



Australian Government

Department of Agriculture
and Water Resources

The interconnected mosquito: managing risk of exotic mosquitoes at Australian first points of entry

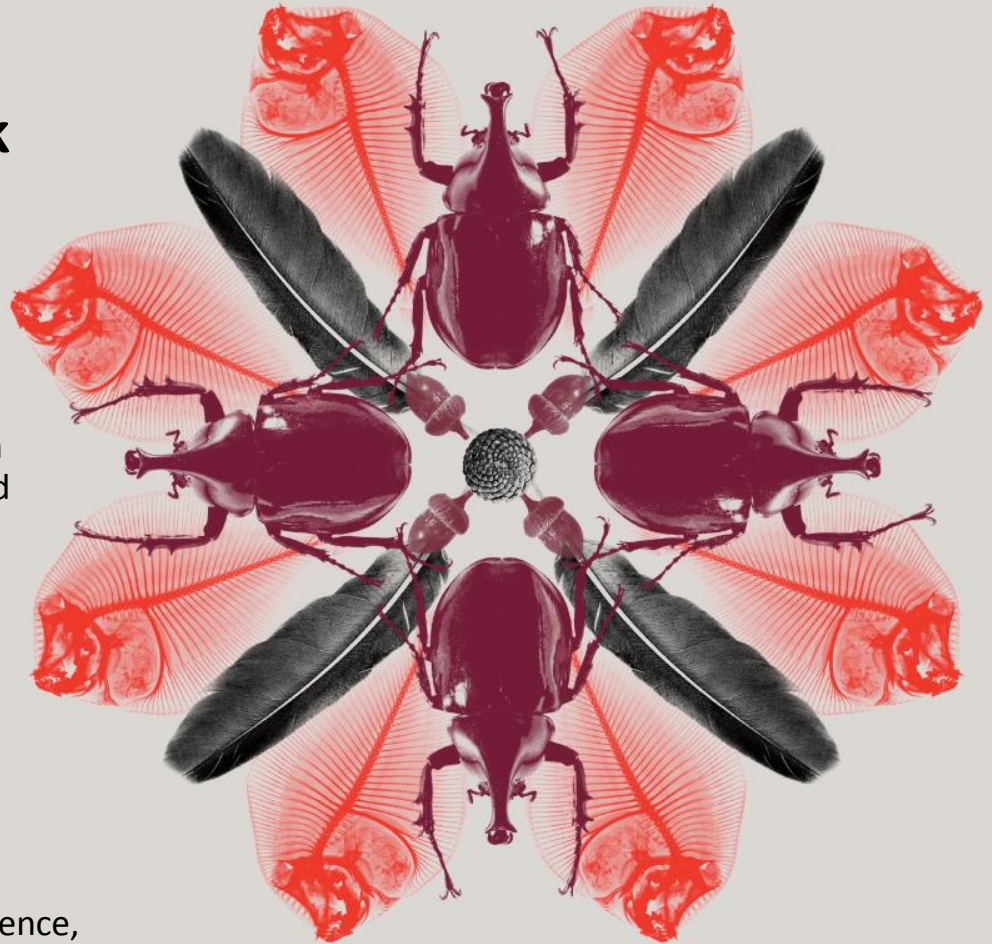
Using a synthesis of science and regulation
to beat an ancient foe in an interconnected
world of international trade

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Why are mosquitoes a risk & what is a vector?

Mosquitoes are parasitic flies that can spread human diseases

- >275 Australian mosquitoes;
>3500 spp. named worldwide!
- Females take blood meals from vertebrates to mature their eggs (protein)
- Arboviruses and malaria hijacked blood feeding as way of spreading to new hosts (vector: organism spreading a pathogen)
- Malaria, Dengue and Zika require vectors currently absent from Australia
- Australia has serious vectors of human diseases exotic to the rest of the world



Impress your BBQ guests by being able to identify who is biting you!

