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THE UNIVERSITY of ADELAIDE

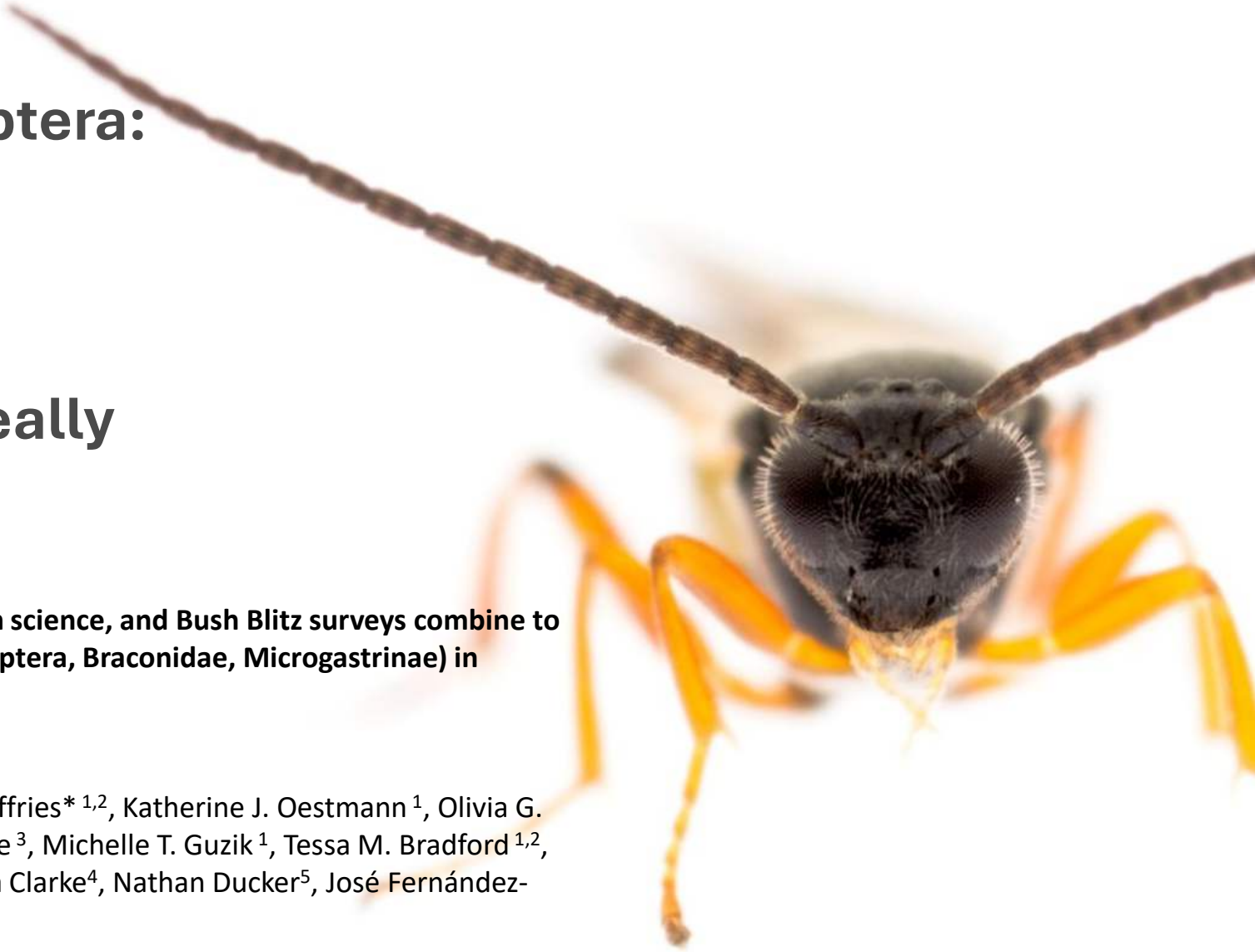
Environment Institute

SAM SOUTH AUSTRALIAN MUSEUM

Australian Biological Resources Study

# Revising the Genus *Apanteles* (Hymenoptera: Braconidae):

# When 'Accelerated' Taxonomy Takes a Really Long Time



**DNA barcoding, integrative taxonomy, citizen science, and Bush Blitz surveys combine to reveal 34 new species of *Apanteles* (Hymenoptera, Braconidae, Microgastrinae) in Australia**

Zookeys (inpress)

Mollie-Rosae Slater-Baker*[1], Erinn P. Fagan-Jeffries*[1,2], Katherine J. Oestmann[1], Olivia G. Portmann[1], Tiahni M. Bament[1], Andy G. Howe[3], Michelle T. Guzik[1], Tessa M. Bradford[1,2], Alana R. McClelland[1], Alice Woodward[4], Sylvia Clarke[4], Nathan Ducker[5], José Fernández-Triana[6].


