NOTE	2012	2011
INCOME			
Department Operating Funds	1	9,656,216	8,871,728
Research Grants and Contracts		4,877,843	5,320,643
Donations		15,985	143,607
Consultancy, Service and Investment Income		172,429	145,354
Other Income - Fees, Sundry Income		159,364	360,191
Internal University Income		118,738	126,559
Internal University Fund Transfers		2,258,983	3,481,867
TOTAL INCOME		17,259,559	18,449,949
EXPENDITURE			
Academic Salaries		9,048,906	8,007,781
Professional Salaries		2,920,595	2,381,002
SALARIES		11,969,501	10,388,783
Contractors and Other Employment		840,464	198,071
Student, Printing and Publications		88,366	74,743
Consumables excluding Internal		580,337	598,911
Internal Consumables and Services		289,038	326,769
Grants to External Organisations		231,136	245,279
Other General Costs		45,795	63,107
Facilities and Equipment		606,809	716,547
Travel		896,389	809,067
NON SALARY COSTS		3,578,334	3,032,495
TOTAL DIRECT COSTS		15,547,835	13,421,278
DIRECTLY CONTROLLABLE SURPLUS/DEFICIT (-)		1,711,724	5,028,670
Infrastructure Costs		29,532	25,156
Faculty Overhead		1,179,587	1,614,653
INDIRECT COSTS		1,209,119	1,639,809
TOTAL DIRECT/INDIRECT COSTS		16,756,954	15,061,088
SURPLUS/DEFICIT (-)		502,605	3,388,861
REPRESENTED BY:			
Operating	2	634,641	791,005
Non Operating	3	-132,036	2,597,856
BALANCE BROUGHT FORWARD			
Operating	2	0	0
Non Operating	3	5,567,951	3,035,219
		5,567,951	3,035,219

NOTES:

Numbers might not add up due to rounding.

1 - Department operating funds are based on the Faculty Funding Model (FFM).

2 - Operating: In general unexpended operating funds and other operating income do not carry forward

3 - Non Operating: Unexpended research grants & contracts; donations; and consultancy, selected service & investment income typically carry forward.

2012 Publications

This list of publications includes papers that were not reported in the 2012 HERDEC. In our discipline it is internationally recognised common practice for research team leaders to be named as last author on peer-reviewed publications, with mentored PhD students or research fellows as first named author.