Head down, abdomen up: *Anopheles*

Body flat, black & white legs: *Aedes*

Body flat, dark legs: *Culex*

Risk: trade routes are new-old pathways for mosquitoes

While trade-facilitated spread of mosquitoes has occurred for centuries, new pathways provide exposure to new risks

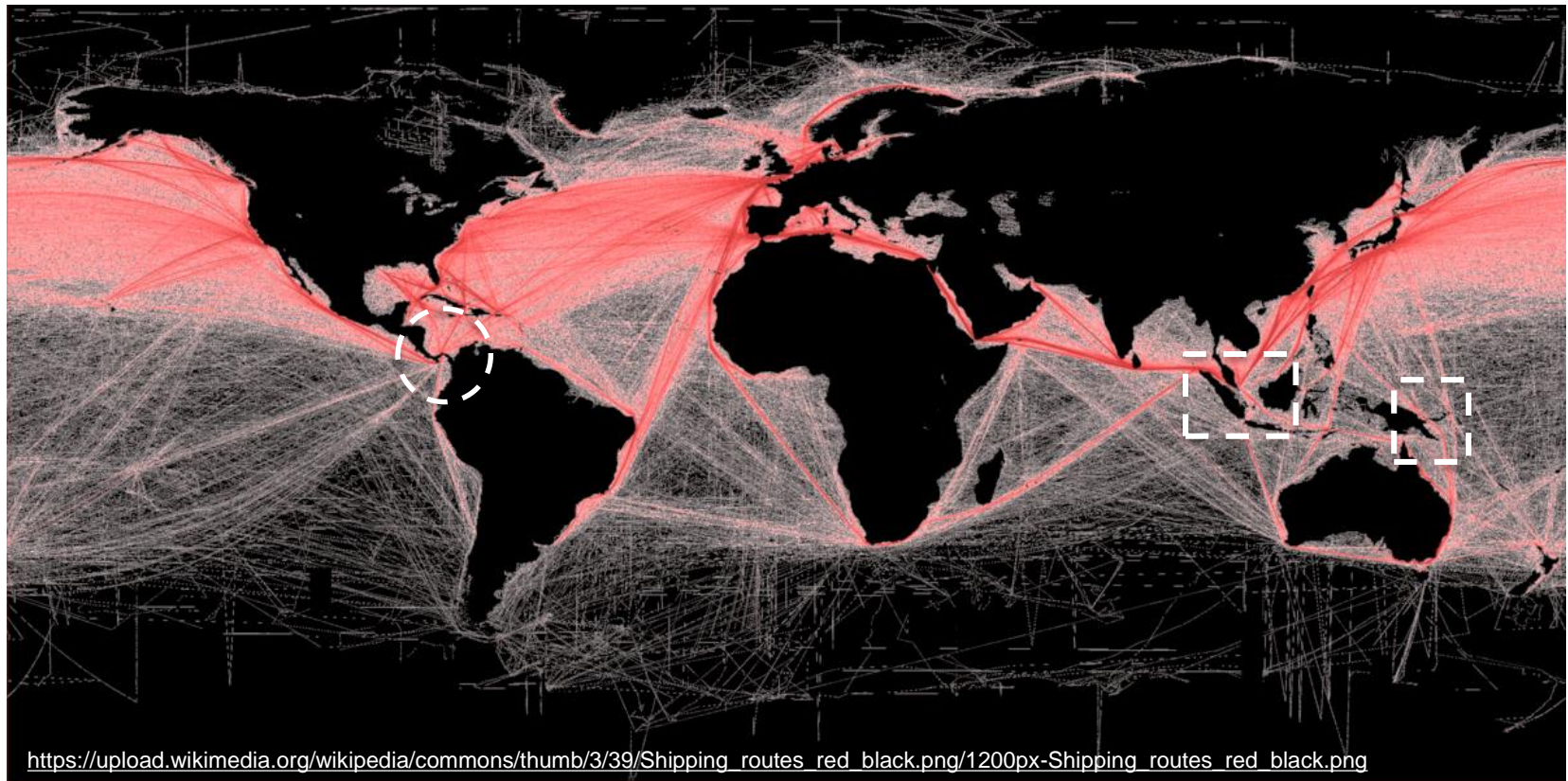
- 1800s: *Aedes aegypti* escapes Africa, yellow fever epidemics in Americas
- 1930s – *Anopheles gambiae* introduced to Brazil; costly eradication & 16,000 dead
- World War Two – air transport identified as pathway for spread of mosquitoes
- 1980s – *Aedes albopictus* arrives in eastern USA; West Nile virus outbreak
- 1994 – *Culex gelidus* appears in Australia; no pathway identified, JE vector overseas



