NSW Health

NSW Arbovirus Surveillance Program Annual report

2021-2022

https://www.health.nsw.gov.au/environment/pests/vector/Pages/annual-report.aspx


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NSW Health acknowledges the traditional owners of the lands on which we work, live and play. We pay our respect to Elders past, present and emerging. This report was produced on the lands of the Burramattagal and Cammeraygal People of New South Wales. NSW Health also acknowledges all the lands across NSW on which mosquito trapping, sentinel chicken surveillance and other components of the Arbovirus Surveillance and Mosquito Monitoring Program are conducted. The knowledge, resilience and strength of Aboriginal Peoples is key to supporting health for Aboriginal communities.

Produced by:

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Contents

Background

The aim of the NSW Arbovirus Surveillance and Mosquito Monitoring Program (ASMMP) is to provide an early warning of increased arboviral risk by monitoring arboviral activity in sentinel chickens and mosquitoes. The ASMMP operates annually from November to April each year, coinciding with the peak of mosquito and arbovirus activity.

Sentinel chicken flocks in inland locations in NSW are tested for the presence of antibodies against flaviviruses of public health concern including Murray Valley encephalitis (MVEV) and Kunjin (KUNV). Mosquito trapping occurs across NSW, and mosquitoes are tested for the presence of both flaviviruses and alphaviruses of public health concern including Ross River Virus (RRV) and Barmah Forest Virus (BFV).

For the purposes of the ASMMP, arbovirus activity in NSW is categorised into three broad virogeographical zones: inland, the tablelands and the coastal strip including Sydney. Within these zones there are differences in the dynamics of environmental factors, mosquito vectors, viral reservoir hosts and mosquito-borne viruses.

Executive summary

This report summarises mosquito trapping and sentinel chicken results in NSW for the 2021-2022 arbovirus season.

Two main models have been developed for the prediction of MVEV epidemic activity in south-eastern Australia: the Forbes' (1978) and Nicholls' (1986) hypotheses. According to Forbes' model, there was a lower risk of an MVEV epidemic for the 2021-2022 season. It is important to note that the Forbes' hypothesis was calculated on environmental conditions experienced during major MVEV epidemic seasons and the models do not propose to predict low to moderate level activity. Thus, negative MVEV models do not necessarily indicate an absence of MVEV activity.

The Nicholls' hypothesis uses the Southern Oscillation as a tool to indicate a possible MVEV epidemic. For 2021, the autumn, winter, and spring Nicholls' values, respectively, were 1008.80mm, 1012.33, and 1009.73. All these values were inside the range of past MVEV epidemic years.

This season was the second consecutive La Niña year, which are typically associated with above average rainfall that can lead to higher mosquito production, particularly across inland regions.

Japanese Encephalitis virus (JEV) appeared in southeastern Australia for the first time, all inland locations. The reasons for the recent emergence of JEV in Australia are unclear. However, it is speculated that migratory wading birds, the primary hosts of the virus, may have been driven to inland regions of Australia following several months of heavy rainfall associated with the La Niña weather system. La Niña years are typically associated with above average rainfall. This season was the second consecutive La Niña year. Heavy rainfall can also lead to higher mosquito production, particularly across inland regions. Potentially, the heavy rainfall inland may have encouraged proliferation of mosquito species which have been considered potential vectors of JEV in Australia including *Culex annulirostris*.

Along the coast, the wet conditions reduced production of *Aedes vigilax* to the lowest numbers recorded within the ASMMP to date, with only around 1,000 trapped for the season.

From 1 January 2021 to December 2022, there were 45 human cases of JEV in Australia and 7 of the people died. In NSW, there were 13 human cases of JEV and 1 MVE case notified during the 2021-2022 season. Actions in response to the emergence of JEV included mosquito management, public warnings, vaccination encouraged for high-risk individuals, and enhanced surveillance. JEV is now included as one of the arboviruses routinely tested for within the NSW Arbovirus Surveillance Program. There were 678 RRV human notifications (81 confirmed and 597 probable cases) and 87 BFV human notifications (7 confirmed and 80 probable cases).

