Insect diversity assessment using air samples collected from approved arrangement facilities.

NATA Accreditation No. 21138

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UNIVERSITY OF CANBERRA | NATIONAL eDNA REFERENCE CENTRE

Australian Government
Department of Agriculture, Fisheries and Forestry

DATA EFFECTS

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Airborne environmental DNA

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what is airborne eDNA

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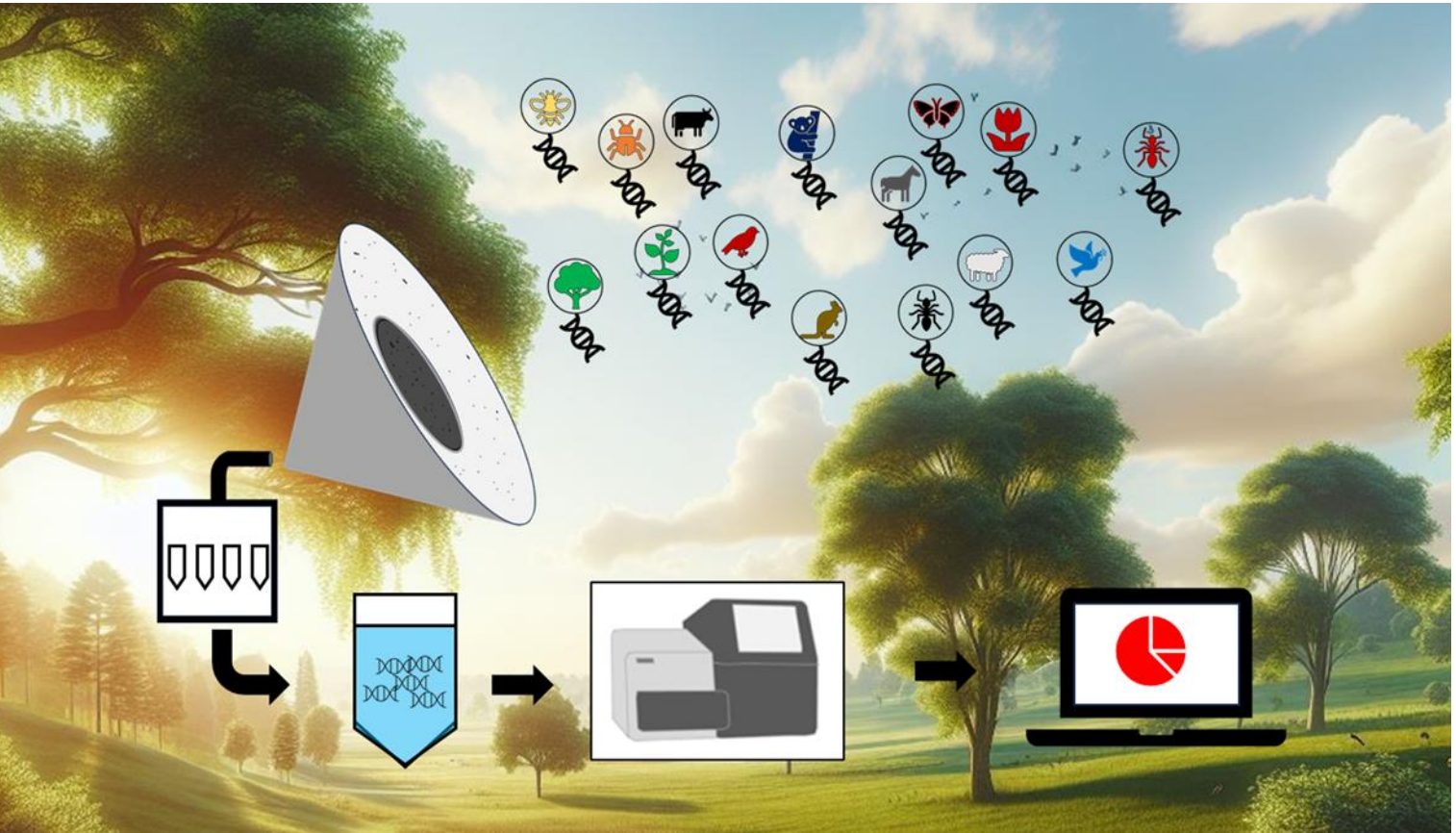
Airborne environmental DNA (eDNA) is an emerging field that allows for the detection of species from their genetic remnants in the air.



Fungi

nature > articles > article

Article | Open access | Published: 10 July 2024

Airborne DNA reveals predictable spatial and seasonal dynamics of fungi

Nerea Abrego, Brendan Furneaux, Bess Hardwick, Panu Somervuo, Isabella Palorinne, Carlos A. Aguilar-

Insect

Received: 12 November 2021 | Revised: 8 February 2022 | Accepted: 9 February 2022

DOI: 10.1002/edn3.290

ORIGINAL ARTICLE

Environmental DNA | WILEY

Airborne environmental DNA metabarcoding for the monitoring of terrestrial insects—A proof of concept from the field

Fabian Roger[1] | Hamid R. Ghanavi[2] | Natalie Danielsson[1] | Niklas Wahlberg[3] |

Received: 5 March 2024 | Revised: 4 June 2024 | Accepted: 9 July 2024

DOI: 10.1002/edn3.591

ORIGINAL ARTICLE

Environmental DNA | WILEY

Continuous daily sampling of airborne eDNA detects all vertebrate species identified by camera traps

