Member experience on prevention and control for Vector Borne Disease [Australia]

Michele Byers BVSc.

Department of Agriculture, Fisheries and Forestry.

19 – 20 September 2024

Tokyo, Japan

World Organisation for Animal Health
Founded as OIE

Vector Borne Disease situations

- An emergent Vector-borne diseases of concern to Australia
  - Japanese encephalitis (Genotype IV)
    - As of 2022 - suspect endemic in northern Australia – low prevalence in northern Australia
    - Uncertainty about southern Australia but we suspect it could have intermittent transmission when environmental conditions are suitable
    - Impact to southern pig herds in 2022:
      - 3-6% annual output lost on farms (~$350-400,000 per 1000 sows)
      - Major producers impacted, collectively housing a significant proportion of the domestic herd
      - Reduction in national fresh pork supply Aug-Nov 2022
    - Impact to human health (from 1st of January 2021)
      - 45 infected cases – 7/45 fatal.
      - Targeted vaccination strategy
    - No known impact to wildlife health if any

1995 - genotype II
3 human cases, 2 fatal – Torres Strait Islands
Evidence of infection in mosquitoes & pigs

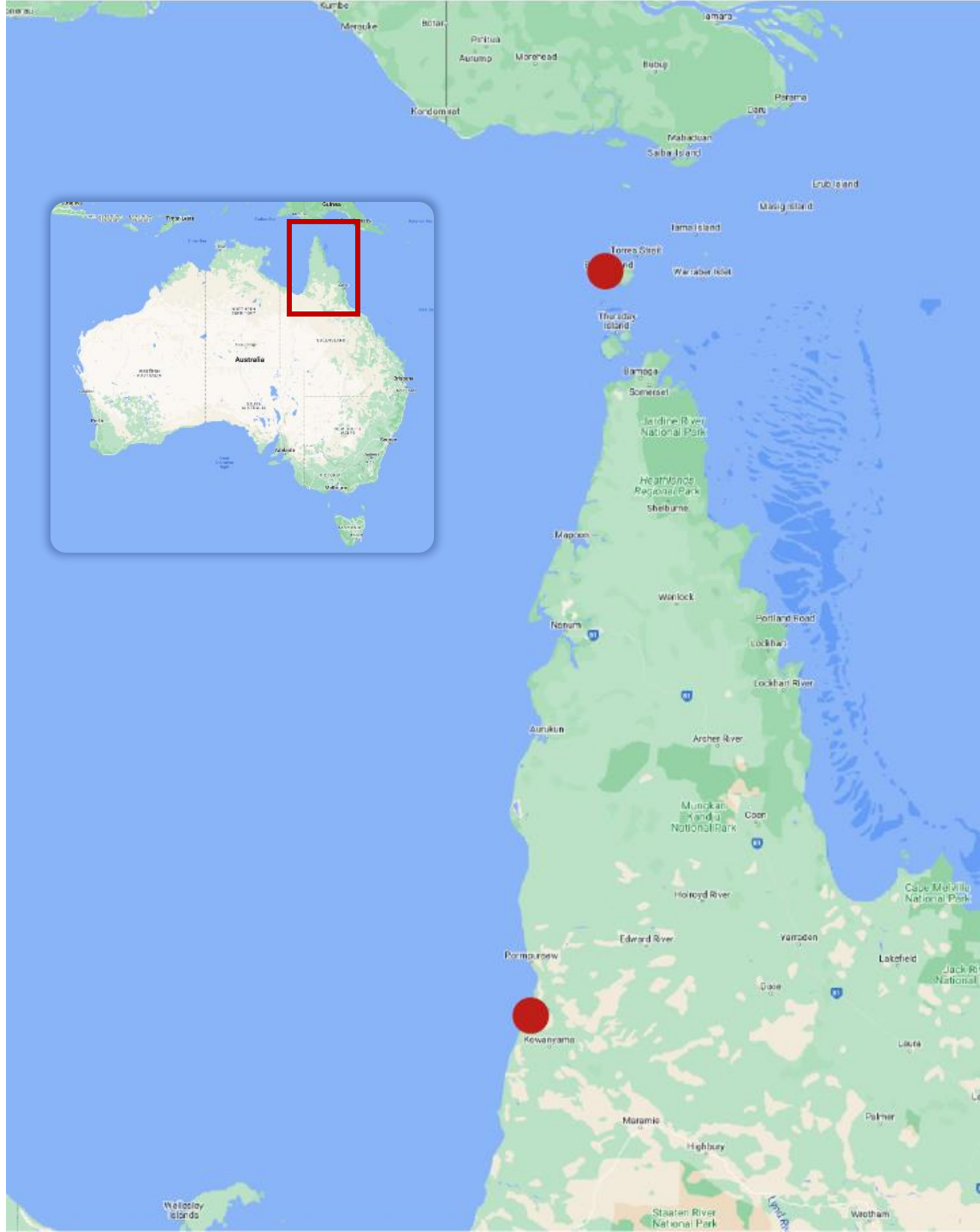
- JE surveillance commenced in multiple animal species in Torres Strait and northern Cape York Peninsula
  - Domestic animal surveys – Torres Strait
  - Feral animal surveys – Torres Strait, Cape York Peninsula
  - Sentinel pigs – Normanton, Old Mapoon, Bamaga airport (NPA) and Badu Island.
  - Wild birds and flying foxes

A DAFF officer taking a blood sample from a domestic pig via the jugular vein

- **1995** - genotype II
  3 human cases, 2 fatal – Torres Strait Islands
  Evidence of infection in mosquitoes & pigs

- **1998** - genotype II
  1 human case – Torres Strait Islands
  1 human case – Cape York

- Early 2000s – commenced mosquito trapping with QH (TPHU) and later JCU (experimental -> operational)
- Sentinel pigs gradually phased out; ceased completely by 2011 (Public health risk to community)



- **1995** - genotype II
  3 human cases, 2 fatal – Torres Strait Islands
  Evidence of infection in mosquitoes & pigs

- **1998** - genotype II
  1 human case – Torres Strait Islands
  1 human case – Cape York

Surveillance shows that virus regularly appears in Torres Strait and Cape York Peninsula

