Australian sphingidae-DNA barcodes challenge current species boundaries and distributions

Rodolphe Rougerie, Ian J. Kitching, Jean Haxaire, Scott E. Miller, Axel Hausmann, Paul D. N. Hebert

AUSTRALIAN SPHINGIDAE

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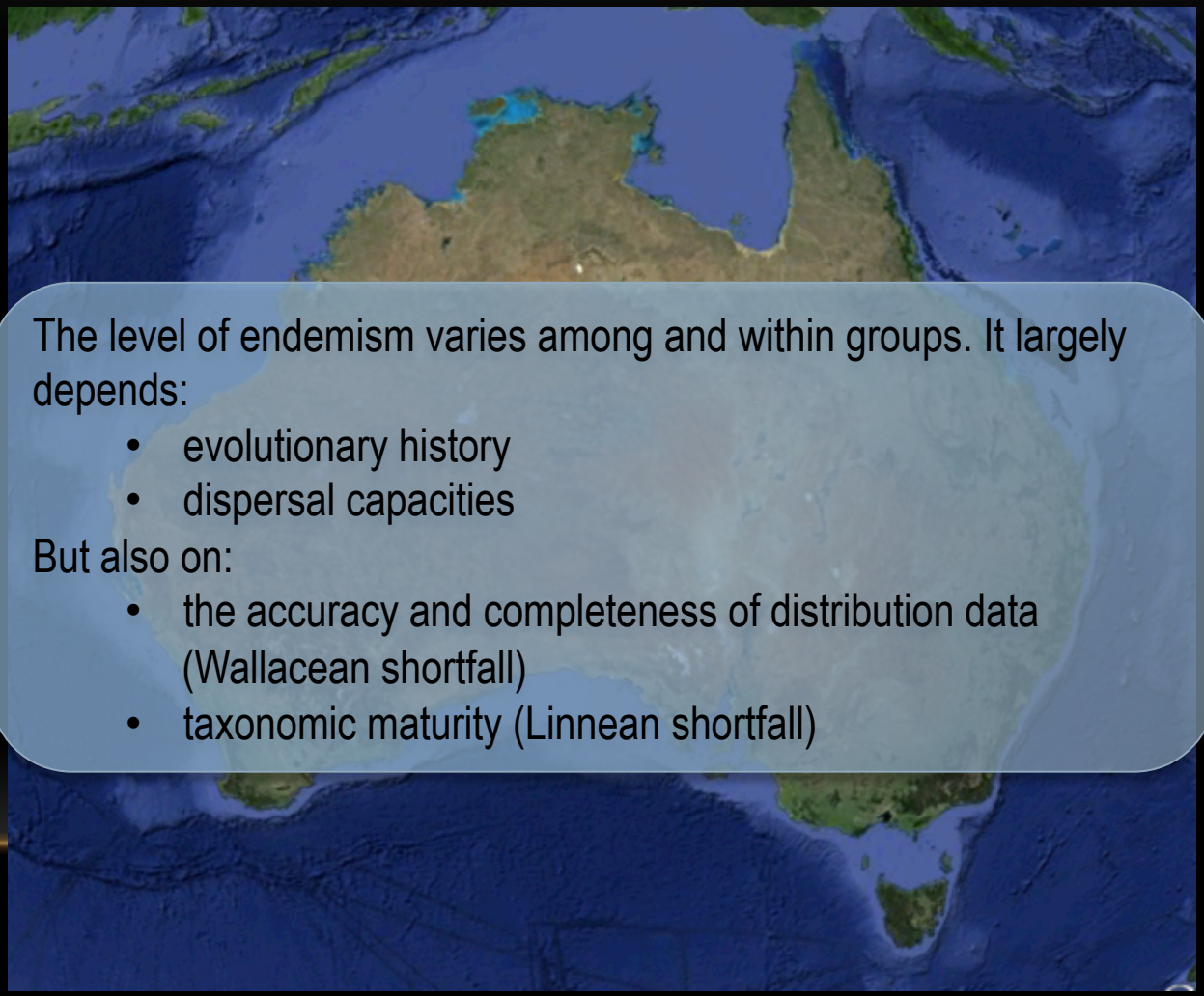
UNIVERSITY of GUELPH

5th International DNA barcoding Conference, 27-31 October 2013, Kunming, Yunnan, China

1. CONTEXT & OBJECTIVES

- The world's largest island: 7.69M km2, diversity of environments
- The Australian fauna is known for its endemism



The level of endemism varies among and within groups. It largely depends:

- evolutionary history
- dispersal capacities

But also on:

- the accuracy and completeness of distribution data (Wallacean shortfall)
- taxonomic maturity (Linnean shortfall)

1. CONTEXT & OBJECTIVES

- Recent advances in integrative species delineation have revealed overlooked or cryptic diversity

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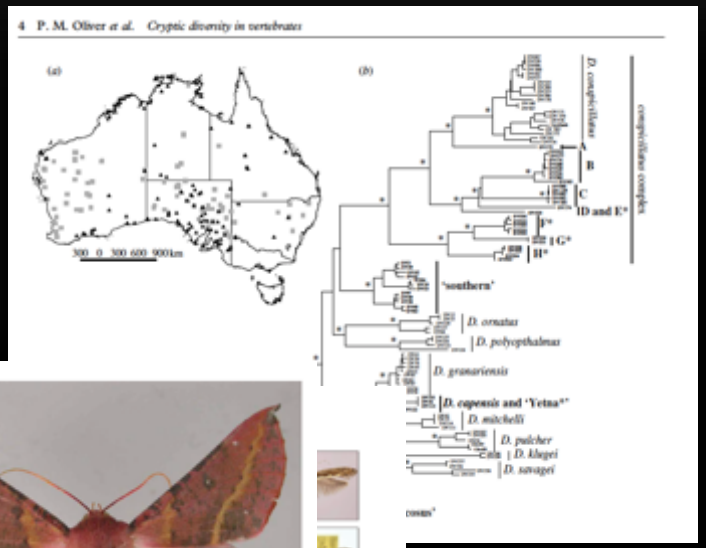
Cryptic diversity in vertebrates: molecular data double estimates of species diversity in a radiation of Australian lizards (*Diplodactylus*, Gekkota)

Paul M. Oliver[1,3,*], Mark Adams[2], Michael S. Y. Lee[1,2], Mark N. Hutchinson[1,3] and Paul Doughty[4]



ZooKeys 327: 43–63 (2013)
doi: 10.3897/zookeys.327.5831
www.zookeys.org
RESEARCH ARTICLE
ZooKeys

***Plutella australiana* (Lepidoptera, Plutellidae), an overlooked diamondback moth revealed by DNA barcodes**

Jean-François Landry[1,†], Paul DN Hebert[2,‡]

Zootaxa 2239: 1–21 (2009)
www.mapress.com/zootaxa/

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ISSN 1175-5326 (print ed
ZOOTAX
ISSN 1175-5334 (online ed

Revision of the Australian *Oenochroma vinaria* Guenée, 1858 species-complex (Lepidoptera: Geometridae, Oenochrominae): DNA barcoding reveals cryptic diversity and assesses status of type specimen without dissection

AXEL HAUSMANN[1], PAUL D.N. HEBERT[2], ANDREW MITCHELL[3], RODOLPHE ROUGERIE[2], MANFRED SOMMERER[4], TED EDWARDS[5], & CATHERINE J. YOUNG[6]

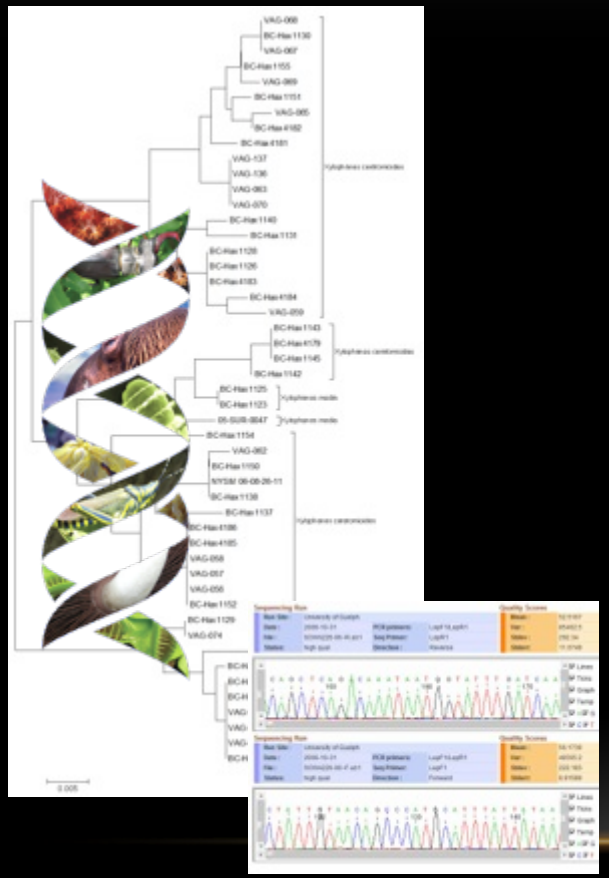
1. CONTEXT & OBJECTIVES

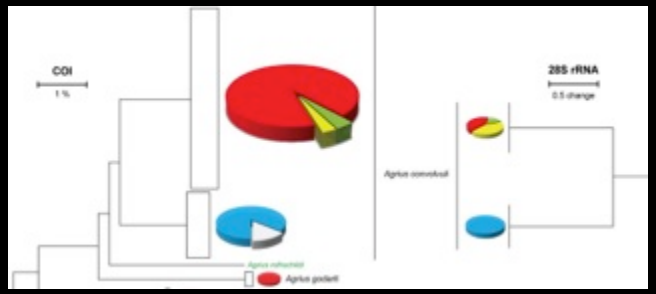
How about the diversity and distribution of Australian Hawkmoths (Lepidoptera: Sphingidae)?