Marcel Polling | Ralph Buij | Ivo Laros | G. Arjen de Groot

Vertebrates

Research article | Open access | Published: 06 December 2021

Airborne environmental DNA metabarcoding detects more diversity, with less sampling effort, than a traditional plant community survey

Mark D. Johnson, Mohamed Fokar, Robert D. Cox & Matthew A. Barnes

BMC Ecology and Evolution **21**, Article number: 218 (2021) | Cite this article

NA

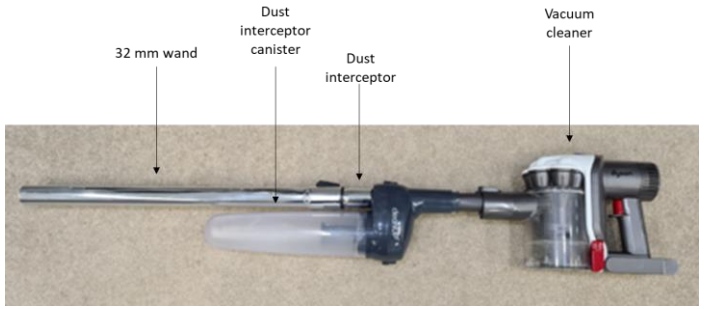
At border biosecurity and eDNA

The biosecurity sector in Australia is built around a need for rapid response

- Quick identification of pest species.
- Risk assessment.
- Actionable decision for biosecurity response.

Australian Department of Agriculture, Fisheries and Forestry funded eDNA application and research by EcoDNA for border biosecurity

eDNA and eRNA using dust samples from shipping container



Automated air sampling devices for remote surveillance inside shipping containers

EcoDNA

Objective

Can we use airborne eDNA for border biosecurity?

Well, it's a question that is not that easy to answer. There are many more questions that need answering before we can answer this.

Can we detect insect diversity in an Approved Arrangement (AA) facility using airborne DNA?

Objectives:

- Develop an automated device capable of continuous airborne DNA collection.
- Uninterrupted sampling of airborne DNA inside an AA
- Downstream analyses for eDNA detection

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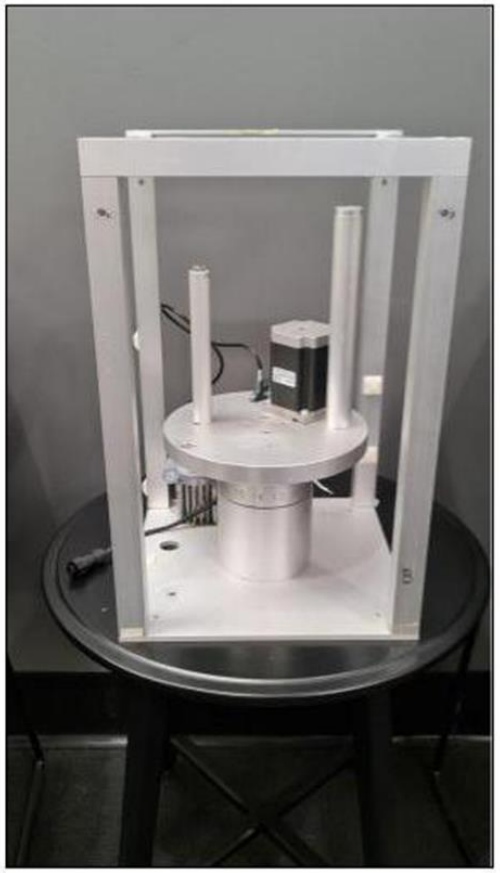
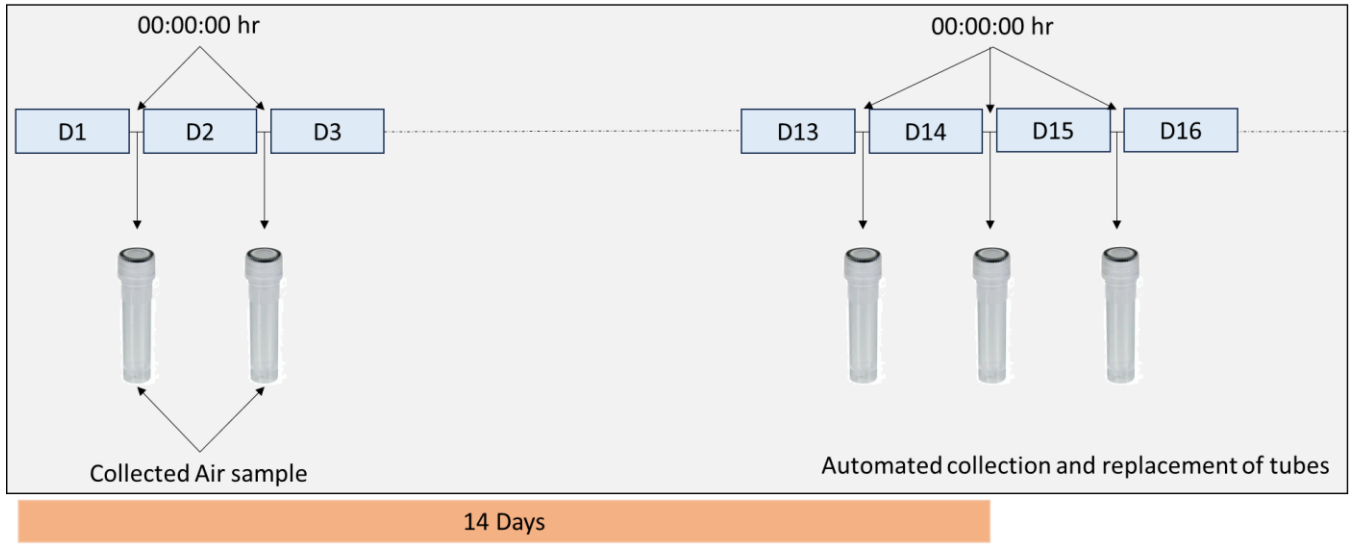
Automated air sampling sentinel units



