

List of potential research projects for honours and postgraduate students in the Department of Biological Sciences (including Brain, Behaviour & Evolution)

Dr Sinan Ali (9850 8141; E7B242; sinan.ali@mq.edu.au)

1. Characterisation and function of sugars on the steroid binding protein CBG
2. Function of CBG in steroid hormone action via membrane binding
3. Sex hormone binding globulin (SHBG) as an anti-oestrogen in breast cancer
4. Development of a novel bioassay for measuring salivary cortisol in real time

Dr. Andrew Allen (9850 9251; E8B217; drew.allen@mq.edu.au)

1. Global biogeography of planktonic foraminifera: relating species abundance to environmental gradients based on population dynamics. (Work being conducted in collaboration with researchers here and in the US on a funded ARC grant.)
2. Effects of global warming on densities and ultrastructures of plant organelles. (Builds on ARC research proposal currently in review. Involves analysis of TEM imagery using stereology techniques. Samples suitable for an honors project have already been prepared.)
3. Effects of global warming on leaf-level nitrogen-phosphorus stoichiometry. (Builds on ARC research proposal currently in review. Involves cultivating plants in growth chambers as well as some laboratory work.)

Dr Leanne Armand. (E8C157, x8351, leanne.armand@mq.edu.au)

Honours projects.

1. To be or not to be a sea-ice indicator species: untangling morphometric differences in the diatom *Eucampia antarctica* (in collaboration with Dr A. Leventer, University of Colgate, USA).
2. Diatom diversity and distribution south of Tasmania using FlowCAM.
3. Antarctic sea-ice diatom distribution and diversity off the Adélie Land coast, Antarctica (potential PhD programme can be developed from this project).
4. Fans, fingers, lumps and lace: the effects of oceanographic and geochemical factors on tropical invertebrate morphology (in collaboration with Dr R. Przeslawski, Geoscience Australia).

Masters and PhD projects (can be expanded to PhD level research programme).

4. Natural iron fertilization on the Kerguelen Plateau: phytoplankton community response (may include sea-going mission in Oct-Nov. 2011).
5. Seasonal variation in diatom export to the Kerguelen Plateau (may include sea-going mission in Oct-Nov. 2011).
6. Phytoplankton characterisation and survey of the Coffs Harbour region, Eastern Australia.
7. Antarctic sea-ice diatom distribution and diversity off the Adélie Land coast, Antarctica.
8. New statistical models in determining palaeo-sea-ice cover from biological and physical data.

Assoc. Prof. Brian Atwell (9850 8224; E8A 205; brian.atwell@mq.edu.au)

1. Physiology, development and molecular genetics of native Australian grasses, particularly rice – research links with APAF, Microscopy Unit and various Australian universities.
2. Physiology and architecture of plants under elevated CO₂ (climate change) - liaising with Dr Belinda Medlyn (E8C209; 9850 8897; belinda.medlyn@mq.edu.au) and using the controlled climate facility at Macquarie
3. Root physiology and development of mutated plants growing in hard matrices (aspects of biophysics and cell biology)

Dr Andrew Barron (W19F, 9850 1310; Andrew.Barron@mq.edu.au)

1. The neurobiology of honey bee dance language.
2. The molecular basis of memory: does long term memory change DNA?
3. Cognition in a minibrain: how smart are Australian native stingless bees?
4. Queen control and social organisation in Australian native stingless bees.

Dr Kate Barry (kate.barry@mq.edu.au, E8A174, 9850 8208)

Projects on the ecology and evolution of sexual reproduction, specifically the evolutionary outcome of reproductive conflict between and within the sexes.

- the evolution of mating strategies
- sexual signalling and mate choice in invertebrates (particularly praying mantids, spiders and butterflies)

Dr Linda Beaumont (9850 8157, E8C246, linda.beaumont@mq.edu.au)

1. Impacts of climate change on birds
2. Vulnerability of Australian ecosystems to climate change
3. Impacts of climate change on species distributions
4. Use of natural history collections to understand biological responses to climate change

Dr Melanie Bishop (Melanie.bishop@mq.edu.au, E8C 159 [inside Climate Risk Centre], 9850 4075)

1. Can Sydney Rock oysters and Pacific oysters be considered functional equivalents?
2. Under what circumstances are ecosystem engineers good buffers of environmental change?
3. Predicting effects of sea-level rise on estuarine soft-sediment communities.
4. Why does leaf litter mixing have non-additive effects on decomposition rate?
5. Impacts of invasive European Shore Crabs on commercially important molluscs
6. Resources from another place and time: the role of wrack in fuelling rock-pool communities.
7. Impacts of climate warming on bioturbation by the benthic bulldozer, *Pyrazus ebeninus*
8. Why do different sources of nutrients (fertilizer vs organic material) differ in their impact to sediment communities?
9. Other mutually agreed-upon projects focusing on coastal systems.

