



PROFESSOR OF EVOLUTION JOINS BIOLOGY

Mats Olsson, a prominent evolutionary biologist, is the newest Professor to join the School of Biological Sciences

Professor Olsson comes to the School from the University of Wollongong where he has held a prestigious Australian Research Council Professorial Fellowship for six years.

An internationally recognised evolutionary biologist, Professor Olsson uses reptilian and amphibian model systems to address questions in evolutionary ecology and genetics. His research uses a multidisciplinary approach – integrating behaviour, biochemistry, genetics, endocrinology, population ecology, and quantitative genetics – to further our understanding of evolution in natural systems.

Professor Robyn Overall, Head of the School of Biological Sciences, says Professor Olsson's appointment will not only strengthen the area of evolution in the School, but will connect important research fields within the School and elsewhere in the University of Sydney. "We are thrilled to welcome Mats to the School. He is a researcher of exceptionally high calibre who will complement our current research profile, which includes a strong presence in reptile physiology, behavioural ecology, evolution and conservation. His use of molecular biological techniques will provide interesting links with the School's current herpetological research and will strengthen ties with molecular biologists within the School and University."

Originally from Sweden, Professor Olsson completed his PhD at the University of Gothenburg before coming to the University of Sydney for a postdoctoral position with Professor Rick Shine. During this time, Professor Olsson did groundbreaking research in the area of cryptic female mate choice. Using polyandrous sand lizards from Sweden, he provided the first clear evidence

that females are able to actively select sperm in their oviduct from distantly related males, thereby enhancing their fitness by avoiding costs of inbreeding.

Following his postdoctoral role, Professor Olsson returned to the University of Gothenburg as an Associate Professor, followed by a Professorship at the University of Wollongong, which he has held for six years.

While he continues to work on sand lizards when visiting his native home, Professor Olsson has embraced the fascinating painted dragons as a new model system with which to study evolution in Australia. In the desert landscape of Yathong Nature Reserve, Professor Olsson and colleague Dr Mo Healey have used an integrated approach to studying the unique lizards - whose males display red, yellow or orange heads - to shed light on the link between male colouration and honest signalling, immunobiology, testosterone levels, dominance behaviour, sperm competition and reproductive fitness.

In his new role in the School of Biological Sciences, Professor Olsson will continue working in broad evolutionary biology – integrating ecology, genetics, behaviour and physiology – and says he is keen to contribute new ideas and research. "I am happy to join this department and look forward to building an integrative lab in collaboration with other evolutionary biologists. I did my first post-doc with Rick Shine over 17 years ago and have stayed in contact or collaborated with him ever since. I am very excited to expand this interaction further and seek new opportunities with the many excellent researchers within the School and elsewhere at the University."

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HEADSPACE



It was wonderful to meet so many of our Alumni and friends at our Botany Lawn Alumni Cocktail Party in October

We were treated to a video collage of "Memories of Charles Birch" collated by one of our Alumni Committee members Warwick Angus (BSc Hons 1999). It formed a focal point for the sharing of memories by those who knew Professor Birch and for current students and staff to appreciate the enormous impact that he has had on the current shape of the School and the field of ecology.

Warwick reflected "I have enjoyed the hours spent putting this video together because it gave me a chance to get to know this inspirational person whom I have never met". I am very grateful to Warwick for the effort he put into this video along with the movie he made of the 2009 Alumni party. I also thank those who contributed material for this video and the "Back to Birch" Memories website.

Our 2010 Murray Lecture delivered by Harvard evolutionary biologist Professor Jonathan Losos was a huge success, attended by over 400 guests. Following the lecture, alumni, students, staff, friends and members of the public enjoyed a drink while rubbing shoulders with herpetology enthusiasts and demonstration reptiles. Professor Losos spent two weeks interacting with staff and students in the School, finishing with a trip to Warrah with our postgraduate research students.