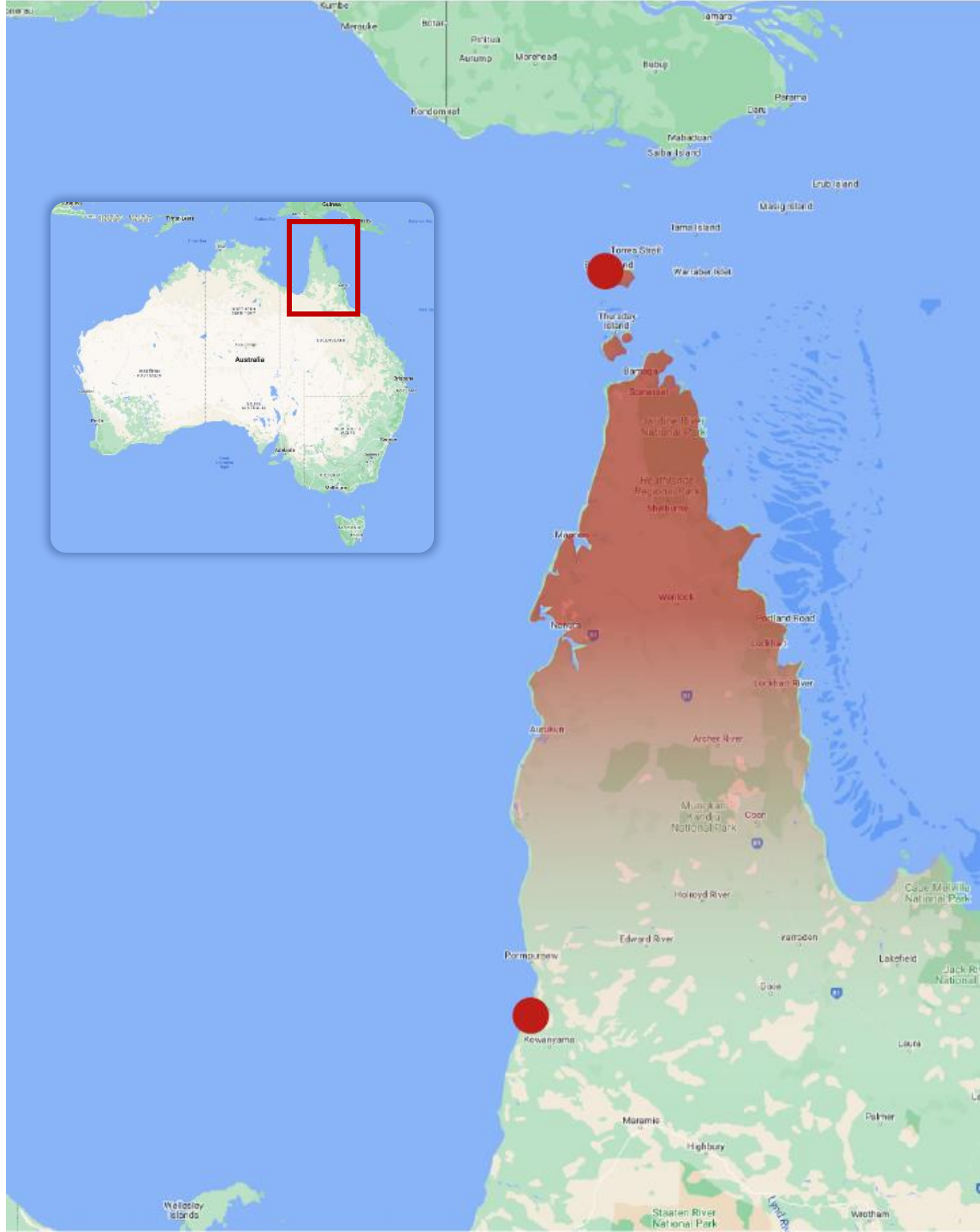
Likely route

Papua New Guinea → Torres Straits → Cape York

Sentinel pigs ceased in 2011

JE serological surveillance (2012-2021)

- Domestic animal surveys
- Feral animal surveys
- Sentinel cattle (2012-20)
- Mosquito trapping (2014 onwards)



- **1995** - genotype II
  3 human cases, 2 fatal – Torres Strait Islands
  Evidence of infection in mosquitoes & pigs
- **1998** - genotype II
  1 human case – Torres Strait Islands
  1 human case – Cape York

Surveillance shows that virus regularly appears in Torres Straits and Cape York Peninsula