Dr. Glenn Brock (9850 8335, E5A 216; glenn.brock@mq.edu.au)

1. Ecospace utilisation and trophic structure of early Cambrian benthic communities from South Australia
2. Structure and formation of Archaeocyath reef bioherms from the Chace Range, southern Flinders Ranges
3. Ecology and Evolution of soft-bodied "Orsten" assemblages from the Middle Cambrian of western QLD
4. Taxonomy and Biodiversity of tropical Foraminifera from the Great Barrier Reef
5. Ordovician faunas from the Emanuel Formation, Canning Basin Western Australia
6. Subsurface biostratigraphy of Cambrian faunas from Central Australia
7. Middle Cambrian phosphatic brachiopods from western Queensland.
8. Developmental biology and biomineralisation of living discinid brachiopods
9. Epibionts in the fossil record – what do they tell us about ancient palaeocommunities
10. Any projects related to the Australian fossil record considered.

Dr Culum Brown (culum.brown@mq.edu.au; 9850 6292)

1. Learning & memory in fishes.
2. Cerebral lateralisation ("handedness") & dual processing in fishes.
3. Environmental enrichment and brain development/plasticity in fishes.
4. Social networks and social transmission of information in fishes.
5. Boldness-shyness traits in fishes; repeatability of personality testing.
6. Native/exotic interactions in fishes.
7. Population genetics in Australian, Panamanian and Indian fishes
8. Prey and predator recognition in hatchery-reared fishes
9. Microhabitat characteristics of roosting locations in grey headed flying foxes
10. Climate modelling for flying foxes
11. Any Behavioural Ecology or Fishy Projects considered.

Prof Ken Cheng (W21A 2; 9850-8613; ken.cheng@mq.edu.au)

1. learning and cognition in free flying honeybees (on campus)
2. navigation, foraging, and learning in red honey ants (field experiments in Alice Springs)

Prof Mark Connor (9114 4030, mark.connor@mq.edu.au, ASAM)

1. Investigating novel drug targets on calcium channels and TRP channels using cell-based assays of intracellular calcium concentration.
2. Investigating agonist biased opioid receptor signalling.
3. Investigating G protein-coupled receptors for novel endocannabinoid compounds.

Dr Jennifer Cornish (jennifer.cornish@mq.edu.au; 9850 9467)

Projects into the neurobiology of drug addiction (cocaine, methamphetamine 'ice') and related disorders (psychosis, anxiety, depression, memory impairments) using techniques in:

1. Neuropharmacology/physiology
2. Behavioural Pharmacology/physiology

3. Cardiovascular Pharmacology/physiology (with Assoc Prof Ann Goodchild)
4. Proteomic analysis of brain areas (with Assoc Prof Paul Haynes)

Assoc. Prof. Jenny Donald (9850 8161; E8C211; jenny.donald@mq.edu.au)

1. Projects in human molecular genetics. Contact Jenny for availability.

Professor Chris Evans (chris.evans@mq.edu.au) in conjunction with Dr. K-lynn Smith (klynn.smith@gmail.com; 0403 388 469).

1. Sociality: does it select for higher intelligence?
2. Personality in fowl: why are males shyer than females?
3. Dear enemy: 'crow' thy neighbor? Testing the assumptions about this well-known but poorly understood call.
4. Using 3D animation to study the form and function of visual signals in fowl
5. Understanding the origin of multimodal (visual and vocal) signals. Why bother with redundant signals?
6. Can chickens use human directed cues to find hidden food sources?

Prof. Michael Gillings (9850 8199, E8A271; mgilling@rna.bio.mq.edu.au)

1. Horizontal gene transfer and Bacterial evolution
2. The molecular ecology of DNA
3. Evolution and diversity of antibiotic resistance integrons and mobile gene cassettes
4. Plasmids and integrons in aquaculture and fresh sea food

Assoc. Prof. Ann Goodchild (98123550; ann.goodchild@mq.edu.au) and Dr Natasha Kumar (9850 4027; natasha.kumar@mq.edu.au)

Systems and signalling group- The Australian School of Advanced Medicine

1. Do closely related relatives of somatostatin alter breathing and blood pressure in the ventral brainstem?
2. What is the chemical code of sympathetic neurons that regulate the release of noradrenaline and arealine from the adrenal medulla?
3. Where does the somatostatin that stops breathing come from in the brain and at which receptors does it act?

Alternative projects are also available.

No knowledge is assumed and no experience is required.

Assoc. Prof. Mariella Herberstein (9850 6276; E8B 111; marie.herberstein@mq.edu.au)

1. Any behavioural/ecological project on insects and spiders
2. Any project relating to the behaviour, ecology and evolution of *Kosciuscola* grasshoppers in the Australian alpine region (Kate Umbers and Marie Herberstein)

and in association with...