# Braconidae: Microgastrinae: *Apanteles*

- Parasitoids of lepidopteran larvae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# Braconidae: Microgastrinae: *Apanteles*

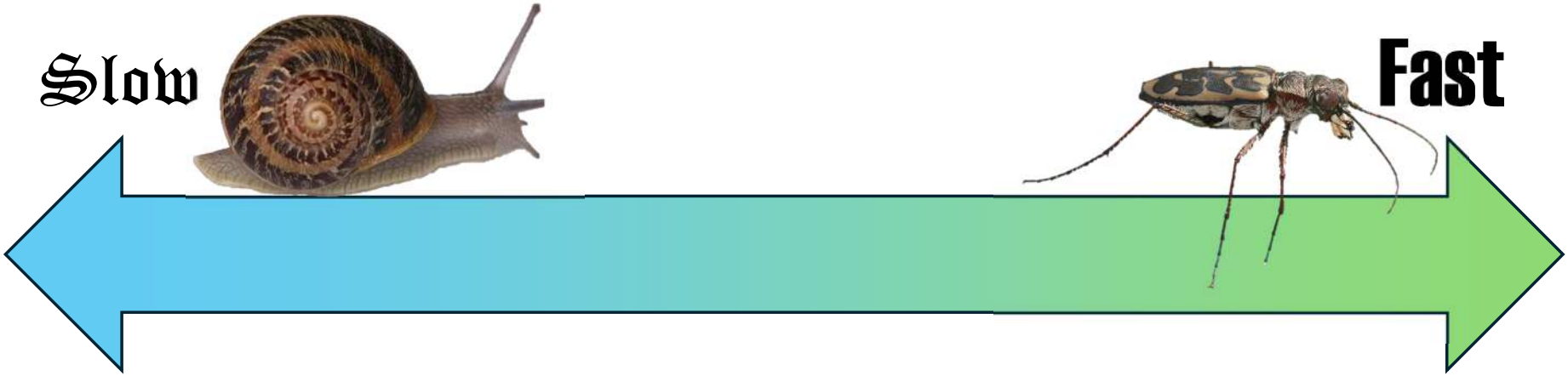
- Parasitoids of lepidopteran larvae
- Cosmopolitan, >600 species described
- Biological control agents
- Morphologically conserved
- Difficult to diagnose from *Dolichogenidea*
- Already 9 species described in Australia – taxonomy needs to integrate



## Approach taken to deal with *Apanteles*

**Priority:** taxonomy that is usable and can be easily built upon

# ‘accelerated taxonomy’




Super thorough
Every hypothesis correct?

**Never win another grant because the paper never gets published**

Shallow
Gets things wrong occasionally?

**Never win another grant because the taxonomic community doesn’t value your work and nobody can use it**

# DNA barcoding-based descriptions

Monograph

ZooKeys 1013: 1-665
https://doi.org/10.3897/zookeys.1013.55600 (02 Feb 2021)

## Minimalist revision and description of 403 new species in 11 subfamilies of Costa Rican braconid parasitoid wasps, including host records for 219 species

Michael J. Sharkey, Daniel H. Janzen, Winnie Hallwachs, Eric G. Chapman, M. Alex Smith, Tanya Dapkey, Allison Brown, Sujeevan Ratnasingham, Suresh Naik, Ramya Manjunath, Kate Perez, Megan Milton, Paul Hebert, Scott R. Shaw, Rebecca N. Kittel, M. Alma Solis, Mark A. Metz, Paul Z. Goldstein, John W. Brown, Donald L. J. Quicke, C. van Achterberg, Brian V. Brown, John M. Burns

Slow

Fast

Super thorough
Every hypothesis correct?


Shallow
Gets things wrong occasionally?