Likely route

Papua New Guinea → Torres Straits → Cape York

- **March 2021** – genotype IV
  1 fatal human case – Tiwi Islands

Unexplained pig deaths

Early January 2022 – Animals with clinical signs appeared in NSW & Queensland

25 February – JEV confirmed (Genotype IV)

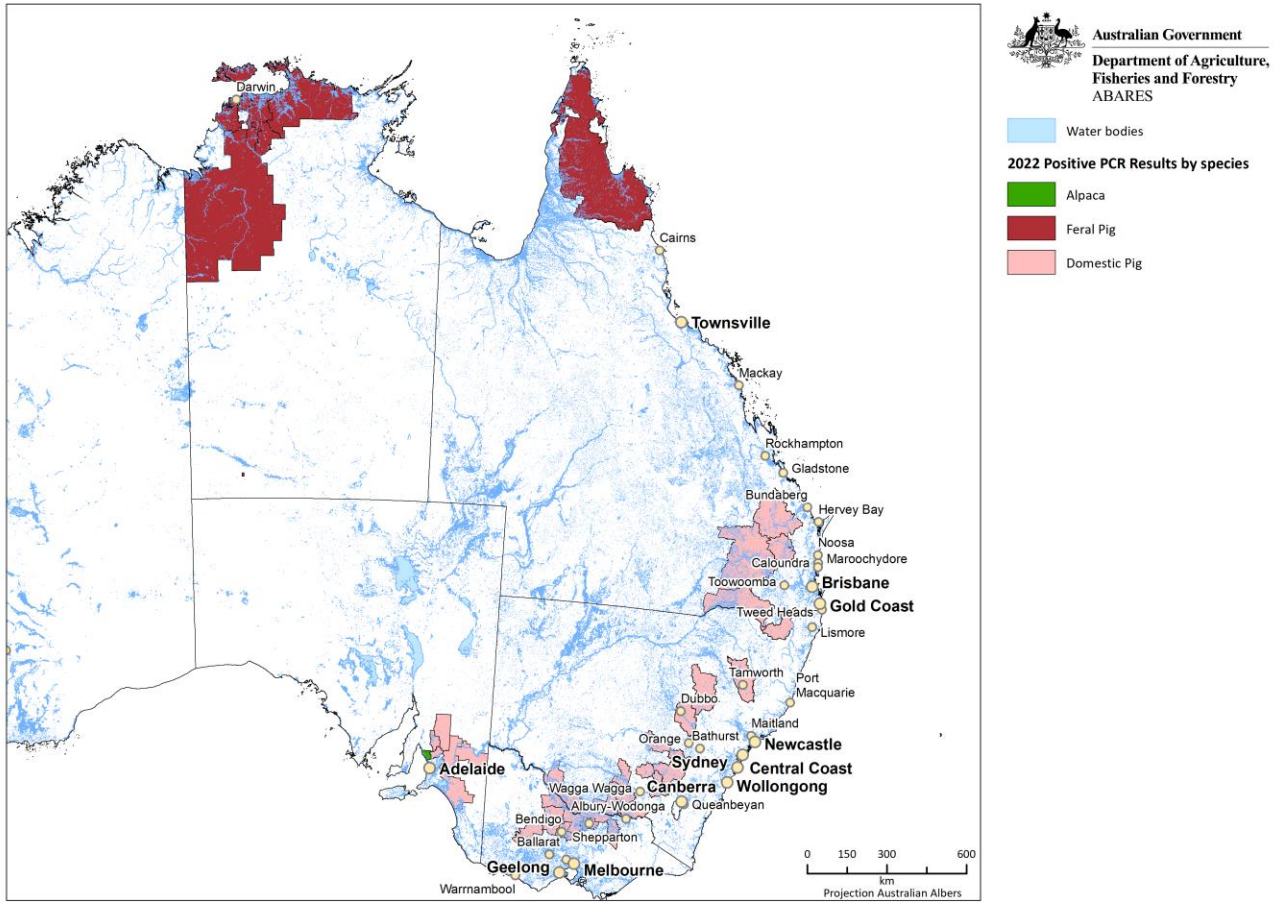
Early March – cases in South Australia

Credit: Bernie Gleeson, SunPork Group

Human cases

First case was reported on 3 March 2022 in Queensland.

Symptoms started at the end of December 2021, but not attributed to JEV at the time