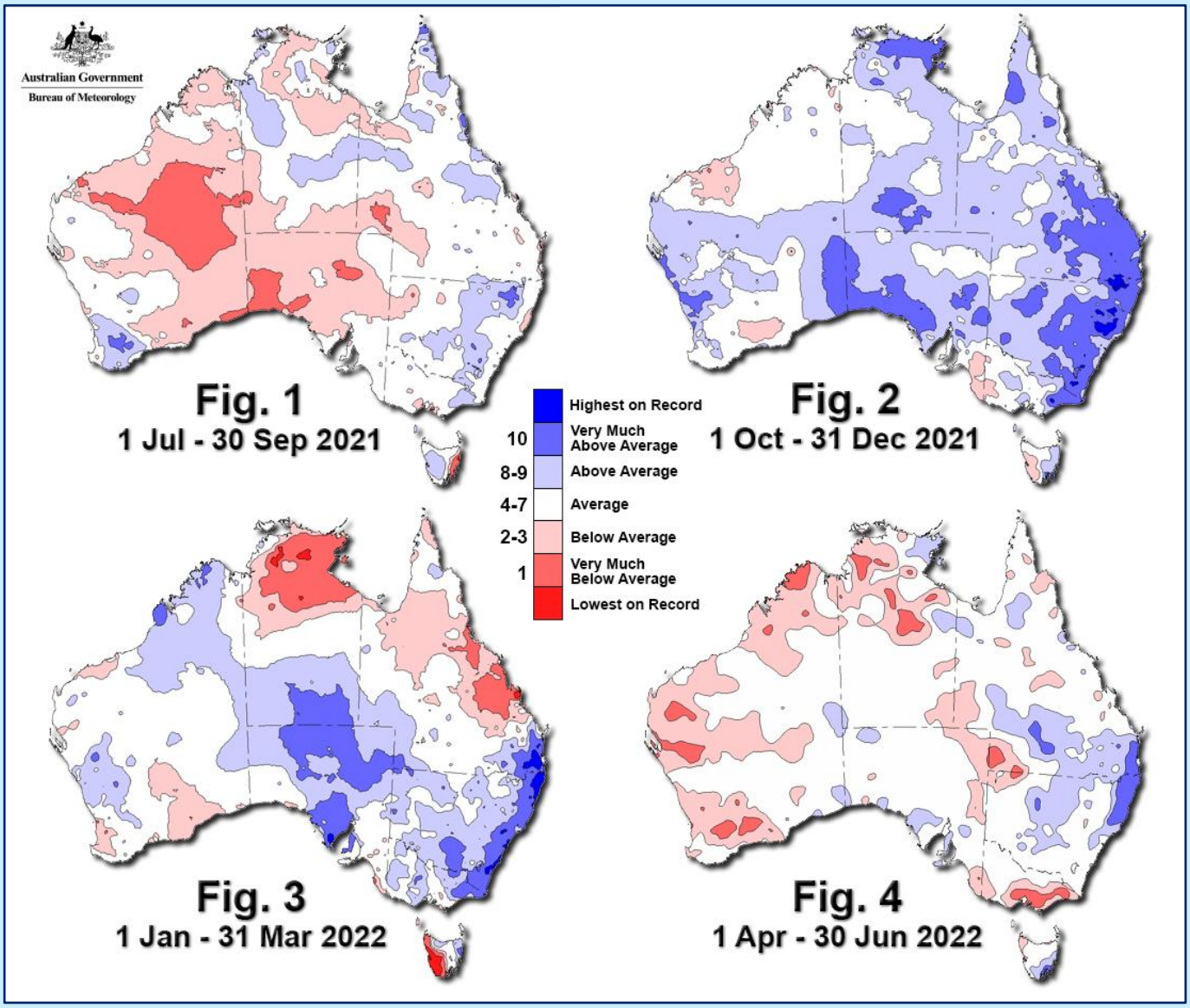
Weather data

Mosquitoes need water to breed. Mosquito abundance is therefore affected by rainfall patterns and irrigation practices in inland regions. In coastal regions, tidal inundation along with rainfall is important. Temperature and/or day-length are often critical in determining the start and duration of mosquito activity for species in temperate zones. Higher temperatures can amplify replication of the virus. Monitoring environmental parameters is therefore crucial.

Rainfall

Figures 1-4 provide an overview of Australian rainfall deciles for the 2021-2022 season. It is important to note that this season was the second consecutive La Niña year. La Niña years are typically associated with above average rainfall.