As we draw to the end the academic year, the School is embarking on a major review of our current teaching programs. I expect this will be an invigorating process as we engage with fresh ideas from the old hands and our new enthusiastic staff members. A potential area for enrichment of our undergraduate experience would be to include a suite of summer experiences under the mentorship of our biology alumni.

I wish you and yours all the best for the festive season and the year ahead.

With warm regards

Robyn Overall

Head, School of Biological Sciences

RESEARCH SPOTLIGHT: ASSOCIATE PROFESSOR JAN MARC



Jan Marc thinks that food security is one of the most critical issues facing the world. In fact, understanding how to improve plant yields in the face of mounting environmental problems was paramount in his early working life and has been a major theme throughout his entire career

“Plants are absolutely essential for our lives,” says Jan Marc, Associate Professor in the School of Biological Sciences and self-confessed plant enthusiast. “The growing human population means demand for food is increasing, but environmental problems, like drought and salinity, are worsening. We need to develop a wisdom about plants so we can effectively grow them.”

What started out as a young farmer’s need to keep his crops alive, Jan’s studious interest in plants has blossomed into a career spent elucidating the cellular and molecular signalling mechanisms by which plants perceive their environment and how they use the mechanisms to adjust their lifestyle.

“The problem is that plants cannot move,” says Jan. “So if something bad happens in their environment, unlike mobile animals, there is no way for them to escape. For this reason, plants have evolved ingenious coping mechanisms, which allow them to detect and respond to both good and bad signals in their environment.”

An enduring area of his research has been in understanding the interaction between the cytoskeleton and phospholipase D (PLD), which is the key enzyme in the signalling process of plants. With colleagues, Jan made a groundbreaking discovery of the connection between PLD and microtubules in the periphery of the cell, known as the cortex. This important discovery has shed light on the

fundamental mechanisms by which plants respond to environmental stress signals.

“Being at the edge of the cell, the cortex is a strategic location for the interception of environmental signals,” says Jan. “We knew that there were microtubules in the cortex that responded to signals, but we didn’t know how. Now we understand how PLD interacts with microtubules to transduce hormonal and environmental stress signals to the cell interior, ultimately allowing the plant to cope with problems like drought and salinity.”

At the cutting edge of his field, Jan has been involved in pioneering cellular and molecular tools in plant sciences. While green fluorescent protein (GFP) is today widely used to visualise biological processes, research from Jan’s laboratory was the first to ever use GFP to visualise the behaviour of microtubules in living plant cells.

Having grown up on a small farm in the Czech Republic, Jan took over the family business as a teenager and by 16 was producing crops on a commercial scale. This early start in agriculture taught him to respect the plants that provided his livelihood, but also to appreciate the power and freedom that comes from education. Soon after arriving in Australia, his dream of starting a career in academia was fulfilled after a position as technical officer in the Botany department at UNSW led him to complete a BSc, honours and finally PhD in plant physiology.

After positions at CSIRO, the ANU and various universities in the US, Jan took up a lectureship in the School of Biological Sciences and has worked here ever since.

Jan says a highlight of working in a university is the opportunity to collaborate with students. “I love seeing young students develop an interest in research, getting fired up about a topic and being involved. It is exciting to be able to nurture their passion for science and to encourage them to continue in this rewarding career.”

Jan has had great research success with honours and undergraduate students who he has inspired to do independent work in his laboratory. Under the guidance of PhD student Zoe Andreeva, experiments conducted recently by third year students in the Plant Growth and Development course led to the important discovery that phospholipase C interacts with the cytoskeleton and plays a role in determining the direction of root and shoot growth. Last year David Seung, from the Talented Student Program, won a prestigious award from the American Society of Plant Biologists for his third year project on the role of ABA in PLD-cytoskeleton interactions.

“These students are my colleagues,” says Jan. “I may know more about one area, but they are teaching me in another. I consider them as intellectual equals, and the relationship is mutually beneficial.”

WHO'S NEW?

OLSSON LAB



DR EMILY MILLER

Dr Emily Miller is an evolutionary biologist who is interested in the application of genetics to better understand sexual behaviour, reproductive strategies and evolutionary history.