Automated air sampling sentinel units designed by DATA EFFECTS

- Capture airborne particles
- Store in a 2 ml tube
- Automated change of tube every 24 hrs



DATA EFFECTS

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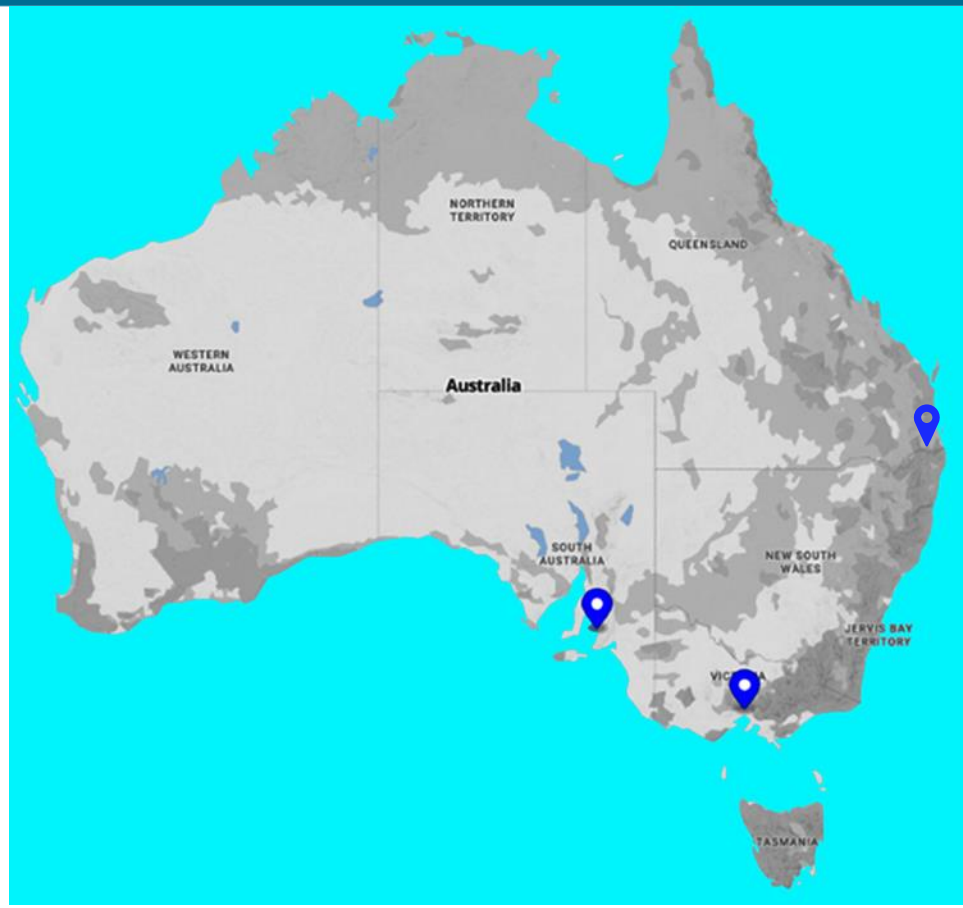
Sampling regime and eDNA metabarcoding

A total of 462 samples were collected from three approved arrangement facilities in Australia.

Sampling sites	Duration	Number of samples*
Rapid Haulage in Adelaide	15/09/2023 – 30/04/2024	191
Mainfreight Perishables in Melbourne	15/09/2023 – 30/04/2024	226
Mainfreight Logistics Brisbane	15/03/2024 – 30/04/2024	45

* Number of samples used for high throughput sequencing



- Metabarcoding was performed following the SOP designed by the National eDNA Reference Centre (NRC)
- **Targeted gene:** COI (FwhF2a and Fdegen primer sets from Elbrecht et al. 2019 with slight modification)
- **Sequencing:** Illumina MiSeq V3 (2x300 Cycles)

