



# PhD Opportunities

## Fruit Fly Sexual Performance



Closing Date: Expressions of interest close at midnight on **30 June, 2016**

Three PhD opportunities are available on projects investigating pre- and post-copulatory sexual performance of Queensland fruit fly (*Bactrocera tryoni*, aka 'Qfly'). Each of these projects is part of a significant collaboration between Macquarie University's Department of Biological Sciences and Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Projects include:

- (1) Polyandry and paternity patterns,
- (2) Mediation of mating-induced sexual inhibition,
- (3) Genetics and genomics of reproductive fitness.

### (1) Polyandry and paternity patterns

Molecular techniques will be used to assess multiple paternity and patterns of sperm use in natural and laboratory populations, and to identify male traits (e.g., size, age, rearing environment, experience, nutritional state) associated with paternity advantages under controlled environmental conditions. The host research groups have been working on Q-fly mating behaviour, physiology, and reproduction for many years, and have access to a vast array of facilities and techniques in house and through collaboration. Existing knowledge and access to ample facilities provides an excellent platform for a motivated and imaginative student to advance this field through the adoption of diverse approaches and methods.

This project would be carried out under supervision of Prof Phil Taylor and Prof Michael Gillings of Macquarie University and Drs John Oakeshott, Ronald Lee and Owain Edwards of CSIRO. The successful applicant would be based principally at Macquarie University in Sydney.

### (2) Mediation of mating-induced sexual inhibition

Virgin female Qflies show high levels of sexual receptivity, but once mated they reject courtship attempts of subsequent males. Previous research has highlighted reproductive accessory gland fluids produced by males and passed with the ejaculate as key. This project will use a combination of genetics/genomics, biochemistry, and metabolomics approaches to identify the factors mediating mating-induced sexual inhibition of female Qflies, to understand their production, and to determine their modes of action. Oakeshott's group at CSIRO has considerable experience investigating the biochemistry and genetics/genomics underpinning mating induced sexual inhibition and related behavioural changes in insects. This group has deep skills in metabolomics and proteomics, and have the in-house state-of-the-art facilities required for successful metabolomics and proteomics. Taylor's group at Macquarie has carried out all of the research on mating induced sexual inhibition in this species to date, and comprises a large research community working on diverse aspects of Qfly behaviour and physiology.

This project would be carried out under the supervision of Dr John Oakeshott of CSIRO (with additional support from Drs Matt Taylor, Gunjan Pandey and Peter Campbell) and Prof Phil Taylor of Macquarie University. The successful applicant would be based principally at CSIRO in Canberra.

### (3) Genetics and genomics of reproductive fitness

The purpose of this research is to identify the genetic basis of reproductive characteristics that drive mating performance of male Queensland fruit fly (e.g., pheromone composition, calling behaviour, reproductive effort, sperm transfer, ability to induce sexual inhibition in mates). The strategy for this research is to first identify the genes underlying these traits of interest, or genetic markers linked to these genes, using quantitative or association genetics methods. Once identified, this information can be used to understand the population genetic processes key to the implementation of the Sterile Insect Technique now in development for the control of Queensland fruit fly. A PhD project would be developed around traits that the project team has identified as being important in driving mating success, and would aim to quantify the level of variation in the trait, identify the genetic basis for this variation, and develop and test strategies to retain variation during domestication for subsequent selection experiments.

This project would be carried out under the supervision of Drs Ronald Lee, John Oakeshott and Owain Edwards of CSIRO and Prof Phil Taylor at Macquarie University. The successful applicant would be based principally at CSIRO in Canberra.

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### Join a large, multidisciplinary and inter-institutional program

Sexual processes are not only a fascinating area of study, but in this case are also important drivers of environmentally benign pest management through Sterile Insect Technique (SIT). Qfly is Australia's most damaging insect pest of horticultural crops. This project is part of a \$20.5 million multi-institution 'SITPlus' collaboration that aims to develop a detailed understanding of Qfly biology as a foundation for effective, environmentally benign and sustainable management practises to combat this major pest, and especially to develop SIT. In SIT, millions of sterile male flies are mass-reared and released to disrupt reproduction of wild populations by inducing reproductive failure. Sex is the 'active ingredient' of SIT; understanding of polyandry, paternity, sexual inhibition and genetics are important for the development of effective SIT. While the research conducted in the advertised PhDs is basic science and will be published as such, it is also strategic in that outcomes will provide guidance and support to an emerging sustainable management program.

Research partners in this Horticulture Innovation Australia 'SITplus' research program include Macquarie University, Commonwealth Scientific and Industrial Research Organisation (CSIRO), New South Wales Department of Primary Industries (NSW DPI), South Australia Research Development Institution (SARDI) and Institute for Plant & Food Research (PFR). Collectively, these institutions bring vast expertise and research capacity to this research program, and maintain a highly collaborative research culture. Accordingly, these projects will be very well supported in terms of supervision, collaborative opportunities, facilities and funding.



Macquarie University and CSIRO have a large research community of Academics, Research Fellows and Research Students working on diverse aspects of Q-fly behaviour, ecology, physiology, and genomics. Macquarie University is set in a park-like campus just 20 minutes from the centre of Sydney and is home to the *Biosecurity Futures Research Centre* and the *Australian Research Council Industrial Transformation Training Centre for Fruit Fly Biosecurity Innovation*. The CSIRO laboratories in Canberra are set within a large biological and agricultural science precinct, within easy walking distance of Canberra city centre.

## Scholarship details

Scholarships are available to eligible candidates to undertake either:

- Direct entry into a 3 year PhD program.

OR

- Research Training Pathway (RTP/iRTP) Masters of Research (MRes) Year 2 followed by a Macquarie University Research Excellence Scholarship (MQRES/iMQRES) for a 3 year PhD. This is referred to as an MRes/PhD 'bundle offer', and provides a pathway to PhD for those candidates who do not meet the requirements for Direct entry.

The value and tenure of the scholarship is:

- \$30,849 pa (2016 rate, subject to indexation, tax free) for up to four years for an MRes/PhD bundle offer or for 3 years for direct entry to PhD. This includes an MQRES stipend of \$25,849 pa plus a scholarship 'top up' of \$5,000 pa.
- International candidates successful for these scholarships are also awarded a tuition fee scholarship covering tuition fees at Macquarie University for up to four years.

To be eligible for a scholarship, applicants are expected to have a record of excellent academic performance and preferably additional relevant research experience and/or peer-reviewed research activity, awards and/or prizes in line with the University's scholarship rating guidelines. Refer to the [Rating Scholarship Applicants](#) section for more information about these guidelines. Students on scholarships are not obliged to contribute to teaching, but may do so to supplement their income if desired. In addition to substantial financial resources to draw on for research, several generous schemes are available to fund travel to visit overseas laboratories or to attend overseas conferences.

Enquiries are welcome, and interested applicants are encouraged to make initial informal contact before applying. Interested applicants should email a letter of interest, academic transcripts, curriculum vitae and the names and contact information of three referees to Prof Phil Taylor (Phil.Taylor@mq.edu.au).

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