Emily completed her PhD at the University of New South Wales in 2009. Her research focused on the use of molecular data to better understand the evolutionary history, mating systems and population dynamics in marsupials. Her results were so compelling that she continued with this research during a post-doctoral fellowship at the University of Sydney with Dr Cath Herbert. After that, she worked in the Science Division at the Department of Environment and Conservation, Western Australia as a Research Scientist, coordinating and conducting the largest scale fauna translocations of mammals between island and mainland sites undertaken in Australia to date.

Recently, Emily was recruited by Mats Olsson in a role combining research and managing his newly established laboratory. Her research with Mats will focus mostly on the molecular ecology of lizards. This complements Emily's previous experience and research interests, and she is particularly excited to be working on a new model system that allows her team to address some of the big questions in evolutionary ecology.



DR MICHAEL TOBLER

Dr Michael Tobler graduated in Integrative Biology at the University of Basel, Switzerland, in 2002 and subsequently moved to Sweden where he went on to do a PhD at the department of Animal Ecology, Lund University, between 2003 and 2007. In 2007, he was awarded a fellowship for prospective researchers from the Swiss National Science Foundation to conduct post-doctoral research with Mats Olsson at the University of Wollongong, Australia.

In 2010, he followed Mats to the University of Sydney and is currently supported by a Marie Curie International Outgoing Fellowship.

Michael's research interests lie within the framework of evolutionary biology and behavioural ecology. He is particularly interested in the links between maternal effects, phenotypic plasticity and life-history strategies. He uses experimental approaches to investigate evolutionary mechanisms underlying phenotypic variation.

Michael's current project assesses whether 'reactive oxygen species', which are often identified as factors of ageing and immune disorders, may act as constraints in the evolution of life histories.



CISSY BALLEEN

Cissy Ballen graduated from the University of Minnesota in 2008 with a degree in Fisheries, Wildlife and Biology. She is currently a PhD student, supervised by Mats Olsson, and is broadly interested in sexual selection. For her PhD, Cissy is examining aspects of colour signaling in two model species - the painted dragon (*Ctenophorus pictus*, pictured below) and the veiled chameleon (*Chamaeleo calytratus*).



credit: Mo Healey

Using the brightly multicolored painted dragons, she will look at aspects of female mate choice and investment trade-offs in different reproductive strategies. The chameleon system is one in which vibrant visual signals are used to transfer information rapidly, but to what extent does the environment influence their capacity for colour change? At the moment, she is happily caring for many recently-hatched baby chameleons!

VISITING PROFESSOR - GEOFF WASTENEYS



credit: MG Savage

Geoffrey Wasteneys, Professor of Botany, Canada Research Chair in Plant Cell Biology and Director of Bioimaging at the University of British Columbia, is a visiting academic in the School of Biological Sciences.

Professor Wasteneys will spend seven months in the School collaborating with plant molecular and cell biologists Professor Robyn Overall and Associate Professor Jan Marc. He says he is excited to be visiting the department, which he considers a hub of excellence in plant biology, and is keen to interact with new colleagues such as Professor Peter Waterhouse.

Professor Wasteneys' research seeks to understand the shape of plants - how they grow in particular directions, respond to stimuli and integrate signals. In particular, his research focuses on microtubules and understanding the fundamental aspects of their organisation and assembly, which has had far-reaching implications in areas from human cancer to biofuel production.

Microtubules are a component of the cytoskeleton and are involved in many cellular processes including mitosis. They are fundamental to all eukaryotic life and, for plants, are essential for shape and axial growth.

In examining the molecular mechanisms that control microtubule dynamics in plant cells, Professor Wasteneys has made some important breakthroughs,

including the identification and characterisation of two important proteins that are associated with microtubules - MOR1 and CLASP.