Elbrecht et al. 2019. DOI 10.7717/peerj.7745

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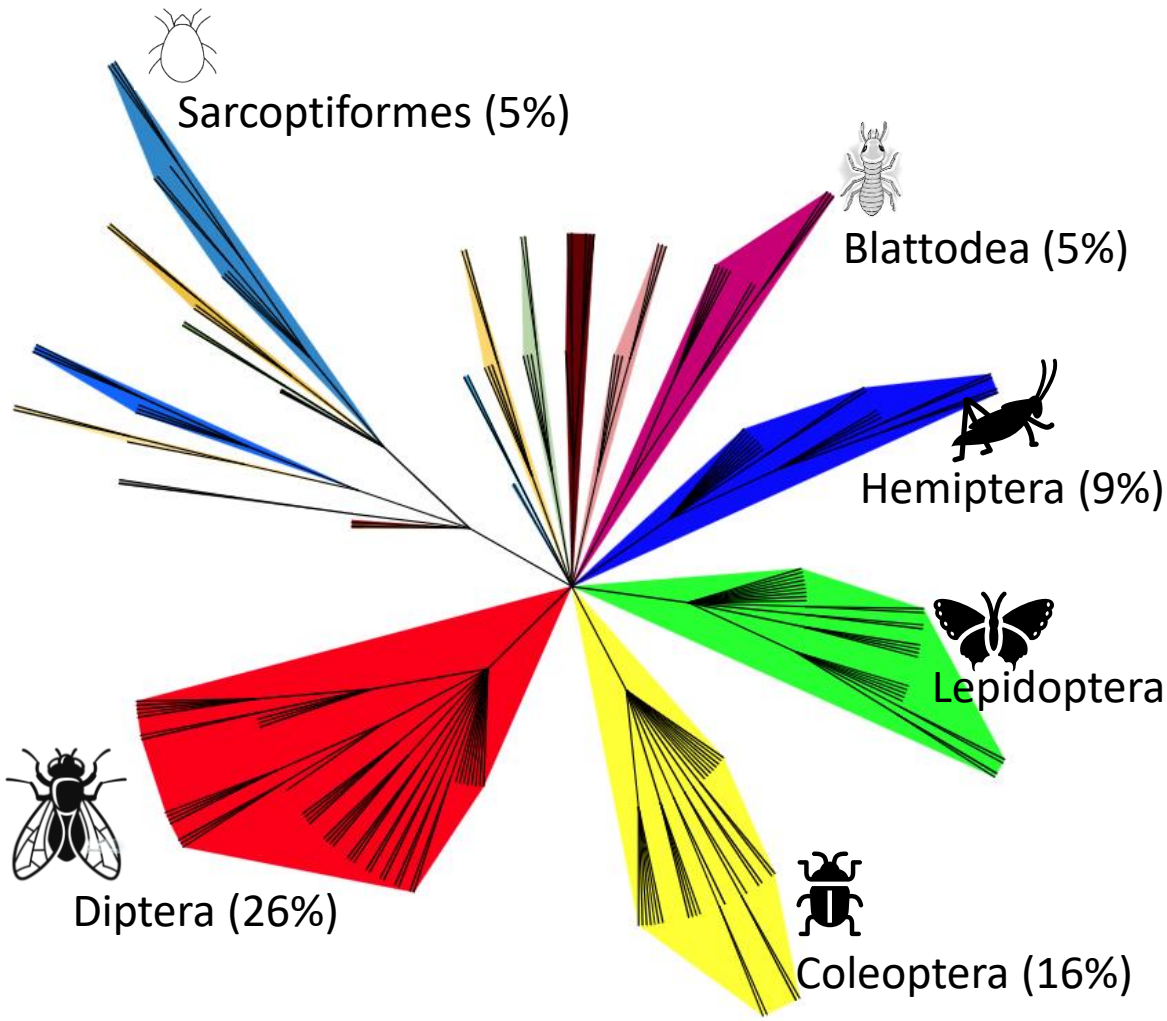
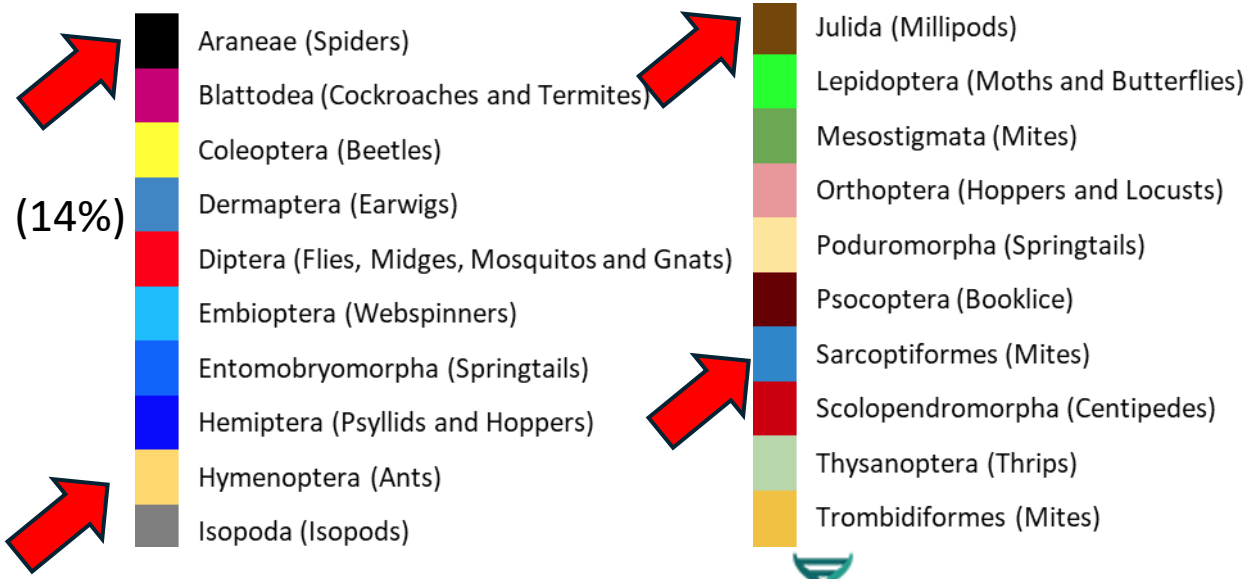
Results (all three sites)



