Biology Honours Projects 2017

A comprehensive guide to the host supervisors, and their research interests, in the School of Biological Sciences

Sureshkumar Balasubramanian

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My group (SKB Lab- where science is fun!) is a translational biology group working on fundamental molecular mechanisms that could lead to range of benefits from therapeutic applications to food security. There are two key research programs that are pursued in my group. First, we are interested in understanding mechanisms through which plants sense and respond to changes in ambient temperature (Sureshkumar et al, *Nature Plants, 2016*, Zhu et al *PLoS Genetics, 2015*, Todesco et al, *Nature, 2010*, Balasubramanian et al, *PLoS Genetics, 2006*). Second aspect relates to a discovery in my group in which we revealed the first and only known triplet repeat expansion associated genetic defect outside humans in the model plant *Arabidopsis thaliana* (Essebier et al, *Frontiers in Neuroscience, 2016*, Cao et al, *Nuc. Acids Res, 2014*, Sureshkumar et al, *Science, 2009*). We currently exploit this system in combination with human cell culture to study fundamental mechanisms underlying triplet expansion associated genetic defects. The primary focus at this stage is related to the molecular biology of Friedreich's ataxia, the most common genetically inherited ataxia for which currently there is no cure. We use a combination of genetic, molecular, biochemical and computational analysis to study the basis of phenotypic variation. The specific project will be negotiated through discussions with the students.

Jeremy Barr

Webpage: https://thebarrlab.org/

Jeremy is a microbiologist, and joins Monash in August 2016. His research group studies bacteriophage and investigates their role and function in the human body. Projects in his group include the bacteriophage adherence to mucus (BAM) model;

utilizing microfluidic devices to create life-like mucosal surfaces; investigating the dynamics of bacteriophage diffusion in complex media and fluids; bioengineering bacteriophages and nanoparticles for prospective biotechnology applications.

John Bowman

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How does a single cell develop into a multicellular embryo with specific tissue and organ patterns?

We are studying pattern formation in land plants, which represent one of the several independent evolutions of multicellular organisms.
We are using *Arabidopsis*, a diminutive flowering plant that is a model for studying many aspects of plant biology as it is amenable to genetic and genomics approaches. We are particularly interested in the genetic control of pattern formation, focusing on the roles of three families of transcription factors.provide insight into how major changes in body plan evolved in the land plants.

Rowan Brookes
Education Honours Project (School of Biological Sciences)

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These projects are co-supervised between Dr Susie Ho and Dr Rowan Brookes

Feb. or July 2017 start

Employability is a major issue in higher education. This is because university graduates face a competitive and changing employment market. Furthermore, the tertiary sector is growing, with more and more students completing degrees and requiring pathways to work.

Our research focuses on the following broad question - "How can we best ensure that science graduates possess the skills to successfully transition into the workplace?".

We are offering Honours projects centred on examining the efficacy of two approaches to fostering employability, with the aim of benchmarking current practice and improving curriculum design into the future.

Two projects are offered in 2017:

What is the impact of internships and work experience on employability undertaken during science degrees? (Project 1, supervised by Rowan Brookes with Susie Ho)

How can the Jock Marshall Reserve be better utilised for problem-based learning using real-world industry challenges? (Project 2, supervised by Susie Ho with Rowan Brookes).

We are seeking dedicated undergraduates with a demonstrated interest in education, who possess initiative and solid skills in academic writing, who will under supervision, design and undertake research for publication in an international education journal.

Rob Bryson-Richardson

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Webpage: http://monash.edu/science/about/schools/biological-sciences/staff/bryson-richardson/
http://myopathyresearch.org

We investigate the genetic causes, mechanisms of disease, and potential therapies for a range of muscle diseases (myopathies), using the advantages of the zebrafish model system for in vivo imaging, genetic manipulation, and screening to accomplish these goals. We have previously utilised zebrafish to provide insights into nemaline and myofibrillar myopathies and explore potential therapies for these conditions. Projects in the lab would focus on investigation of novel muscle disease genes and characterisation of disease models.

