Advancing Terrestrial Biosecurity: Developing Air-Based eDNA Monitoring for Early Detection of Invasive Species

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B3 Science Solutions for Better Border Biosecurity AOTEAROA NEW ZEALAND

NZ BIOSECURITY

The New Zealand Government spends $418 million annually on biosecurity monitoring, eradication and management programs…

Once new plant invaders have crossed into NZ, they are tough to contain and require comprehensive resources to monitor and eradicate…

Early identification of new plant invaders through ***extensive monitoring*** represents the best approach if eradication is to be successful…

Invasive plants, pest and disease impact ecosystems and communities…

NZ BIOSECURITY

Mycoplasma bovis

Queensland fruit fly *Bactrocera tryo*

Saffron thistle (*Carthamus lanatus*)

Velvetleaf (*Abutilon theophrasti*)

NZ BIOSECURITY - CURRENT SURVEILLANCE MEASURES

- Most surveillance is targeted
  - Fruit flies, Spongy moths, Mosquitoes, Ants
- Surveillance of insect damage to plants in high risk areas – ports, airports and transitional facilities
- Many species are missed by these measures – many new species are found first by the public
- Large gaps in current surveillance programmes
  - ¼ of spp. have no prior record of invading new areas
- There is a need for advanced terrestrial biosecurity surveillance at high risk sites……

Credit :PoT C3

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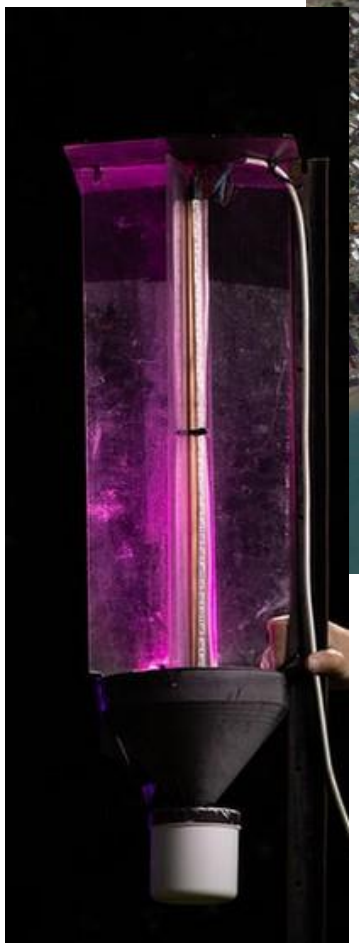
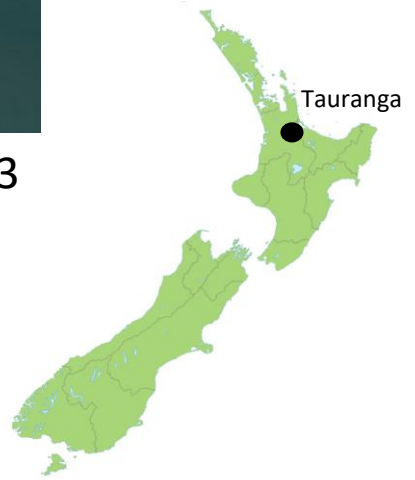
Case Study 1: Light Trap eDNA



Credit :PoT C3

Test eDNA capture in the Port of Tauranga using light traps



LIGHT TRAP eDNA

NEW ZEALAND'S BIOLOGICAL HERITAGE | Ngā Kōlora Tuku Iho | National SCIENCE Challenges