- one of the best known family of Lepidoptera
- mature taxonomy
- A variety of distribution types
- Comprehensive DNA barcode library for the world fauna

2. AN INTEGRATIVE APPROACH

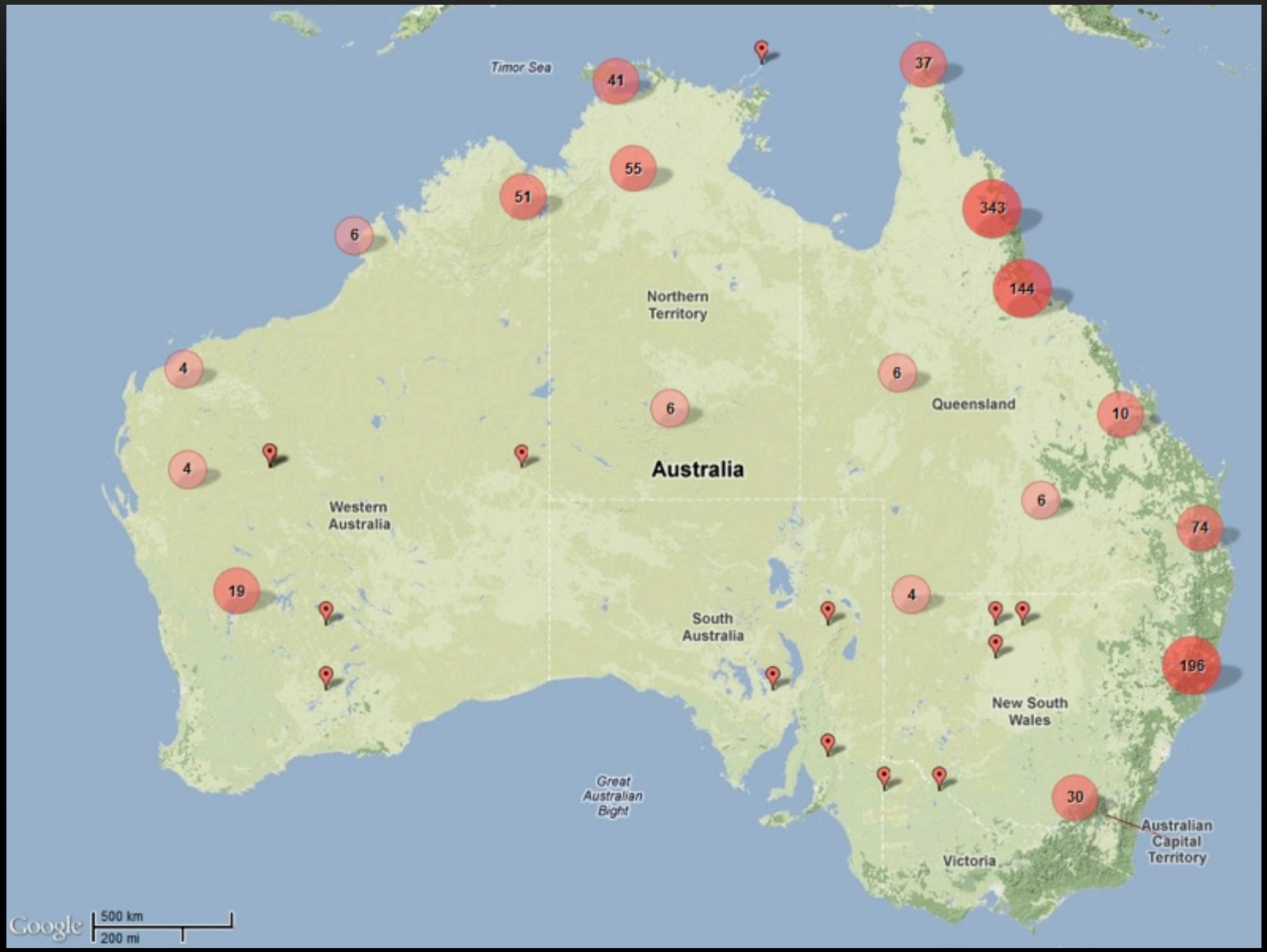
We combined DNA barcoding, morphology and a nuclear marker (28S rDNA) in selected cases





2. AN INTEGRATIVE APPROACH

~1200 samples processed, producing 1054 DNA barcodes for 72 species / subspecies



3. THE DIVERSITY OF AUSTRALIAN SPHINGIDAE REVISITED

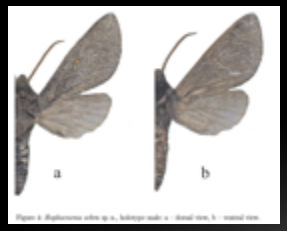
Description of 4 new Australian species

Psilogramma exigua Brechlin, Lane & Kitching, 2010
Psilogramma penumbra Lane, Moulds & Tuttle, 2011
Hopliocnema lacunosa Tuttle, Moulds & Lane, 2012
Hopliocnema ochra Tuttle, Moulds & Lane, 2012

A review of the hawk moth genus *Hopliocnema* ROTHSCHILD & JORDAN, with the description of two new species (Lepidoptera: Sphingidae)

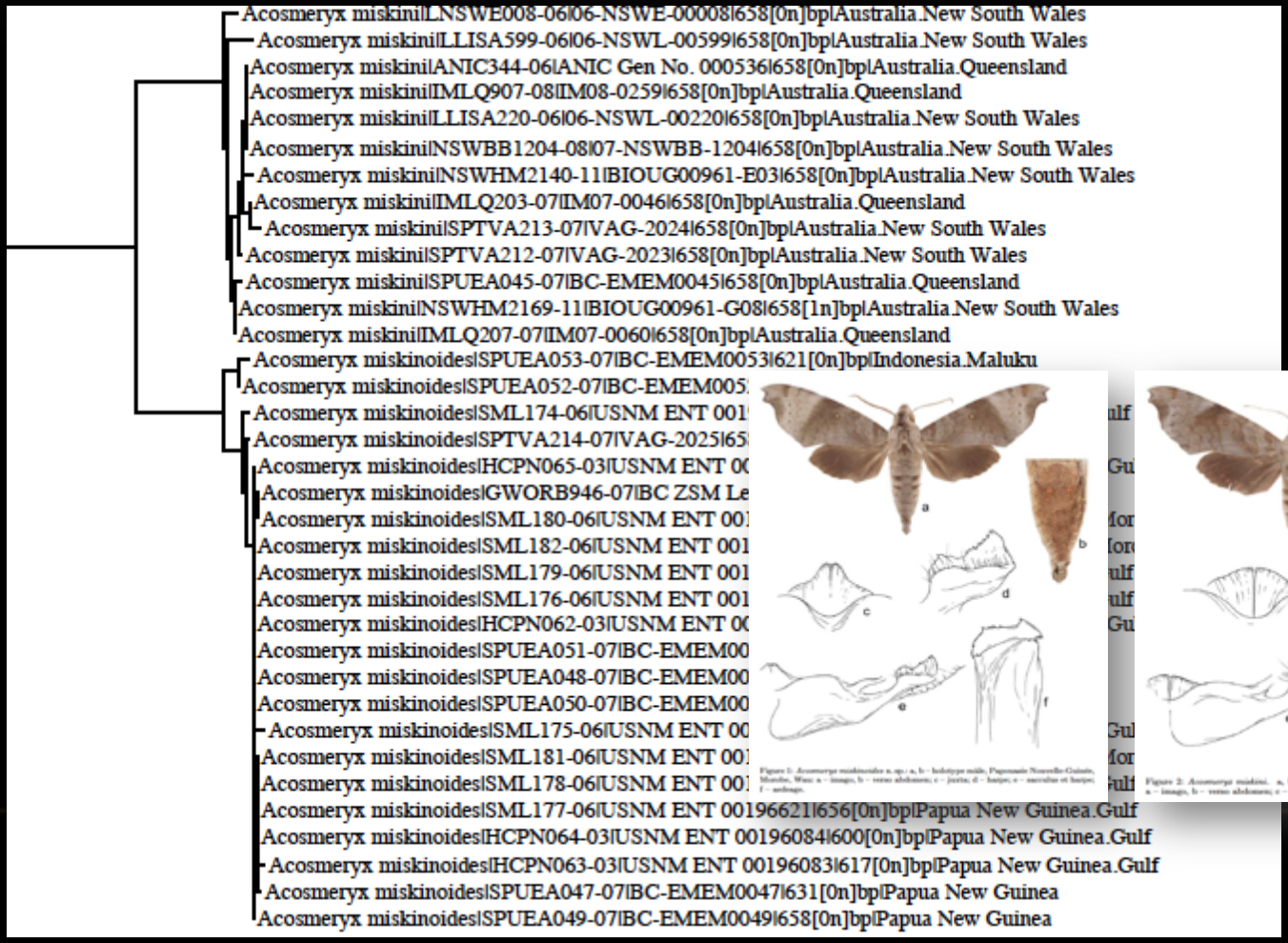
James P. Tuttle[1], *Max S. Moulds*[2] *& David A. Lane*[3]

[1] *57 Inkerman St., St. Kilda, Victoria 3182*
[2] *Entomology Dept., Australian Museum, 6 College St., Sydney, NSW 2010, e-mail: msmoulds@gmail.com*
[3] *3 Janda St., Atherton, Queensland 4883*



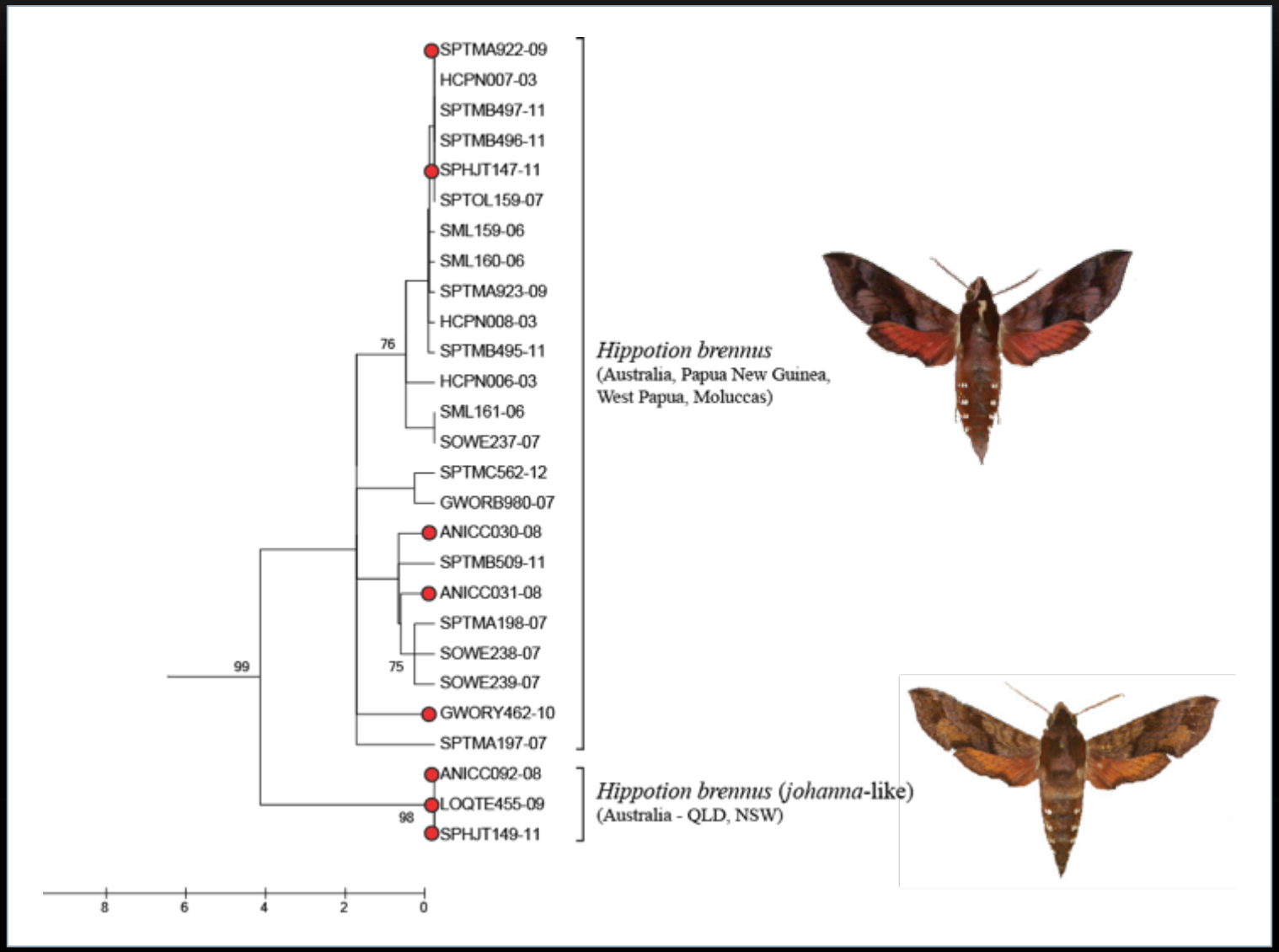
3. THE DIVERSITY OF AUSTRALIAN SPHINGIDAE REVISITED

