ENTOMOLOGICAL SOCIETY OF QUEENSLAND INC

NEWS BULLETIN

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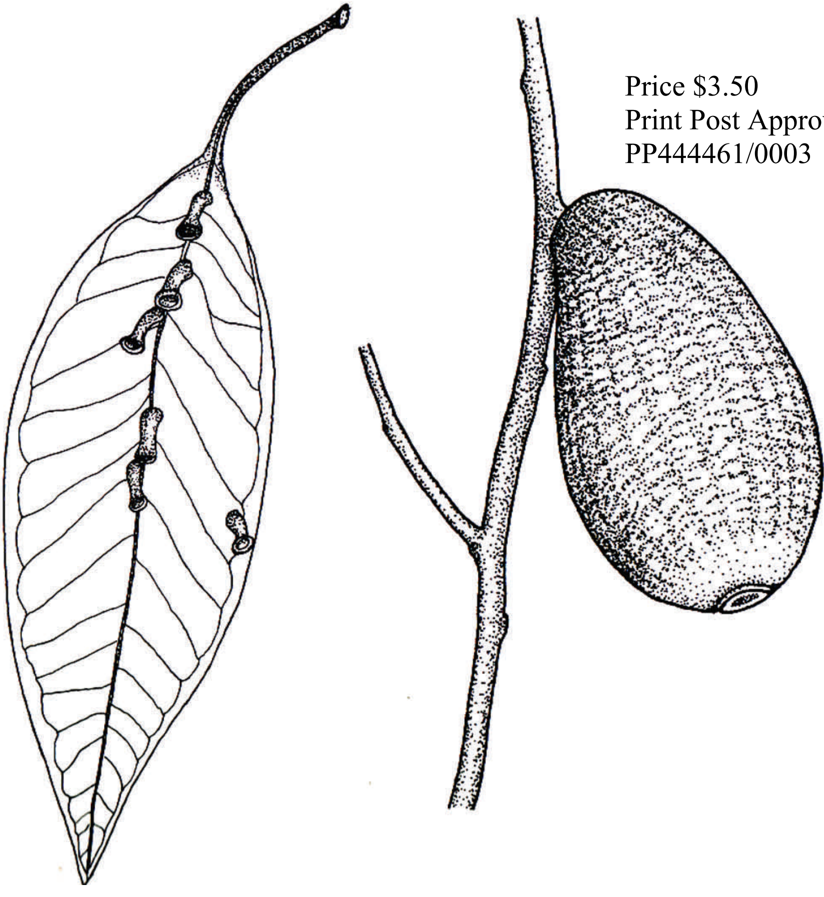

Volume 39, Issue 7, October 2011

THE ENTOMOLOGICAL SOCIETY OF QUEENSLAND

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Front cover illustration: Galls induced by the scale insect *Apiomorpha conica* (Eriococcidae) on *Eucalyptus obliqua*. Top: tubular galls on leaves induced by males. Bottom: gall induced by female on stem. Original drawing by Penny Gullan.

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The **ENTOMOLOGICAL SOCIETY OF QUEENSLAND INC.**, since its inception in 1923, has striven to promote the development of pure and applied entomological research in Australia, particularly in Queensland. The Society promotes liaison among entomologists through regular meetings and the distribution of a *News Bulletin* to members. Meetings are announced in the *News Bulletin*, and are normally held on the second Monday of each month (March to June, August to December), or on Tuesday if Monday is a public holiday. Visitors and members are welcome. Membership information can be obtained from the Honorary Secretary, or other office bearers of the Society. Membership is open to anyone interested in Entomology.

Contributions to the *News Bulletin* such as items of news, trip reports, announcements, etc are welcome and should be sent to the News Bulletin Editor.

The Society publishes **THE AUSTRALIAN ENTOMOLOGIST**. This is a refereed, illustrated journal devoted to Entomology in the Australian region, including New Zealand, Papua New Guinea and the islands of the South Western Pacific. The journal is published in four parts annually.

EMBLEM: The Society's emblem, chosen in 1973 on the 50th anniversary of the Society, is the king stag beetle, *Phalacrognathus muelleri* (Macleay), family Lucanidae (Coleoptera). Its magnificent purple and green colouration makes it one of the most attractive beetle species in Australia. It is restricted to the rainforests of northern Queensland.