"The discovery of MOR1 is important, not only because it will help us to understand microtubule dynamics, but also because it is a homologue of an important human cancer protein, TOGp. So while my research team is discovering MOR1's role in plant shape, they are also contributing to the understanding of how cancer progresses," says Professor Wasteneys.

"Identifying the protein CLASP has also shed light on the fascinating way that microtubules use the geometric cues of sharp cell edges to self organise into parallel arrays - a process that ultimately determines the plant's growth and development."

To understand how it is that microtubules self organise, Professor Wasteneys uses live cell imaging in concert with mathematical modelling, to better define the mechanisms that drive spatial organisation of the cytoskeleton on a cell-wide basis. While in Sydney, he hopes to gain a better understanding of how dynamic events at the cellular scale can be correlated with high-resolution 3D imaging.

"Although my work is primarily at the molecular and cellular level, understanding microtubule organisation has implications at the broader scale. For example, we are now in a better position to understand how this spatial organisation of microtubules controls the synthesis and mechanical properties of nature's most abundant biopolymer - cellulose. We are using this knowledge, in collaboration with wood scientists, to increase the efficiency of producing biofuels such as ethanol."

For his Australian visit, Professor Wasteneys is hosted by Professor Robyn Overall and the pair hope to collaborate on a project to understand the relationship between microtubule dynamics and the handedness of organ twisting. "We think that chirality is related to inter-cellular communication, which is Robyn's area of expertise. So I have arrived in the best place to investigate this topic."

LIZARD EVOLUTION IN ACTION

BY BRIDGET MURPHY

A bizarre species of Australian lizard has been caught midway through the process of losing its eggshell, in a rare example of evolution in action. The research by Professor Mike Thompson was featured in the *Sydney Morning Herald* on October 9.

Most lizards lay eggs with opaque white shells. As a result of the evolution of live birth, other lizards have eggs with no shell and they retain the eggs inside their body until they are fully developed. Researchers have long predicted that the eggshell gradually becomes thinner during the evolution of live birth until it disappears completely. Until now there were no transitional forms to support this scenario.

Professor Thompson's research, conducted with a team led by Dr. James Stewart of East Tennessee State University and published in the *Journal of Morphology*, found the definitive transitional forms they were looking for. Three-toed skinks (*Saiphos equalis*) from more northern parts of NSW retain eggs inside their body for longer than their Sydney relatives and are thought to be further through the evolutionary process. The research found that northern three-toed skinks have thinner eggshells than skinks of the same species in Sydney.



The three-toed skink lives its entire life underground and gives birth to live young. Credit: Nadav Pezara.

2ND YEAR STUDENT DISCOVERS NEW SPECIES

A love for fishing, a keen eye and a curious mind led second-year zoology student, Ryan Keith, to discover a new species of nematode. The remarkable finding, from research conducted for his advanced animals project, sheds light on a little-known fish parasite that could prove important for aquaculture

Science is full of serendipitous discovery, and for Ryan Keith, his moment came after a fishing trip in November 2009.

"I had caught some lovely dusky flathead, which I was preparing for the table," remembers Ryan. "I noticed some worms infecting the gonads of the fish. Having fished Central Coast estuaries for ten years, I wondered what impact they were having on the host."

After his initial observation, Ryan immediately searched for information on parasites of flathead. He found that the nematode *Philometra pellucida* had been discovered in the gonads of sand flathead in New South Wales, but had reason to believe that it was not the same nematode.

"Not only did the description of *P. pellucida* not match my observed nematode, but I also learned that *Philometra* species are highly host-specific parasites, indicating that the nematodes I found in the dusky flathead could possibly belong to a new species."

The opportunity to test his hypothesis came in February the following year when Ryan started the second year course, Invertebrate Zoology (Advanced), run by Dr Elizabeth May. In this course, advanced students are required to do an independent research project in conjunction with a scientist of their choosing. While many students chose to assist researchers with an ongoing project, Dr May offered Ryan the option of conducting his own research project. "I thought that this represented an exciting and serendipitous opportunity to pursue my investigation of parasitic nematodes," said Ryan.