DNA barcode split within *Acosmeryx miskini* (Murray, 1873) confirmed the status and led to the description of *A. miskinoides* Vaglia & Haxaire, 2007 from Papua New Guinea and Indonesia (Maluku)



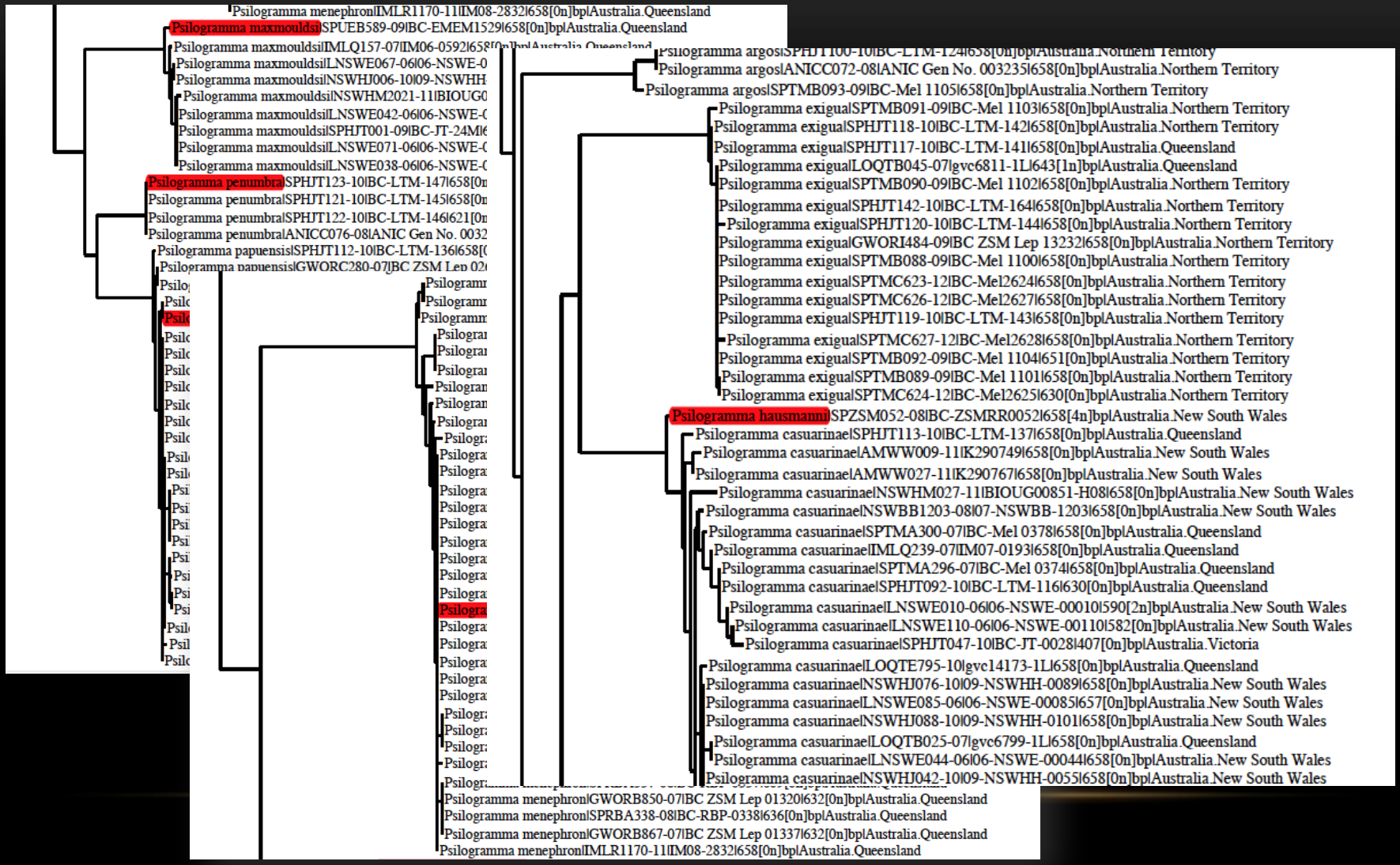
3. THE DIVERSITY OF AUSTRALIAN SPHINGIDAE REVISITED

Hippotion johanna (Kirby, 1877), considered a synonym of *H. brennus* (Stoll, 1782), is a valid species.

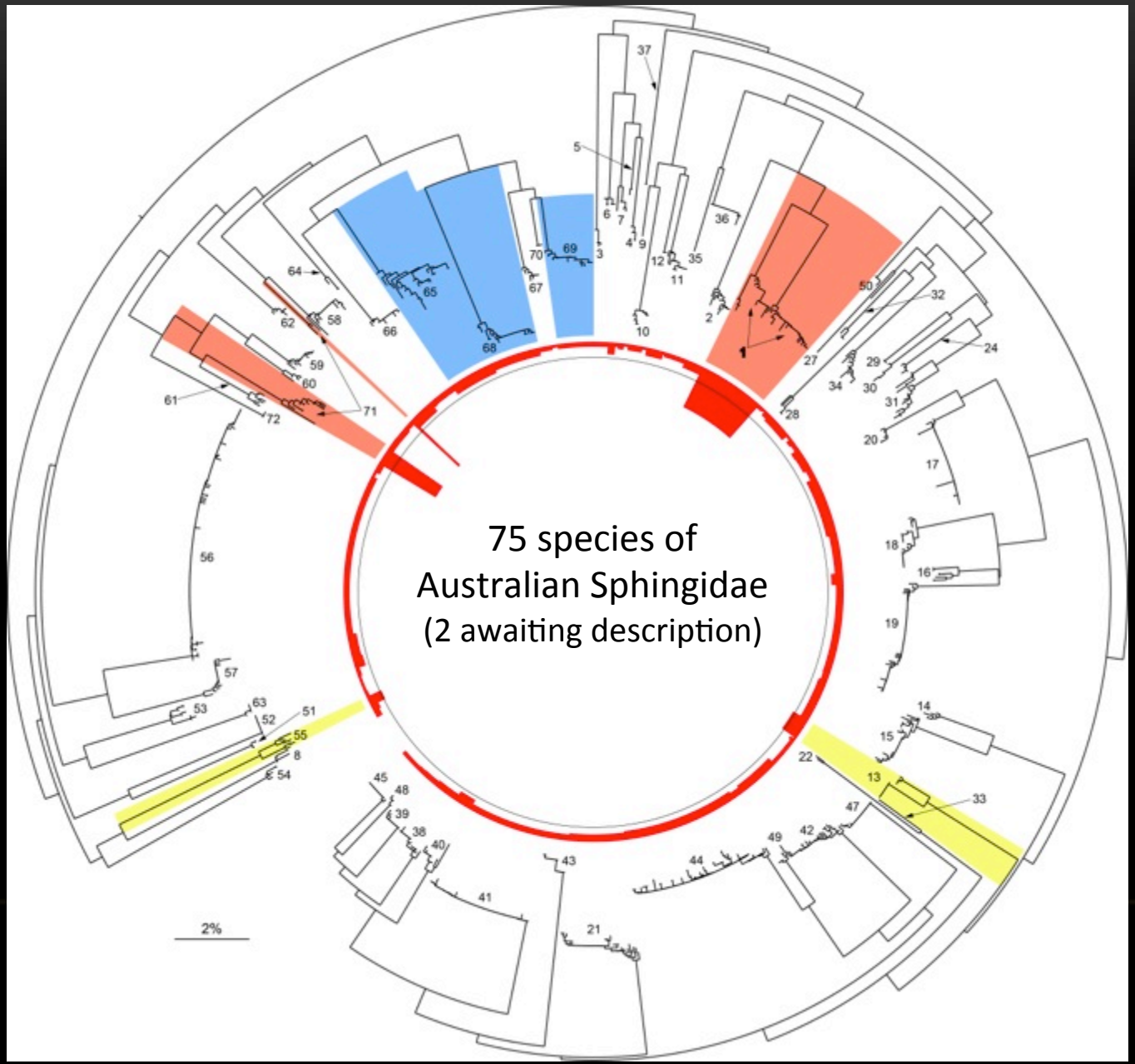


3. THE DIVERSITY OF AUSTRALIAN SPHINGIDAE REVISITED

3 synonyms in genus *Psilogramma* (holotypes sequenced)



3. THE DIVERSITY OF AUSTRALIAN SPHINGIDAE REVISITED



4. A BROADER PERSPECTIVE

Addition of 735 records of conspecific samples and closely related species from outside Australia

