

CSIRO ECOSYTEM SCIENCES www.csiro.au/anic

# **Our first issue**

David Yeates, Director, and Beth Mantle, Manager, ANIC

This is the first issue of *ANICdotes*. Our aim is to keep readers up to date with research and curation in the Australian National Insect Collection, the world's largest collection of Australian insects.

The Head of ANIC for the last decade, Dr John La Salle, has recently taken up a position as interim Director of the Atlas of Living Australia (ALA) following the departure of Donald Hobern to head the Global Biodiversity Information Facility in Copenhagen. David Yeates was appointed Director of ANIC on John's departure. We wish John all the best in his new role.

The mission of the ANIC is to broaden and deepen our understanding of Australian Insects through research and education, and to manage and develop the collections as authoritative vouchers of Australia's biodiversity. This is an exciting time for the collections in CSIRO. After many years of management by separate Divisions, for the first time the CSIRO collections are being managed as one unit. This is in recognition of their unique and important place in Australia's biodiversity research infrastructure. ANIC is now administered with the other large natural history collections – the Australian National Herbarium (ANH), the Australian National Wildlife Collection (ANWC) in Canberra and the Australian National Fish Collection (ANFC) in Hobart.

Collections-based research in CSIRO is being transformed right now in at least two important ways. Greater access to the

knowledge embodied in the collections through activities such as the ALA is both increasing awareness of the collections, and creating greater demand for further digitisation and databasing.



David Yeates Beth Mantle

Molecular biology is playing a more important role in the collections, and the growing revolution in genomics is providing us with a much larger armoury of tools to understand biological relationships and evolution. This also creates even more demand for the knowledge and material in the collections.

The Canberra-based collections ANWC, ANIC and ANH will also benefit by being part of the Centre for Biodiversity Analysis, headed by Laureate Professor Craig Moritz, and based across Clunies Ross St at the Australian National University. The CBA began on July 1, and Craig is a joint appointment with ANU and CSIRO.

Each issue of *ANICdotes* will highlight research activities and products, field expeditions, our expanding program to digitise the collection, and visitors to the collection. We will always have a focus on the active and creative people that make all this happen.

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BANNER: Graphium macleayanus image from the Biodiversity Heritage Library. PHOTOS: all photos taken by Chris Manchester except pages 3 & 4 taken by You Ning Su.





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# A longing for longicorns

#### Adam Slipinski

Adam Slipinski, Hermes Escalona (visiting scientist from the Universidad Central de Venezuela) and Anne Hastings were awarded an Australian Biological Resources Study (ABRS) grant to revise and to develop interactive keys to the genera of the Australian long-horned beetles (Cerambycidae), subfamily Cerambycinae. This award follows recently completed revision and LUCID identification keys to the genera of subfamily Lamiinae.

Cerambycidae are among the most highly diverse and speciose groups of beetles (Coleoptera). Their bodies exhibit a truly amazing array of sizes, colours and forms ranging from 2.5 mm long Cyrtinus to the largest known titan beetle (Titanus giganteus) inhabiting the Amazonian rainforests. With estimates ranging as high as 35 000 species in more than 5200 genera, long-horned beetles are a very significant component of the world's terrestrial fauna. Virtually all Cerambycidae feed on living or dead plant tissues and play a significant role in all terrestrial environments where plants are found. These beetles often attack and kill living forest or orchard trees and develop in construction timber, causing serious damage. Many species are listed as quarantine pests because of their destructive role in the timber industry, with several species listed as obligatory vectors of injurious pine nematodes of the genus Bursaphellenhus, responsible for the decimation of pine plantations in Europe and Asia.

With about 1200 described and hundreds of undescribed species, Cerambycidae is one of the largest families of Australian beetles and, except for the relatively well-known and economically important tribe Phoracantini, no serious research has been done in the last 40 years. Now, with the support of ABRS, keys to the genera and associated taxon information will be made available as a website, to be known



as "The Genera of Australian Cerambycidae" that will be publicly available in early 2013.