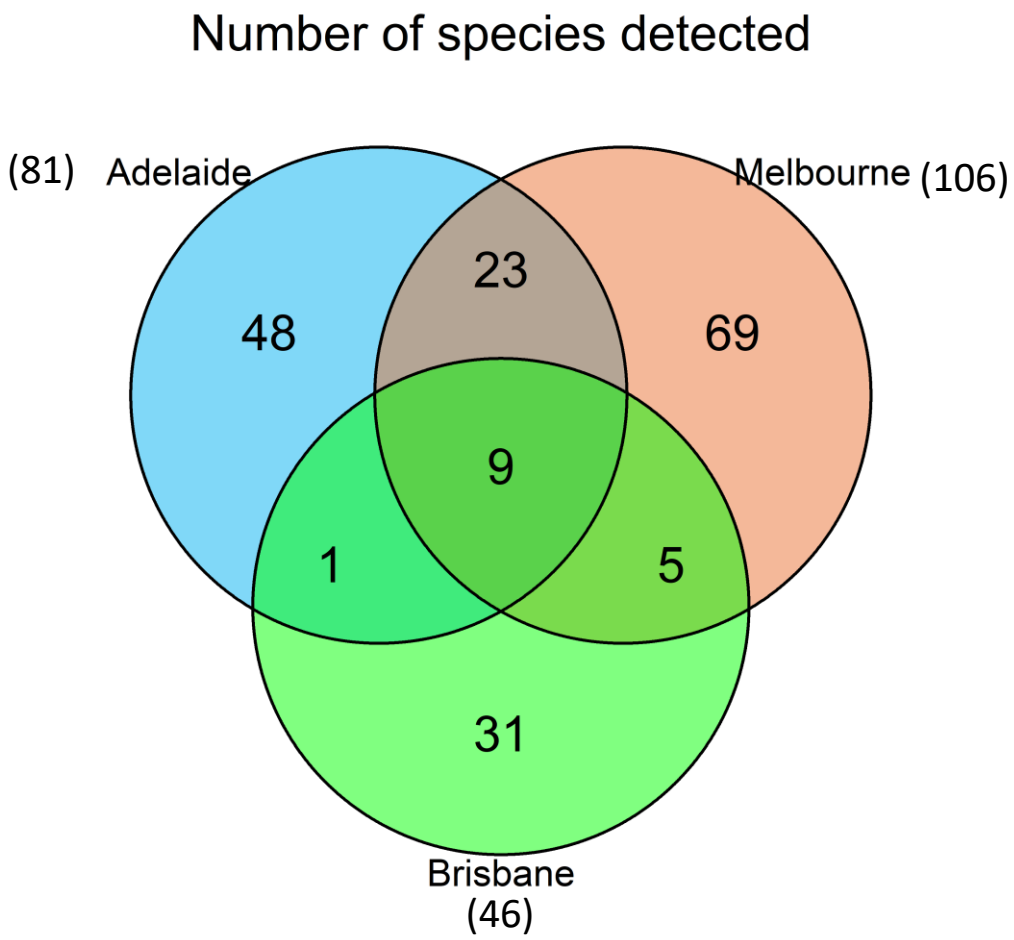
186 insect species belonging to 20 insect orders