Martin Burd

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http://www.monash.edu/research/people/profiles/profile.html?sid=1539&pid=2978

Research in our lab is focused on macroevolutionary patterns of plant traits, particularly reproductive traits (floral color, mate limitation of reproductive success, heterospory). Interested students should contact Martin Burd early to discuss possible projects.

Richard Burke

Room: G32B, 18 Innovation Walk
Email: Richard.Burke@monash.edu
Webpage: https://sites.google.com/site/burkeresearchgroup/home

The Burke Laboratory uses the model organism Drosophila melanogaster to investigate the molecular genetics of ion transport and homeostasis in animals. Metal ions such as copper and zinc and cations such as chloride play critical roles in biology as protein co-factors and signalling molecules and mutation of key ion

transport genes are known to cause several diverse human diseases. We use Drosophila to elucidate the function of these genes and screen for drugs able to restore function to mutant transport proteins. Honours projects in the Burke laboratory typically involve a combination of fly genetics, molecular biology and fluorescence confocal microscopy.

David Chapple

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Email: David.Chapple@monash.edu
Webpage: https://sites.google.com/site/chapplelab/

The Chapple Lab investigates the evolutionary ecology of environmental change. We use field studies, field- and lab-based experiments, comparative analyses, morphological analyses and molecular approaches to examine the impact of past, current, and future environmental change on phenotype, life-history and distribution. We use squamate reptiles as model systems in which to examine the ecological and evolutionary impacts of environmental change. Our current research is focused on *Lampropholis* skinks and *Egernia* group lizards, and the macroecology of lizards. For further information see https://sites.google.com/site/chapplelab/

Steven Chown

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Our research is focused on two areas. First, we investigate responses to variable environments and how they influence population dynamics both at the local scale and at regional, macroecological levels. Typically we focus on traits such as development rate, metabolic rate, thermal tolerances, water loss and body size. And mitigation of the impacts of environmental change in bult, agricultural and conservation landscapes is a key concern of the work. Second we are concerned with biodiversity patterns and conservation across the broader Antarctic region. This includes work in the sub-Antarctic and on the continent itself. The fields encompass community ecology, invasion biology and phylogeography/phylogenomics.Recent overviews of our work and approach can be found in Chown *et al*. 2015 *Nature*, Chown & Convey 2016 *Annual Review of Entomology*, and Chown & Gaston 2016 *Functional Ecology*.

Applications for Honours projects are welcomed from high-achieving, motivated students who wish to do excellent science with impact. Options are available for work at the computer (e.g. conservation planning, macroecology), in the laboratory (traits and their evolution), and/or in the field (population dynamics, community ecology). Previous Honours students have travelled to the Antarctic and/or worked on projects concerning the region.

Rohan Clarke

Room: 223, 18 Innovation Walk
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Webpage: http://researchecology.com.au/

The Clarke lab is interested in various aspects of avian movement ecology. Current research in our group includes projects on avian malaria dynamics in a diverse bird community, the conservation management of threatened species, and interactions between offshore development, seabirds and other marine vertebrates. Any honours project would be tailored to best meet the student's interests and our research objectives.

Tim Connallon

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Website: http://timconnallon.com/

Research in the lab uses quantitative genetic and population genetic models to build better bridges between theory and data, and to generate new empirical predictions that may be tested using targeted lab experiments and/or analyses of public datasets. Topics of interest in the lab include: The evolution of sexual dimorphism, the maintenance of genetic variation for fitness and disease, the genetic basis of adaptation, the evolution of genome structure, sex chromosome evolution, and the interaction between dispersal and geographically local adaptation. Potential honours projects may strike a balance between theoretical work, data analysis, and lab experiments using Drosophila.

