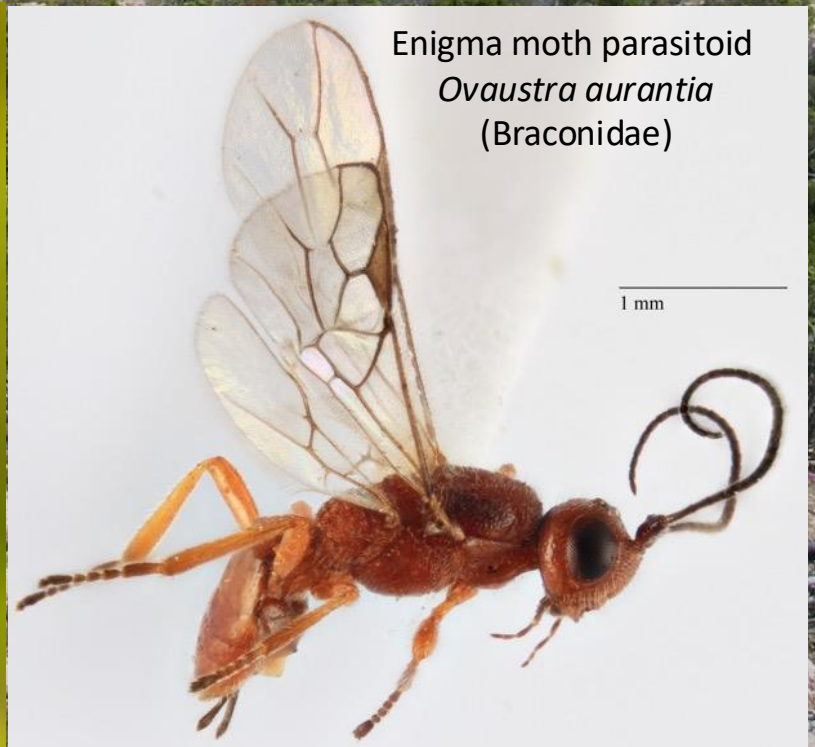
Discovery at Bushland Conservation Mouth Flat Heritage Area

A novel, specific, tri-trophic interaction with high co-extinction risk:
Enigma moth – Enigma moth parasitoid – Slender cypress pine

Why preserve remnant native vegetation?
Most high quality habitats in Australia will support rare/unknown invertebrates

Enigma moth
Aenigmatinea glatzella
(Aenigmatineidae)



Enigma moth parasitoid
Ovaustra aurantia
(Braconidae)

Systematic Entomology

Kristensen *et al.* 2015

Systematic Entomology (2015), **40**, 5–16

A new extant family of primitive moths from Kangaroo Island, Australia, and its significance for understanding early Lepidoptera evolution