Technical innovations

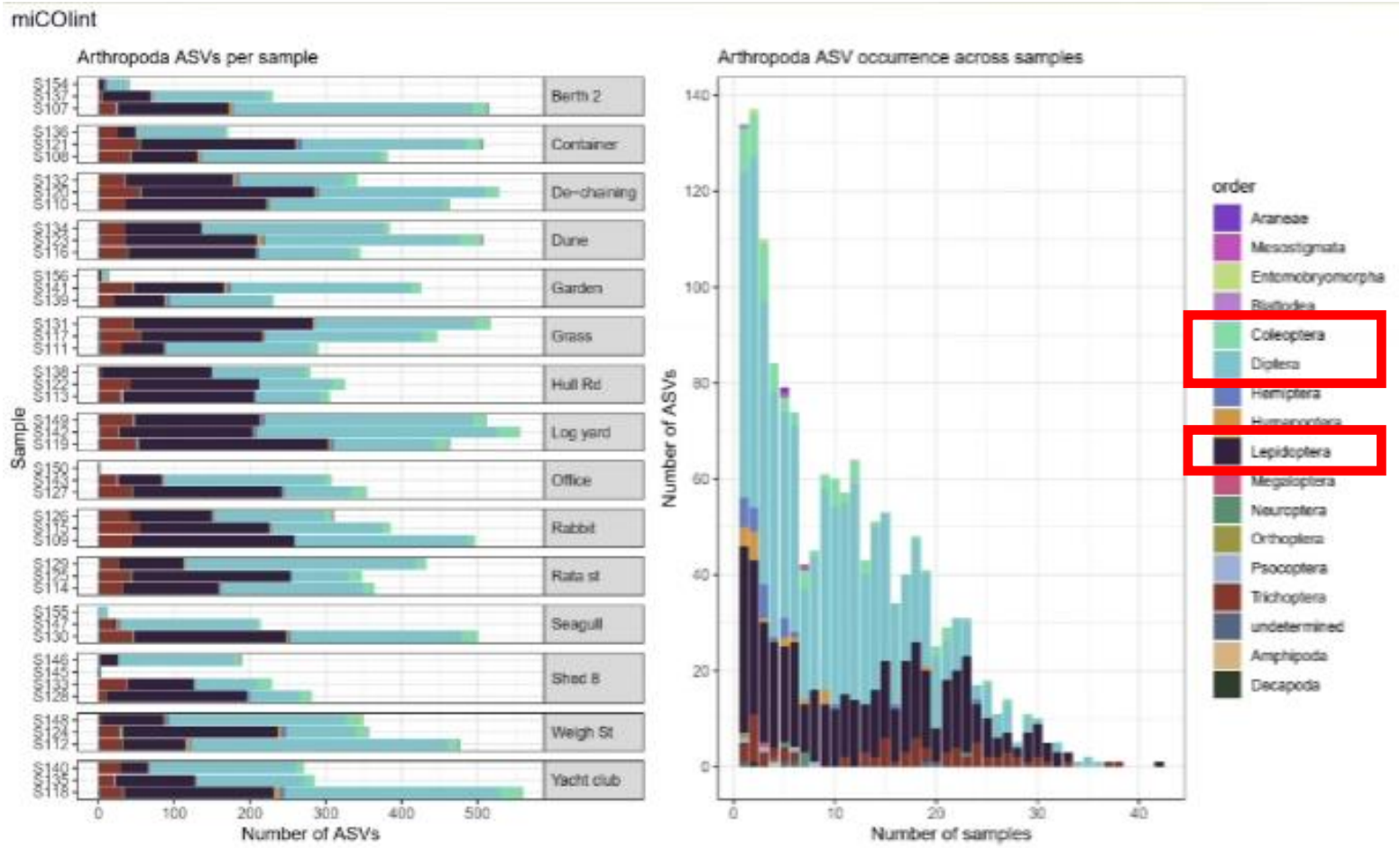
- Size-based filtering

Preeti Panda
Plant & Food

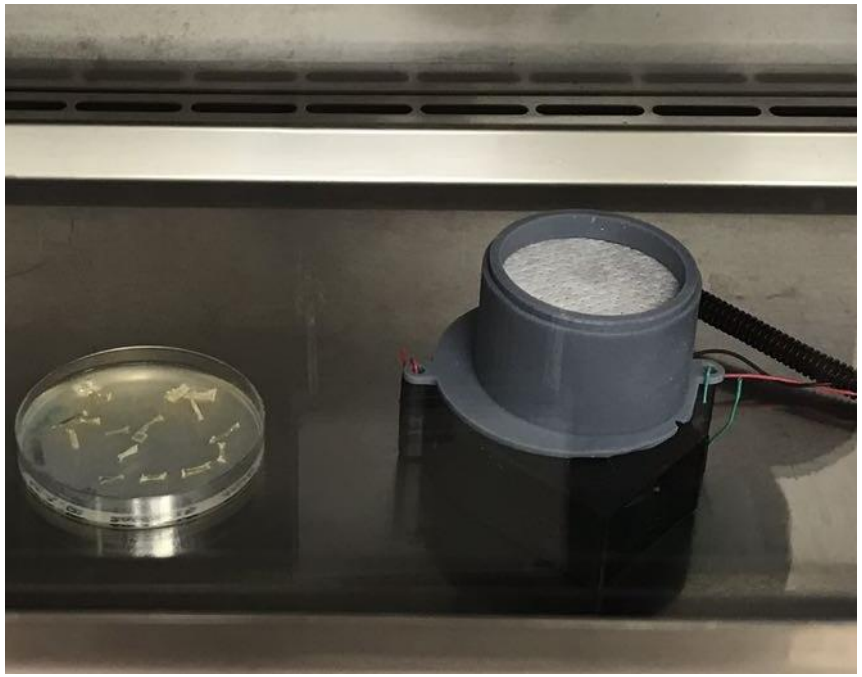
Primer set	target	size (bp)
hexCOI f4/r4	COI	~322
mlCOIintf/dgHCO2198	COI	~313
hex12S f2/r2	12S	~319
sterno12S f/r	12S	~225
chiar16S f/r	16S	~348