Culex gelidus – an introduced species that may be a future problem for northern Australia?

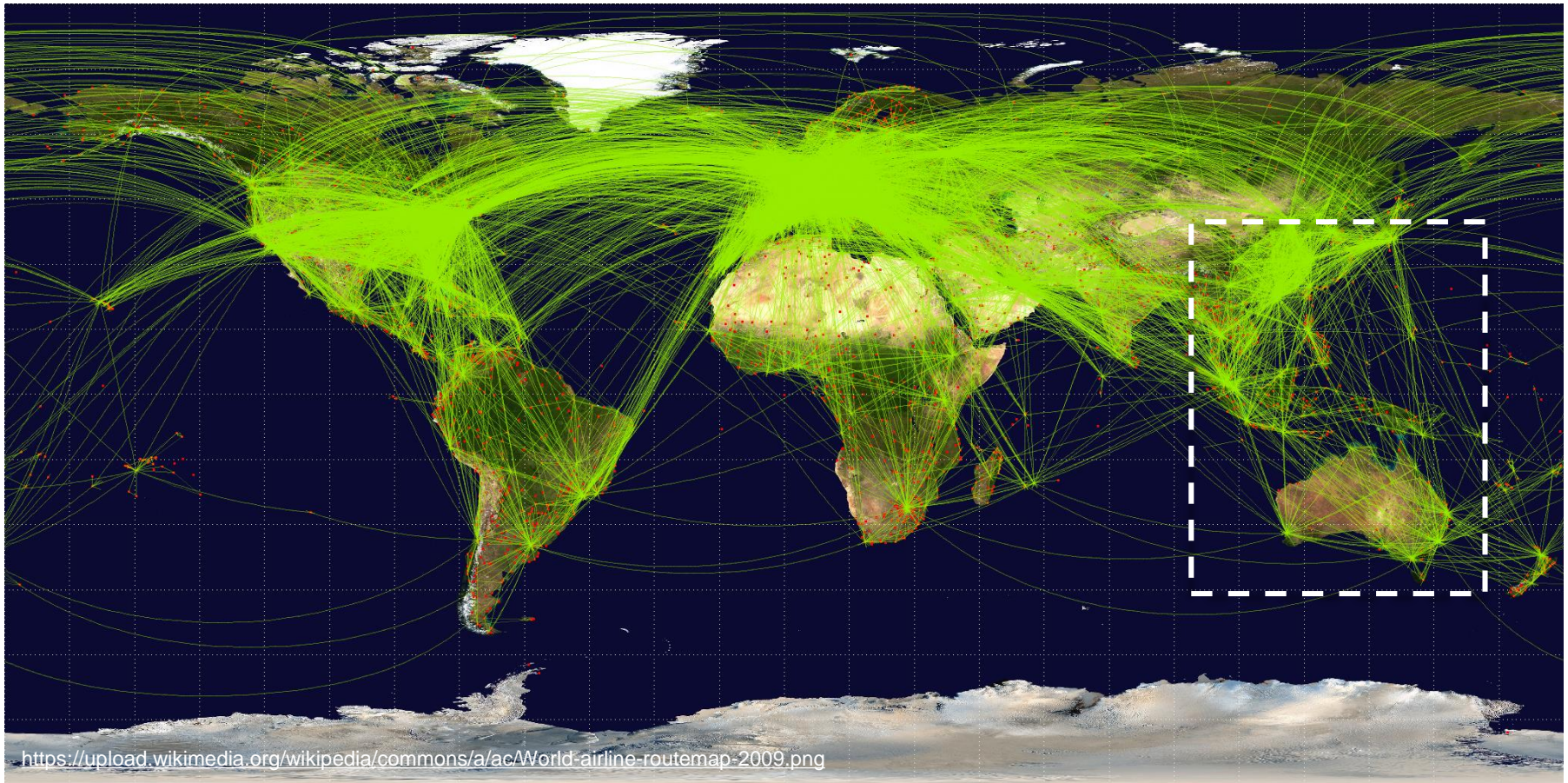
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Sea transport pathways historically important; but relatively long duration = specialist risk