# DNA barcoding-based descriptions

**Whilst some papers maybe too extreme(?)…**

- barcodes are extremely useful for providing initial framework

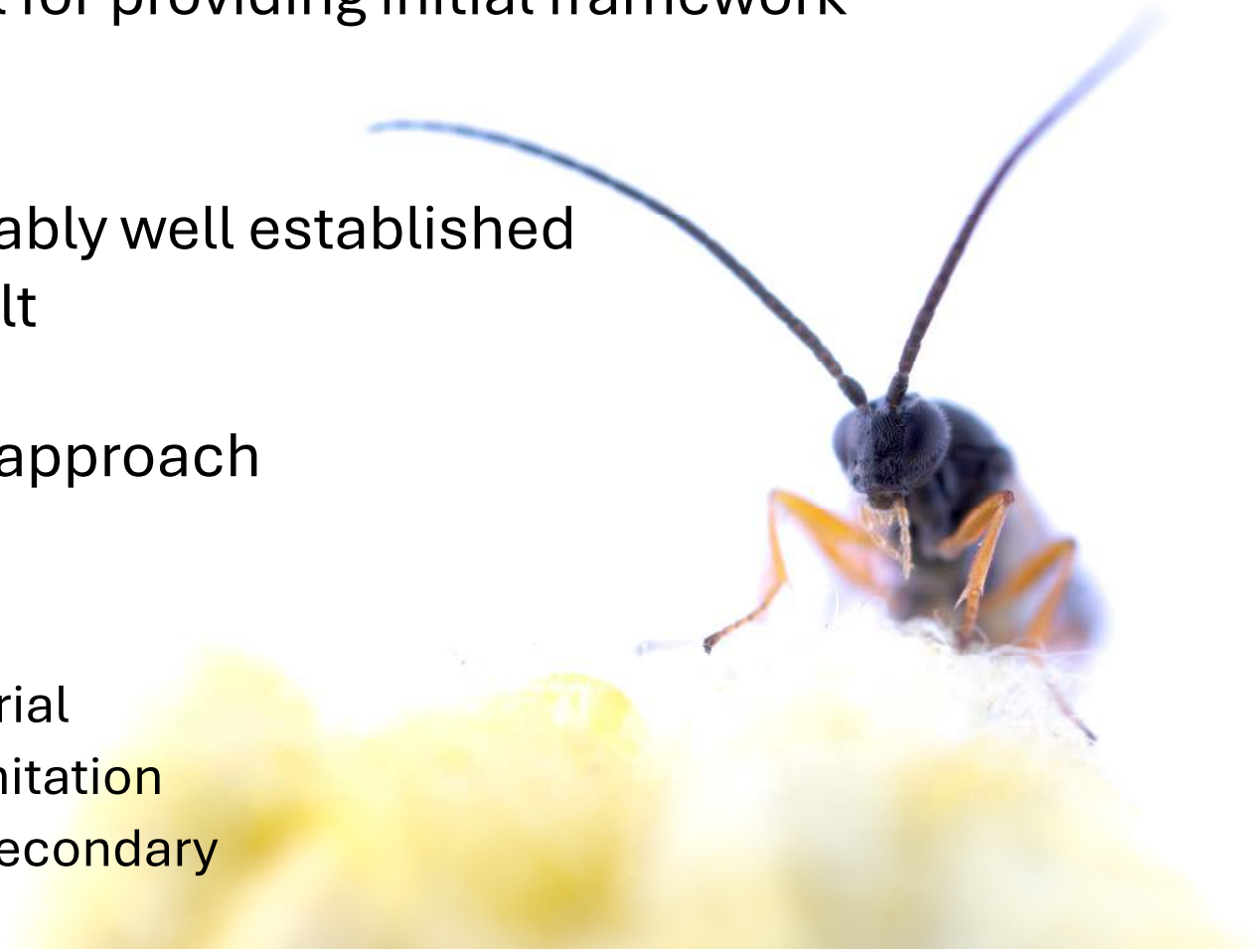
**Microgastrinae**

- thresholds actually reasonably well established
- morphology really is difficult

We took a **DNA barcode 'first'** approach

(rather than DNA barcode only)

- **First step** = barcoding all material
- **First priority** = molecular delimitation
  - morphology is supportive/secondary