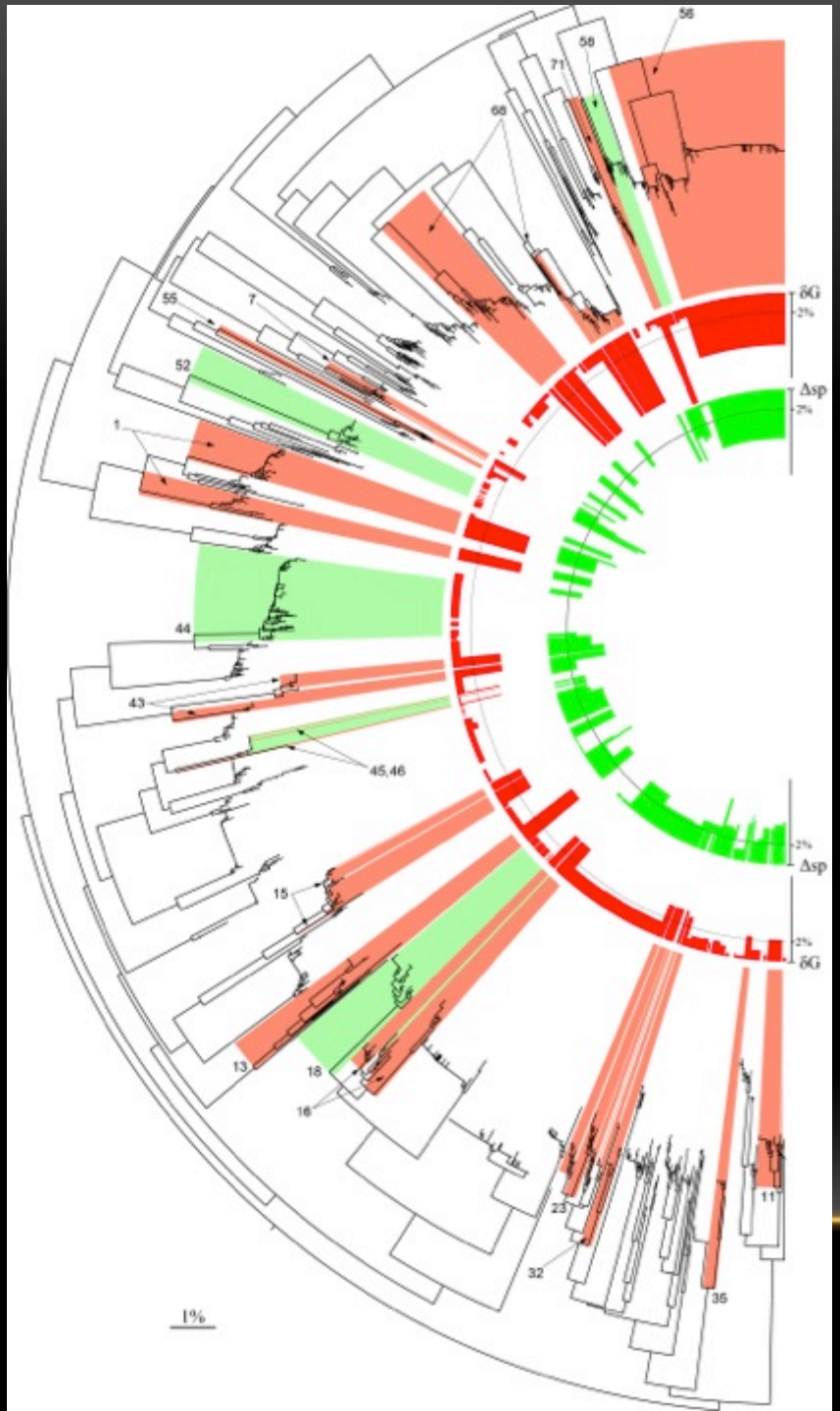
4. A BROADER PERSPECTIVE

17. *Hippotion celerio*

4. A BROADER PERSPECTIVE

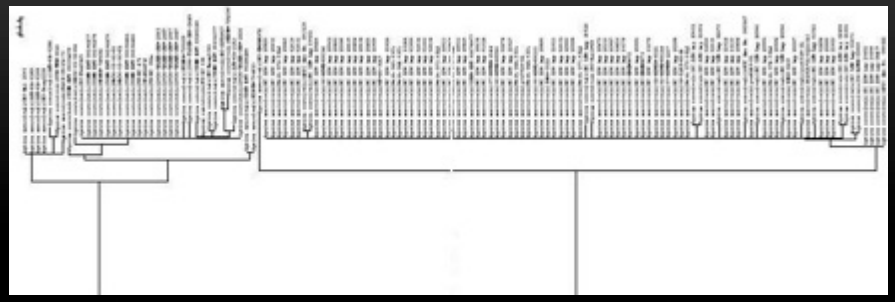
19. *Hippotion scrofa*

26. *Macroglossum hirundo errans*, *M. h. hirundo*, *M. hirundo lifuensis*

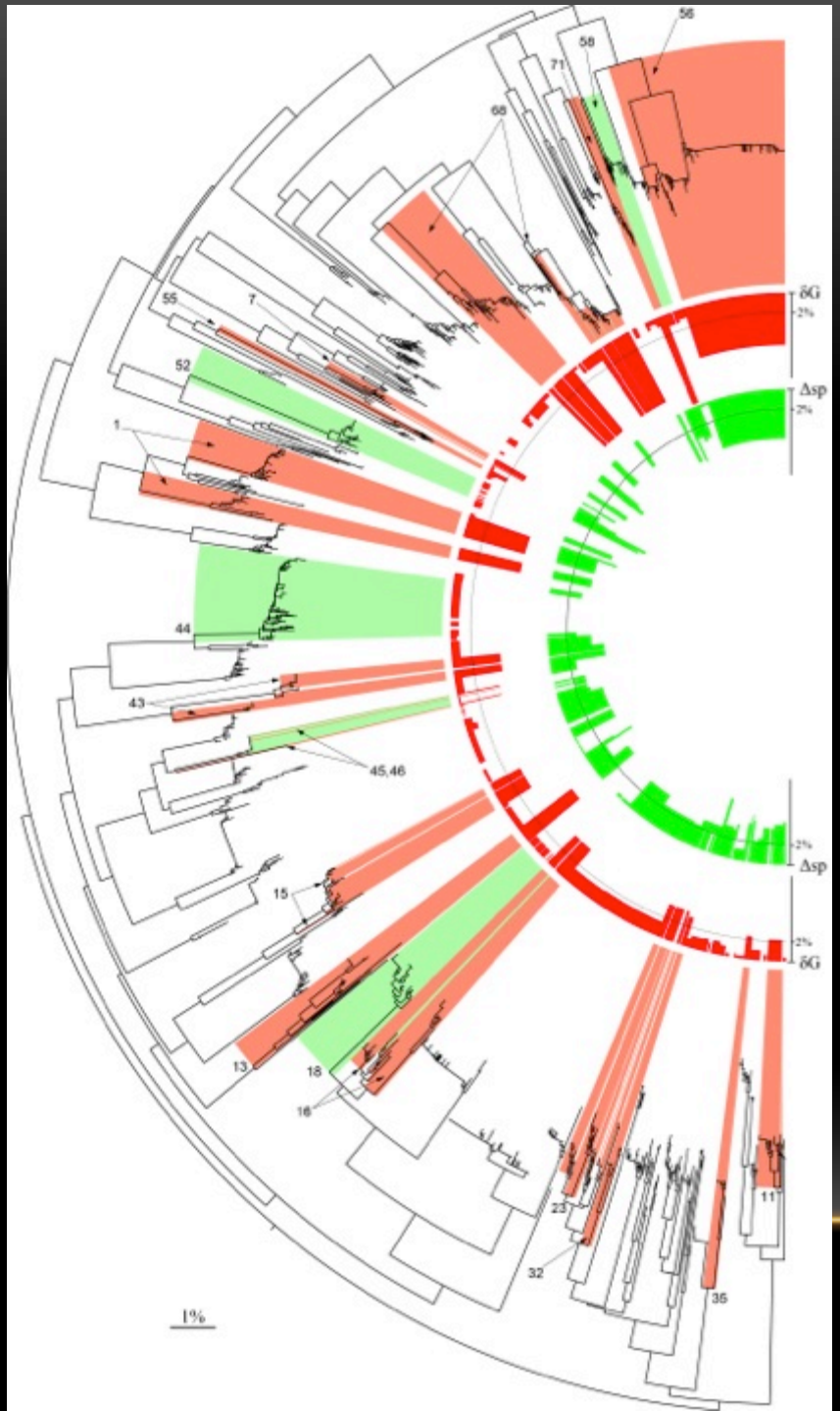


- 40 Australian taxa have ranges extending outside the continent
- 10 of these with deep COI divergences (2.1 to 8.25% K2P)

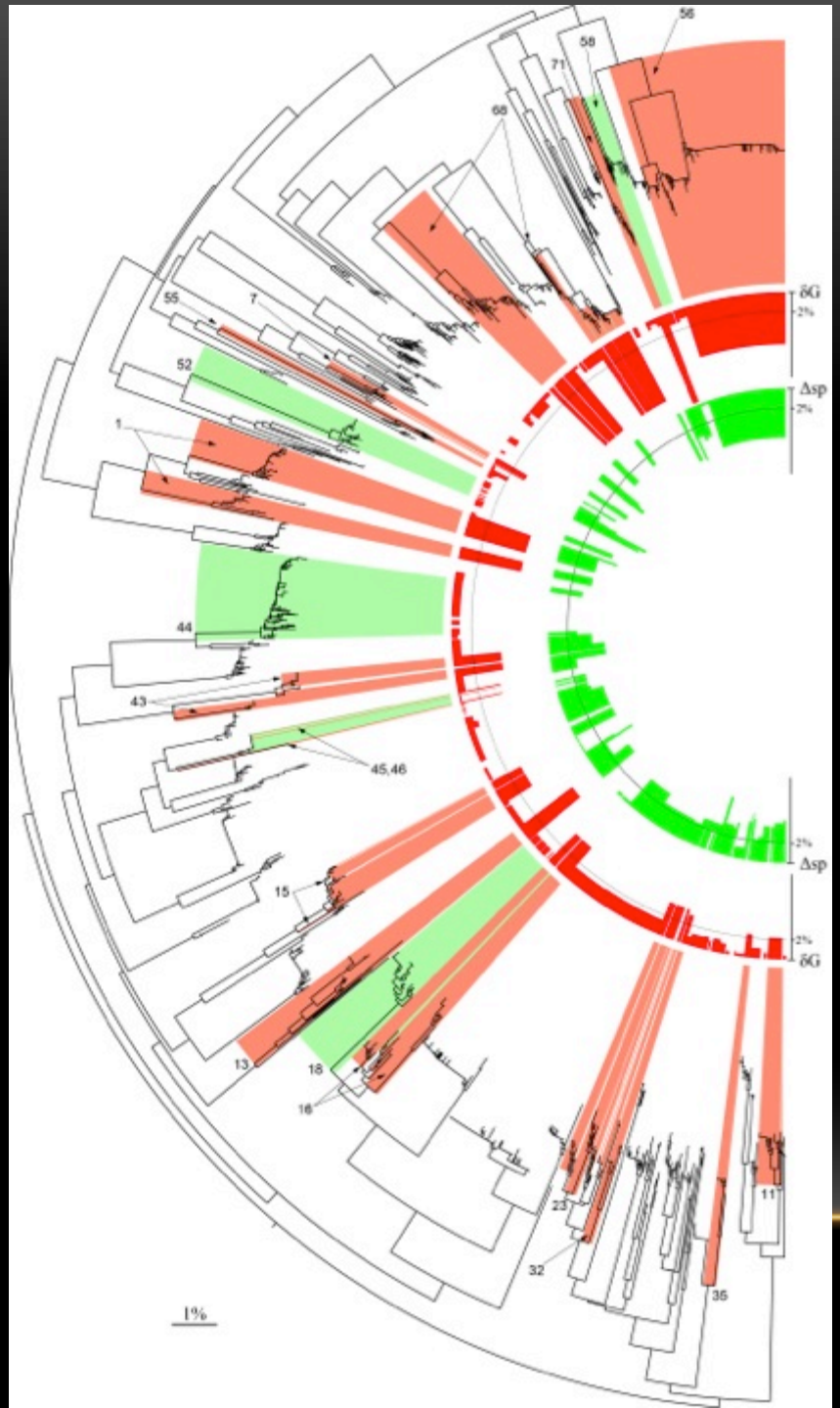
4. A BROADER PERSPECTIVE



Agrius convolvuli – « Convolvulus Hawkmoth »
5.37% divergence in COI; 28S rDNA congruent