- O/s detections associated Panama Canal (vs. strictly offshore trade routes to AU)
- Hostile pathway (salt water, low humidity), easier to manage risk (time, access)
- Suited to larvae, lower risk diversity (breeding on vessel needed – *Aedes/Culex*)

Air transport is efficient, larger risk profile



- Short duration favours adult survival – suits potentially any mosquito species
- Harder to manage risk (hold inaccessible during flight, ULD treatment options)

What is vector monitoring & what does it achieve?

Vector monitoring is a WHO requirement that focuses on port hygiene as means to manage international disease spread

- International Health Regulations:
 - Management of all human health vectors in FPOE environment
 - Minimises risk to FPOE users (airport malaria, endemic pathogens)
 - Reduce risk of vector spread internationally (import & export)
- Department of Agriculture responsible for vector monitoring in Australia
 - *Biosecurity Act 2015*: Agriculture & Health co-administer
 - Agriculture operationalises Health policy expectations for vector monitoring & other IHR obligations
 - Vector monitoring aligns with existing DAWR capabilities
 - Allows direct feedback of results into operations: risk-based intervention

Vector monitoring is not a measure – but it verifies the measures work



Vector monitoring does not directly manage pathway risk, unlike disinsection and pratique activities

How do we monitor?

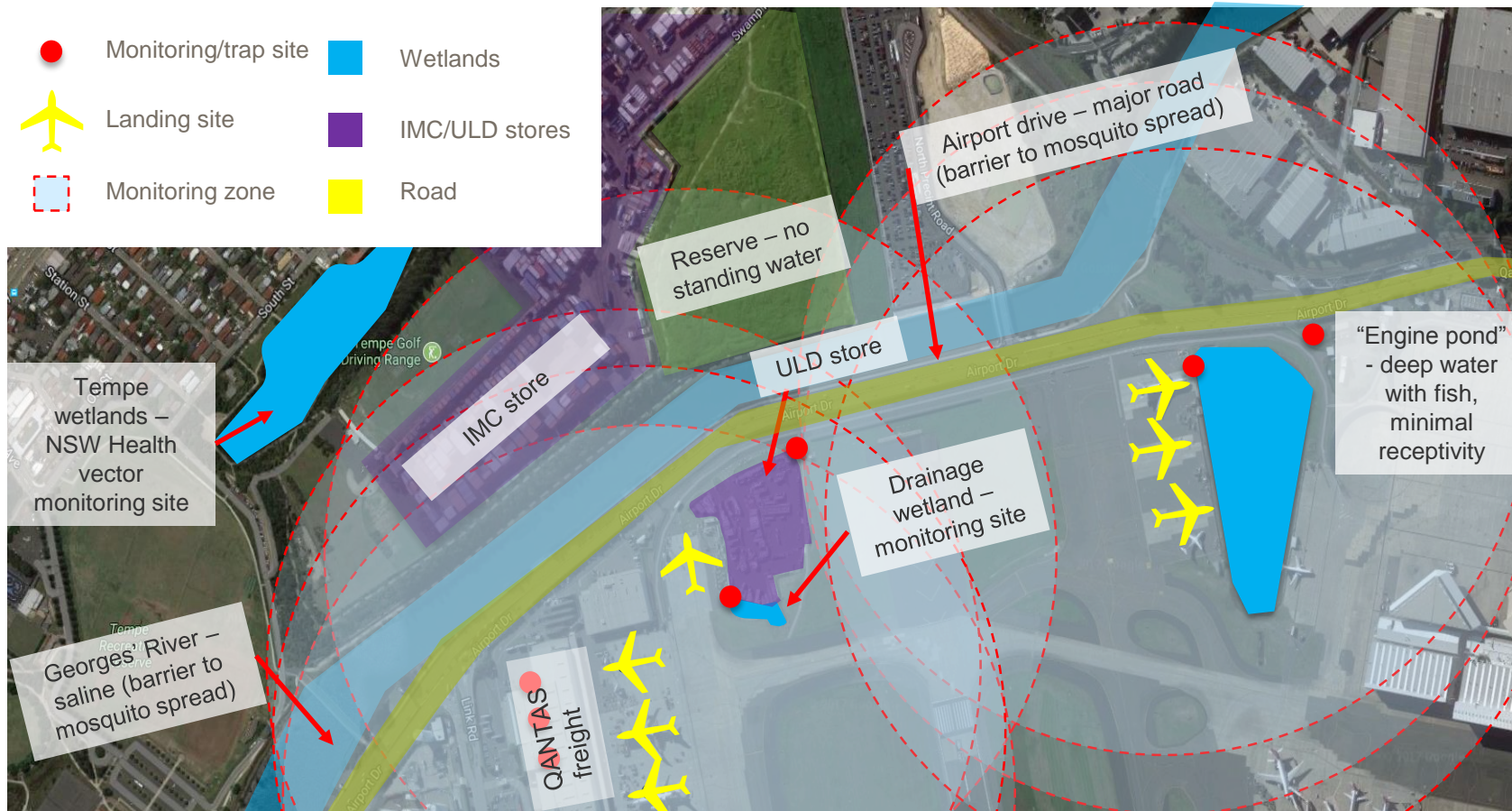
Geospatial analysis and ground surveys used to identify risk & inform trap placement

Example - Sydney airport



How do we monitor?

Geospatial analysis and ground surveys used to identify risk & inform trap placement



How do we monitor?

Traps targeting strategic mosquito life history stages are used to monitor presence of vector species in the FPOE environment