Carly Cook

Room: G18F, 18 Innovation Walk
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Webpage: http://carlycookresearch.wordpress.com/

Carly Cook's lab is interested in integrating science into conservation management decisions. Research in Carly's lab ranges from understanding the effectiveness, and cost-effectiveness of common management actions to understanding the use of evidence in conservation decisions. Possible projects include exploring the use of evolutionary theory in threatened species management (with Carla Sgro). Projects can also be negotiated with students based on their interests. For more information about Carly's lab and research interests visit: www.carlycookresearch.wordpress.com

Damian Dowling

Room: 439, 18 Innovation Walk
Email: Damian.Dowling@monash.edu
Webpage: www.damiandowlinglab.com

Damian Dowling's research group studies evolutionary conflict – both between the sexes, and between genomes. Research in the group is diverse, but generally follows three themes. Honours projects can be developed within any of these themes.

1) In many species, females mate many times within the one reproductive bout. Why do they do this? Traditional sexual selection theory suggests they will acquire genetic benefits for their offspring via multiple mating, but new data suggests that the costs of promiscuity will often outweigh the benefits.

2) Why do females typically live longer than males? Our research suggests the answer might light in the maternally-inherited mitochondrial genome. Maternal inheritance means that the mitochondria are selected for performance in females only. This enables male-harming mutations to inadvertently accumulate within the genome, depressing male longevity.

3) We are studying whether maternal inheritance of mitochondria will facilitate the evolution of genes within the mitochondrial DNA that are sexually antagonistic – benefiting female function, but harming males.

Alistair Evans

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Webpage: http://evomorph.org

The EvoMorph Lab explores the many aspects of biology that influence the shape or morphology of animals - evolution, development and function. We incorporate functional morphology, evo-devo and palaeontology using 3D scanning, 3D printing, biomechanics and developmental biology to answer fundamental questions about the evolution of animal morphology. Previous students in our lab have worked on whales, marsupials, carnivores, seals and insects, both extant and extinct. Future projects may include diprotodont marsupials, invertebrate body plans or whale evolution.

Ros Gleadow

Room: 311, 18 Innovation Walk
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Webpage: http://ecofizz.org/
http://tinyurl.com/hp3suws

Ros Gleadow leads the Plant Ecophysiology Group. We study the impact of climate change on plant growth and composition, and food security. We work at all scales from molecular genetics to distribution modelling. The group currently focusses on tropical crops that make cyanide: sorghum, taro and cassava. We also have projects studying the environmental effects on cyanide-containing eucalypts and their suitability for koalas and the environmental impact of the invasive tree, Pittosporum.

Chris Greening

Website: http://www.greeninglab.com/

Chris is a microbiologist, and joins Monash in June 2016. His group is called the Integrative Microbiology Lab. The group explores how bacteria persist under adverse environmental conditions. Bacteria are able to dominate practically all ecosystems due to their unprecedented ability to enter dormant states that resist environmental change. The group is interested in understanding the metabolic processes that aerobic bacteria use to remain energised and survive stress in these dormant states. Towards this goal, the group has identified multiple novel mechanisms through which aerobic bacteria survive starvation, hypoxia, and oxidative stress. The group employs a wide range of techniques to explore biological processes from enzymes to ecosystems, including bacterial culturing, genetic dissection, protein biochemistry, and environmental surveys.

Matt Hall

Room: 233A, 18 Innovation Walk
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The Hall research group explores how evolution has shaped the different strategies that animals use to cope with sex, disease, and death. Using small aquatic invertebrates, known as the water flea, we study how external experiences (such as diet or environment), or innate factors (such as genes and family history), combine to make individuals more or less attractive, healthy, or long-lived. Our group offers projects that explore the interplay between evolution of infectious disease, the conflict between males and females and trait investment, and the genetic and environmental basis of ageing.

Kathryn Hodgins

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Climates encountered by wide-ranging species can vary enormously, from frigid arctic temperatures to seasonally hot and dry Mediterranean climates to suffocating

tropical humidity. Populations of a species can evolve through natural selection to optimize their traits in response to these different environments in a process called local adaptation. Using genomic and experimental studies of invasive plants, our lab seeks to identify the genes underlying such adaptive differences and to understand the constraints and biases that may impact the genetic basis of adaptation. From slowing the evolution of herbicide resistance to speeding up adaptation to climate change, our ability to manage the process of local adaptation will be enhanced by a better understanding of how often the same adaptive solutions arise and the genetic mechanisms that underlie them.