Traditionally Cerambycidae have been the focus of study by forest entomologists and amateurs because of their large size, eye-catching coloration, and high value on collectors' trading markets. This amateur-heavy taxonomic approach has remained the status quo and the knowledge of phylogeny and classification of this group clearly reflects that legacy. Taxonomy has relied heavily on a combination of very few characters available from external morphology without phylogenetic context resulting in an unnecessary proliferation of tribal and generic taxa, and making a serious comprehensive study a challenging task.

Australian cerambycid taxa will be studied in a global context using modern morphological and molecular techniques, establishing a firm framework for further research. This project brings together many aspects of the most comprehensive and detailed study yet undertaken on the Cerambycidae. Hermes and Adam will collaborate with many colleagues from all over the world in this research project, such as Petr Svacha (Czech Republic), Duane McKenna, Steve Lingafelter (USA).

Adam Slipinski and Hermes Escalona.

# The Scribbly Gum Moth study, Ogmograptis (Lepidoptera: Bucculatricidae)

### E.D. Edwards and Marianne Horak

There must be some early 19th century mentions of scribbles on gums as they were common in the Sydney region at first settlement. However, the first mention in the scientific literature is by Ferdinand von Müeller who described *Eucalyptus signata* in 1859 (currently a synonym of *E. racemosa*) expressly for its scribbled bark.

The moth whose larvae make the scribbles was first reared by Tom Greaves of CSIR Entomology at Piccadilly Circus in the Brindabella Range ACT on snow gums. Specimens sent to Edward Meyrick in the UK, the doyen of microlepidoptera at that time, were described as *Ogmograptis scribula* in 1935, in reference to the ogam script of ancient Celtic writing.

Meanwhile the iconic scribbles, familiar to all in southeastern Australia, entered popular literature first through the children's stories of May Gibbs and later through the poetry of Judith Wright.

Then came a long period where angels feared to tread. Meyrick was unsure of the family placement of the Scribbly Gum Moth and this doubt continued culminating in its omission from Ian Common's *Moths of Australia*, although it was mentioned in *Insects of Australia*.

Enter a schoolgirl, Julia Cooke, who planned a school project on scribbly gum moths and who became enthused with the shape and orientation of the scribbles, their distribution on a tree and differences between scribbles on different eucalypts. She later studied biology at ANU and moved on to a PhD at Macquarie University. There she applied modern statistical methods to her school project and published her findings.

Julia's work captured the imagination of Max Day, retired but formerly in the Division of Entomology, the CSIRO Executive and Chief of Forestry. Max wanted action. The result was a team consisting of Marianne Horak, Max Day, Celia Barlow, Ted Edwards and later Steve Cameron and You Ning Su.

There were many hurdles to overcome. When and how was the best way to find or rear the adult moths? How could live larvae be found? How do the larvae and tree interact? How does the tree shed its bark? What is making the "ghost scribbles"?

Fortunately Celia lived on a rural property, and if more fence posts were cut than was strictly necessary science gained by it. Larvae were found, cocoons were found, eucalypts studied, literature and moths studied, and slowly a picture emerged.

Notably, information was poor on how eucalypts shed their bark. Clearly the larvae feed in a very precise layer in the bark which would mark the split for next year's shed. The split marks the course of a cork cambium which does not visibly develop until well into larval growth. The family placement of the moths was questionable. In *Insects of Australia* they were placed in the Bucculatricidae on the sole basis of the characteristically ribbed cocoon but were there other apomorphies to confirm the family?



Scribbly Gum and moth larva.





Ogmograptis sp. Scribbly Gum Moth.

Their larvae clearly feed in the growth cambium.