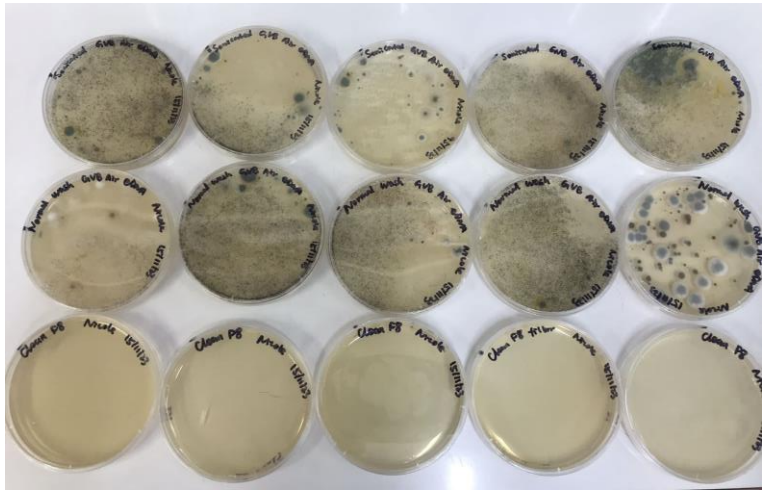
trapping insect DNA Dhami

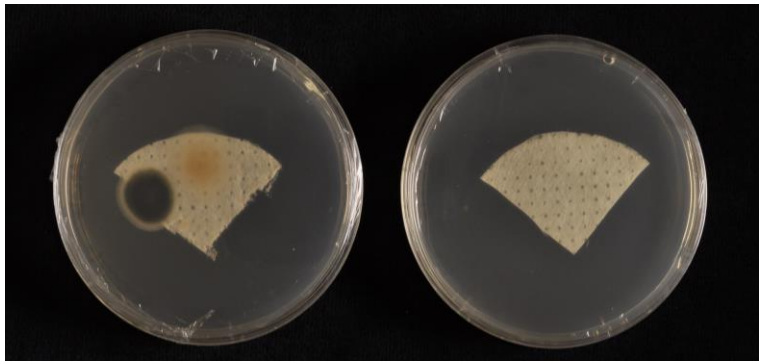
LIGHT TRAP eDNA



Case Study 2: Air DNA



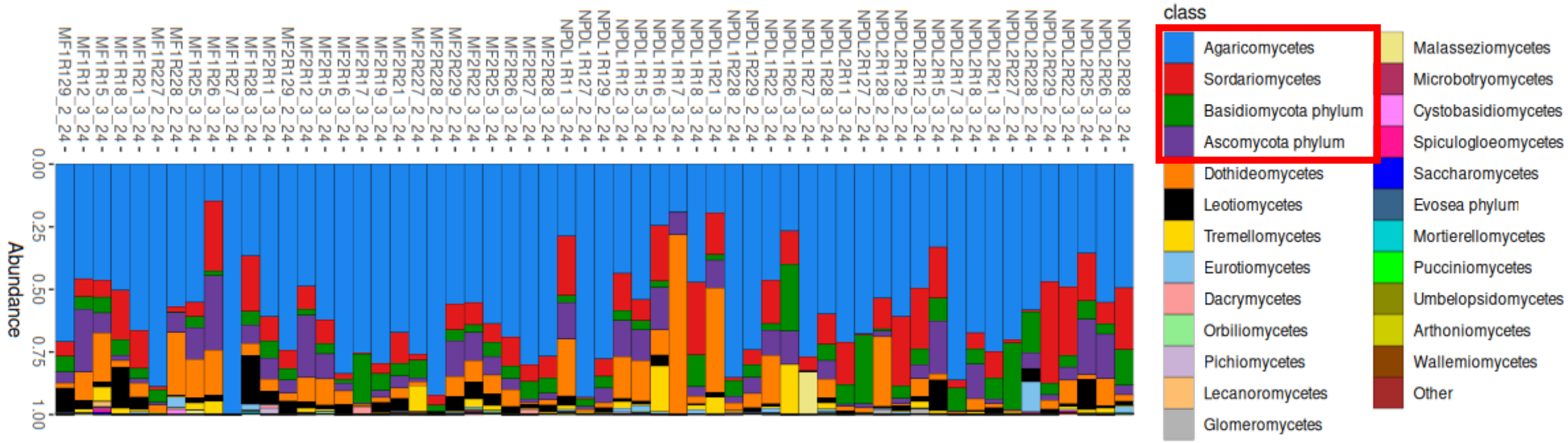




AIR DNA


416014
45G1
30,480 KGS
67,200 LBS
3,765 KGS
8,300 LBS
26,715 KGS
58,900 LBS
76.4 CUM.
2,698 CUFT.

CASE STUDY 2: AIR DNA



Study 3: Evaluation of eDNA Methods

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Targets:-Mammal, Fungal, Bacteria and Insect

Evaluation of eDNA Methods

CONCLUSION

- Light Trap eDNA
  - Insects – moths, flies, and beetles

- Air eDNA
  - Fungal and bacteria – pathogenic strains

- Open questions re passive vs active filtration
  - volume of filtration
  - filter matrix for cell capture
  - sampling time/duration

- Implementation Strategy?

ACKNOWLEDGMENTS

- Ngāti Whakaue

- Biological Heritage– National Science Challenge
- Dr Andrew Dopheide - Manaaki Whenua – Landcare Research
- Dr Manpreet Dhami - Manaaki Whenua – Landcare Research
- Simon Bulman – Plant and Food
- A/Prof Steve Pawson - University of Canterbury

- SPS Biota
- Port of Tauranga
- Mainfreight

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WHAT TRAPS ARE THE MOST EFFECTIVE?

- 253,582 invertebrates
- 46,821 beetles, 209 species
  - Light traps most effective
    - 84% of species were collected in light traps
  - Pitfall traps sampled a different fauna
    - Light and pitfall traps combined collected >90% of species