Minutes of General Meeting

Held in Meeting Room (Seminar Room 1–ground floor) Ecosciences Precinct, Boggo Rd, Dutton Park, Monday, October 10, 2011 at 1 pm.

Chair: Matt Purcell

Attendance: Bradley Brown, Stephen Cameron, Alexandra Glauerdt, Tim Heard, Judy King, Simon Lawson, Lance Maddock, Penny Mills, Chris Moeseneder, Geoff Monteith, John Moss, Helen Nahrung, Matt Purcell, Mark Schutze, Federica Turco.

Visitors: Solomon Balagawi, Yuvarin Boortop**,** C. Paull.

Apologies: Justin Bartlett, Richard Bull, Lyn Cook, Cory Dale, Ross Kendall, Chris Lambkin, Stacey McLean, Morris Mckee, Desley Tree.

Minutes: The minutes of the last General Meeting were circulated in News Bulletin Vol. 39, Issue 6, September 2011.
Moved that the minutes be accepted as a true record: Penny Mills
Seconded: Simon Lawson
Carried unanimously.

Business arising
None.

Nominations for Membership:
There were no nominations.

General Business:
1. Second reminder to collecting permit holders that reports should have been sent to Chris Lambkin by the end of September.

2. Perkins Memorial Lecture- Dr Peter Cranston and Dr Penny Gullan:
'*Can teaching engender enthusiasm for Entomology?'*

Please note the meeting starts at 5pm, and it will be followed by a BBQ – the cost will be $5.00.

For catering purposes please email Matt Purcell matthew.purcell@csiro.au or Judy King cjking2@bigpond.net.au if you will be attending

3. The December meeting is Notes and Exhibits. Please start thinking about a contribution, and contact Lyn Cook or Judy King if you would like to contribute.

Main Business

Synchronised rhythmicity in bioluminescent insects: differences between cave-adapted and forest-adapted *Arachnocampa* species

David Merritt, School of Biological Sciences, The University of Queensland

Glowworms are the larval stage of flies in genus *Arachnocampa*, Family Keroplatidae, found only in Australia and New Zealand. Eight species have been described (Baker, 2010). Glowworms have a very specialised foraging strategy: they use bioluminescence as a lure to attract small phototropic insects into a web spun by the otherwise immobile larvae (Meyer-Rochow, 2007). The larval light organ is derived from the distal segments of the four Malpighian tubules (Wheeler & Williams, 1915). *Arachnocampa* are susceptible to desiccation and require humid environments (Baker, 2004; Baker & Merritt, 2003; Richards, 1960), consequently they are found either in rainforest or in caves with a flowing stream. A study of the phylogenetics and distribution of *Arachnocampa* in Australia recently resulted in the description of five new species (Baker, 2010) and revealed that the New Zealand species, *A. luminosa,* is sister group to all Australian species.

In this presentation, I compare the regulation of bioluminescence of *Arachnocampa flava* from south-east Queensland with *Arachnocampa tasmaniensis* from Tasmania. *A. tasmaniensis* is one of the species that reaches very high numbers in caves. MtDNA studies have shown that cave and forest populations from any one geographic region, e.g. Tasmania or New Zealand, belong to the same species (Baker et al., 2008). In caves, colonies tend to be concentrated in the entrance regions because they prey upon flying insects washed into the cave as immature stages through stream drift. In some caves with fauna-rich in-flow streams, large populations can be present in the completely dark zone some distance from the entrance. Here, temperature is constant through the year and there are few, if any, further cues as to time of day.

Because *Arachnocampa* in forest habitats glow only at night, we suspected that their bioluminescence could come under circadian regulation. Most animals have circadian clocks that control the onset of certain behaviours or metabolic processes at a particular time of day. Animals exposed to the night:dark cycles have their endogenous circadian clock reset (entrained) regularly. It is only when animals are placed in constant darkness that we see signs of their endogenous rhythms. BSc student Saki Aotani carried out such experiments on *A. flava* from south-east Queensland, showing that the larvae continue to bioluminesce in a periodic pattern even when in constant darkness (Merritt & Aotani, 2008). Characteristically, they free-run in DD, meaning that the onset of bioluminescence happened predictably, but not at a precise 24 hour interval; rather, each larva has its own inherent free-running period.