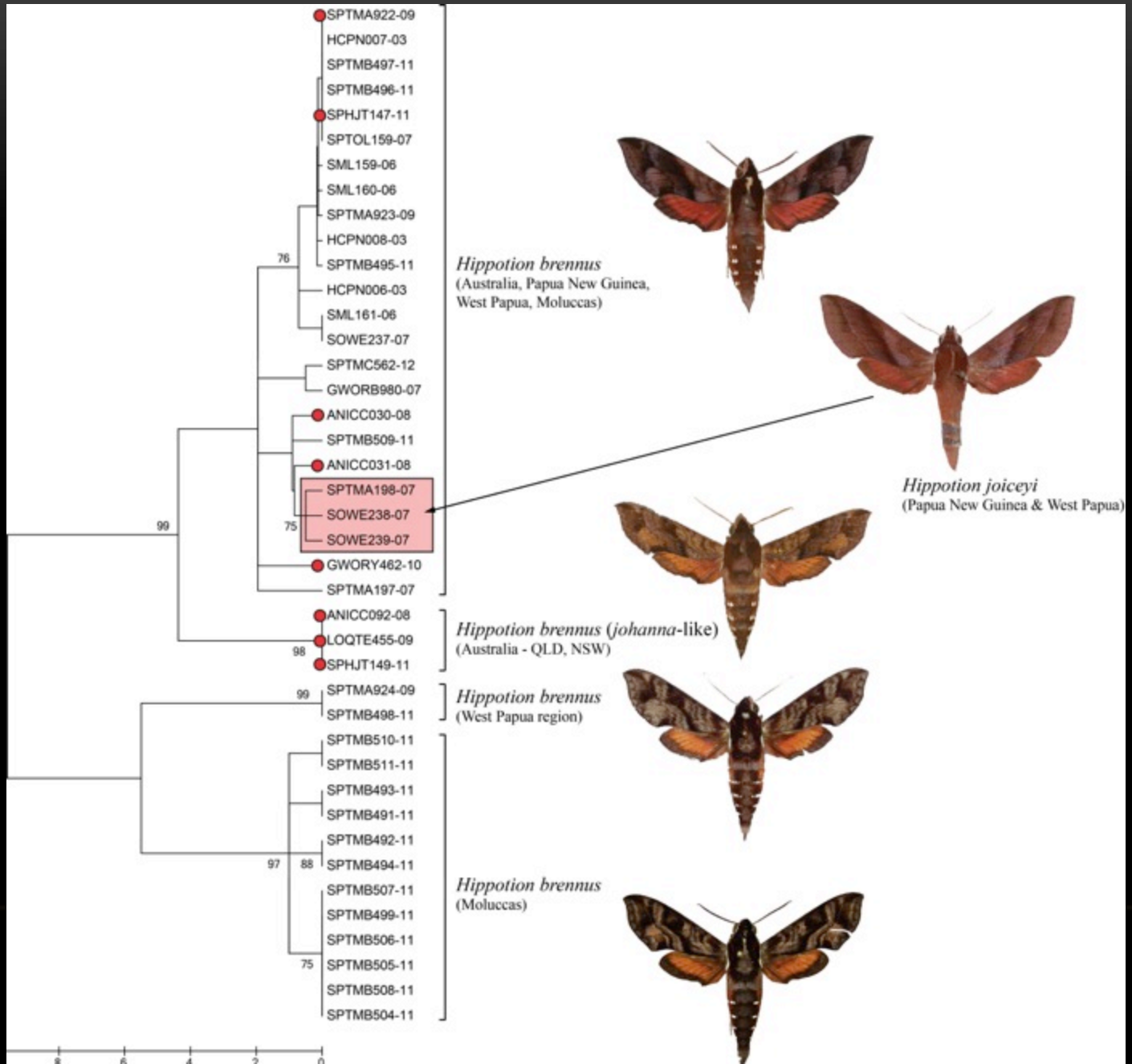


- 40 Australian taxa have ranges extending outside the continent
- 10 of these with deep COI divergences (2.1 to 8.25% K2P)
- 28S rDNA support in *Agrius convolvuli*
- Morphological evidence found in 3 cases already
- 1 split challenges a case of proposed synonymy
- In 4 cases the genetic splits are associated with range disjunctions of several thousand kilometers that cross major biogeographical boundaries
- 2 cases represent species complexes in need of taxonomic revisions

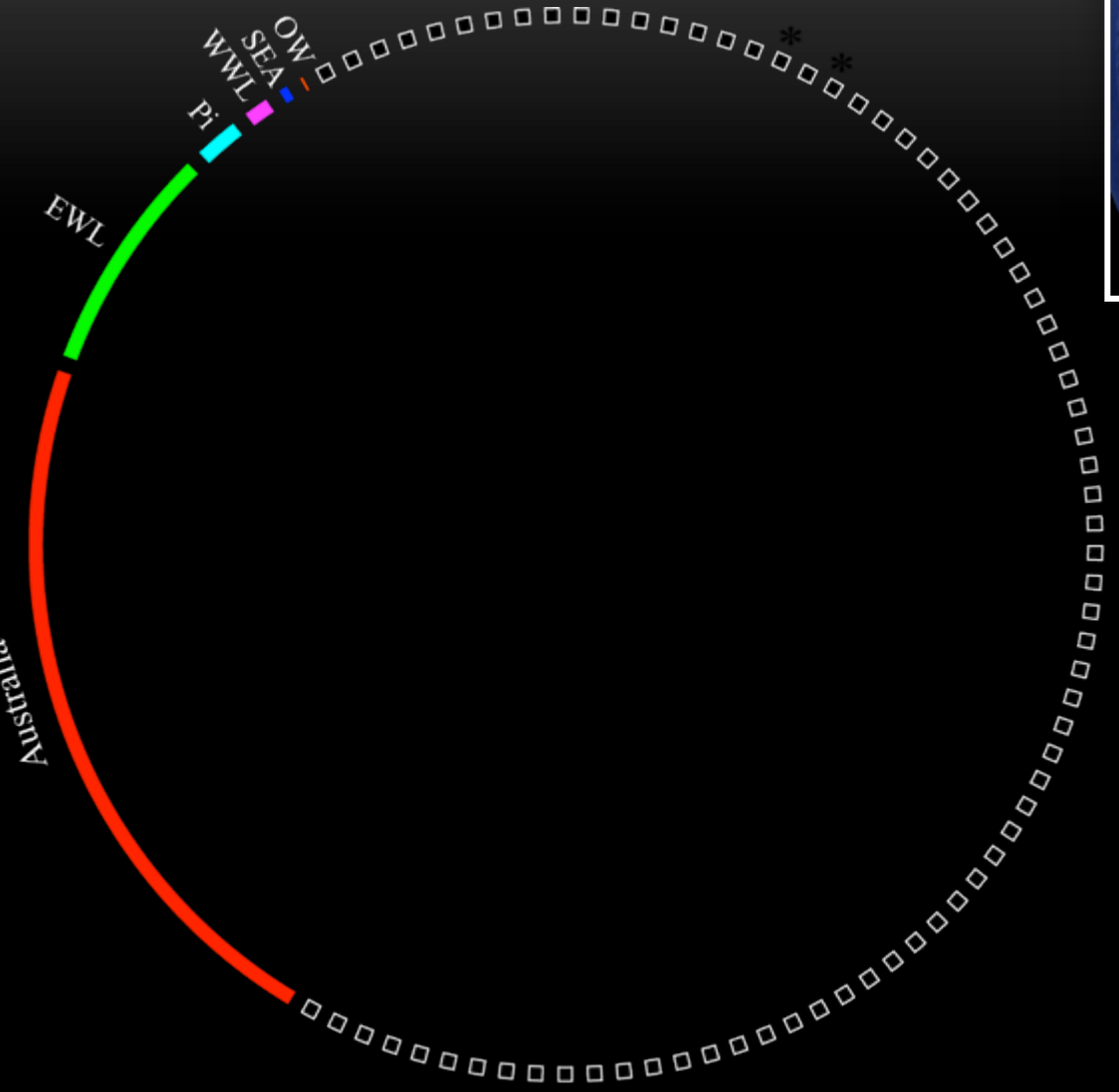


- 8 cases of « barcode sharing » with distinct species/subspecies from outside Australia
- 2 likely caused by mis-identifications
- 3 likely cases of synonymy
- 2 possible cases of introgression/ hybridization