The result has been the description of 11 new species in Ogmograptis. Some are typical scribbly gum moths which form a very tight taxonomic group. However there is no perfect relationship of one tree species to one moth species. Some trees have two moths, some moths have two trees. Other *Oamograptis* species form two other taxonomic groups with unknown biologies. Larval characters now appear important in the apomorphies defining the Bucculatricidae and this work will result in a redefinition of the family. The southern hemisphere Bucculatricidae now clearly retain many plesiomorphies compared to Bucculatrix which is dominant in the northern hemisphere. Surprises have come in the larval behaviour where the last instar larva grows rapidly on a diet of callus tissue laid down by the tree in the last leg of the mine. The study will improve our knowledge of world Bucculatricidae immensely and is a classic study of insect-plant interactions.

Max Whitten has published another version of the story in *Meanjin* 71(2): 30-38 (2012).

The full *Ogmograptis* study will appear shortly in *Invertebrate Systematics*.

# Member of the Order of Australia for Ted Edwards

#### Marianne Horak

Ted Edwards was awarded Member of the Order of Australia in the recent Queen's birthday honours list "for services to science in the field of entomology, particularly butterflies and moths, as an author, researcher and mentor".

This award recognises Ted's efforts since his retirement in 2000 to provide identifications, advice and assistance in numerous ways to researchers, students, authors and members of the public. This has meant that publications on Australian Lepidoptera have been based on reliable names and sound information which would not have been possible without his contribution. In this way Ted has provided essential input into hundreds of publications and projects in fields as diverse as taxonomy, biological control, medicine, biodiversity, biosecurity, conservation, agriculture, forestry, ecology and general public interest. For these reasosn, the entomological and Lepidoptera communities provided strong support for the award.

Integral to Ted's work has been the Fellowships provided by CSIRO Ecosystem Sciences which have allowed Ted access to the ANIC, library and computing services. The 30-year close collaboration between Ted and Marianne Horak, who has also recently retired, made the most of their complementary skills and was an essential ingredient in this award. In retirement Ted has played a critical role in the recent volumes of Monographs on Australian Lepidoptera, cataloguing a range of families for ABRS's Australian Faunal Directory, editing Australian Moths Online and supporting the ANIC Moth Weekends. His ongoing and crucial input in building and curating the Lepidoptera collection means that his knowledge will also be available for future taxonomic studies. The high scientific standard of Ted's contributions is illustrated by the fact that all three books of which he has been a co-author have received Whitley Commendations.



Ted Edwards.

## **Australian Faunal Directory**

**Debbie Jennings** 



ANIC AFD team.

The Australian Biological Resources Study (ABRS) was launched by the Commonwealth Government in 1973 with aim of coordinating and assisting in the documentation and classification of the Australian flora and fauna. From the beginning, ANIC staff were successful in securing grants to contribute to the *Zoological Catalogue of Australia*, a series of detailed species inventories that were to cover the whole described fauna. Between 1985 and 2001, Hilda Abbey, John Balderson, Eva Bugledich, Andrew Calder, Jo Cardale, Gerry Cassis, Ted Edwards, Penny Greenslade, Mark Harvey, Keith Houston, John Lawrence, Lee Miller, Barry Moore, Laurence Mound, Judy Newland, Janet Pyke, Leanne Regan, David Rentz, Alison Roach, Bob Taylor and Tom Weir compiled volumes on diverse insect and arachnid orders.

By the mid 1990s, advances in computer technology and the advent of the Internet opened up the possibility of providing public access to the databases behind the printed ZCA volumes. ABRS embraced the IT revolution, providing crucial support for the testing and implementation of biological informatics software developed largely by a team based at CSIRO. Ten years later, the full fauna catalogue was available online as the *Australian Faunal Directory* (AFD), with Alice Wells doing a fabulous job in co-ordinating the project across various institutions. The AFD aims to be an authoritative catalogue of all validly published names, including synonyms and homonyms, set out in a modern classification.