Given that the bioluminescence rhythm of the rainforest species, *A. flava*, is entrained by daily light:dark cycles so that larvae glow only during the night, we considered the question; what happens to the bioluminescence rhythm in cave populations of glowworms? The most likely event was that individuals remain rhythmic but the population would be desynchronised because individuals cycle in accord with their internal free-running periods. Alternatively, larvae could synchronise to each others' bioluminescence. To test these hypotheses we needed a location where dense populations are found in caves so I travelled to southern Tasmania where colleague Arthur Clarke has been carrying out biospeleological studies in Mystery Creek Cave (Fig.1). Using time-lapse digital cameras to record bioluminesce we found that cave larvae maintain a highly synchronised, high amplitude 24 h rhythm. Surprisingly, the peak bioluminescence occurred at a time of day, approximately 2 pm, when it was still daylight outside the cave (Merritt & Clarke, 2011).

The timing of the peak was not a fleeting phenomenon. Returning to the same cave every summer over three years showed the colony maintained the afternoon peak year to year. Further, cave populations in far distant caves showed approximately the same timing. Another important finding was that exposure of cave-dwelling *A. tasmaniensis* to artificial light regimes using LED light sources and 12 volt-powered timers caused larvae in the dark zone to shift the period of their bioluminescence rhythm. Surprisingly, they shifted their rhythm so that the propensity to glow was greatest when they anticipated the light to come on. Suspecting that this phenomenon reflected a behavior that caused larvae to synchronise to each others' glows, we took larvae back to the lab and showed that this is the case (Merritt & Clarke, 2011). Synchronisation could be advantageous by allowing larvae to glow collectively most brightly when prey are flying; a type of group foraging using light as the lure. Timed trapping of flying prey insects in the cave showed a rhythm to their activity with a peak occurring in the early evening, but it did not precisely match the peak bioluminescence intensity.

Most recently we have been investigating the differences in the bioluminescence propensity rhythm between *A. flava* (no significant cave populations) and *A. tasmaniensis* (significant cave and forest

Figure 1. David Merritt setting up a time-lapse camera in Mystery Creek Cave, Tasmania.

populations). By combining cave-based and laboratory studies exposing larvae to different intensities of light we have found that *A. tasmaniensis'* bioluminescence propensity rhythm peaks during the day, no matter what environment they inhabit. The reason that bioluminescence is apparent only at night in rainforest populations is that daylight inhibits the underlying tendency to glow and shunts bioluminescence into the night. On the other hand, *A. flava's* bioluminescence propensity rhythm is what would be expected of a nocturnally glowing animal: it peaks during the night. We consider that the difference between the two species reflects the fact that *A. tasmaniensis* is highly cave-adapted and, inside caves, synchronization is important in maximizing foraging success.

To place this work in an ecological and evolutionary context, this is the first time that the underlying rhythmicity of two such closely related species has been shown to be diametrically opposite. Is it linked to a strong association with caves, and is it linked to the evolutionary history of the genus? Fortunately, due to Claire Baker's work, we know the phylogenetic relationships of all species in the genus *Arachnocampa* (Baker et al., 2008) so we will be able to map the bioluminescence rhythm type on the phylogenetic tree, enabling us to make inferences about how and when substantial transitions in rhythmic behavior occurred (Fig. 2).

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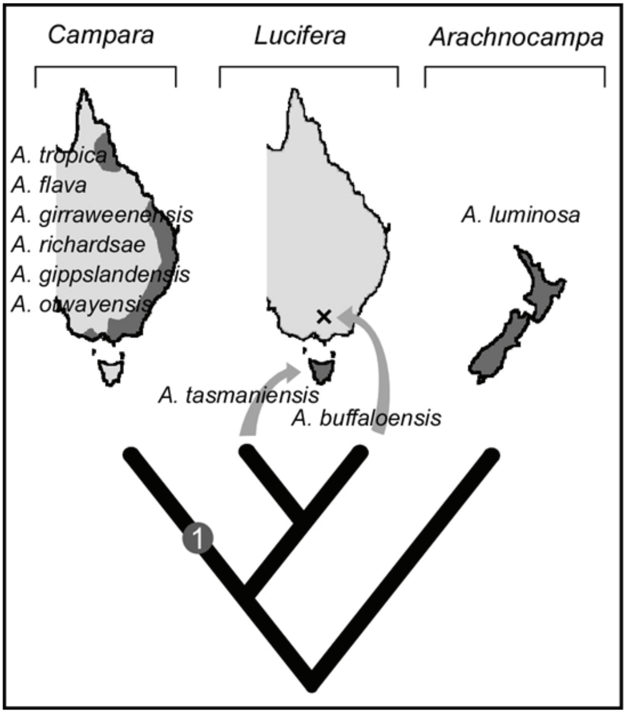

Figure 2. A phylogenetic tree showing the relationships of the subgenera and species of genus *Arachnocampa*. *A. tasmaniensis* and *A. flava* belong to different subgenera.