Photos: George Gibbs

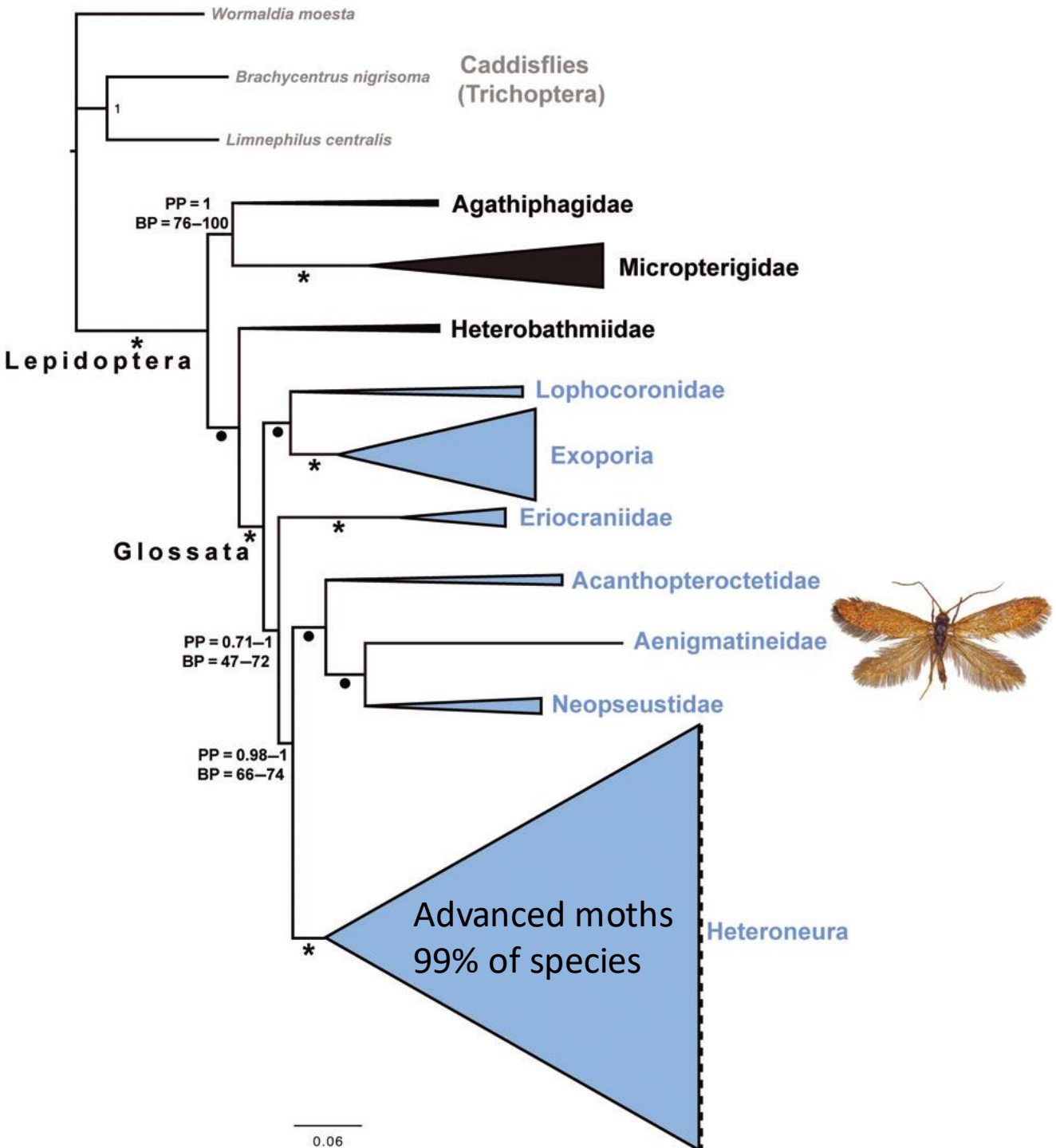
Enigma moth – *Aenigmatinea glatzella* Kristensen & Edwards, 2015
Specific association with Slender cypress pine - *Callitris gracilis*
Adult females oviposit under leaves of growing foliar tips
Atypical larvae feed and pupate in chambers in wood of small stems
IUCN Critically Endangered