ANIC staff have continued to contribute significantly to the AFD in various invertebrate taxa, updating published groups and cataloguing new ones. In 2010 ANIC won the tender to compile various checklists covering moths (Lepidoptera), beetles (Coleoptera), mites (Acari), nematodes (Nematoda) and ants (Formicidae), with a two year deadline. Delays beyond ANIC's control left only 18 months for a dedicated and hardworking team headed by Beth Mantle to complete the work.

The AFD's coverage of moths and butterflies (Lepidoptera) was relatively extensive at the outset, with Ted Edwards having added 18 families covering approximately 3000 valid species to the list. However, there have been significant taxonomic changes over time, and much of the current checklisting involved documenting these changes. The team of Ted Edwards, Robyn Meier and You Ning Su made changes to 3865 species entries and entered 331 additional species. The total Lepidoptera count in AFD now stands at 10,751 valid species names, together with over 6700 synonyms and homonyms.

Adam Slipinski led the Coleoptera checklisting groups covering the Tenebrionoidea, Staphylinoidea, Cucujoidea and Hydrophiloidea, with Rolf Oberprieler leading the Curculionoidea team. These groups include the darkling beetles, rove beetles, water scavenger beetles and weevils as well as a host of other poorly known taxa. Together Adam, Rolf, Tom Weir, Kim Pullen, Ewa Slipinska, Robyn Meier and Debbie Jennings entered an impressive 13,484 names for 10,473 valid species. Bruce Halliday (Acari) and Steve Shattuck (Formicidae) were well organised, and compiled their checklists with no technical assistance. The Acari are ubiquitous but notoriously poorly know; the AFD list now runs to 3507 valid species together with over 300 synonyms and homonyms. The taxonomic study of Formicidae in Australia has benefitted greatly from the presence of a dedicated ANIC specialist for a long period. The Australian ant fauna is very diverse, and the AFD list now comprises 1867 names for 1350 valid species.

Nematodes are ubiquitous in practically all terrestrial, freshwater and marine environments. Over 50% of the described world species are parasitic, and there are numerous economically important species. The checklisters, Mike Hodda (leader) and Debbie Jennings, overcame significant obstacles to document this taxonomically difficult group and produce an AFD total of 3048 species names representing 2633 valid species.

Further statistical data is available on the AFD website.



## **RESOURCES**

### Ozthrips.org

This fully illustrated, Lucid-based introduction to thrips provides keys to all nine families and subfamilies, together with keys to the 330 Australian species in 96 genera of the suborder Terebrantia, including most pest species and illustrations of crop damage. DAFF made it possible for Dena Paris to design the system prepared by Laurence Mound and Desley Tree of Queensland.



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### **Collection Management & Curation Column**

**Beth Mantle** 

I often say (boast!) that ANIC is the largest collection of Australian invertebrates in the world. I have no reason to doubt that this is true; except that I don't actually know how many specimens we have in our collection! I know that we have at least 22,000 drawers in three large collection halls. I know we have 1,372 cabinets of specimens in ethanol. Recently, I was asked how many holotypes were deposited in ANIC and, while I can provide a good estimate (16,744 recognised types, including paratypes), virtually none of these is digitised or available online.

This year, ANIC intends to digitise primary types across all groups in the collection. We intend to database each type specimen, capture at least one image, including specimen labels (see figure), and deliver the record to the Atlas of Living Australia and GBIF. Not only will this provide a useful source of information to entomologists worldwide, it is helping ANIC get its own house in order. We know that we can't digitise everything, but we can focus our efforts on the most important specimens, such as holotypes.

In other news, two of our curation staff are currently overseas developing their skills in taxonomy and identification. Nicole Fisher is at Tovetorp Zoological Research Station in Sweden attending "The HYM Course". This intensive, two week residential course is highly regarded by hymenopterists and is coordinated by some of the best experts in this field. Meanwhile, Robyn Meier is working in the Museum of Comparative Zoology at Harvard University, Boston for a month. Robyn will be flexing her identification muscles on the MCZ ant collection, while also imaging Australian types as she works her way through the collection. Keep an eye out for news from these two travellers in the next edition of ANICdotes.