Vote of Thanks: Geoff Monteith

Next meeting: Reminder that the next meeting will be The Perkins Memorial on Monday, November 14 at 5pm.

Any other Business? No.

The Chair closed the meeting at 2.05pm

Main Business from September General Meeting

Smelling the forests for the trees: semiochemicals for forest pest management

Andrew Hayes, Helen Nahrung, Manon Griffiths & Simon Lawson

Horticulture and Forestry Science, Department of Employment, Economic Development & Innovation

Simon Lawson opened the talk with a general discussion about semiochemicals and their role in pest management and then described research into the sex pheromones of cossid moths in Queensland.

Hardwood plantation forestry in the subtropics

Eucalypt plantations (*Eucalyptus* and *Corymbia* species) are a relatively new sector of the plantation industry in subtropical Australia, with some 156 000 ha planted in Queensland and New South Wales over the last 15 or so years. Significant productivity losses in these plantations are caused by a suite of co-evolved endemic pests and diseases. Research is therefore needed to develop effective, environmentally friendly pest and disease management strategies that minimise rotation length and maximise productivity to ensure the long-term viability of the industry. For insect pest management there is a shift away from usage of chemicals to more ecologically-based strategies such as the use of semiochemicals.

What are semiochemicals and how are they used?

A semiochemical is a chemical emitted by a plant or animal that evokes a behavioural or physiological response in another organism. These can be divided into several categories, depending on the species involved and direction of the response. <u>Pheromones</u> are chemicals that elicit a response in the same species. Commonly known examples of pheromones include sex pheromones (used for mate location, particularly in the Lepidoptera), aggregation pheromones (e.g. bark beetles), trail pheromones (ants), alarm pheromones (aphids) and marking pheromones (parasitic wasps). <u>Allelochemicals</u> are chemicals that elicit a reaction from a different species: *Kairomones* are favourable to the receiver (e.g. plant attractants for insect feeding), *Synomones* are mutualistic (e.g. fragrances for pollinators and herbivore-induced plant volatiles that attract natural enemies – the 'calling for help' phenomenon) and *Allomones* that are favourable to the emitter (e.g. defensive chemicals of plants). Semiochemicals are used in pest management in a variety of ways, including for population monitoring (IPM thresholds, quarantine and biosecurity pest detection and for determining area freedom for market access) and population regulation (trapping, attract and kill, mating or behaviour disruption, predator/parasitoid attraction to crops, and push/pull strategies).

Semiochemical product development

Developing semiochemicals for pest management can be divided into discovery and commercial application phases. The discovery phase is relatively risky since there is no guarantee that for a given pest that a commercially viable product can be developed, though this risk can be lowered by careful definition of the pest problem and the system within it operates. Discovery typically involves use of laboratory techniques such as Gas Chromatography – Mass Spectrometry (GC-MS) to identify candidate chemicals and GC-Electroantennography (GC-EAD), olfactometers and wind tunnels to determine insect responsiveness to identified chemicals. Once activity has been demonstrated, formulation of blends and dispenser and trap design can take place in field testing. Commercial investment most commonly takes place after successful field testing demonstrates proof of concept, allowing for larger scale field evaluation and commercial scale-up.