4. A BROADER PERSPECTIVE



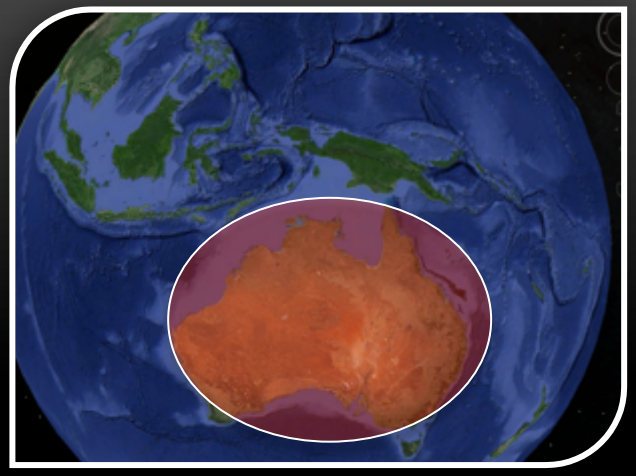
5. CONCLUDING REMARKS

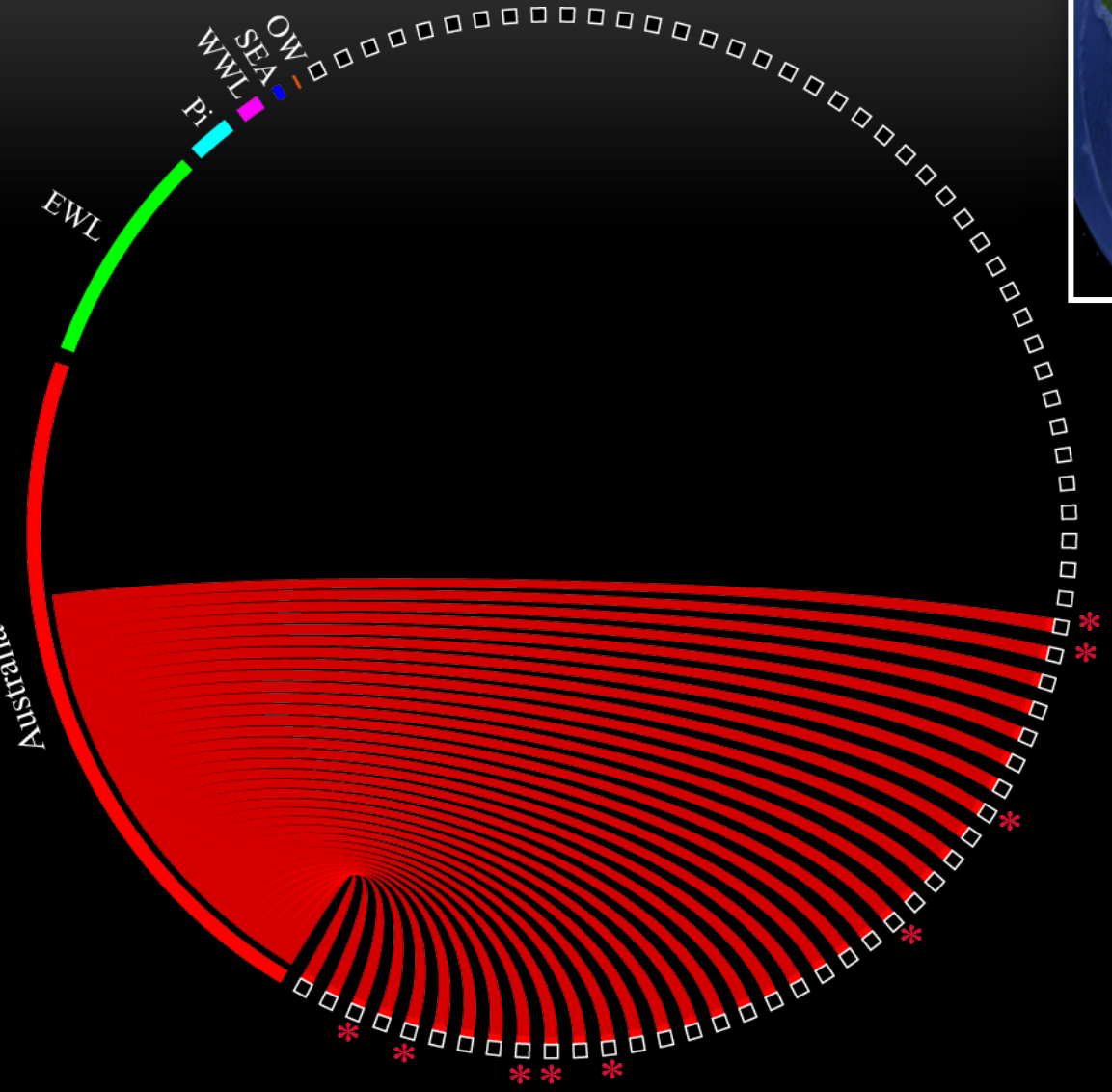


Refined account of the diversity of Australian Sphingidae

75 species
(+10%)