Aaron Harmer (E8A295; 9850 6279; aharmer@bio.mq.edu.au)

1. Biomechanical properties of spider orb-webs.

Interested students will conduct fieldwork and laboratory experiments in a cross-disciplinary project incorporating aspects of both spider behaviour and the physics of spider silks.

Dr Roger Hiller (9850 8148; E8A 208; roger.hiller@mq.edu.au)

1. Molecular Biology of the main intrinsic LHC from a Dinoflagellate
- involves algal culture, phage library screening, DNA sequencing and RT-PCR.

Dr Grant Hose (E8C153; 9850-6296; grant.hose@mq.edu.au)

1. Tolerance and resilience of groundwater ecosystems to disturbance
2. Testing the biodiversity-ecosystem function relationship in groundwaters
3. Using metagenomics to assess pollution impacts in freshwaters
4. Response of stream invertebrate communities to environmental change

Prof. Lesley Hughes (9850 8195; lesley.hughes@mq.edu.au)

1. The role of temperature in determining altitudinal gradients in the composition of biological assemblages within a river valley (co-supervised by Eren Turak, Dept of Environment and Climate Change)
2. Climate change and semi-arid vegetation (co-supervised by Dr John Pickard, Graduate School of Environment)

Dr Darrell Kemp (E8A-275; 9850-8355; darrell.kemp@mq.edu.au)

Lab- and field-based projects involving animal behaviour, breeding experiments, quantitative and molecular genetics, spectrometry (colour measurement) and electron microscopy. Specific projects could be embedded within the following themes (plus similar ones):

1. The evolution of sexual signal traits and behaviours in brightly coloured tropical freshwater fish (particular interest in the evolution of ultraviolet colour signals);
2. The evolution and genetics of colouration and signaling behaviour in butterflies, bugs, other insects;
3. The evolutionary dynamics of interactions between insect hosts and bacterial endosymbionts; particularly 'male killing' or 'feminizing' Wolbachia in butterflies;
4. The occurrence and cause of sex-ratio biases (deviations from 50:50 males:females) in Australian butterfly populations;
5. Adaptive potential in tropical and temperate butterfly populations, particularly as it pertains to the ability of populations/species to evolve under changing climate scenarios.

Assoc. Prof. Michelle Leishman (E8A170; 9850 9180;

michelle.leishman@mq.edu.au;

<http://www.bio.mq.edu.au/dept/centres/pirel/index.html>)

Any projects in plant invasion ecology and restoration ecology, including

1. responses of exotic and native plants to additional CO₂
2. competitive interactions between exotic and native plants under different resource conditions
3. bioclimatic modeling of plants under climate change

4. quantifying the effectiveness of bioretention of nutrients in urban stormwater design
5. volatile emissions from plants grown under high CO₂ – with **Dr Belinda Medlyn** (9850 8208, bmedlyn@bio.mq.edu.au) and **Dr Ian Jamie** (9850 8293, ijamie@alchemist.chem.mq.edu.au)
6. the smell of invasive success: comparative analyses of plant scents produced by invasive plants - with **Dr Ian Jamie** (9850 8293, ijamie@alchemist.chem.mq.edu.au)

Dr Joshua Madin (E8B 216; 9850- 8667; joshua.madin@mq.edu.au)

1. Any questions that focus on coral reef ecology, ecological biomechanics, or ecological informatics
2. Modeling relationships between reef fish swimming ability and hydrodynamic gradients (coral reef fishes)
3. Optimal branching architecture of plants over environmental gradients (plant biomechanics)
4. Developing a knowledge model for the ecological and environmental sciences (ecological informatics)

Dr Belinda Medlyn (E8C209; 9850 8897; belinda.medlyn@mq.edu.au)

A range of projects related to climate change impacts on forests

- interactions between rising CO₂, drought and temperature, using large-scale field experiments in western Sydney
- water relations of Eucalyptus trees under current and future atmospheric CO₂ concentrations
- investigating plant mortality under drought conditions (with Dr Melanie Zeppel)

Dr Simon McMullan (Australian School of Advanced Medicine; 9812- 3552; simon.mcmullan@asam.mq.edu.au)

1. How do cardiovascular control neurons communicate with each other to optimally distribute blood through the body?

Dr David Nipperess (E8B105; 9850 6950; david.nipperess@mq.edu.au)

1. Do phylogenetically diverse plant communities support more insect species than less diverse communities?
2. Australian and global hotspots for mammalian phylogenetic diversity
3. Rapid biodiversity assessment of invertebrates - combining parataxonomy with DNA barcoding
4. Bird diversity in riparian zones in suburban and rural landscapes - what is the effect of the landscape matrix?