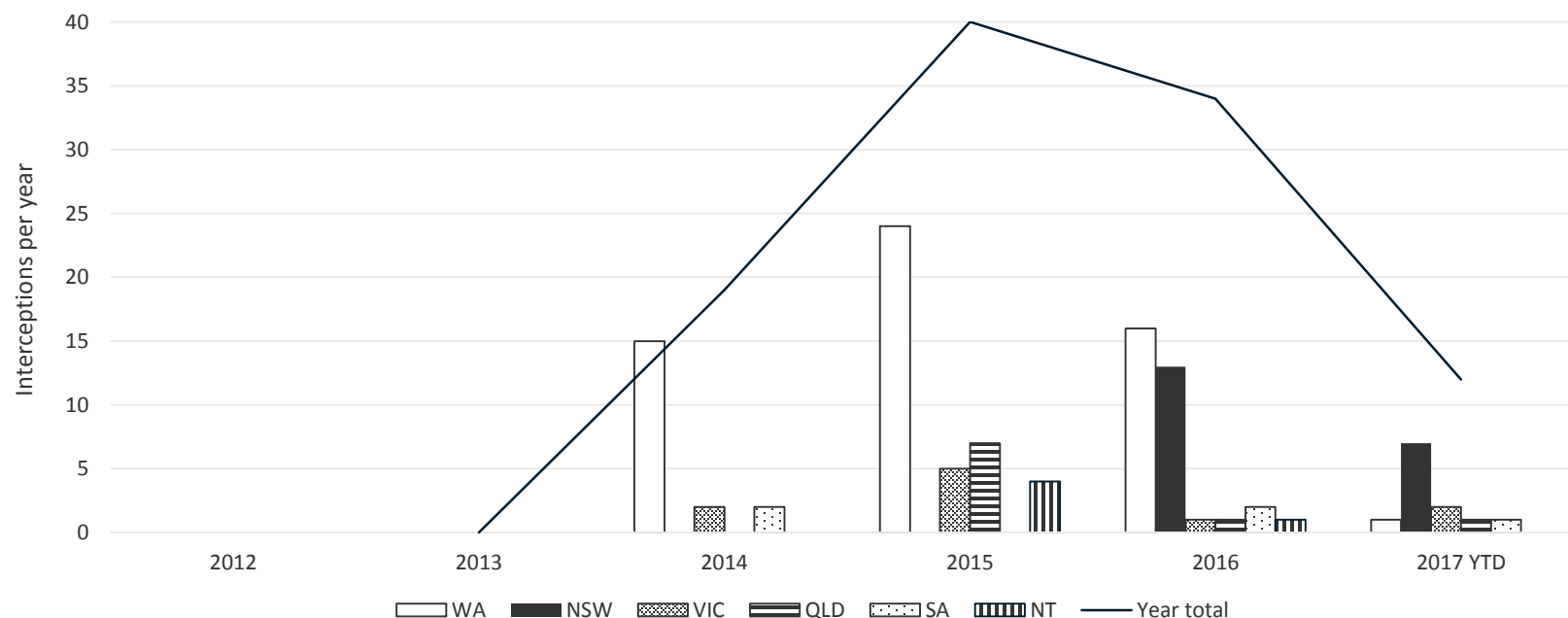
Vector monitoring ranges from using cutting-edge traps and geospatial analysis...



...to low tech – tyre traps & dipping water bodies!

Exotic mosquito detections in Australia

Exotic mosquito detections at international airports increased abruptly in 2014 from zero detections previously



- All interceptions: *Aedes aegypti*
- Air passenger baggage/freight – detections in baggage make-up areas

How do we respond to these detections?

Responses are structured & require cooperation and coordination

- Commonwealth governments:
 - Initial identification
 - Advises state/territory of detection
 - Enhanced trapping & reporting
(daily for 10 days, then every 2 days for 7 days)
- State/territory governments:
 - Confirmatory identification
 - Treatment decision making & direction
(incl. assessment of pesticide resistance risk)
 - Close-out of response
- Port/facility operator:
 - Facilitation of treatments