Animals

84 infected piggeries

Positives in feral pigs in the NT, QLD and northern WA

26 horses with probable JE

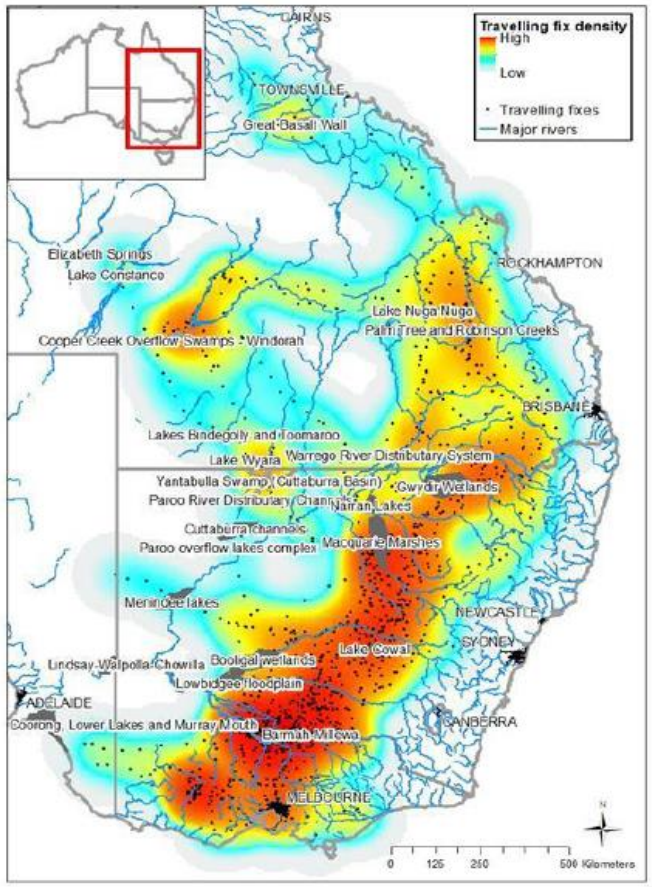
None have been definitively confirmed

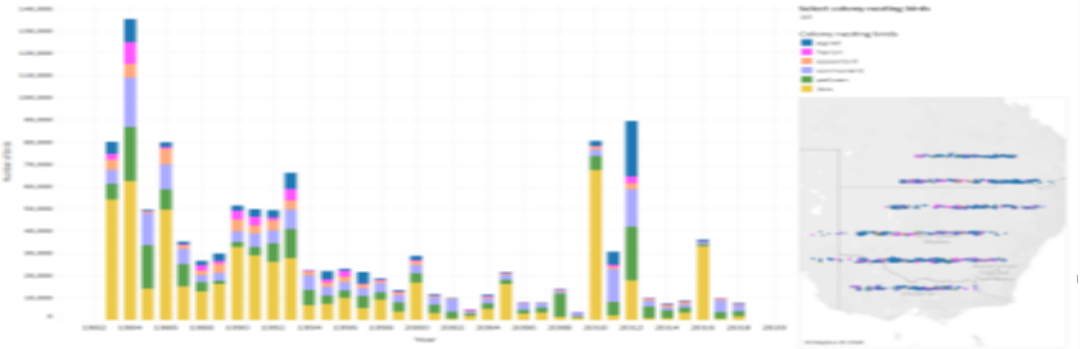
Cases in NSW and Victoria

1 positive alpaca

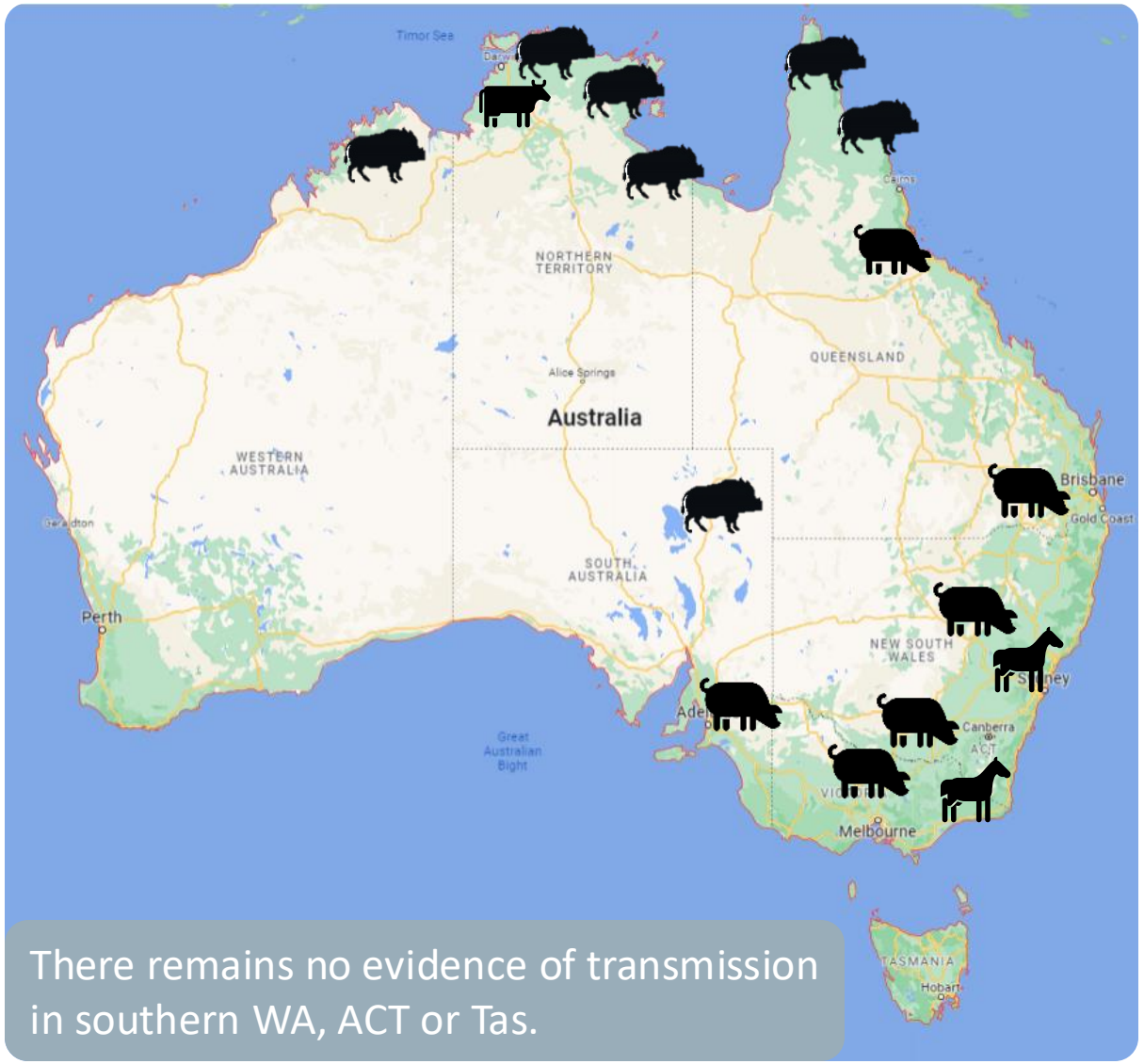
One health aspects

Human cases - 2022	Confirmed	Probable	Deaths
New South Wales	14	0	2
Northern Territory	2	0	1
Queensland	2	3	1
South Australia	6	4	2
Victoria	11	3	1
Total	35	10	7





Summary of JE exposure in animals 2020 - 2022



There remains no evidence of transmission in southern WA, ACT or Tas.

Evidence of JEV in northern Australia

Nov 2020 to Dec 2022

- Feral pigs (PCR, serology)
- Domestic pigs (PCR)
- Cattle (serology)

JEV Exposure **~Sept 2021 to Jun 2022**

- Domestic pigs (PCR)

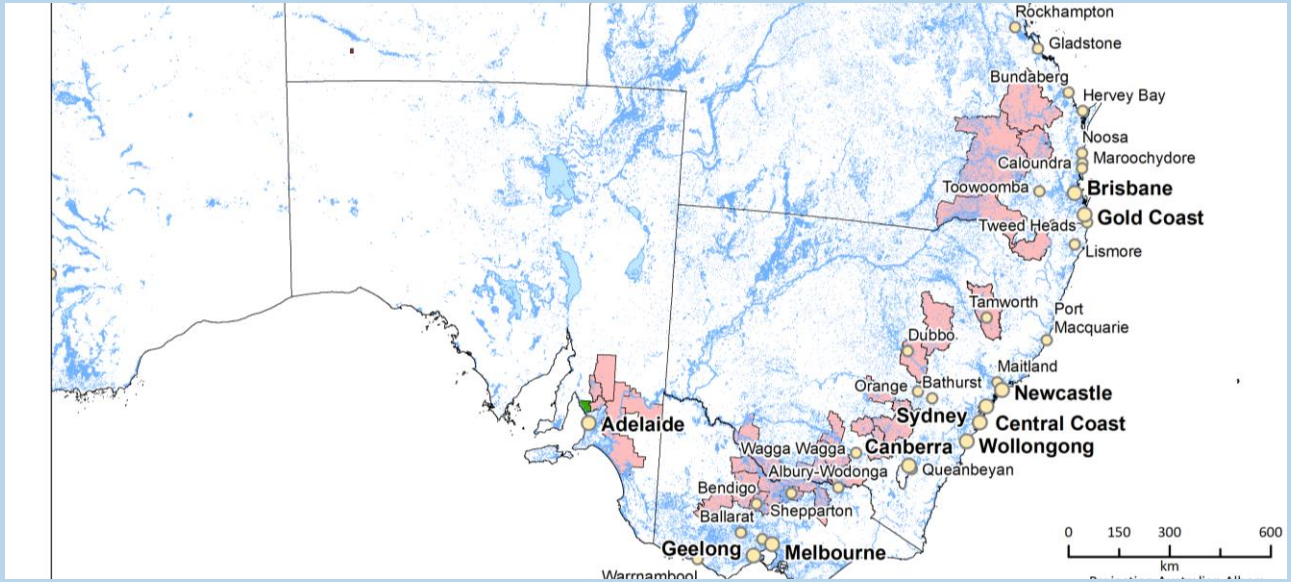
JEV exposure **~Sept 2021 to Apr 2022**

- Domestic pigs (PCR)
- Alpaca (PCR, serology)
- Horses (serology)

Estimated exposure periods in the south-east aligns with months when mosquitos are expected to have been active.