# Number of specimens

**Using all specimens of *Apanteles* ever collected**

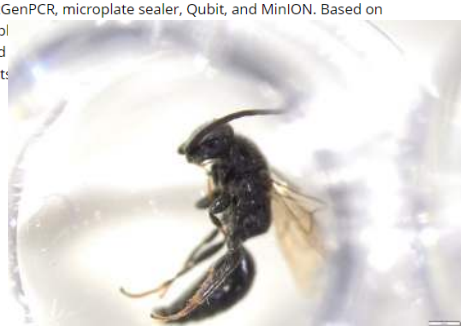
**Only using material from ethanol that was successfully sequenced**


Full COI + *wg* barcodes
(for most specimens)

# Rapid DNA barcoding in-house

**Only using material from ethanol that was successfully sequenced**

**Tiahni Bament, honours 2024**



MOLECULAR ECOLOGY RESOURCES

RESOURCE ARTICLE | Open Access

**Express barcoding with NextGenPCR and MinION for species-level sorting of ecological samples**

Cristina Vasilita, Vivian Feng, Aslak Kappel Hansen, Emily Hartop, Amrita Srivathsan, Robin Struijk, Rudolf Meier

First published: 19 January 2024 | https://doi.org/10.1111/1755-0998.13922

Cristina Vasilita and Vivian Feng contributed equally to this work.
**Handling Editor:** Paula Arribas

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## Abstract

The use of DNA barcoding is well established for specimen identification and large-scale biodiversity discovery, but remains underutilized for time-sensitive applications such as rapid species discovery in field stations, identifying pests, citizen science projects, and authenticating food. The main reason is that existing express barcoding workflows are either too expensive or can only be used in very well-equipped laboratories by highly-
w an alternative workflow combining rapid DNA extraction with
ction with NextGenPCR thermocyclers, and sequencing with
ers. We demonstrate the power of the approach by generating
imens within 6 h including specimen identification through
ired only the following major equipment that easily fits onto a
NextGenPCR, microplate sealer, Qubit, and MinION. Based on
simpl
, and
ojects

**minion**

**MinION**

# Specimen sources

**Only using material from ethanol that was successfully sequenced**

Museum collections are critical – particularly partially sorted ethanol material

Loaning already barcoded material from elsewhere

Sharing of material from colleagues

Targeted field trips/new material

**= 389 specimens with sequence data**

# Molecular delimitation

**Every possible delimitation tool?**

Multiple methods for each gene

**Single method (e.g. BINs) only**

Slow

Fast

| | COI | | | | WG | | | |
|---|---|---|---|---|---|---|---|---|
| | BINS | 2% | K80 ASAP | PTP | Haplotypes | K80 (1) ASAP | PTP | Consensus |
| AUMIC033-18 Cotesia deliadis Australia BOLD AAA7143 | | | | | | | | |
| AUMIC460-18 Iconella Australia BOLD ADL3294 | | | | | | | | |
| AUMIC377-18 Iconella Australia BOLD ADL3294 | | | | | | | | |
| AUMIC051-18 Apanteles Australia BOLD ADL5064 | 1 | | | | 60 | | | *A. apollo* / MRSB01 |
| AUMIC479-18 Apanteles Australia BOLD ADL5654 | 2 | | | | 52 | | | *A. artemis* / MRSB02 |
| AUMIC1282-24 Braconidae Australia BOLD AFQ8210 | 3 | | | | 53 | | | MRSB03 |
| AUMIC1279-24 Braconidae Australia BOLD AFQ8210 | | | | | X | X | X | |
| AUMIC240-18 Apanteles Australia BOLD AAM5747 | 4 | | | | X | X | X | *A.* sp. nr. *carpatus* / MRSB04.B |
| HYQT720-10 Apanteles Australia BOLD AAM5747 | | | | | X | X | X | |

# Species to describe?

**Everything in the dataset (48 molecular lineages)**

**Only really clear-cut examples**

Strategic decisions (34 species)