Forestry semiochemistry R&D in Queensland

Cossid moths as pests internationally

Cossid wood moths are significant pests of forest plantations worldwide, including species such as the Teak beehole borer (*Xyleutes ceramicus*) on Teak, the Coffee borer (*Zeuzera coffeae*) on Teak, Mahogany and Sandalwood carpenterworms (*Prionoxystus robiniae* & others) in North American hardwoods and our endemic wood moths (*Endoxyla cinereus* & *Culama australis*) on native *Eucalyptus* in Australia. Of biosecurity concern for Australia are two endemic cossids that have host-switched to exotic eucalypts in South Africa (*Coryphodema tristis*) and Chile (*Chilecomadia valdiviana*) (Paine et al. 2011). Current management focuses on tree species/site matching, optimum silvicultural practice (including fertilisation, weed control, thinning) hygiene thinning and selection for resistance. Insecticidal control through stem injection is generally impractical, expensive in plantations, and often ineffective. Use of sex pheromones in mating disruption has been used for the horticultural pests *Cossus cossus* & *Zeuzera pyrina* in Europe, but has not been used for cossids in forestry plantations as yet, although a successful similar example is the clearwing moth borer (*Paranthrene robiniae*) in hybrid poplar plantations in Washington State, USA.

Cossid pests of eucalypt plantations

Giant wood moth (*Endoxyla cinereus*)

The giant wood moth is a primary pest of a wide range of *Eucalyptus* spp. in the subtropics and tropics of eastern Australia (Lawson et al. 2002). Larvae are solitary feeders, producing large J-shaped tunnels in the sapwood/heartwood of trees, feeding on the callus formed around the entry hole. Feeding leads to stem breakage in young trees and extensive degrade to timber and pulp (caused by the physical tunnelling and associated fungal staining and rot).

Culama wood moth (*Culama australis*)

Culama is a secondary pest in Australia, using giant wood moth and longicorn attacks, or stress-induced bark cracking to enter the cambium. It is a gregarious feeder, expanding damage to the cambium and tunnelling into the sapwood & heartwood. Its feeding can girdle young trees and it introduces extensive fungal staining and rot by exposing large areas of sapwood.

Coryphodema tristis on exotic eucalypts in South Africa

This goat moth is highly polyphagous. In Africa its usual hosts are bush willow, apple, quince and many other species. It was first found attacking *Eucalyptus nitens* in plantations in Mpumulanga province in South Africa in 2004. High incidences of attack have been recorded in some plantations, with up to 100% trees infested (Boreham 2006). It causes mortality and significant wood quality degrade.

Sex pheromones of *Culama australis*

All known primary cossid pheromones are straight, long-chain acetates, usually a mixture of two or more. These vary in the length of the carbon chain (between 10 and 14 carbon atoms), the position and number of double bonds in the chain and in stereochemistry.

In 2008, we used solvent extraction of pheromones from the glands of calling females in conjunction with GC-MS to characterise the compounds. From this we identified two candidate 14-carbon acetates & the mixture ratio. This *Culama* pheromone was successfully field tested in 2008-09 and an optimal blend ratio identified. This pheromone is now about to be used as an experimental tool in research that DEEDI is undertaking on the landscape level movement of moths between native forest and plantations. This will assist us in producing risk models that will enable plantation managers to better manage stem borers in plantations in the future. We also collaborated with researchers in South Africa to assist in

Previous page: Giant wood moth, *Endoxyla cinereus* (top); *Culama* wood moth, *Culama australis* (middle); larvae of Goat moth, *Coryphodema* tristis (bottom). **This page:** damage caused by *Culama* wood moth.

identifying the pheromone blend of *C. tristis*. Availability of this pheromone will assist in the early detection of this potential biosecurity threat should it ever arrive in Australia.

Andrew Hayes then spoke about semiochemical research into defoliating pests in eucalypt plantations in Queensland.

Interactions between *Corymbia* plantation species and hybrids and their arthropod herbivores.

Hybridization is an important biological phenomenon that can be used to understand the evolutionary process of speciation of plants and their associated pests and diseases. Interactions between hybrid plants and the herbivores of the parental taxa may be used to elucidate the various cues being used by the pests for host location or other processes. The chemical composition of plants, and their physical foliar attributes, including leaf thickness, trichome density, moisture content and specific leaf weight were compared between allopatric pure and commercial hybrid species of *Corymbia*, an important subtropical hardwood taxon. The leaf-eating beetle *Paropsis atomaria*, to which the pure taxa represented host (*C. variegata*) and non-host (*C. torelliana*) plants, was used to examine patterns of herbivory in relation to these traits.