World Organisation for Animal Health
Founded as OIE

The Murray Darling Basin (MDB)



Recent climatic events impacting the MDB

2017 to February 2020: widespread drought; MDB <6% capacity

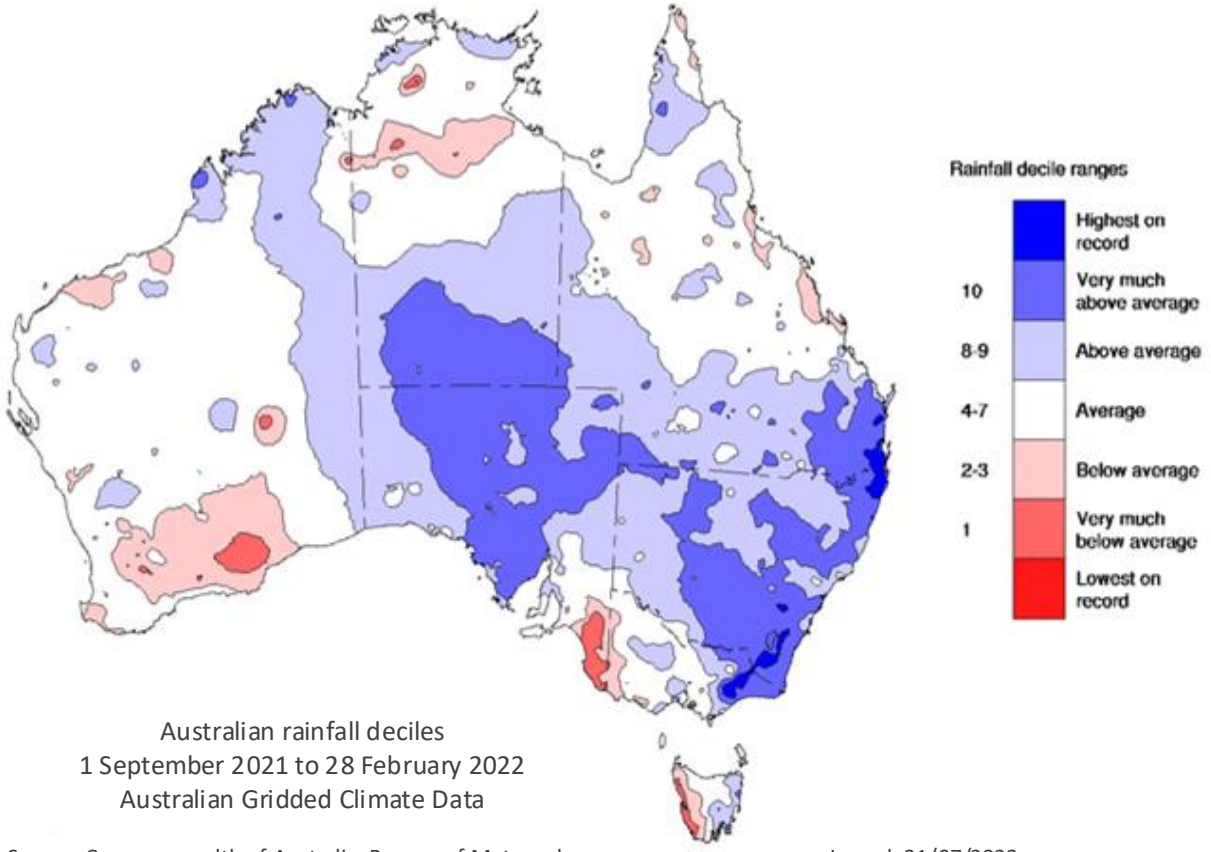
March 2020: drought breaks; flooding over much of eastern Australia

2020-21 summer: above average rainfall

March 2021: flooding in eastern and central Australia

November 2021: Australia's wettest on record; MDB at 90.9% capacity

2021-2022 summer: above average rainfall along the east coast Queensland to Victoria, much of inland NSW, the Eyre Peninsula, South Australia, and central Australia.



Australian rainfall deciles
1 September 2021 to 28 February 2022
Australian Gridded Climate Data

Source: Commonwealth of Australia, Bureau of Meteorology

Issued: 21/07/2022

NAQS JEV diagnostics – 2022

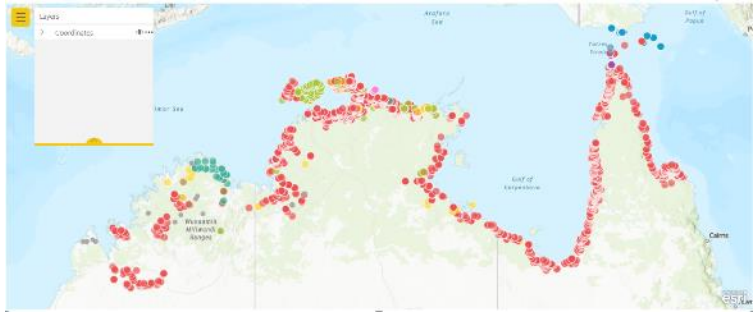
- JEV samples (Pigs)
  - Serum
    - JEV competitive Ab ELISA (ACDP)
    - MVEV blocking Ab ELISA (ACDP)
    - KUNV blocking Ab ELISA (ACDP)
    - Follow up with Plaque Reduction Neutralisation tests
  - Tonsils
    - JEV PCR (State laboratories)
  - Foetuses
    - Abnormal – mummified or aborted
      - Histopathology + PCR (state labs)