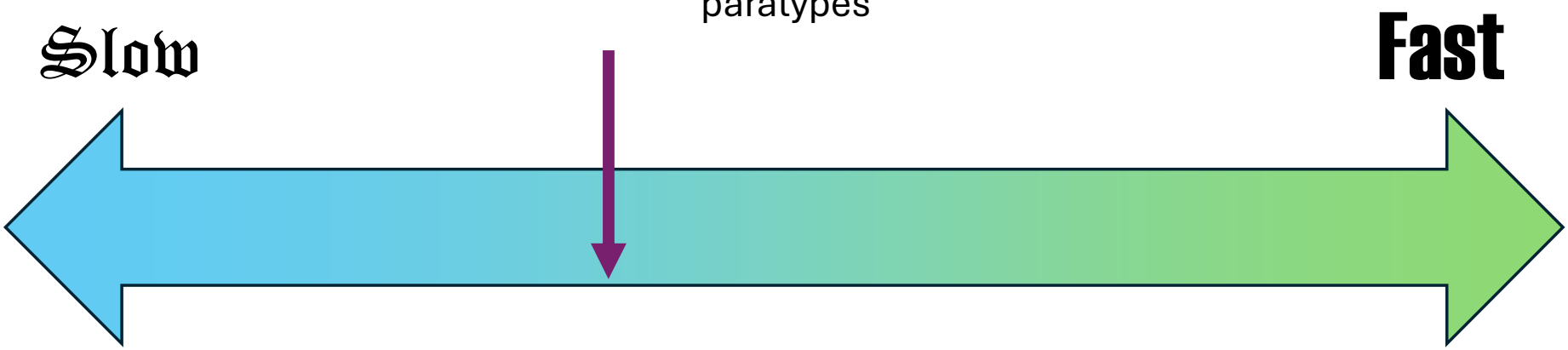

- Female specimens
- Endemic? (based on DNA barcoding)

# Morphological key/diagnosis

**Multiple morphological characters to support each species, key to species**

**'reasonable' time** spent to find at least one diagnostic character for each species and check it is consistent among paratypes