Foliar Traits and *Paropsis atomaria*

Hybrid physical foliar traits were generally intermediate to the parents, or favoured the *C. torelliana* parent. The chemical profiles of terpenes extracted from leaves were all statistically distinguishable, and the hybrid was intermediate between the two parents (ANOSIM: Global $R = 0.814$, $P = 0.001$; CV, CT: $R=0.964$, $P=0.008$; CV, CT×CV: $R=0.834$, $P=0.008$; CT, CT×CV: $R=1$, $P=0.008$). Some chemical components were identified only in the *C. variegata* leaves, or were detected in all taxa, but levels were significantly different in different taxa. Approximetely 20% of all identified compounds were only detected in *C. variegata*. Could one (or more) of these be used for host location and selection? Field and laboratory beetle feeding preference, while showing some variability, were generally intermediate to those exhibited by parent taxa, thus suggesting an additive inheritance pattern.

The hybrid susceptibility hypothesis was not supported by our field or laboratory studies, and there was no strong relationship between adult preference and larval performance. The most-preferred adult host was the sympatric taxon, although this species supported the lowest larval survival, while the hybrid produced significantly smaller pupae than the pure species. The findings suggest a chemical basis for host selection behaviour and indicate that it may be possible to select for resistance to this insect pest in these commercially important hardwood trees (Nahrung et al 2009).

Foliar Traits and other herbivores

A second study was also described, which expanded the range of plant taxa studied and also the herbivore species, we looked to see if the same patterns held in this more diverse study.

Pure *C. torelliana*, and hybrids of *C. torelliana* with three congeneric taxa, *C. citriodora*, *C. henryi* and *C. variegata* were assessed in common garden field plots for the abundance and distribution of herbivory by four distinct herbivore taxa. These were leaf blister sawfly (*Phylacteophaga froggatti*), the leaf beetle (*P. atomaria*), eriophyid mites (*Acalox* and *Rhombacus* spp.) and the leafhopper (*Kahaono montana*). Differing feeding strategies and levels of polyphagy among these herbivores allowed us to test hypotheses regarding heritability of susceptibility and relationships to two of the plant secondary metabolites (PSMs) α-pinene and 1,8-cineole.

Above: Leaf beetle, *Paropsis atomaria.*

Leaf sample extracts were statistically distinguishable between taxa (ANOSIM: Global R = 0.627, P = 0.001), and pairwise comparisons further identified these distinctions, especially that samples from *C. torelliana* × *C. variegata* clustered separately from *C. torelliana* and the other hybrids.

We found that herbivore species showed differential responses to different taxa and monoterpene contents. For example, eriophyid mites, the most monophagous of our censused herbivores, avoided the pure species, but fed on hybrid taxa, supporting hypotheses on hybrid susceptibility. The most polyphagous herbivore (leaf blister sawfly *Phylacteophaga froggatti*) showed no evidence of response to plant secondary metabolites (PSMs), while the distribution and abundance patterns of *Paropsis atomaria* showed some relationship to monoterpene yields (Nahrung et al 2011).

Understanding biosynthesis, heritability and the ecological significance of plant secondary metabolites, particularly terpenes, is important in understanding plant-herbivore interactions. Understanding the preferences of insect pests will assist in the choice of parental taxa and hybrids used for forestry, as these hardwoods become an ever more important component of the industry.

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NOTICE OF NEXT MEETING

Perkins Memorial Lecture

Frederick Athol Perkins (1897-1976)

This biennial lecture celebrates the memory of Frederick Athol Perkins, a founder of the Entomological Society of Queensland, first lecturer in entomology at the University of Queensland (1926), and first Head of the Department of Entomology (1952). Athol Perkins influenced entomology in Queensland for half a century in a way that no other entomologist has yet emulated.

Monday 14th November 2011

LECTURE at 5PM - followed by BBQ

Seminar Room 1, Ground Floor
Ecosciences Precinct, Boggo Rd, Dutton Park

No need to sign-in at front desk.

BBQ

Cost $5
Drinks available for purchase.

RSVP to Matt Purcell by Friday 11th November
Matthew.Purcell@csiro.au

Visit **www.esq.org.au/meetings.html** for maps of venue

THIS YEARS LECTURE:

Can teaching engender enthusiasm for Entomology?

by

Profs Penny Gullan and Peter Cranston

Adjunct Professors, Research School of Biology, ANU

Abstract: F.A. Perkins is remembered for his passionate love and enthusiasm for all things entomological, with his influence in Queensland spanning 50 years. The sum of our combined experience in entomology now exceeds that of Perkins, and we will consider how much 'love and enthusiasm' for insects contributes to modern teaching of the subject. We take examples from teaching in the UK, Australia and a decade in California, and authorship of the principal textbook in the field (The Insects: an Outline of Entomology), now in its 4th edition.