After accepting Ryan's proposal to investigate the dusky flathead nematode, Dr May referred him to Dr Maria Capa of the Australian Museum's marine invertebrates research team. Ryan discussed his observations with Dr Capa, who is a leading expert in the classification of polychaete worms, and the pair decided to conduct a preliminary study to identify and classify the mysterious nematode.

To do this, Ryan returned to the Tuggerah Lakes estuary to catch dusky flathead and any hitchhiker nematodes. He examined the external anatomy of the worms using scanning electron microscopy (SEM) and extracted their DNA for phylogenetic analysis. "Thanks to Dr Capa's formidable experience in the areas of phylogeny and cladistics, and her willingness to refer me to Sue Lindsay and Dr Rebecca Johnson for matters of microscopy and DNA sequencing, I was able to draw on real expertise for the different areas of my study," says Ryan.

Interestingly, Ryan's results indicated that he had likely discovered a new species of nematode within the

genus *Philometra*. Phylogenetic analysis showed that his specimens were at least 6.6% different from any other known philometrid species and SEM micrographs confirmed they were morphologically unique due to their inner papillae, which were much smaller than those of other species.

The nematode is currently referred to as *Philometra sp. n.*, and Ryan says a great deal of work remains to be done. "While the morphological and molecular analyses suggested that the specimens were different from the described



2nd-year zoology student, Ryan Keith, fishing for dusky flathead. Credit: RK

Philometra species considered in my study, we can't say for sure that the specimens represent a new species. I am treating *Philometra sp. n.* as a species *inquirenda*, indicating that further research is required to confirm the identity of the specimens."

Although he has submitted his report for assessment, Ryan plans to continue this work next year, albeit in his spare time. "Dr Capa has offered to assist me in continuing my studies of this species *inquirenda*. Although next year, my third in the Bachelor of Science Advanced degree, will surely be a busy one, I do intend to pursue my investigation of *Philometra sp. n.* with great enthusiasm."

Ryan will receive the Mary Besly Prize for the best invertebrate zoology assignment for his work this year.

ALUMNI PROFILE: ELLEN O'BRIEN



Ellen O'Brien (BSc in *Botany & Microbiology* '80; MSc in *Marine Biology* '90), environmental consultant and Principal of CPG Australia Pty Ltd's Sustainability & Environment portfolio, talks to *Biology News* about her career and the project she has been undertaking for the last few months.

Can you describe the project with which you were recently involved?

I have spent the last few months leading a small team of environmental consultants preparing environmental management and sustainability plans, as part of the preparation of a tender, for the construction and operation of a light rail network on the Gold Coast.

This is an interesting project as it offers an opportunity for a high growth rate city, which is highly dependent on motor vehicles, to make the modal shift to rapid transit public transport. The light rail has lots of potential for environmental and social benefits, including reduced greenhouse gas emissions and traffic congestion, and greater connectivity of public transport routes in the city.

What role is environmental consultancy playing in Australia?

The dilemma we have as a society in Australia is how we manage ourselves as a sustainable community. With increased pressure on natural systems through extraction of resources and pressure for housing, industry and services from the on-going migration of our population to coasts and major cities, we have to rely on getting the balance right. We still do not understand fully how ecological systems respond to change and stress, or the timescales for them to recover or adapt.

Environmental consultants make predictions based on available research, experience and knowledge of previous projects and therefore play an important role in influencing decisions about how the resources are used and shared, and what are the important or sensitive environments that must be protected and managed.

One of the challenges we face in the management of resources – including water, energy, biodiversity – is how we can improve environmental outcomes within the framework of continued development. Finding sustainable solutions that satisfy economic and business demands, as well as meeting (or exceeding) environmental and social expectations is the key to motivating change for a sustainable future and this is where environmental consultants can help identify those solutions and become advocates for that change.

How did you get from university to where you are now?