Enigma moth – *Aenigmatinea glatzella* Kristensen & Edwards, 2015

Adult female ovipositing beneath leaves of *Callitris gracilis*

Larvae are highly reduced due to enclosed environment

Enigma moth – *Aenigmatinea glatzella* Kristensen & Edwards, 2015

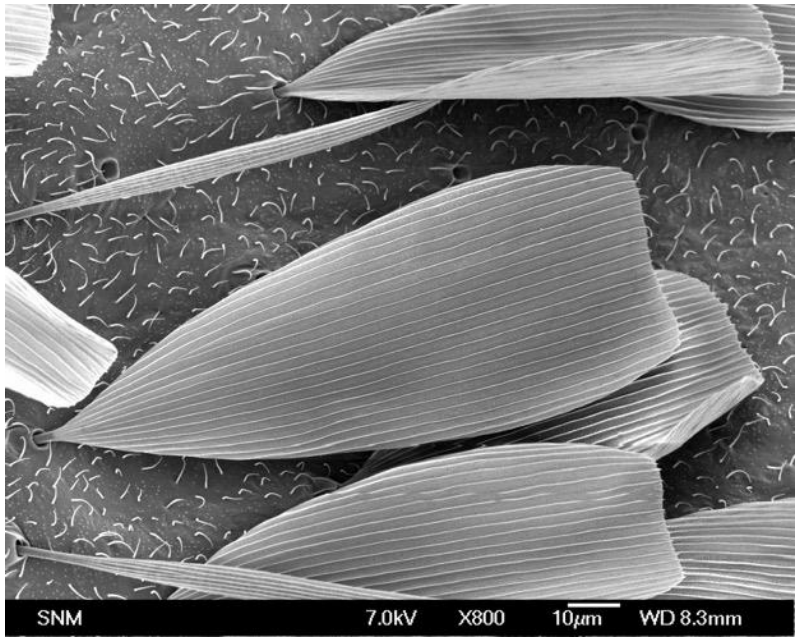


Enigma moth is relatively primitive

Phylogenetic placement based on morphology would have required ad-hoc assumptions and been incorrect (hence the “enigma”)

Part of a clade that is sister to Heteroneura, which contains 99% of lepidopteran species