5. CONCLUDING REMARKS

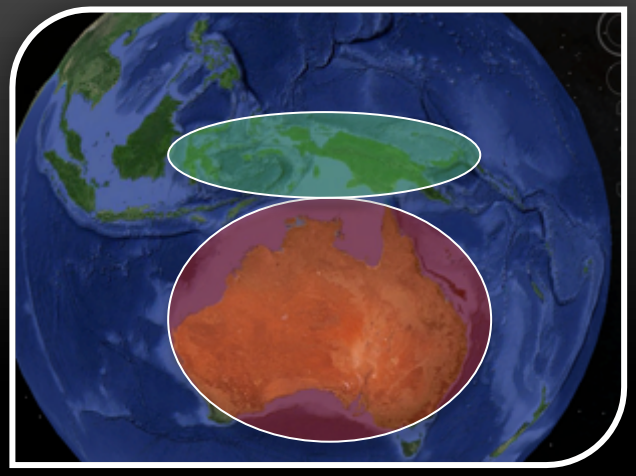


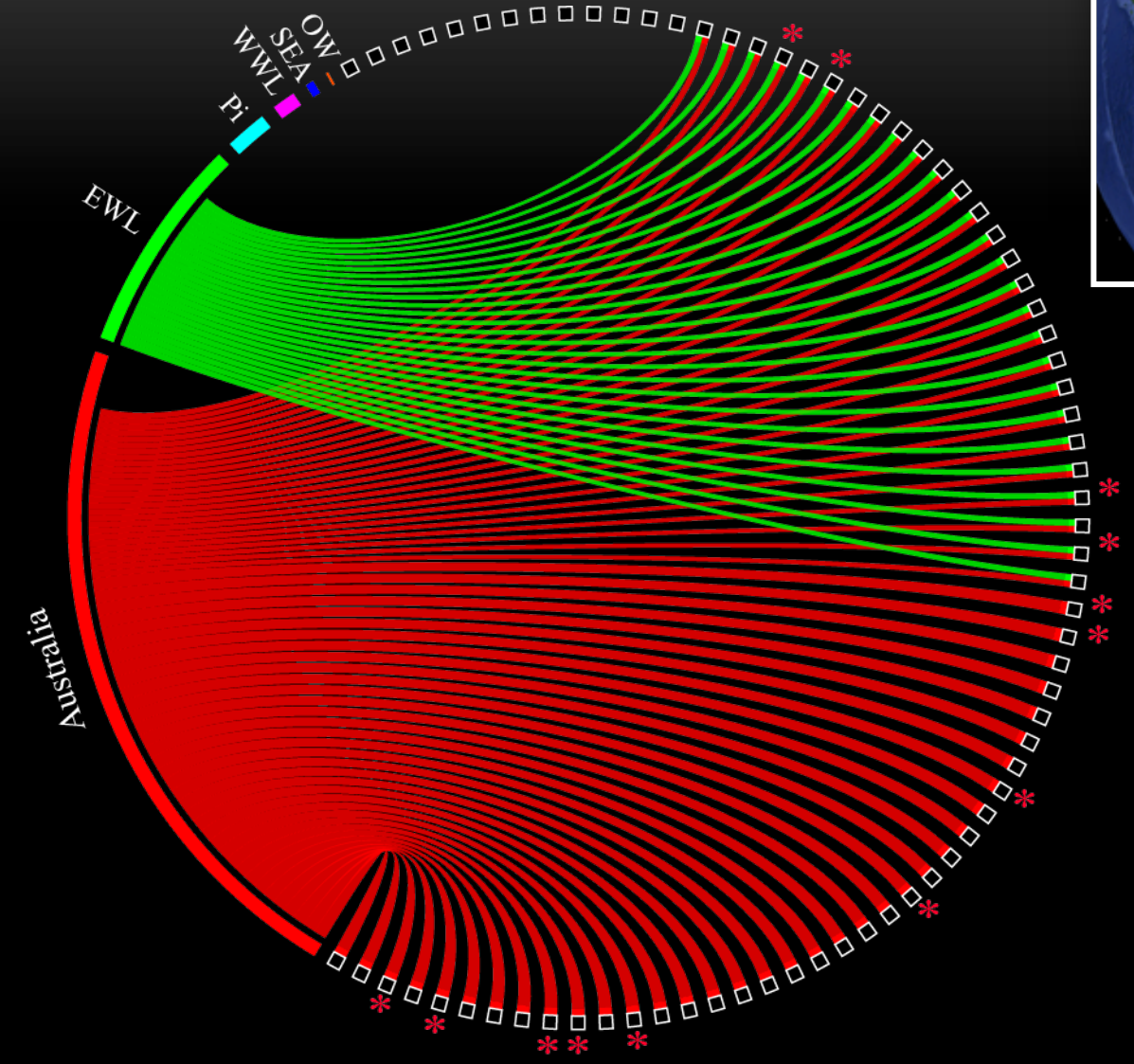


Refined account of the distribution of Australian Sphingidae

35 endemic species

5. CONCLUDING REMARKS

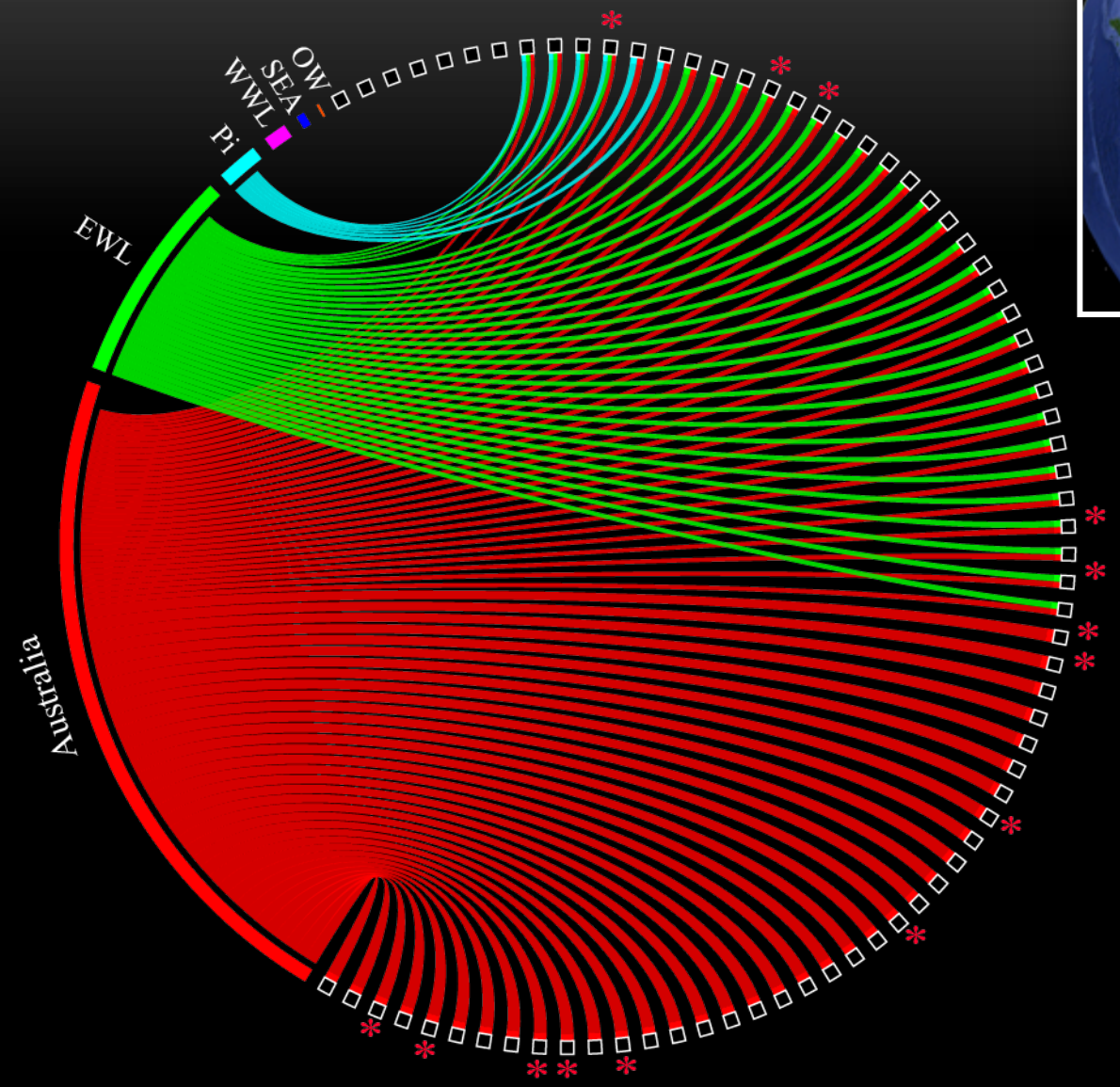


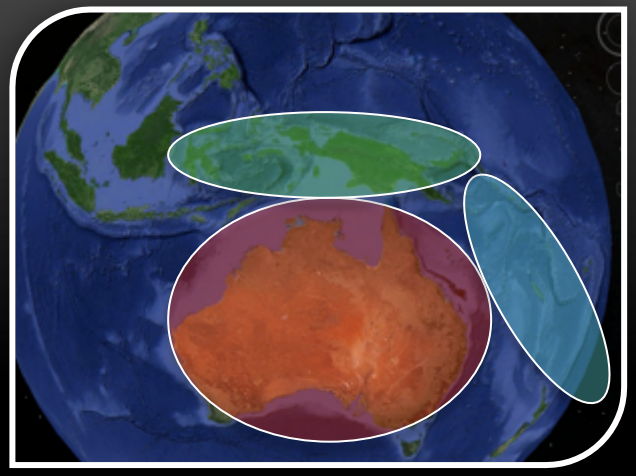


Refined account of the distribution of Australian Sphngidae

27 species also in Malesia east of Wallace's Line

5. CONCLUDING REMARKS

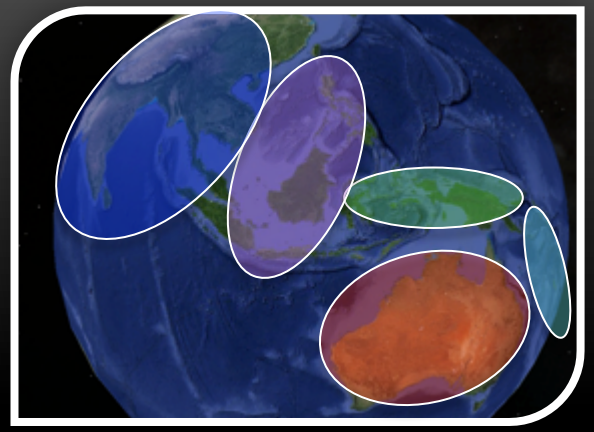


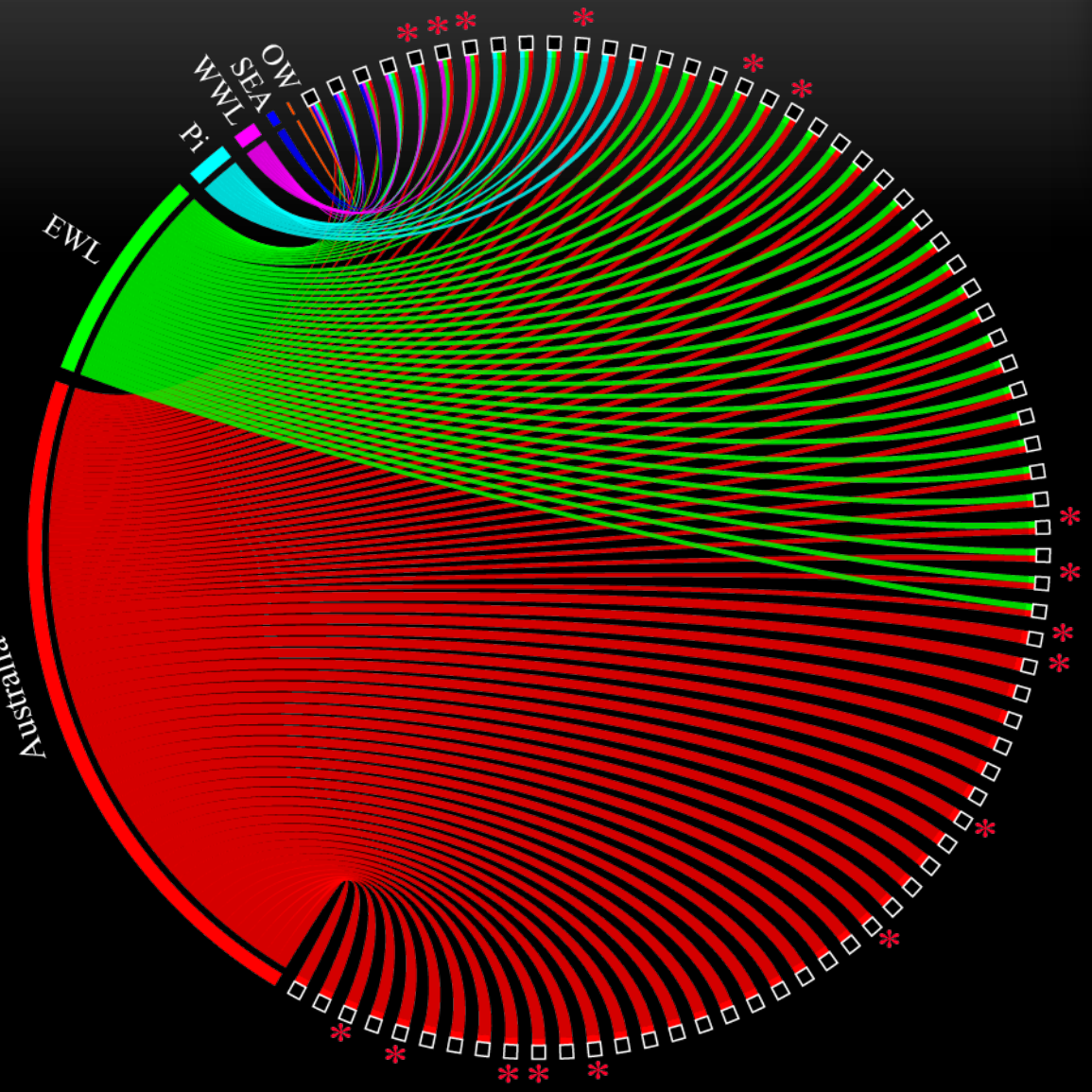


Refined account of the distribution of Australian Sphingidae

6 species also in Pacific Islands

5. CONCLUDING REMARKS

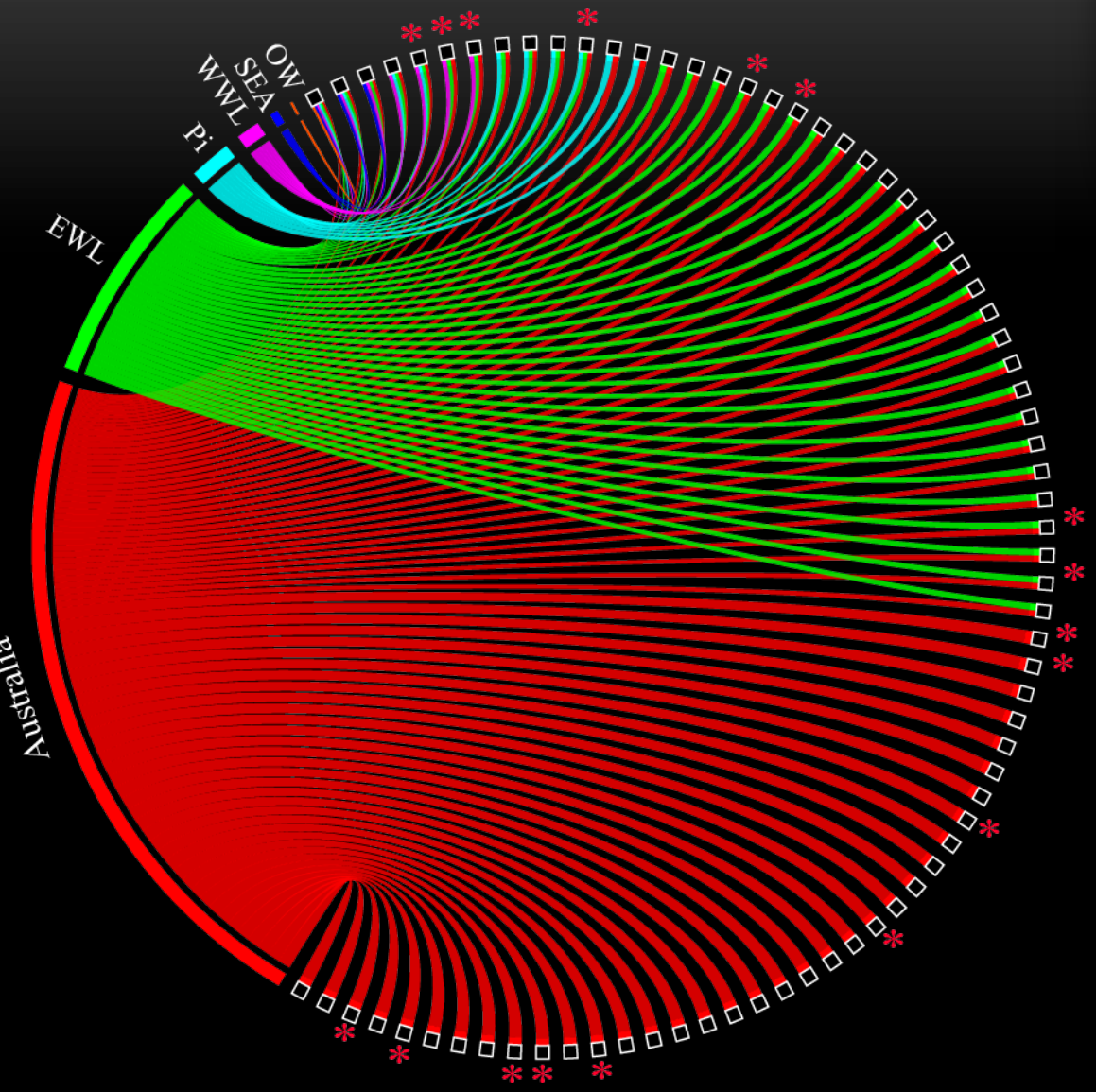


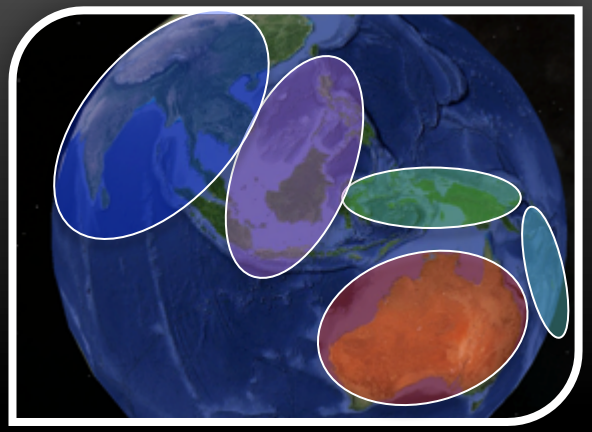


Refined account of the distribution of Australian Sphingidae

- 6 species in Melanesia west of Wallace's Line
- 3 species in South-East Asia
- 1 broadly distributed in the Old World