Dr Ross Peacock (9850 8297; ross.peacock@mq.edu.au)

1. Climate variability and rainforest tree dynamics, seedling physiology, litter productivity and recruitment. Research combines field based monitoring, glasshouse trials and modelling.
2. Development of biodiversity surrogates and structural indices for monitoring change in forest condition in northern NSW (with Dr Chris McElhinny ANU and Forests NSW).

Research will be undertaken jointly with a large project team being established in late 2010.

3. Interaction of rainforest fauna, fine scale climate monitoring and seedling survival at Werrikimbe National Park (jointly with NPWS).
4. Development of improved methods for modelling spatial patterns of biodiversity in northern NSW using Generalised Dissimilarity Modelling (with Dr Simon Ferrier CSIRO Entomology and DECCW)

Dr Michelle Power (mpower@els.mq.edu.au; 9850 6974)

1. Diversity and evolution of parasites of marsupials
2. Microbial profiling for conservation of Australian sea lions (with Prof. Rob Harcourt GSE)
3. Epidemiology of Giardia in humans in NSW

Dr Michelle Power & Prof. Michael Gillings

1. The impacts of human sewage on the Antarctic environment: spatial and temporal distribution of antibiotic resistance genes from human microbes.

Professor Colin Prentice (E8C269; 9850-4227; colin.prentice@mq.edu.au)

1. What controls fire? Analysis of global data on fire (from satellites), climate, and human activities.
2. What can we learn from changes in the stable isotope composition of methane in ice cores?
3. Quantifying the natural cycle of NH_x (ammonium and ammonia) in the atmosphere and biosphere.
4. Influence of slope and aspect on photosynthesis and transpiration at different latitudes. [Would suit a mathematically inclined student.]
5. The effect of low CO₂ during ice ages on the world distribution of forests and savannas.
6. Quantifying the emissions of isoprenoids by plants – developing and analysing a global data set.
7. Using plant traits to infer past climate changes.
8. Testing a new stomatal conductance model using stable carbon isotope data.
9. Global analysis of leaf phenology using satellite observations.
10. Climate change and bioclimate change – what's the difference? [Would suit a moderately mathematically inclined student.]

Assoc. Prof. David Raftos (9850 8402; E8C 245; david.raftos@mq.edu.au) & Dr Sham Nair (9850 9686; E8C 246; sham.nair@mq.edu.au)

1. QX disease in Sydney Rock oysters
2. Disease control in abalone
3. Hypervariable defence proteins from sea urchins
4. Effects of environmental stress on protein expression in oysters and sea urchins
5. Environmental proteomics in marine invertebrates
6. Evolution of the immune system: Identification of the cellular components that provide invertebrate cells with their molecular concept of individuality

7. Genetic control of fertilisation success in oysters

Dr Julia Raftos (9850 6275; E8B105; julia.raftos@mq.edu.au)

1. Modelling the glutathione metabolism in human red blood cells

Dr Adam Stow (9850 6292; E8A269; adam.stow@mq.edu.au)

1. Relationships between the evolution of sociality, reduction of genetic variability and production of antimicrobial compounds in arthropods
2. Rapid methods for detecting antimicrobial compounds from insects
3. Going with the crowd - the ecology of sociality in thrips
4. Teddybear's Picnic - population structuring of teddybear bees and their bugs
5. Taxonomy and parentage analysis of Cunningham's Skinks species complex

Prof Mark Westoby (E8C 161; 9850 8196; mark.westoby@mq.edu.au, <http://www.bio.mq.edu.au/ecology/westoby/mark.htm>)

1. Twig design and twig breakage compared across species (a mixture of biomechanical measurements in the lab with comparisons of actual breakage rates in the field)
2. Mechanics of breakage of grass stems in relation to the persistence of grass fuels for bushfires (again a matter of comparing across species in the field, but with rigorous biomechanical measurements using the Universal Testing Machine)
3. Anatomy of woody stems in relation to hydraulics and breakage risk (emphasis on quantitative microscopy technique, but the question is about large-scale patterns in the nature of stemwood across different species)
4. Modeling natural selection on plant strategies under rising CO₂ (for students with interests in mathematical modelling)

Dr Ian Wright (E8C210; 9850-4228; ian.wright@mq.edu.au; www.bio.mq.edu.au/~iwright/wright.htm)

Projects focusing on plant ecology or ecophysiology, e.g.

1. Quantifying variation in plant function (and “functional” traits) along climate and soil fertility gradients: field experiments, or glasshouse experiments.
 2. Coordination of photosynthetic traits and plant hydraulic properties.
 3. Comparison of within-species and between-species vertical gradients in light availability and leaf traits (leaf structure, nutrient and pigment concentrations).
 4. Using leaf traits of fossil species for paleo-ecological reconstruction.
- Any other mutually-agreed topic. Come and talk to me about your ideas or interests.