Michael McDonald

Webpage: http://www.mcdonald-lab.com/

Mike is an evolutionary microbiologist, and starts at Monash ion July 2016. Mike's group is interested in the genetics of adaptation. To study this question, his lab propagates populations of yeast (and other microbes) for 1000's of generations in a variety of laboratory environments. Microbes grow and divide very quickly, providing a means for directly observing evolution as it happens. The goal is to understand how organisms adapt to better fit their environment, asking what genes do adaptive mutations occur in, how do the mutations change the genetic program of the cell and ultimately, whether we can predict how organisms will respond to environmental change. Mike's lab employs methods such as high throughput robotic liquid handling, whole genome sequencing and molecular genetic techniques.

Melodie McGeoch

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Research in the McGeoch Group focuses on the ecology and conservation of populations, communities and landscapes.

We use plant and animal populations and communities to examine the response of biodiversity to changing environments, including the dynamics of biological invasions. Our work ranges from quantifying and modelling the abundance and distribution of species, to examining the consequences of global change for protected areas. This research frequently feeds into environmental policy and management.

The golden thread that weaves its way through everything we do is the relationship and dynamics between individuals, species and objects in space, and how best to use this information in biodiversity conservation.

Beth McGraw

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Webpage: www.vectorbiologygroup.com

Feb or July 2017 start

I am an evolutionary biologist interested in how hosts and parasites interact. My lab group studies how mosquitoes transmit dengue virus and specifically how the mosquito genome controls virus transmission. To do this we infect mosquitoes with virus and study how virus moves through the body and is ultimately transmitted in the saliva. In association with studying that process we are currently examining mosquito lipid profiles, innate immune function and the role of symbiotic bacteria. An honours project would relate to one of these topic areas. Honours students in my group work in close association with a more senior researcher. I am happy to discuss potential projects in person.

Dustin Marshall

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Webpage: http://meeg.org/

We work on questions ranging from community ecology through to quantitative genetics. Most of our work focuses on sessile marine invertebrates living in coastal systems — these organisms are extremely amenable to manipulation and can be tracked in the field for extended periods of time.

Some of us are interested in traditional marine ecology whereas others are evolutionary biologists who happen to work on marine invertebrates.

Christen Mirth

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We study the regulation and evolution of environmentally-dependent traits in species from the genus Drosophila. Recently, our efforts have focused on understanding:

1) Developmental Plasticity and Evolution of Body Size and Shape;

2) The Relationship between Foraging Behaviour and Life History Traits.

We use the genetic tools available in *Drosophila melanogaster* to dissect how environmental signals, like nutrition and temperature, regulate growth and foraging

choices. By analysing the changes in these mechanisms with genetic variation both within and across species, we hope to identify how these environmentally-dependent traits evolve to create species-specific differences.

Keyne Monro

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My research group explores microevolutionary processes such as selection and adaptation, and the evolutionary ecology of benthic marine organisms.

Joslin Moore

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Webpage: http://joslinmooreresearch.wordpress.com/

Possible project opportunities

Feb. or July 2017 start

I develop projects in consultation with the student. My research group focuses on using experiments, ecological models and decision analysis to better understand and manage plant communities and populations. My group works predominantly on grassland restoration on the western edge of Melbourne and on peatland management and invasive plant species in the Victorian Alps. Check out my group's website for more information.

A mid-year start enables projects that include fieldwork in the Victorian Alps.

July 2017 start

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Anne Peters

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The Behavioural and Evolutionary Ecology of Birds group seeks to answer questions such as: how do animals balance investment in sex and health; what are the costs and benefits of cooperative breeding; why is there such a diversity of bird colours; how is climate change affecting birds. We do a lot of fieldwork, locally on a population of superb fairy-wrens at Lysterfield Park, and at our long-term study site in the Kimberley. Additionally, we use the long-term data record present in museum collections of preserved specimens for comparative analyses.