This is an example of the most basic form of holotype imaging. The specimen, labels (including ANIC database number) and a scale are all visible. The record and image will be delivered to the Atlas of Living Australia and GBIF.

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# **Digitisation Update**

#### **Beth Mantle**

Natural history collections are progressively becoming virtual collections that can be viewed and searched online through portals such as the Atlas of Living Australia and GBIF. ANIC is engaged in a range of digitising activities but the one that is receiving quite a bit of attention is our whole-drawer imaging project.



An example of a whole-drawer image of specimens from the ANIC Lepidoptera collection acquired using SatScan<sup>™</sup>.

ANIC is using the SatScan<sup>™</sup> whole-drawer imaging system to acquire ultra-high resolution images of insect drawers. You can see the system in operation in this YouTube video: www.youtube.com/watch?v=ogpiqzDqa4A. The final TIFF images, which are between 400-500 MB in size, are uploaded to Morphbank-ALA for viewing, annotation, and download.

So far, more than 2,000 drawers have been imaged and uploaded, representing approximately 10% of the whole collection. At this rate, it is hoped that the entire collection will be imaged by 2015, providing virtual access to researchers, no matter where they are in the world.

There are a number of benefits with undertaking an enormous project like this. For example, by providing users with the ability to search the collection for themselves, we expect a reduction in the number of enquiries and loan requests. The images have also proven to be useful for remote identification of material by experts, which adds value to the specimens in the collection. If you would like to read more about whole-drawer imaging you can download our recent publication on the topic from ZooKeys:

www.pensoft.net/journals/zookeys/article/3169/abstract/

In each edition of ANICdotes we will provide an update on which insect groups have been imaged and are available for viewing online. The following groups have been imaged as of August 2012:

- Dragonflies (Odonata)
- Cicadas (Hemiptera: Auchenorrhyncha)
- Cockroaches (Blattodea)
- Stick Insects (Phasmatodea)
- Mantids (Mantodea)

# **VISITORS**

**Dr Brian Wiegmann**, William Neal Reynolds Distinguished Professor from the Department of Entomology at North Carolina State University in the USA is spending his sabbatical in ANIC working with David Yeates. Professor Wiegmann's visit is being sponsored by CSIRO's Distinguished Visiting Scientist program. Among other things, Brian and David plan to develop datasets for addressing major challenges of dipteran evolution using phylogenomic data.



### **Honorary Fellows - the ANIC community elders**

**Bruce Halliday** 

For some of us, the end of our period of professional employment does not mean the end of our working lives in entomology. After 20 or more years of work on insects, we become addicted to taxonomy, and feel that we still have something to offer. Fortunately CSIRO recognises that, and makes it possible for us to continue working after we retire. The Honorary Fellow program provides facilities for retired scientists to keep working and to make use of their specialised skills, and often represents the most productive and rewarding phase of a scientist's career. Apart from continuing their own research programs, the Honorary Fellows play a valuable role as experienced mentors for young scientists, and have the freedom to contribute to their science in other ways, such as writing and editing books and journals, teaching and supervising students and visitors, and playing a leading role in the management of societies and conferences, without the administrative constraints they experience as employees. At the moment ANIC hosts eight Honorary Fellows under this program.

In the Lepidoptera team, Max Day and Marianne Horak, with several other collaborators, have been working on the taxonomy and biology of the group of moths whose caterpillars produce the well-known markings on the bark of scribbly gums. The socalled scribbly-gum moths in the genus *Ogmograptis* are much more complicated and interesting than the team expected when they started this project. The genus includes at least twelve species, most of which were only discovered recently, using a combination of morphological and molecular data. A major paper on this fascinating group of moths will be published very soon, and the project has already been attracting attention in newspapers and other news media.