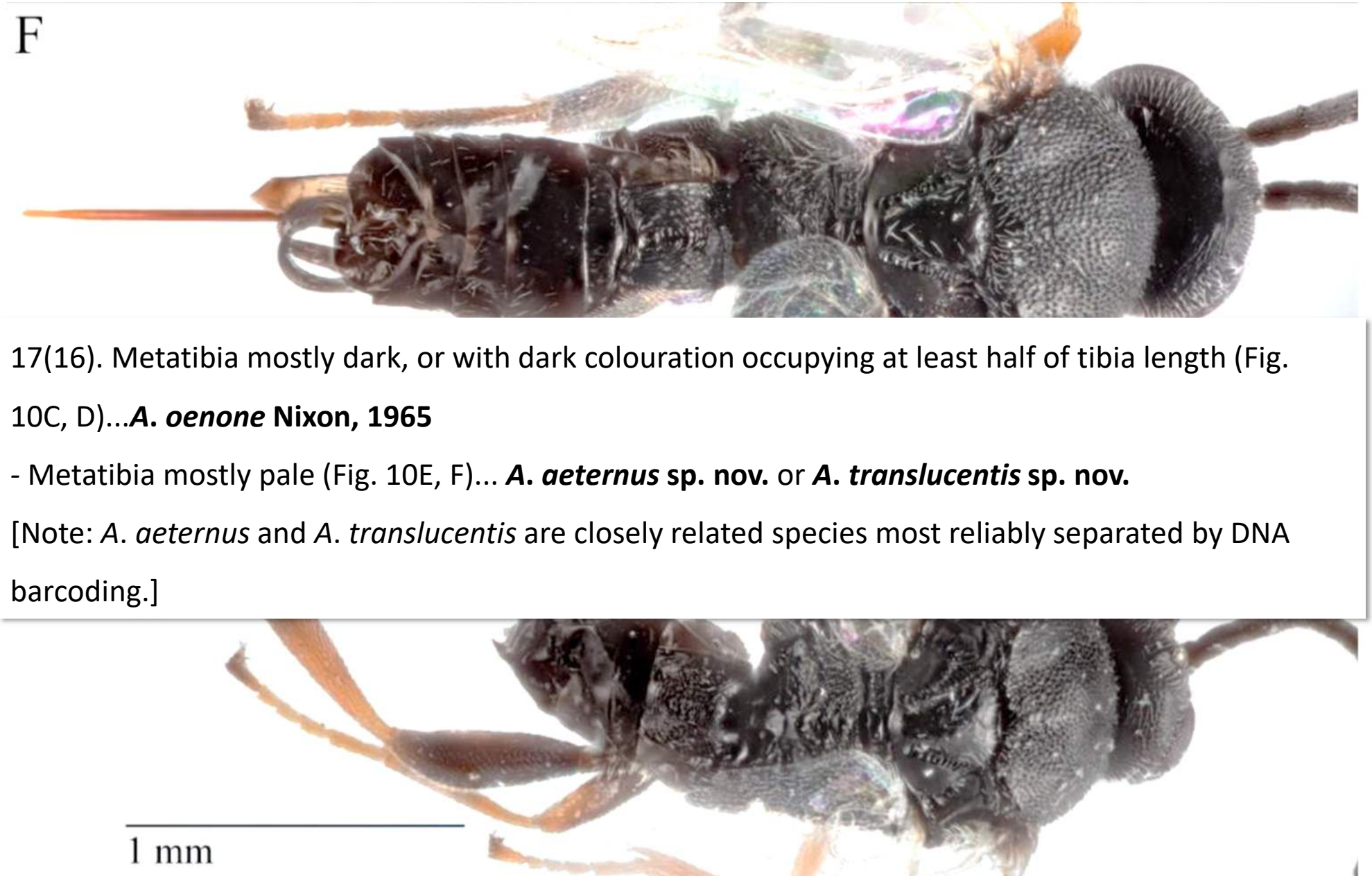
**Molecular data only**




Supported short morphological description with:

- Full image plates
- DNA data
- All specimens in Australian institutions

**Species still described where a character could not be found if molecular evidence was strong**




17(16). Metatibia mostly dark, or with dark colouration occupying at least half of tibia length (Fig. 10C, D)...***A. oenone*** **Nixon, 1965**

- Metatibia mostly pale (Fig. 10E, F)... ***A. aeternus*** **sp. nov.** or ***A. translucentis*** **sp. nov.**

[Note: *A*. *aeternus* and *A*. *translucentis* are closely related species most reliably separated by DNA barcoding.]

# Names

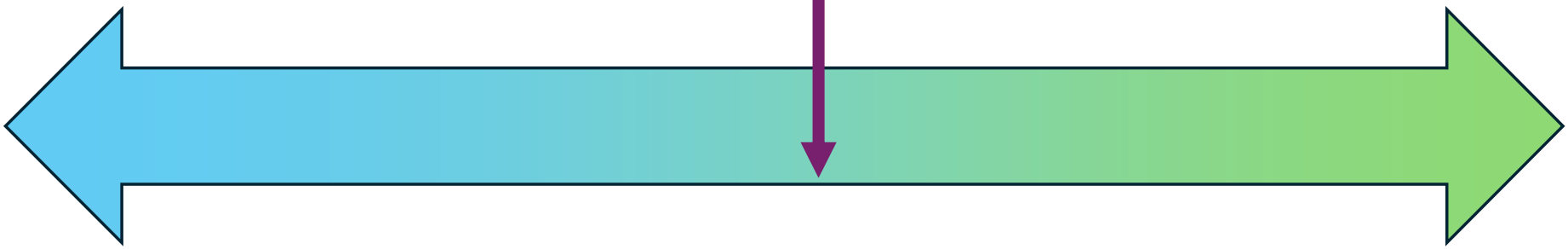
**Community consultation**

Worked with Insect Investigator schools for a a few names

**Numerical?**

Slow

Fast



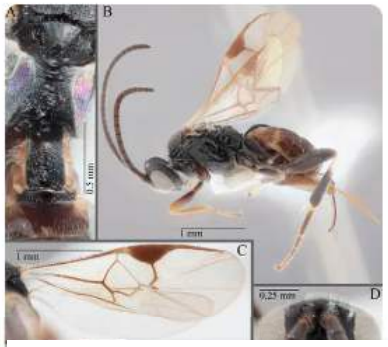
Insect Investigators + 6 • 6mo

Apanteles (sp. 41) - Springsure

# Naming process with schools

**Information**

**Here is your new species! Apanteles ...**



**Name ideas - don't forget to explain what the name means!**

**Apanteles Mountain wasp**

-Located in Springsure area
-local Football team
- mountains all across center queensland
- Latin Name : Atlatus

♡ 3 · 26

**Anonymous** 6mo
Latin Name 'atlatus Aculeus'

**Insect Investigators** 6mo
Ooh I love the idea of naming it

**Erinn's summary of ideas - just to simplify**

**Apanteles 'rough country' (Erinn will work on translation)**

You just have to decide if you want rough as in bumpy or rough as in harsh

♡ 0 · 2

**Anonymous** 6mo
HARSH

**Anonymous** 6mo

**General comments**

**Final ideas?**

When you've run out of ideas maybe comment here that you're finished, and we can compile the short list (and I'll check the Latin translations) for you to decide on?