Matthew Piper

Room: G18, 18 Innovation walk
Email: Matthew.Piper@monash.edu
Webpage: www.piperlab.org

Diet as medicine: investigating how nutrition can enhance health, suppress appetite and extend lifespan in *Drosophila*

My lab uses the fruitfly *Drosophila melanogaster* to investigate the mechanisms by which nutrition affects long-term health and behaviour. In particular the proportion of amino acids in the diet have recently been implicated as potent modulators of growth, fecundity, ageing and satiety. Using new innovations in fly diets and methods for their design, projects are available to investigate each of these interactive effects. Ultimately, we seek to pin down the molecular mechanisms underlying these interactions, meaning the work is easily expandable into longer-term projects.

Richard Reina

Room: G20, 25 Rainforest walk
Email: Richard.Reina@monash.edu
Webpage: http://richardreina.com/

My research revolves around studying animal responses to challenges from their environments and from human activity to understand how they deal with different these stressors. Most of the work is on marine animals including sharks, rays, penguins and turtles, but I have also studied frogs, crocodiles, lizards and small marsupials. The purpose of this research is to apply our improved knowledge to the conservation and management of affected species and ecosystems.

Projects in 2017/18:

Reproduction and foraging of penguins - July 2017 start

Little penguins, *Eudyptula minor*, live and breed in a large colony at Phillip Island southeast of Melbourne. As part of an ongoing program of the Phillip Island Nature Park (PINP) studying the population dynamics and biology of these penguins, a project opportunity exists to study the reproductive biology, behaviour and/or foraging of the penguins in the colony. Studies of parenting and foraging success are possible to understand the relationships between allocation of time and resources to food acquisition and reproduction. Other topics may be negotiated depending on student interests. The project is available for a mid-year start only and will probably require several days per week to be spent at Phillip Island between September and February. This project is co-supervised by Dr André Chiaradia of PINP.

Project by negotiation - July 2017 start

I will consider projects suggested by students in the areas of ecological physiology of vertebrate animals in any environment. Let me know if you have your own project ideas.

Carla Sgrò

Room: 439a, 18 Innovation Walk
Email: Carla.Sgro@monash.edu
Webpage: http://carlasgrolab.org

The focus of my research group is to better understand how species adapt to rapid environmental change. Our research focuses on the interplay between organisms, their genes and their environment to understand the factors that facilitate or constrain species responses to climate change. Our work stresses the importance of both genetic adaptation and phenotypic plasticity in underpinning responses to global change.

We address three core questions in our research:

1. How does the environment influence the expression of the phenotypic and genetic variation that underpins adaptation?
2. What role does nutrition play in mediating evolutionary responses to climate change?
3. How important is sex-specific adaptation to evolutionary responses to climate change?

There are a range of projects available addressing these questions.

Interested students should visit my website http://www.carlasgrolab.org/research for more information and email me on carla.sgro@monash.edu to arrange a chat.

Paul Sunnucks

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Email: Paul.Sunnucks@monash.edu
Webpage:http://www.monash.edu/science/schools/biological-sciences/staff2/sunnucks
https://sites.google.com/site/sunnucksresearchgroup/home

Paul Sunnucks heads the Persistence and Adaptation Research Team (PART). Researchers in this team apply combinations of wildlife biology, ecological genomics/genetics and spatial environmental analysis to Australian native species under natural and human-impacted conditions.

Current major project areas include:

(1) Evolutionary adaptation of birds to their local environments. We have recently discovered that a common bird, the Eastern Yellow Robin, seems to be splitting into an inland form and a coastal form. We are running a major field and genomics program to understand this phenomenon better and test how much it applies to other species of bird.

(2) Evolutionary rescue of Australian wildlife. We are working with management agencies to experimentally supplement the genetic diversity of threatened species including Leadbeater's Possum, Helmeted honeyeater, Macquarie Perch, and a grassland daisy, and to monitor their fitness and genomic responses to this management intervention.