About the lecturers

Professors Pete Cranston and Penny Gullan are emeritus in the Division of Evolution, Ecology & Genetics of the Research School of Biology at the ANU. In November 2010, they returned to Australia after nearly 11 years as academics in the Department of Entomology at the University of California in Davis, where they taught undergraduate courses in General Entomology, Systematic Entomology, and Biodiversity, as well as running numerous postgraduate seminar courses. Pete conducts research on the evolution, taxonomy and ecology of non-biting midges (Diptera: Chironomidae) and Penny specialises in the systematics of scale insects (Coccoidea). They continue their respective research programs at the ANU and Pete also remains the principal editor for the journal 'Systematic Entomology'. The most recent edition of their textbook 'The Insects: An Outline of Entomology' was published in 2010 and has become the major entomology text worldwide.

Entomology's newest Nobel laureates

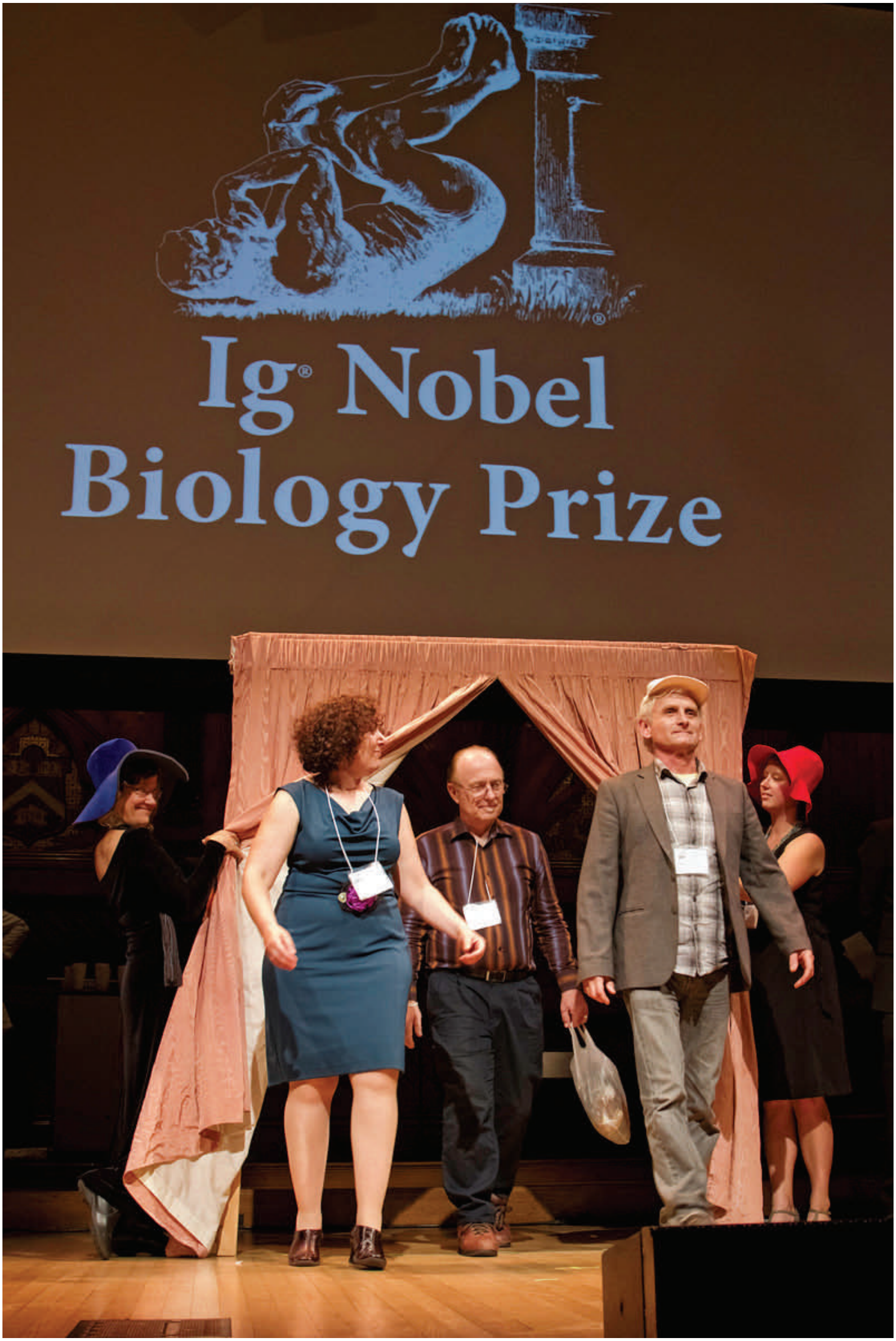
Australian Entomologist David Rentz (below left) and colleague Darryl Gwynne (right), from University of Toronto, were awarded the Ig Nobel Prize for Biology for their 1983 paper "Beetles on the bottle: Male buprestids mistake stubbies for females" published in the *Australian Journal of Entomology* (volume 22, issue 1).