Journal articles

- Ajani, P., Brett S., Krogh, M., Scanes, P., Webster, G. & Armand, L. (2012). The risk of harmful algal blooms (HABs) in the oyster growing estuaries of New South Wales. *Environmental Monitoring and Assessment*, 185(6): 5295-5316
- Allen, L. E., Barry, K. L., & Holwell, G. I. (2012). Mate location and antennal morphology in the praying mantid *Hierodula majuscula*. *Australian Journal of Entomology*, 51(2), 133-140.
- Amaral, A. R., Beheregaray, L. B., Bilgmann, K., Boutov, D., Freitas, L., Robertson, K. M., Sequeira, M., Stockin, K. A., Coelho, M. M. & Möller, L. M. (2012). Seascape genetics of a globally distributed, highly mobile marine mammal: the short-beaked common dolphin (genus *Delphinus*). *PLoS ONE*, 7(2), e31482.
- Amaral, A. R., Beheregaray, L. B., Bilgmann, K., Freitas, L., Robertson, K. M., Sequeira, M., Stockin, K. A., Coelho, M. M. & Möller, L. M. (2012). Influences of past climatic changes on historical population structure and demography of a cosmopolitan marine predator, the common dolphin (genus *Delphinus*). *Molecular Ecology*, 21(19), 4854-4871.
- Amaral, A. R., Jackson, J. A., Möller, L. M., Beheregaray, L. B. & Coelho, M. C. (2012). Species tree of a recent radiation: The subfamily Delphininae (Cetacea, Mammalia). *Molecular Phylogenetics and Evolution*, 64(1), 243-253.
- Amaral, V., Cabral, H. N., & Bishop, M. J. (2012). Effects of estuarine acidification on predator-prey interactions. *Marine Ecology Progress Series*, 445, 117-127.
- Amaral, V., Cabral, H. N., & Bishop, M. J. (2012). Moderate acidification affects growth but not survival of 6-month-old oysters. *Aquatic Ecology*, 46(1), 119-127.
- Amaral, V., Thompson, E. L., Bishop, M. J., & Raftos, D. A. (2012). The proteomes of Sydney rock oysters vary spatially according to exposure to acid sulfate runoff. *Marine and Freshwater Research*, 63(4), 361-369.
- Asher, A. J., Waldron, L. S., & Power, M. L. (2012). Evaluation of a PCR protocol for sensitive detection of *Giardia intestinalis* in human faeces. *Parasitology Research*, 110(2), 853-858.
- Asher, A. J., Waldron, L. S., & Power, M. L. (2012). Rapid identification of *Giardia duodenalis* assemblages in NSW using terminal-restriction fragment length polymorphism. *Parasitology*, 139(8), 1005-1013.
- Asmyhr, M. G. & Cooper, S. J. B. (2012). Difficulties barcoding in the dark: the case of crustacean stygofauna from eastern Australia. *Invertebrate Systematics*, 26(6), 583-591.
- Asmyhr, M. G., Stow, A. J., & Hose, G. (2012). The first set of microsatellite markers developed for the ancient Parabathynellidae (Syncarida, Malacostraca) and their utility for other groundwater fauna. *Conservation Genetics Resources*, 4(3), 587-589.
- Attard, C. R., Beheregaray, L. B., Jenner, K. C. S., Gill, P. C., Jenner, M. N., Morrice, M. G., Robertson, K. M. & Möller, L. M. (2012). Hybridization of Southern Hemisphere blue whale subspecies and a sympatric area off Antarctica: impacts of whaling or climate change? *Molecular Ecology*, 21(23), 5715-5727.
- Baird, A. H., Sommer, B., & Madin, J. S. (2012). Pole-ward range expansion of *Acropora* spp. along the east coast of Australia. *Coral Reefs*, 31(4), 1063.
- Banik, G. R., Birch, D., Stark, D., & Ellis, J. T. (2012). A microscopic description and ultrastructural characterisation of *Dientamoeba fragilis*: An emerging cause of human enteric disease. *International Journal for Parasitology*, 42(2), 139-153.
- Barron, A. B., & Brown, M. J. (2012). Science journalism: Let's talk about sex. *Nature*, 488(7410), 151-152.
- Barton, C. V., Duursma, R. A., Medlyn, B. E., Ellsworth, D. S., Eamus, D., Tissue, D. T., Adams, M. A., Conroy, J., Crous, K. Y., Liberloo, M., Löw, M., Linder, S. & McMurtrie, R. E. (2012). Effects of elevated atmospheric [CO₂] on instantaneous transpiration efficiency at leaf and canopy scales in *Eucalyptus saligna*. *Global Change Biology*, 18(2), 585-595.
- Beaumont, L. J., & Duursma, D. (2012). Global Projections of 21st Century Land-Use Changes in Regions Adjacent to Protected Areas. *PLoS ONE*, 7(8), e43714.
- Bednarski, J. B., Taylor, P. & Jakob, E. M. (2012). Optical cues used in predation by jumping spiders, *Phidippus audax* (Araneae, Salticidae). *Animal Behaviour*, 84(5), 1221-1227.
- Bibost, A.L., Kydd, E. & Brown, C. (2012). The effect of sex and early environment on the lateralization of the rainbowfish *Melanotaenia duboulayi*. *Behavioral Lateralization in Vertebrates*, 9-24
- Birnbaum, C., Barrett, L. G., Thrall, P. H., & Leishman, M. R. (2012). Mutualisms are not constraining cross-continental invasion success of *Acacia* species within Australia. *Diversity and Distributions*, 18(10), 962-976.
- Bishop, M. J., Byers, J. E., Marcek, B. J., & Gribben, P. E. (2012). Density-dependent facilitation cascades determine epifaunal community structure in temperate Australian mangroves. *Ecology*, 93(6), 1388-1401.
- Boomer, J. J., Harcourt, R. G., Francis, M. P., & Stow, A. J. (2012). Genetic divergence, speciation and biogeography of *Mustelus* (sharks) in the central Indo-Pacific and Australasia. *Molecular Phylogenetics and Evolution*, 64(3), 697-703.
- Braconnot, P., Harrison, S. P., Kageyama, M., Bartlein, P. J., Masson-Delmotte, V., Abe-Ouchi, A., Otto-Bleisner, B. & Zhao, Y. (2012). Evaluation of climate models using palaeoclimatic data. *Nature Climate Change*, 2, 417-424.
- Bragg, J. G., Quigg, A., Raven, J. A., & Wagner, A. (2012). Protein elemental sparing and codon usage bias are correlated among bacteria. *Molecular Ecology*, 21(10), 2480-2487.
- Brazill-Boast, J. (2012). Competition for resources mediated by intrinsic social dominance in sympatric finches. *Ibis*, 155(1), 189-193.
- Brown, C. (2012). Tool use in fishes. *Fish and Fisheries*, 13(1), 105-115.
- Brown, C., Garwood, M. P., & Williamson, J. E. (2012). It pays to cheat: tactical deception in a cephalopod social signalling system. *Biology Letters*, 8(5), 729-732.
- Browning, L. E., Patrick, S. C., Rollins, L. A., Griffith, S. C., & Russell, A. F. (2012). Kin selection, not group augmentation, predicts helping in an obligate cooperatively breeding bird. *Proceedings of the Royal Society B: Biological Sciences*, 279(1743), 3861-3869.
- Browning, L. E., Young, C. M., Savage, J. L., Russell, D. J. F., Barclay, H., Griffith, S. C. & Russell, A. F. (2012). Carer provisioning rules in an obligate cooperative breeder: prey type, size and delivery rate. *Behavioral Ecology and Sociobiology* 66, 1639-1649.
- Bush, A., Theischinger, G., Nipperess, D., Turak, E. & Hughes, L. (2012). Dragonflies: climate canaries for river management. *Diversity and Distributions*, 19(1), 86-97.
- Bush, A., Nipperess, D., Turak, E. & Hughes, L. (2012). Determining vulnerability of stream communities to climate change at the landscape scale. *Freshwater Biology*, 57(8), 1689-1701.
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