Ted Edwards has spent more than 40 years studying moths, and is now able to share his comprehensive knowledge by helping other people identify their specimens, by providing training to young lepidopterists, by writing books and articles



ANIC Honorary Fellows, August 2012. Left to right: Laurence Mound, Bruce Halliday, Barry Richardson, Ted Edwards, Marianne Horak, Tom Weir, Max Day. Absent: John Lawrence (Queensland)

about moths, and by supporting research projects on moths and butterflies in ANIC and elsewhere.

Laurence Mound is a world leader in the study of thrips. He has published hundreds of papers on thrips, and still travels extensively to collect new specimens. He manages the ANIC collections of thrips and aphids, and hosts a steady stream of visitors and students. He is currently working on formal taxonomic studies of several groups of these fascinating creatures, as well as producing or contributing to interactive electronic identification guides and databases for thrips of Australia, California, and southeast Asia. One of these, a full account of the 350 species of Thysanoptera-Terebrantia known from Australia, is available at www.ozthrips.org.

Arachnids are not insects, but they form the basis of some of ANIC's long-running research programs. Bruce Halliday has been working on mites in ANIC for over 30 years, and has published over 100 books and papers on the subject. He is currently collaborating with colleagues in Brazil, Iran, Switzerland, Poland, the Czech Republic, and Japan, to produce taxonomic revisions and catalogues of a variety of different groups of mites. He recently completed a revised edition of a checklist of all the mites that are known to occur in Australia, and the results are available as part of the Australian Faunal Directory. Barry Richardson is working on taxonomic studies of Australian jumping spiders in the family Salticidae. The family includes the beautiful peacock spider and its relatives, which mount spectacular courtship displays similar to those seen in the birds of paradise. Barry is also using his ecological skills to analyse biodiversity data, to improve the analytical tools that are used to measure and compare the biodiversity of different sampling areas.

John Lawrence is one of the world's leading beetle specialists. He is working on a new book on Australian Coleoptera, which is due for publication in 2013. It will include complete descriptions of all 117 families of beetles that occur in Australia, based on both adults and larvae, with new information on adult and larval morphology, major habitats, habits and life history, distribution, and fossil history. His projects also include more formal taxonomic studies of a range of beetle families at the species level, as well as major contributions to the molecular and morphological study of the phylogeny and evolution of the major beetle groups, and training of young coleopterists in international workshops. After 34 years of work in ANIC, Tom Weir recently joined the ranks of the Honorary Fellows. Tom is writing several chapters for the new beetle book, as well as using his lifetime of knowledge of beetles and other insects to provide support for many other ecological and taxonomic projects.

The ANIC Honorary Fellows published more than 50 papers and electronic documents in the last year, and contributed to the life of ANIC in many other ways. While some people play golf or go fishing when they retire, we Honorary Fellows keep our hands and minds active doing what we do best, in a program that benefits us personally, as well as making valuable contributions to ANIC and entomology in general.

# **Recent publications**

### **ELECTRONIC RESOURCES**

Hoddle M.S., **Mound L.A.** & Paris D.L. (2012) *Thrips of California 2012*. Cd-rom published by CBIT Publishing, Queensland. http://keys.lucidcentral.org/keys/v3/thrips\_of\_california/Thrips\_of\_ California.html

**Mound L.A.**, Tree DC & Paris D. *Ozthrips – Thysanoptera in Australia*. www.ozthrips.org

Halliday, R.B. 2012. Superorder Acari. In *Australian Faunal Directory*. www.environment.gov.au/biodiversity/abrs/online-resources/fauna/ afd/taxa/ACARI (Australian Biological Resources Study, Canberra).

#### **BOOK CHAPTERS**

Monteiro R.C. & **Mound L.A**. Thysanoptera. pp. 407–422. In: Rafael, JA, Melo, GAR, de Carvalho, CJB, Casari, SA & Constantino, R [eds] *Insetos do Brasil: Diversidade e Taxonomia*. Holos Editora, Ribeirão Preto. xiv + 796 p.

#### JOURNAL ARTICLES

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