Both flying and crawling insects



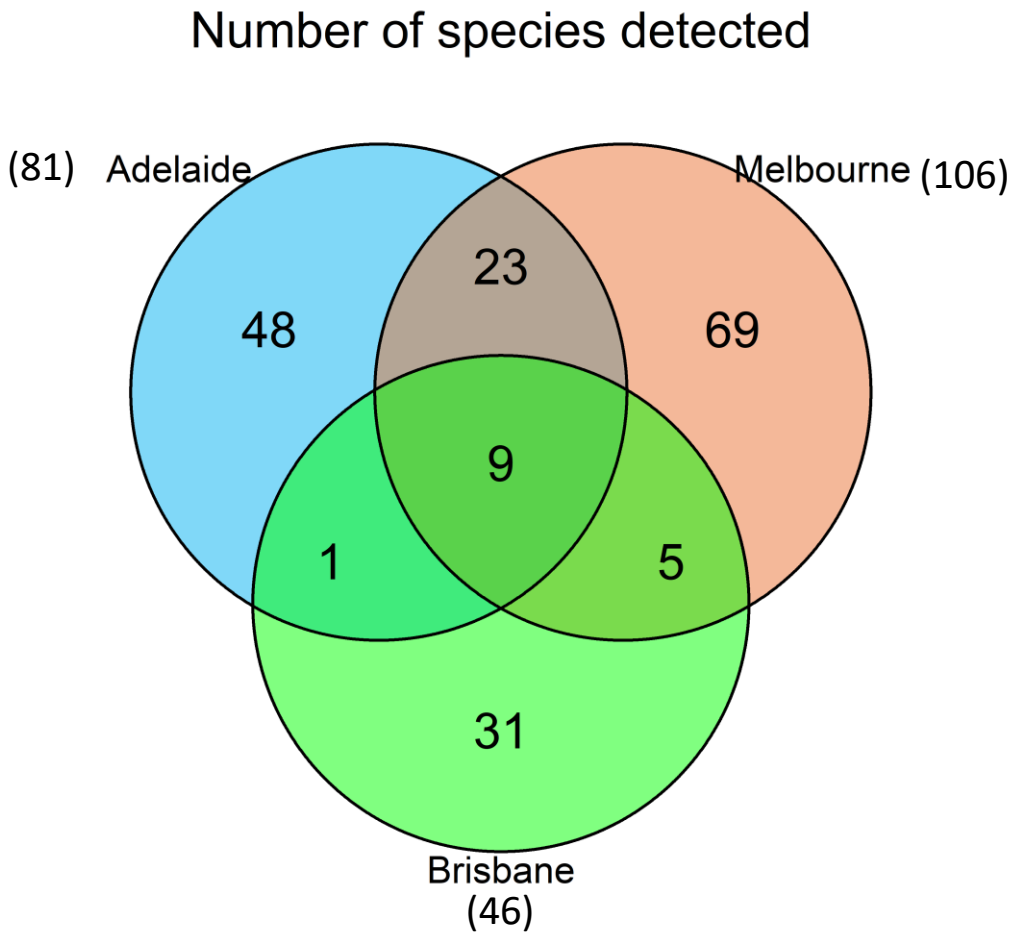
EcoDNA

Results (all three sites)



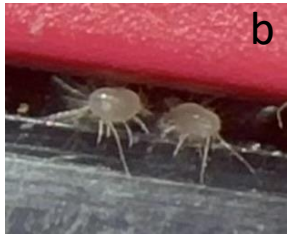
EcoDNA

Results (all three sites)

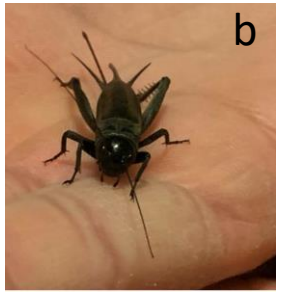


Frequently detected species:

Aleuroglyphus ovatus
(brown-legged mite)

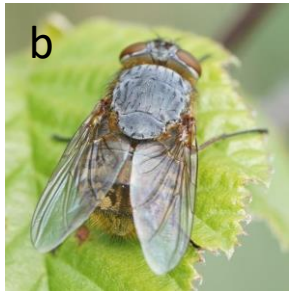


Tyrophagus putrescentiae
(a cosmopolitan mite species)



Teleogryllus commodus
(black field cricket)

Coptotermes acinaciformis
(subterranean termite)



Calliphora stygia
(brown blowfly)

Image source:
a) Zou et al. 2023 (DOI: 10.1007/s10493-023-00861-9)
b) Atlas of Living Australia (https://www.ala.org.au/)

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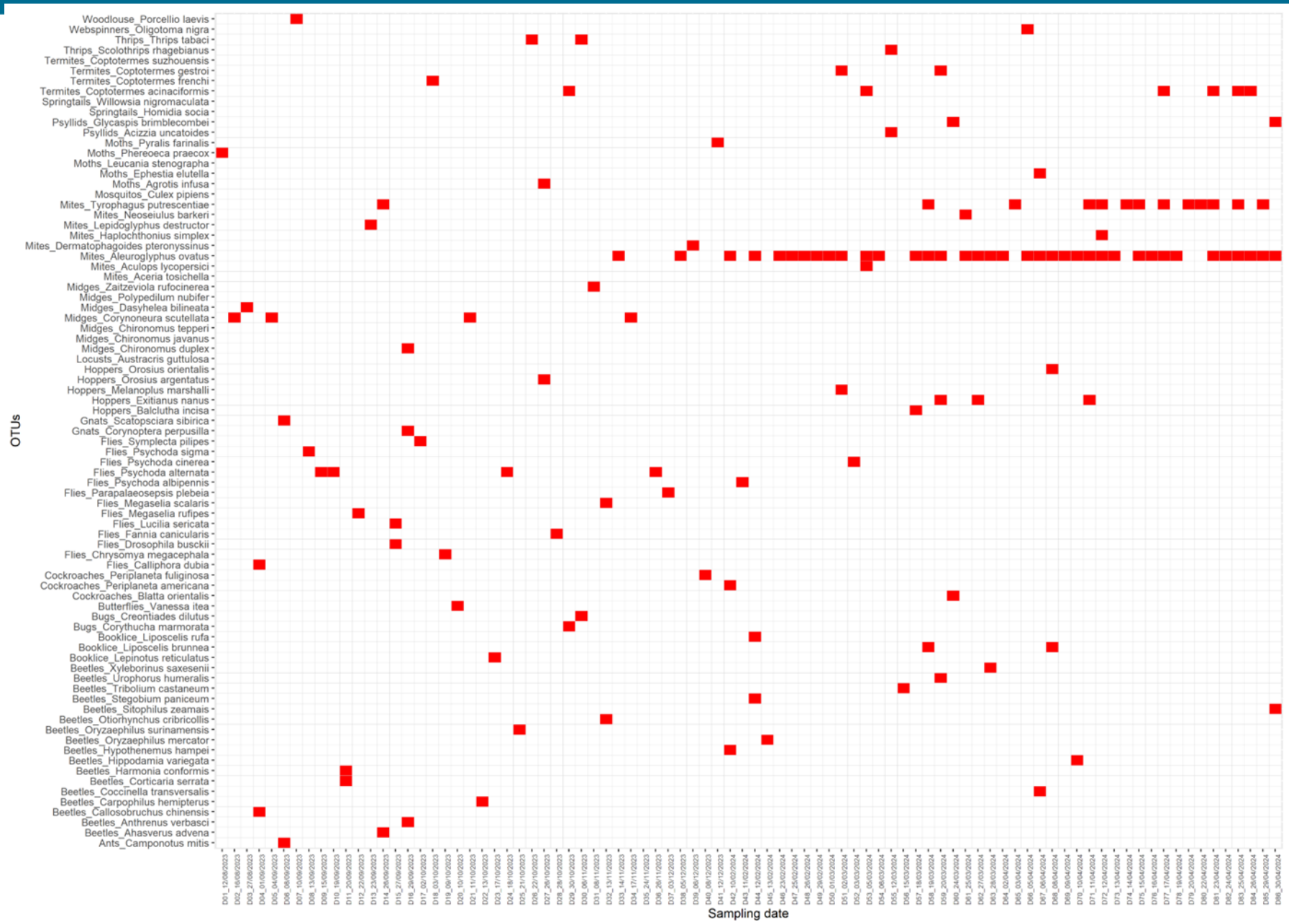
Results (Adelaide)