Marina Telonis-Scott

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http://www.monash.edu/science/schools/biological-sciences/staff2/marina-telonis-scott

My research program is geared towards adaptation genomics to better understand how organisms counter climatic extremes in a rapidly changing environment. I utilise a range of quantitative genetic, real time PCR, and Illumina Next generation sequencing technologies to explore a range of *Drosophila* phenotypes in populations from different climatic origins. I'm most excited about understanding how genes are

utilised to generate phenotypic variation buy probing the transcriptome, 'the doing molecules' of genes and how transcripts are processed to generate diversity.

Potential project opportunities:

- **Bioinformatic projects:** DNA sequence variant calling and analysis in wild climatically diverged *Drosophila melanogaster*
- **Laboratory projects:** Candidate climatic gene exploration using CRISPR (genome editing) or RNAi (gene knockdown) in *Drosophila*

Coral Warr

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Webpage: http://coralwarr.com/

***Drosophila* Cellular and Developmental Genetics**

In the Warr lab we are interested in how cells receive and respond to signals from the environment or from each other both during development and in the adult organism. Understanding this is critical because dysregulation of cell signalling underlies many of the major diseases that afflict society, including cancer and obesity. We use *Drosophila melanogaster* as a model organism because most cell signalling pathways are shared with humans, and in flies we have many sophisticated genetic and molecular approaches available to study gene function. Honours projects are available to study cell signalling during embryo development and during growth.

Craig White

Room: 119, 18 Innovation walk
Email: Craig.White@monash.edu
Webpage: https://evolutionaryphysiology.com/

Members of the Evolutionary Physiology group are interested in describing and understanding the causes and consequences of broad-scale variation in the physiology of animals. We study a range of traits, with an emphasis on metabolic rate, water loss, and breathing patterns, and employ a range of approaches including manipulative experiments, comparative studies, experimental evolution, and quantitative genetic analyses.

Potential project opportunities

- The relationship between metabolic rate and body mass is strong, but the shape of the relationship has been strongly debated for years. This project will examine the statistical approaches used to analyse the relationship between metabolic rate and body mass, to determine the adequacy of existing analyses.

- Although much of the research examining water loss in insects has focussed on respiratory water loss, particularly in the context of discontinuous gas exchange, most insects actually lose more water through their cuticle than their respiratory system. This project will use our cockroach model to test for phenotypic and genetic correlations between respiratory and cuticular water loss, to determine if selection on water loss will alter these traits together.

- The Oxygen and Capacity Limited Thermal Tolerance (OCLTT) hypothesis proposes that cardiorespiratory system failure is the principal determinant of the upper thermal limit of animals, and therefore a primary determinant of their realised thermal niche. The hypothesis has been tested and supported in many species, but it remains controversial. This project would synthesise the results of these tests using a phylogenetically informed meta-analysis framework, to test the generality of the OCLTT hypothesis in diverse groups of animals.

- Recent work has shown that animals allocate significant energy to growth even when fasted; the ongoing costs of growth may therefore influence the relationship between metabolic rate and body mass during ontogeny. Using our cockroach model, we have previously shown that ambient hypoxia slows growth; this project will exploit this effect of ambient oxygen to examine the interaction between growth rate, body mass, and metabolic rate during ontogenetic growth.

Bob Wong

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Email: Bob.Wong@monash.edu
Webpage: http://www.bobwonglab.org/

Research in our group focuses on animal behaviour, with a particular emphasis on how animals go about finding mates and looking after their young. We are also interested on getting students involved in projects investigating the impacts of environmental change on animal behaviour and the evolutionary process. To this end, we are particularly keen on uncovering the behavioural impacts of pharmaceutical pollutants (i.e. human and veterinary drugs) that enter the environment and have the potential to affect sexual (and other) behaviours in exposed wildlife.

For more details of our research, please check out: bobwonglab.org