♡ 0 · 13

**Anonymous** 6mo
Remember Peter that the kids have to have a reason/explanation behind the name which Erinn will include in the description/article.
tudents, this name
pecies forever -
ant! Andy

gators 6mo
l use the name for
ed years! I use
undred years ago all

**Final notes!**

**Final vote on naming unnomously by students: Apanteles alatomicans. The reason for naming refers to the beauty of the wasp and the shiny/twinkle of its wings particularly and the fact the students also believe it is found in a place representing Australian beauty - the outback. Here this little lady of beauty quietly goes about her business helping us to protect our crops from the devastating caterpillars that seek to destroy them.**

1. Recorded video or virtual workshop
2. Collation of ideas on a Padlet
3. Feedback and shortlist
4. Vote for favourite name amongst students/schools

# *Apanteles alatomicans* – twinkle wings

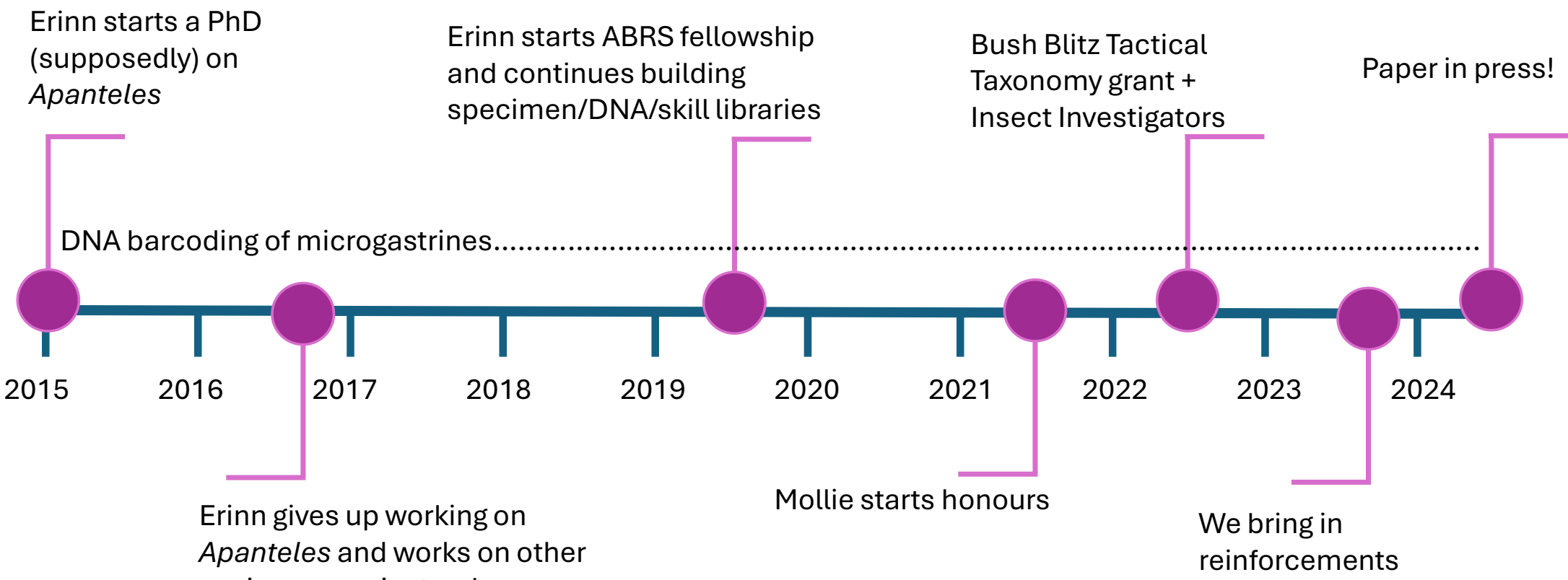
**Etymology.**

This species was named by students in **year 9 at Springsure State School in QLD,** who in year 7 ran the Malaise trap that collected several of the paratype specimens. The epithet should be treated as an adjective and is formed from the Latin 'alatus' (furnished with wings) and 'micans' (twinkling) and the wasp was affectionately given the nickname **"Mr Twinkle Wings"** in the taxonomy workshop. In the words of the class teacher, Peter Spencer: "The reason for naming refers to the beauty of the wasp and the shiny/twinkle of its wings particularly, and the fact the students also believe it is found in a place representing Australian beauty - the outback."