My career started as an undergrad, when I worked part-time in the Biochemistry Department whilst I was finishing my degree. I picked up a second part-time job, with Associate Professor Rosalind Hinde (Biological Sciences), which marked the start of my lifelong interest in marine systems. I continued to work at the University of Sydney for about 11 years, assisting with various research grants for a number of different departments.

After leaving the University I took a position with Sydney Water, investigating pollution impacts on coastal systems. My career then became more land-based when I started working as a consultant with Australian Water Technologies doing environmental assessment projects.

I then ran my own environmental consulting business for five years and took an opportunity to do a part-time MBA through Macquarie Graduate School of Management.

In recent years, my career has focused on sustainability issues. I spent three years working in the local government sector on sustainability and environmental education projects with the community, local businesses and within the Council, then moved back to the consulting world, mostly as a sustainability and resource efficiency coach for small and medium enterprises.

I have only been with my current employer for seven months, and in that time, have been working mostly on environmental management for transport projects.

What have been the highlights of your career?

1. Working on One Tree Island – what a place to “think” and be inspired.
2. Facilitating practical sustainability education programs for small business and community. It is great to see people's response to learning how to take action at a local level.
3. Influencing project managers to adopt environmental best practice principles in their work.

Did you always want to be an environmental consultant?

I had no idea what an environmental consultant was when I started my career or at university. I have always been curious about how things work, especially biological things, so I was probably predestined to end up puzzling over nature and how to protect it.

BIOLOGY 2010 ALUMNI FUNCTION

On October 29, The School of Biological Sciences opened its doors to alumni and friends by hosting a cocktail function on the Botany Lawn. This is the third time the School has held an alumni function, which invites alumni and their families to reconnect with former colleagues and the School. This year, the School paid special tribute to Professor Charles Birch, the renowned ecologist who was Professor of Biology for 25 years.

Head of School, Professor Robyn Overall, and Chair of the Alumni Committee, Professor Mike Thompson, welcomed an exciting mix of local and international alumni as well as some much-loved former

members of staff, to the Macleay building and Botany Lawn.

As usual we drew a lucky door prize, which this year consisted of luxury champagne generously donated by European Caterers. Professor Anthony Hannan (BSc Hons '92; PhD '96), who narrowly missed out on winning in 2008, drew the prize, which was taken home by Stephen Kuschert (MSc '86).

The School would once again like to acknowledge the many people who helped in making the function a success. Warrick Angus (BSc Hons '99), with contributions from Peter Farleigh, created the tribute video honouring the life of



Warrick Angus with Professor Ian Hume. Credit: Jacquie Herbert

Charles Birch; Jacquie Herbert (BSc Hons '01) took the photos; Jo Walker (BSc '93; Grad Dip '94), Bobby Tamayo (BSc '95) and Sarah Newell provided significant help and our many students acted as wait staff.

2010 MURRAY LECTURE

This year's Murray Lectureship, presented by Professor Jonathan Losos from Harvard University, was a huge success with activities running for two weeks in October. Professor Losos presented a fascinating lecture about lizards, and his own research on evolution, to the public in a Sydney Science Forum lecture held in the Eastern Avenue Auditorium. He also engaged the postgraduate students in mentoring activities in a weekend retreat at the Warrah field station. The School thanks Professor Losos and looks forward to welcoming the 2011 Murray Lecturer, Professor Jim Haseloff, from the University of Cambridge.



Left: Postgraduate students with Jonathan Losos (third from right) at Warrah. Credit: Will Armour
Right: PhD student Cissy Ballen shows off a corn snake at a reptile demonstration following the Murray Lecture public talk in the Eastern Ave Auditorium.



WELCOMING NEW BIOLOGY ALUMNI

The School would also like to thank Professor Rick Shine who welcomed new alumni to our community by providing the occasional address at the May 28 graduation in the Great Hall.



Professor Mike Thompson (far left) and Professor Rick Shine (far right) with honours student David Llewellyn and his parents following the May 28 Faculty of Science graduation ceremony.

BIOLOGICAL
SCIENCES

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