Adelaide:

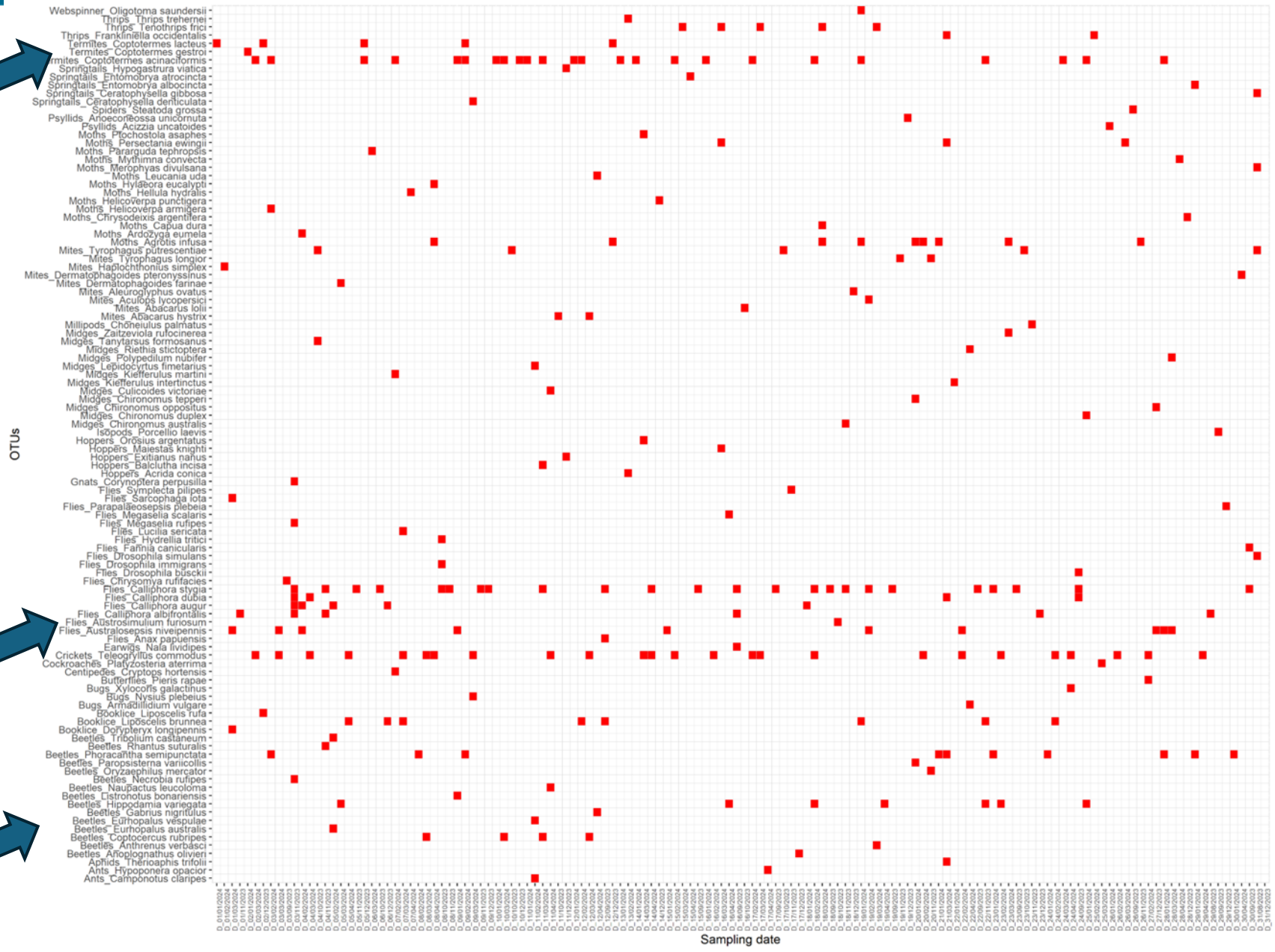
Number of samples with no detection	105
Number of samples with at least one positive detection	86
Total	191