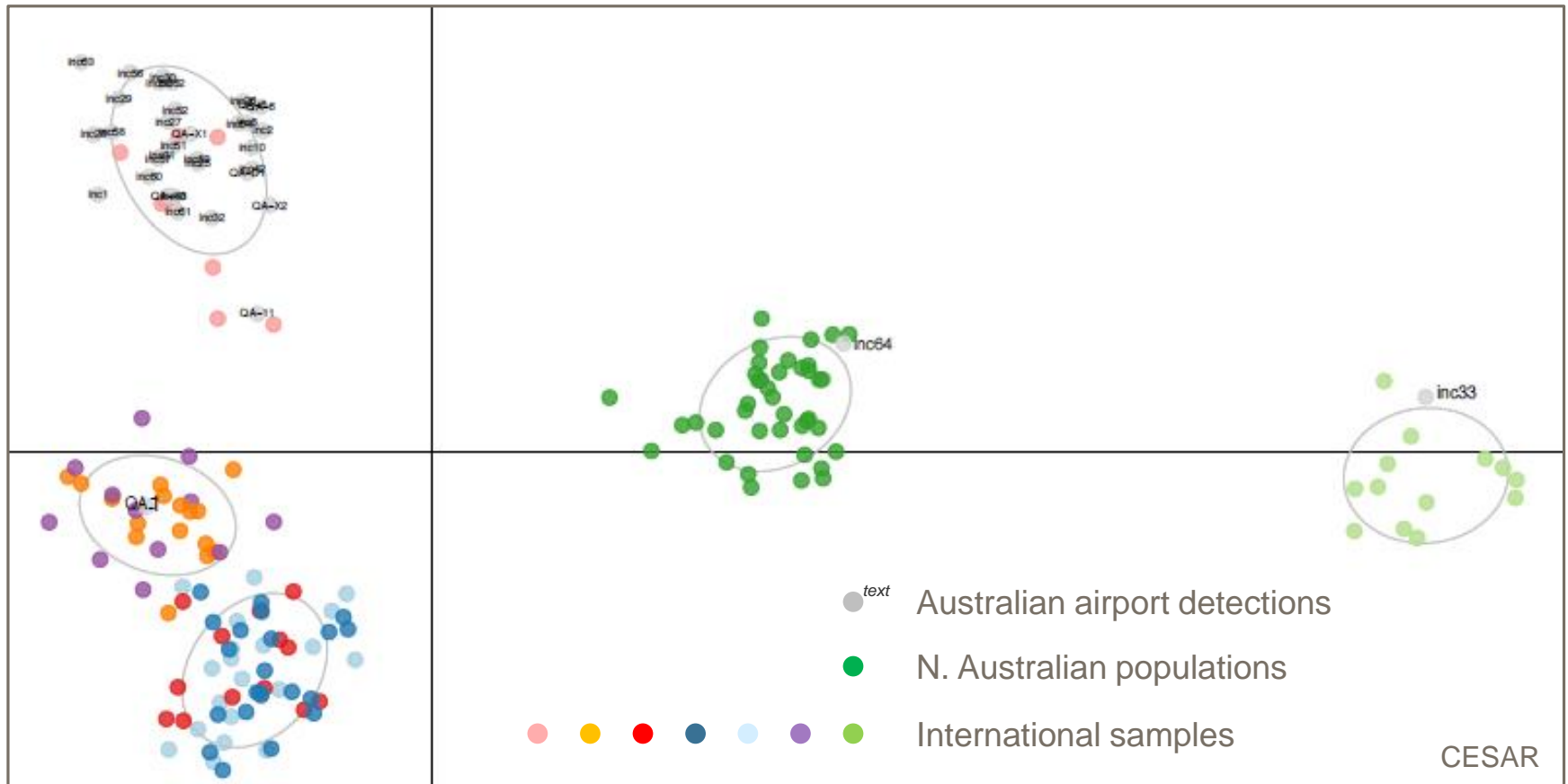


Risk management – where did they come from?

Understanding pathways responsible for exotic mosquitoes allows opportunities to manage risks offshore

- Ongoing project with CESAR
- Double-digest restriction-site Associated DNA sequencing (ddRADSeq)
 - Genomic analysis of single-nucleotide polymorphism (SNP)
 - High resolution assessment of population variation (cluster analysis)
 - Robust; >4000 SNPs assessed per sample
 - Uses established molecular library of target mosquitoes from risk ports
- Pesticide resistance testing (kdr)
 - Reflects population-level pesticide resistance
 - Pesticide resistant genotypes of *Ae. aegypti* absent from Australia

Results – a work in progress



The future

Vector monitoring will continue to evolve with advancing tech and learnings from molecular analysis

- Molecular evidence forms basis for management opportunities
 - Diplomatic engagement
 - Pathway-targeted treatments
 - Targeted intelligence
- Arbovirus testing (state/territory govts.)
- New tech opportunities:
 - Mosquito traps with laser counting and SMS alert capabilities!
 - Rapid, high-volume molecular analysis of larvae (RSVP – QLD Health)