	Molecular testing	Serology: virus-specific ELISA screen (single sampling event)			Serology: PRNT (single sampling event)		
Pig flavivirus category	**PCR**	**JEV**	**MVEV**	**KUNV**	**JEV**	**MVEV**	**KUNV**
Confirmed JEV – PCR evidence	+						
Probable JEV exposure – serological evidence (*)	- OR not tested	+	-	-			
Confirmed JEV exposure – serological evidence	- OR not tested	At least one positive			+ AND titre >fourfold higher than others	+/-	+/-
Probable MVEV exposure – serological evidence (*)	- OR not tested	-	+	-			
Confirmed MVEV exposure – serological evidence	- OR not tested	At least one positive			+/-	+ AND titre >fourfold higher than others	+/-
Probable KUNV exposure – serological evidence (*)	- OR not tested	-	-	+			
Confirmed KUNV exposure – serological evidence	- OR not tested	At least one positive			+/-	+/-	+ AND titre >fourfold higher than others
Inconclusive Flavivirus Exposure	- OR not tested	Two or more positive					
	- OR not tested	Two or more positive			One or more positive but not fourfold difference		
Negative	- OR not tested	All three negative					
	- OR not tested	One or more positive			All three negative		

Response to Vector Borne Diseases

- Surveillance for JEV
  - Mosquito surveillance (Health)
    - Established mosquito or flavivirus surveillance systems in each state
  - Animal Health surveillance
    - General Surveillance system
      - Reliant of clinical animals investigated and reported by veterinary practitioners
    - Targeted Surveillance
      - Some states maintain sentinel chicken surveillance program (Health)
      - Feral animal surveillance
- Responses and control
  - Vector control
  - Vector prevention
  - Vaccination
    - Humans - 2 available vaccines in Australia:
      - Single dose, live attenuated virus vaccine
      - Double dose, inactivated vaccine (29 day interval)
    - Animals – no licensed vaccines available, but research and development work is underway.
- Contingency plans available
  - AusvetPlan Manuals

Surveillance strategy - NAQS Feral Animal Surveys



A summary of feral and domestic animals sampled by NAQS (2012-2022 – each colour = different species)

- Targeted surveys for exotic diseases in feral animals
  - Target list of diseases of risk to northern Australia
    - => by unregulated pathways
  - Aerial survey, humane destruction of feral animals
    - Target “back of the pack”
    - Lame, unwell animals
    - Subset of “healthy”
  - External and post-mortem examination – data collected
  - Samples collected
  - Further investigation if unusual PM findings

World Organisation for Animal Health
Founded as OIE

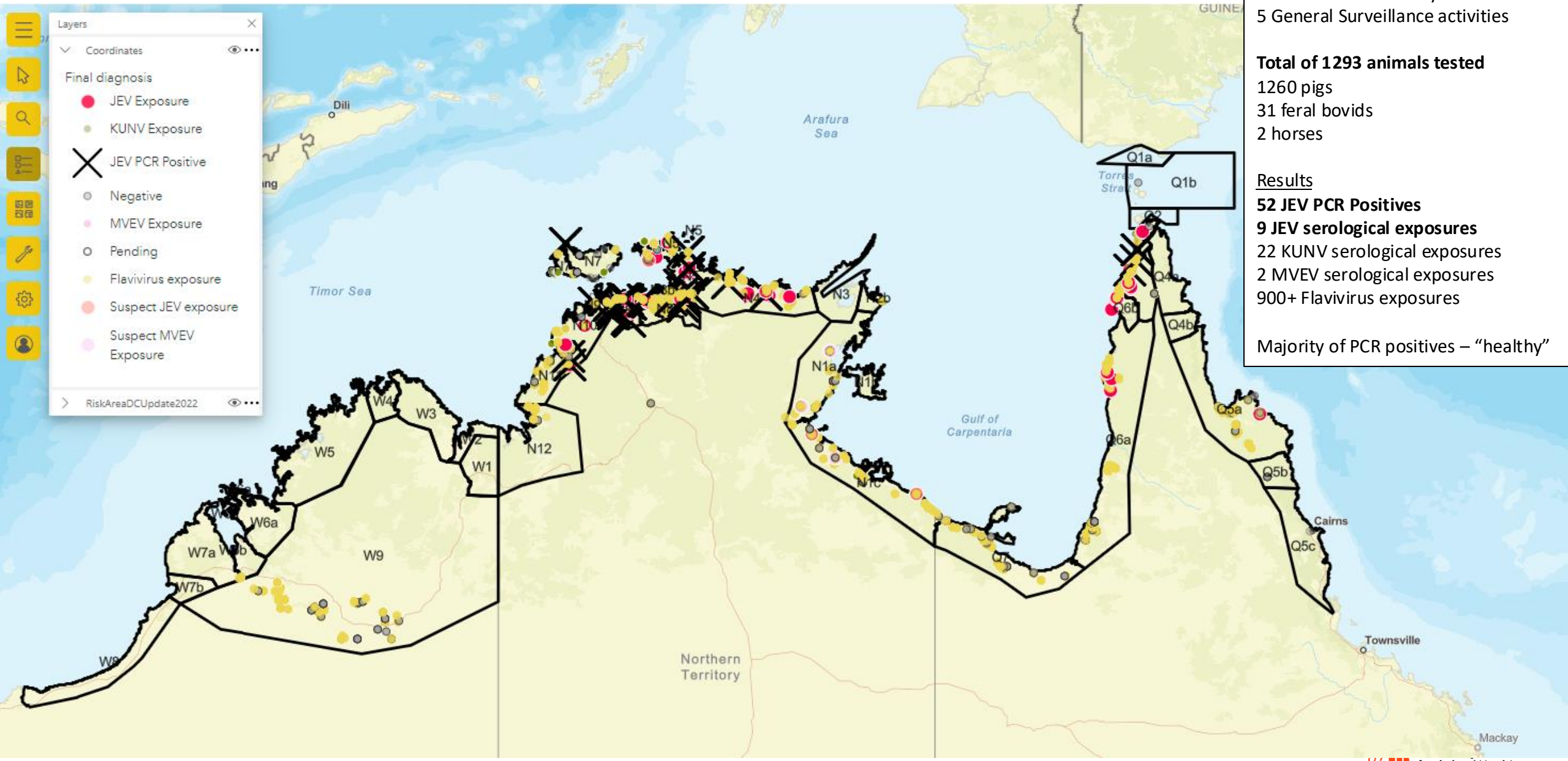
2022:

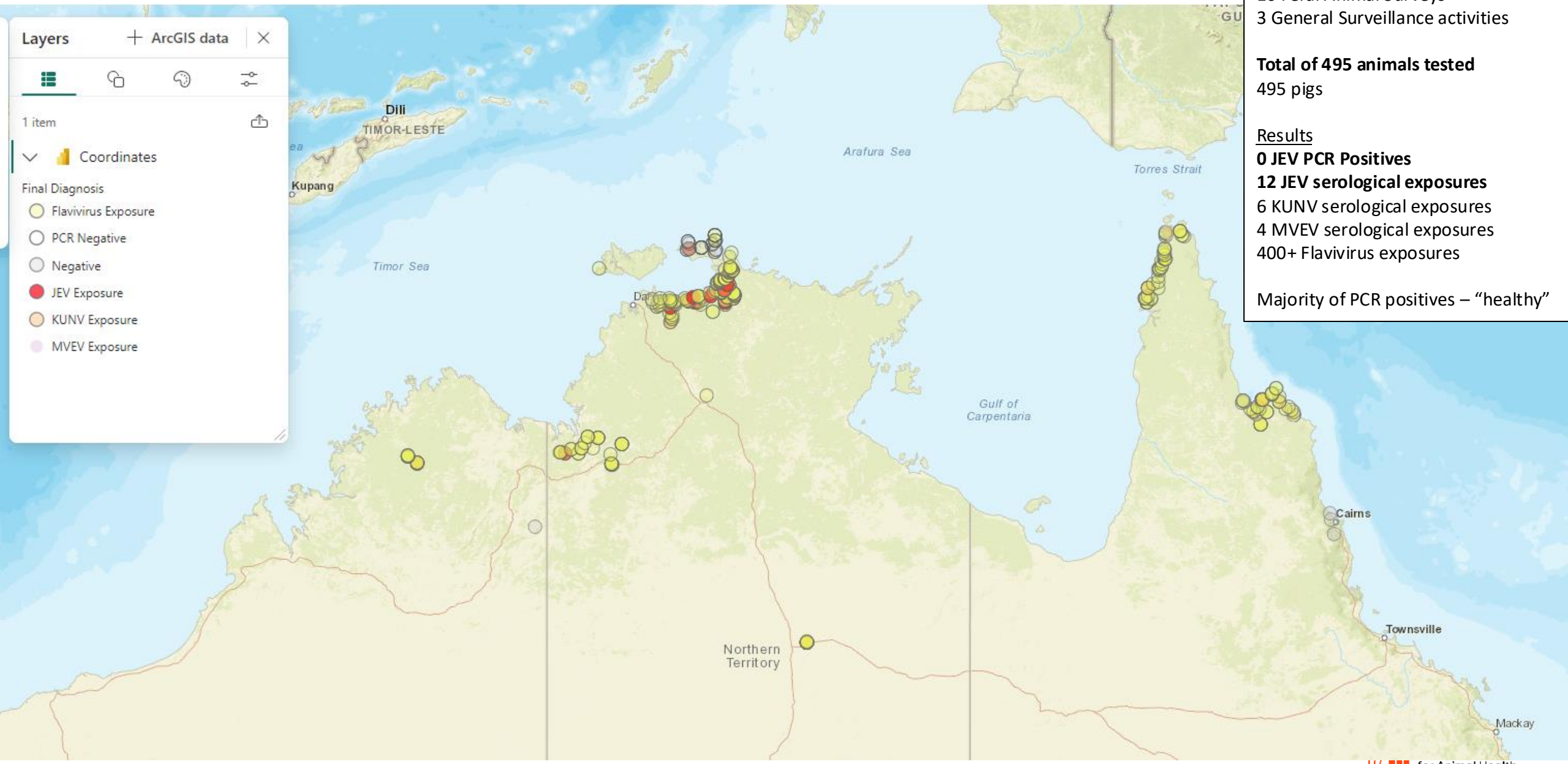
15 Feral Animal Surveys
5 General Surveillance activities

Total of 1293 animals tested
1260 pigs
31 feral bovids
2 horses

Results
52 JEV PCR Positives
9 JEV serological exposures
22 KUNV serological exposures
2 MVEV serological exposures
900+ Flavivirus exposures

Majority of PCR positives – "healthy"





2023:

10 Feral Animal Surveys
3 General Surveillance activities

Total of 495 animals tested
495 pigs

Results
0 JEV PCR Positives
12 JEV serological exposures
6 KUNV serological exposures
4 MVEV serological exposures
400+ Flavivirus exposures

Majority of PCR positives – “healthy”