Results (Melbourne)

Melbourne:

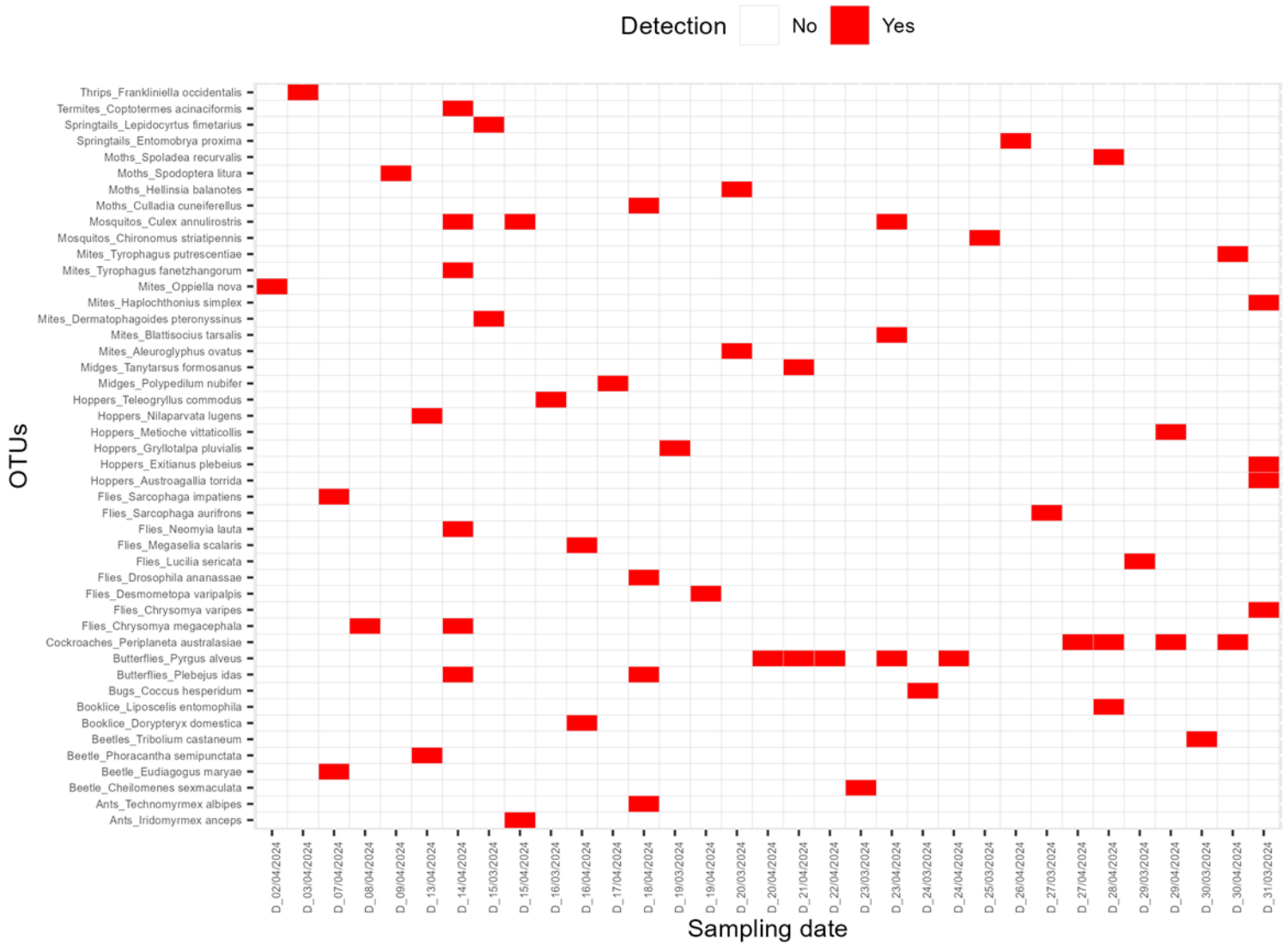
Number of samples with no detection	90
Number of samples with at least one positive detection	136
Total	226



Results (Brisbane)

Brisbane:

Number of samples with no detection	12
Number of samples with at least one positive detection	33
Total	45



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Conclusion and Future Direction

What we have learned:

- ✓ Automated air sampling sentinel units can capture airborne eDNA at the approved arrangement facilities.
- ✓ Airborne eDNA is efficient in detecting both flying and crawling insects.

Can this help the government in actionable decision-making

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Conclusion and Future Direction

What we have learned:

- ✓ Automated air sampling sentinel units can capture airborne eDNA at the approved arrangement facilities.
- ✓ Airborne eDNA is efficient in detecting both flying and crawling insects.

Can this help the government in actionable decision-making

- ✓ It is unclear if some of the non-frequent detections were from live/active insects within the facility or historical traces from external sources.
- ✓ To overcome this, we are currently performing environmental RNA (eRNA) based experiments.

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