5. CONCLUDING REMARKS

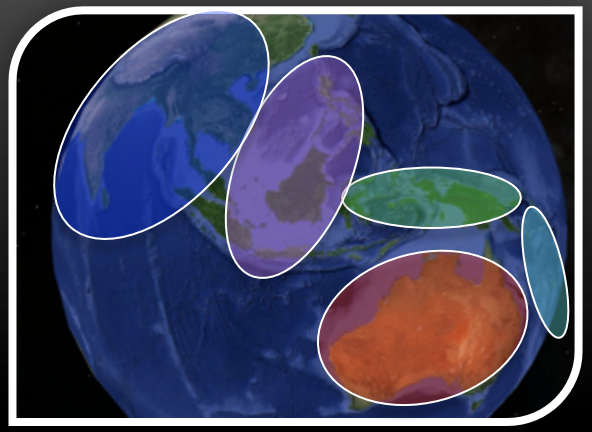




Overall:

- 10% increase in species diversity
- 35% increase in number of strict endemics

5. CONCLUDING REMARKS



Linnean and Wallacean shortfalls significant even in one of the best documented group of insects

Integrating DNA barcoding is a straightforward way to re-evaluate species boundaries and distribution

Overall:

- 10% increase in species diversity
- 35% increase in number of strict endemics

ACKNOWLEDGMENTS

- Taxonomists / Collectors: Ron Brechlin, Graeme Cocks, Ted Edwards, Ulf Eitschberger, Yves Estradel, Egbert Friedrich, Marianne Horak, David Lane, John La Salle, Ian McMillan, Tomas Melichar, Andrew Mitchell, Max Moulds, Jim Tuttle, and Thierry Vaglia.
- Colleagues at the Canadian Centre for DNA Barcoding.
- Funding agencies: NSERC, Genome Canada and the Ontario Genomics Institute

Thank *you*
for your attention!

NSERC CRSNG

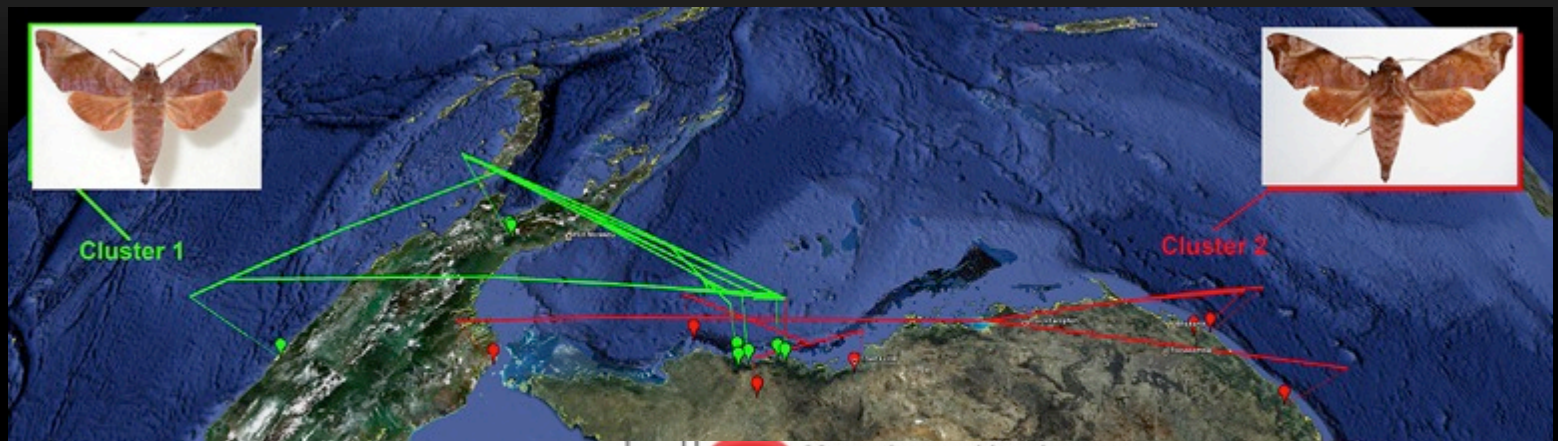
GenomeCanada

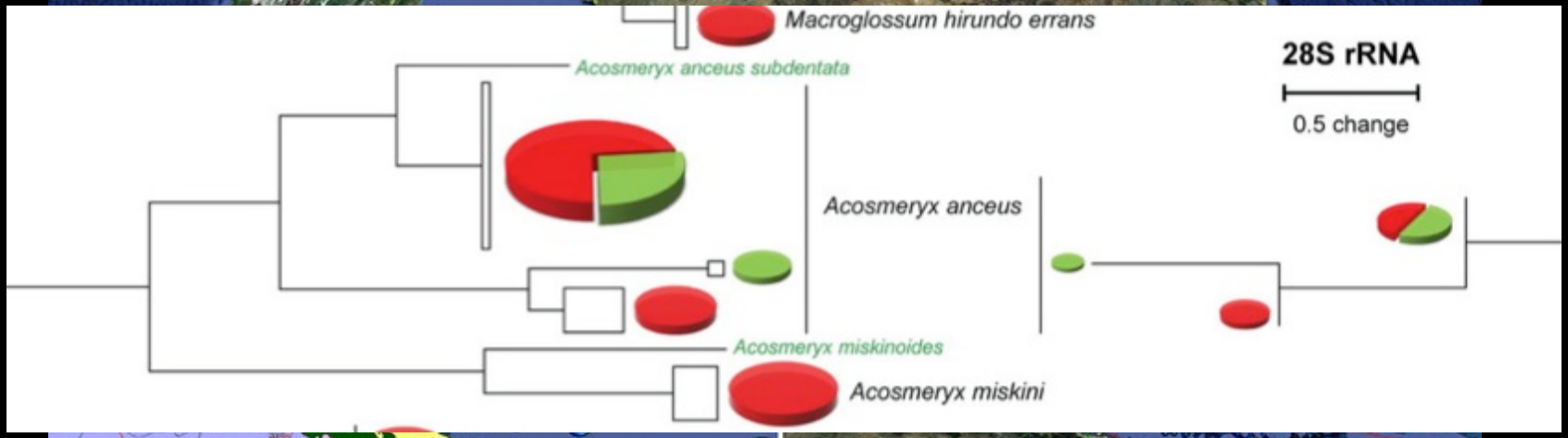
OntarioGenomicsInstitute

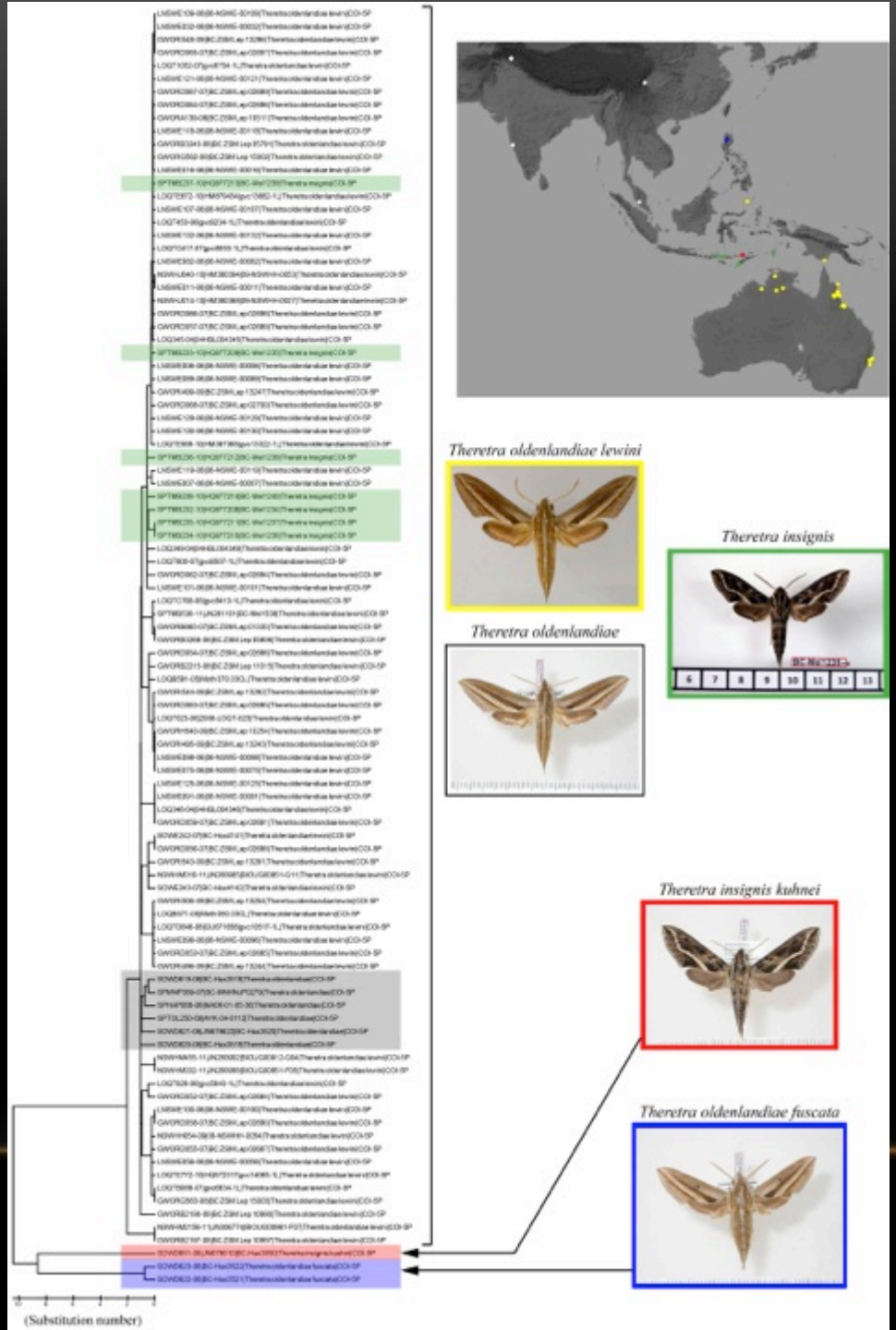
international BARCODE OF LIFE

3. THE DIVERSITY OF AUSTRALIAN SPHINGIDAE REVISITED

Two species within *Acosmeryx anceus* (Stol, 1781)






Theretra oldenlandiae lewini
Theretra insignis
Theretra oldenlandiae
Theretra insignis kuhnei
Theretra oldenlandiae fuscata
(Substitution number)