for Animal Health
Founded as OIE

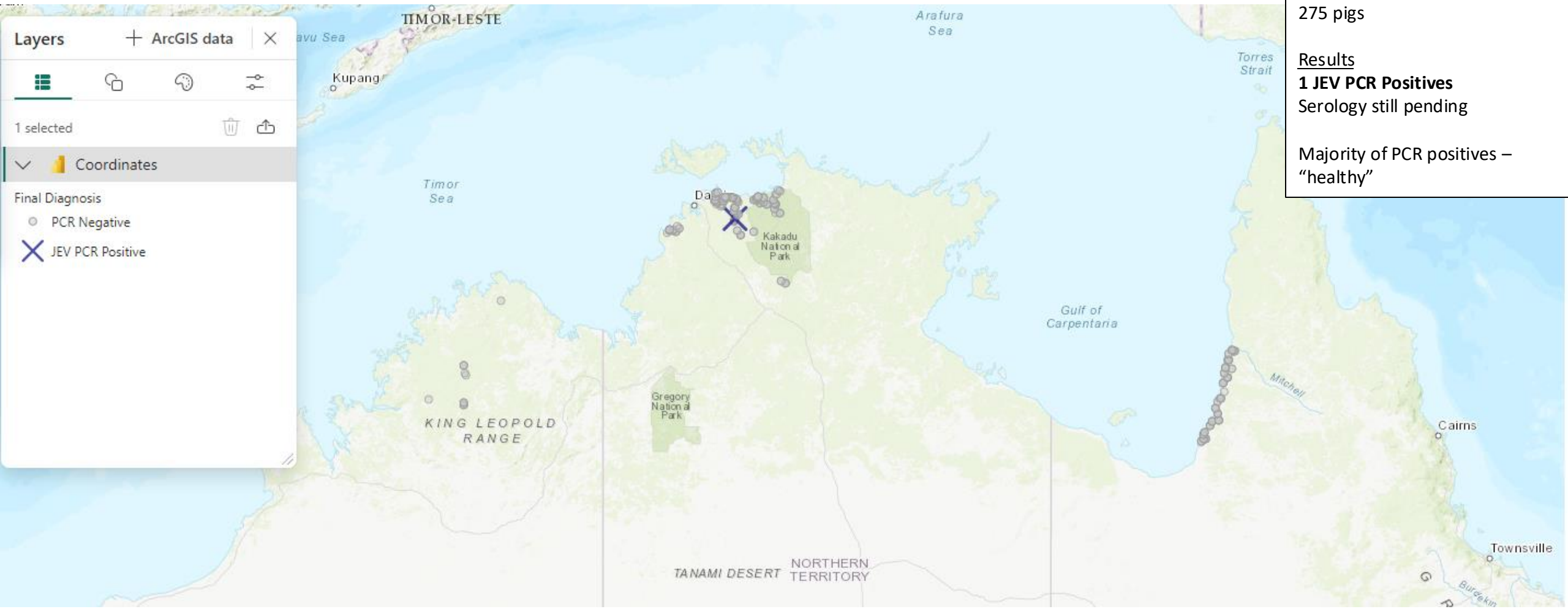
2024:

5 Feral Animal Surveys (so far)
3 General Surveillance activities

Total of 275 animals tested
275 pigs

Results
1 JEV PCR Positives
Serology still pending

Majority of PCR positives – "healthy"



Impact of the actions

- Minimising spillover events into domestic piggeries
  - Aggressive mosquito control interventions in areas around piggeries
- Surveillance challenges
  - Over-reliance on a single system (such as vector-based surveillance) to serve as an early warning tool
  - Solution – establishing data sharing across sectors and jurisdictions is required for multimodal surveillance – targeted and general surveillance.
- Vaccination of at-risk populations
  - Vaccination was made available for at-risk populations based on detections of positive animals.
- No subsequent cases
  - Due to blunted host transmission due to prior exposure
  - Competition with other flaviviruses
  - Host species distribution constantly shifting with water movement

Challenge and possible solutions

- Diagnostic challenges
  - Past surveillance was heavily reliant on serology as primary form.
    - Cross reactions with other viruses in JEV-serocomplex, many that are endemic to Australia, do complicate this approach.
  - PCR on aborted material (from sows) is a useful tool, however potential 3-month lag for timely detection.
  - Solution - PCR on feral pig tonsils was found to be an effective tool for at scale surveillance in feral pigs and has been utilized by NAQS since 2022.
  - Solution - Experimental work underway for the use of chew ropes is being explored as a monitoring tool for pigs within production systems.
- Surveillance challenges
  - Over-reliance on a single system (such as vector-based surveillance) to serve as an early warning tool
  - Solution – establishing data sharing across sectors and jurisdictions is required for multimodal surveillance – targeted and general surveillance.

Collaboration with other sectors under One Health approach

- Animal Health
  - Emergency Animal Disease Response Agreement
    - EAD response and governance in Australia involving the Commonwealth and state/territory governments and animal production industry bodies
  - AUSVETPLAN manuals
    - Roles and responsibilities as well as national disease control policies.
  - Wildlife Health Australia
    - National Program that focuses on wildlife health (inclusive of feral animals)
  - The Australian Government - Department of Agriculture, Fisheries and Forestry
    - DAFF is responsible for managing the impacts of an EAD outbreak on international trade in live animals and/or animal products.
    - In the event of a large, multijurisdictional outbreak, DAFF provides national response coordination including coordinating requests for resource deployment from within Australia or under the International Animal Health Emergency Reserve arrangements.
  - State and Territories
    - Primary responsibility to manage EAD events within their jurisdictions, using their respective biosecurity legislation to impose disease control measures
- Human Health
  - National Health Security Agreement
    - Framework to support a coordinated national response to public health emergencies.
  - The Australia Government – Department of Health and Aged Care
    - DHAC provides national leadership and coordination
  - States and Territories
    - Primary responsibility for responding to a communicable disease notification within their jurisdiction
  - Australian Health Protection Principal Committee (AHPPC)
    - National leadership through cross jurisdictional collaboration in managing health protection incidents and coordinating the national health response to incidents.

Detection bias: JEV is more readily detected in large populations of breeding sows and feral pigs. This gives the appearance that the virus is associated with pigs.

Harness science: Existing relationships with wildlife organisations and their disease experts and ecologists, was invaluable in accessing knowledge and data. Wildlife Health Australia (WHA) provided this insight, particularly around water birds.

Pre-2022, JEV's designation as a vector-borne disease meant focus was on mosquitos, yet broader virus movement dynamics needs to consider wildlife hosts.

One Health collaboration: Pre-existing data sharing arrangements with public health colleagues is essential when faced with an outbreak affecting both pigs and people.

Public coverage: human cases will always get more attention than pig cases.

Communication strategy around the interlinking of health shared across humans/animals/environment

Thank you

Michele Byers

Veterinary Officer

Michele.byers@aff.gov.au

World Organisation for Animal Health
Founded as OIE

Expectations for the VBDs workshop (Not Included in the Presentation)

- Please share your expectations for the VBDs workshop
- What specific information about VBDs you expect to obtain from experts
- What disease experience you expect to gain from member countries/territories

World Organisation for Animal Health
Founded as OIE