Closest relatives from South America, North America & South East Asia

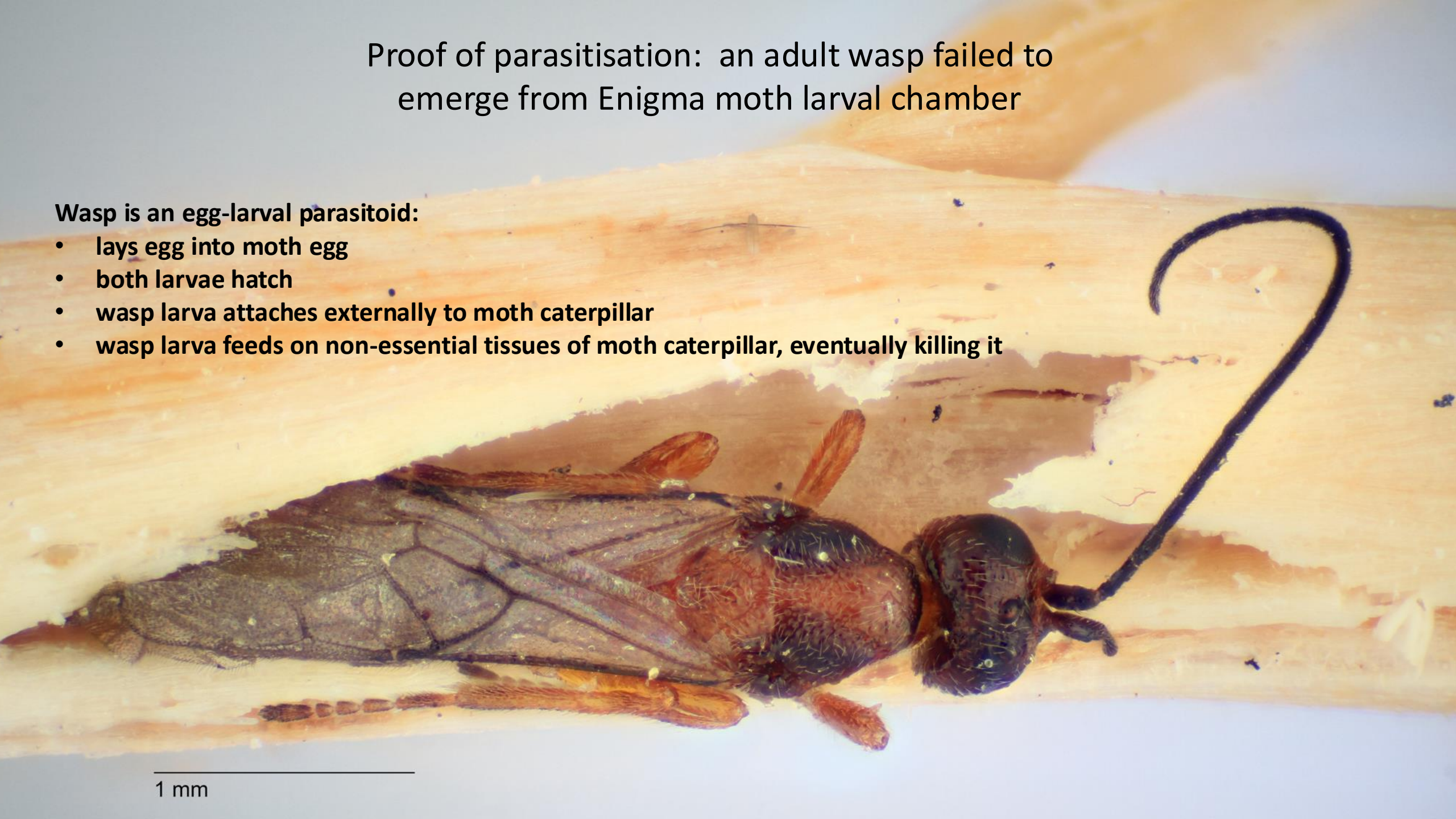


During observations, witnessed braconid wasp associated with *Callitris* foliage & ovipositing at same site as Enigma moth

Proof of parasitisation: an adult wasp failed to emerge from Enigma moth larval chamber

Wasp is an egg-larval parasitoid:

- **lays egg into moth egg**
- **both larvae hatch**
- **wasp larva attaches externally to moth caterpillar**
- **wasp larva feeds on non-essential tissues of moth caterpillar, eventually killing it**