# *Apanteles cuprum* - copper

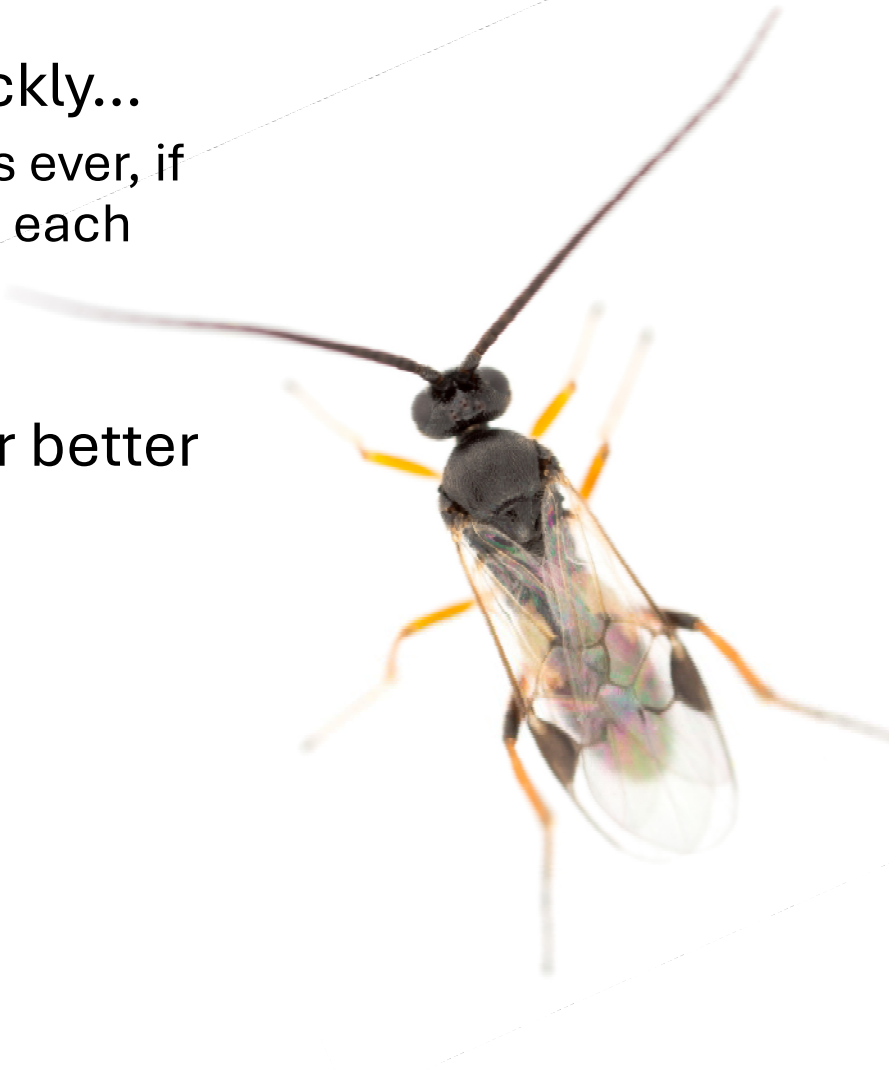
**Etymology.**

The species epithet is a Latin noun in apposition (genitive case) and was named by students at **Mount Molloy State School**, who collected two paratype specimens during 'Insect Investigators'. The Latin noun **means 'copper'** (the metal) and the students chose the name to relate to the **rich copper resources found in the Mount Molloy region**. Whilst the species is found in many places without copper mining, we think this name is also apt because of the **more coppery colour of this species** compared to many others in the genus.


Erinn starts a PhD (supposedly) on *Apanteles*
Erinn starts ABRS fellowship and continues building specimen/DNA/skill libraries
Bush Blitz Tactical Taxonomy grant + Insect Investigators
Paper in press!
DNA barcoding of microgastrines
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Erinn gives up working on *Apanteles* and works on other easier genera instead
Mollie starts honours
We bring in reinforcements

# ‘accelerated taxonomy’ – what does this mean?

- Barcoding provides species hypotheses quickly…
  - but morphological diagnoses take just as long as ever, if you are still trying to find a character to separate each species from all the others (and build a key)
- Collaboration and student training makes for better taxonomy
- Where to now? Many more species?

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Australian Biological Resources Study

BushBlitz