The Ig Nobel Prize, a parody of the true Nobel Prize, has been presented annually by humor magazine *Annals of Improbable Research* since 1991. The awards, given for 10 categories, are presented to recipients by real Nobel laureates at a ceremony held at Harvard University, Massachusetts, USA. According to the Improbable Research website, the Ig Nobel Prizes 'honor achievements that first make people laugh, and then make them think', and 'celebrate the unusual, honor the imaginative, and spur people's interest in science, medicine and technology'.

Gwynne and Rentz's paper describes the attempts of males of the jewel beetle species *Julodimorpha saundersii* (then a synonym of *J. bakewelli*) to mate with discarded beer bottles in the Dongara district of Western Australia.

Other awards were given for investigations on "the ideal density of airborne wasabi to awaken sleeping people in case of fire or other emergency" (Chemistry Prize), and "why discus throwers become dizzy, while hammer throwers don't" (Physics Prize).

Science, boring? ………… certainly not!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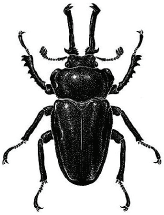

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DIARY DATES 2011

Meetings held 2nd Monday of the month (or Tuesday if Monday is a public holiday)

MAR—Monday 14th	Matt Purcell	AGM and President's Address
APR—Monday 11th	Dr Diana Leeman	Small hive beetle, a recently established scourge of apiaries
MAY—Monday 9th	Dr Tim Heard (CSIRO)	Australian native stingless bees
JUN—Tuesday 14th	Notes and Exhibits & Student Award Presentation	
AUG—Monday 8th	Gunter Maywald	Shaking the eucalypt leaf beetle tree: some highs & lows
SEP—Monday 12th	DEEDI Forest Health	Semiochemicals for forest pest management
OCT—Monday 10th	Dr David Merritt (UQ)	Synchronised rhythmicity in bioluminescent insects
NOV—Monday 14th	Profs Gullan & Cranston	Perkins Memorial Lecture
DEC—Monday 12th	Notes & Exhibits	

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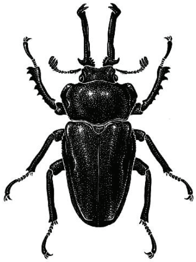
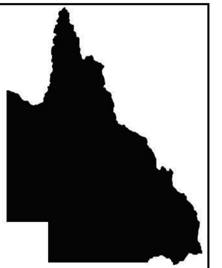


THE ENTOMOLOGICAL SOCIETY OF QUEENSLAND



NOTICE OF NEXT MEETING

Monday 14th November 2011, 5pm

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Perkins Memorial Lecture & BBQ

Can teaching engender enthusiasm for Entomology?

by

Profs Penny Gullan and Peter Cranston

Research School of Biology, ANU

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Seminar Room 1
Ground Floor, Ecosciences Precinct
Boggo Road, DUTTON PARK

More venue details available at
http://www.esq.org.au/meetings.html

ALL WELCOME

NEXT NEWS BULLETIN

Volume 39, Issue 8 (November 2011)
due early December

CONTRIBUTIONS WELCOME

DEADLINE - Thursday 24th November
Send your news/stories/notices to the editor
(justin.bartlett@deedi.qld.gov.au)