TAXONOMIC ARTICLE

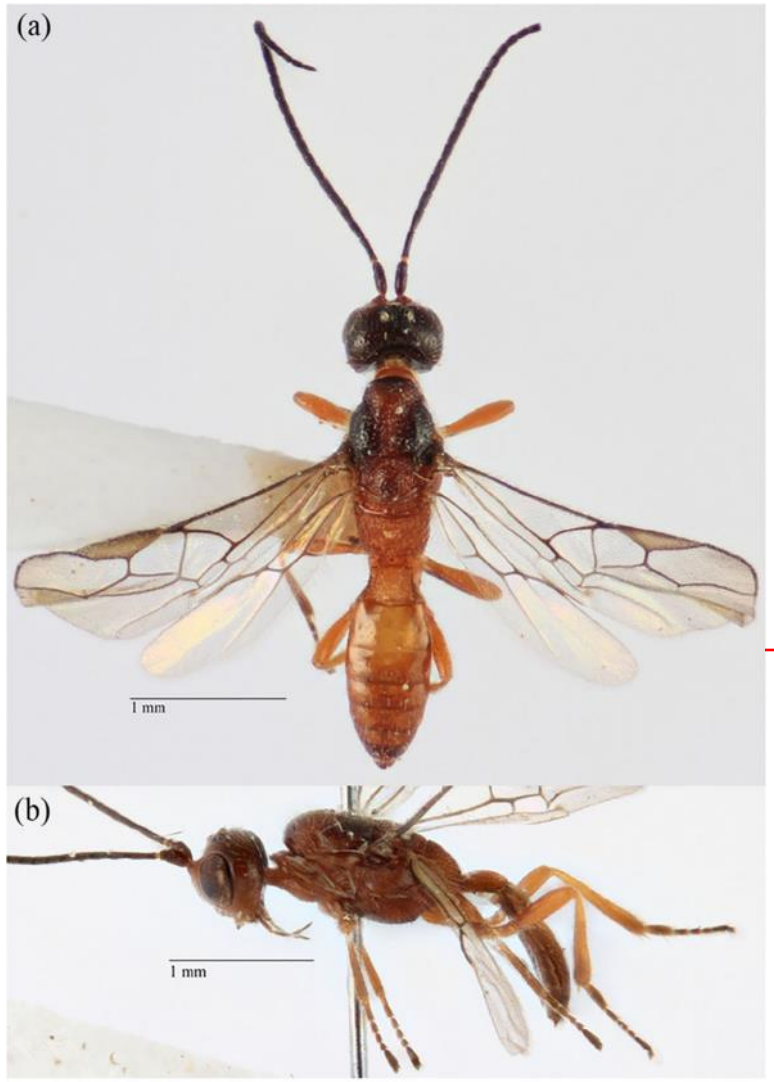
Austral Entomology WILEY

Glatz *et al.* 2022

Enigma moth parasitoid: a new Australian cyclostome genus and species, *Ovaustra aurantia* Tetley, Glatz & Fagan Jeffries, gen. et sp. nov. (Hymenoptera: Braconidae) from Kangaroo Island

Ovaustra aurantia (subfamily Mesostoinae)

COI data confirmed *Ovaustra* as a new genus in subfamily Mesostoinae



Austrohormius sp.|BIOUG27033-C01|Australia
Austrohormius sp.|BIOUG27183-H02|Australia
Austrohormius sp.|BIOUG27537-G01|Australia
Austrohormius sp.|CNIN4019|Australia
Aspilodemon sp.|BIOUG05058-D10|Honduras
Hydrangeocola sp.|BIOUG28011-F01|Costa Rica
Andesipolis(?) sp.|gvcT09511|Australia
Mesostoa kerri|AY935415|Australia
Aspilodemon sp.|BIOUG31681-H04|Costa Rica
Andesipolis sp.|CNIN4278|Chile
Hydrangeocola llaollin|CNIN3058|Argentina
Opiopterus sp.|MK779447|Australia
Proavga sp.|BIOUG00902-C03|Australia
Andesipolis sp.|BIOUG37600-C01|Australia
Mesostoinae gen. undet.|09-NSWHH-2220|Australia
Austrohormius sp.|BIOUG27300-H02|Australia
Hydrangeocola sp.|BIOUG31616-E08|Costa Rica
Austrohormius sp.|BIOUG27881-C09|Australia
***Ovaustra aurantia* gen. et. sp. nov.**
Maxfischeri tricolor|CNC1045818|Australia
Maxfischeria tricolor|FJ361242|Australia
Doryctomorpha sp.|CNIN4280|New Zealand
Doryctomorpha antipoda|NZAC04049894|New Zealand
Rhyssaloides sp.|NZAC04086869|New Zealand
Metaspathius sharkeyi|MG700348|New Zealand
Metaspathius kuscheli|NZAC04036800|New Zealand
Rhyssaloides sp.|BIOUG14866-D09|New Zealand
Rhyssaloides sp.|NZAC04049074|New Zealand
Zealastoa waitakerensis|NZAC04194128|New Zealand
Aphidiinae
Remaining cyclostomes sensu lato
Non-cyclostomes
Apozyginae|*Apozyx penai*|CNC1045801
Ichneumonidae
Megaspilidae sp. KR2706441
0.6

Mesostoinae *sensu lato* + Maxfischerinae
Braconidae

Endemic
NZ clade

Distribution expanded since initial discovery at Mouth Flat
Limited distribution is a key threat to the moth and wasp
Threat of co-extinction: fire, drought
Candidates for EPBC listing

Drought in 2024-2025 impacted costal foliage including *Callitris* at Mouth Flat

Lack of rain combined with salty coastal wind has killed a lot of the foliage on the windward side – some plants have been killed

Ongoing challenge for Mouth Flat site which is probably a long-term refuge from severe fire