Figures 1-4: Quarterly Rainfall Deciles, Australian Bureau of Meteorology



- **Figure 1: July 2021 to September 2021**. Rainfall was mostly average across the state, with the slopes district experiencing above average precipitation.
- **Figure 2: October 2021 to December 2021**. There were extremely wet conditions across eastern

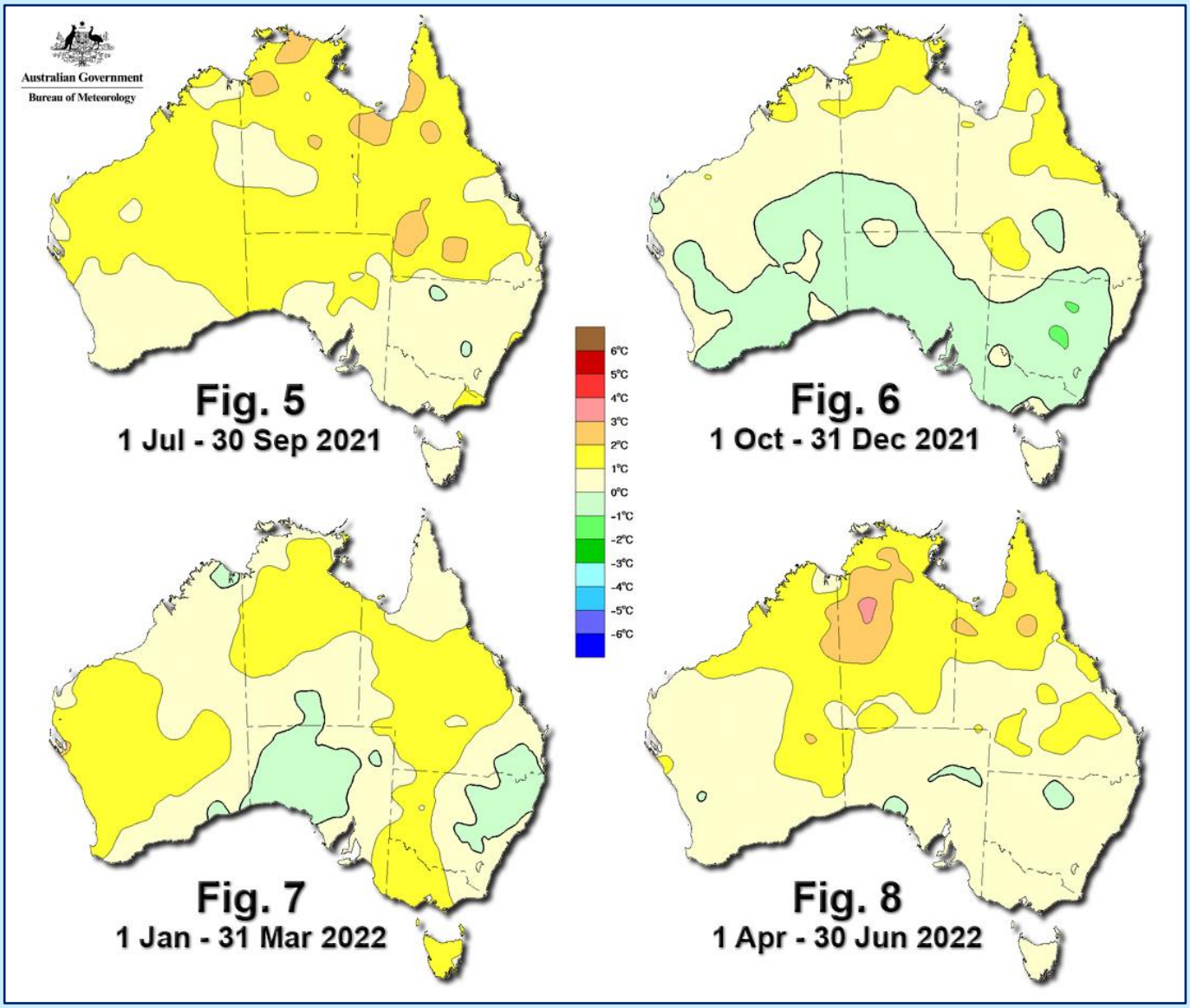
Australia, with nearly all NSW having above average rainfall. Much of the tablelands, slopes, and coastal regions experienced very much above average rainfall.

- **Figure 3: January 2022 to March 2022**. Above average rainfall was recorded across most for the state, with very much above average precipitation along the ranges and coast.
- **Figure 4: April 2022 to June 2022**. Rainfall was very much above average for the north coast, above average for the slopes, and average elsewhere.

Temperature

Figures 5-8 provide an overview of Australian temperature anomalies (departures from the normal) for the 2021-2022 season. Overall temperatures tended to be around normal to slightly cooler than average.

Figures 5-8: Quarterly Temperature Anomalies, Australian Bureau of Meteorology



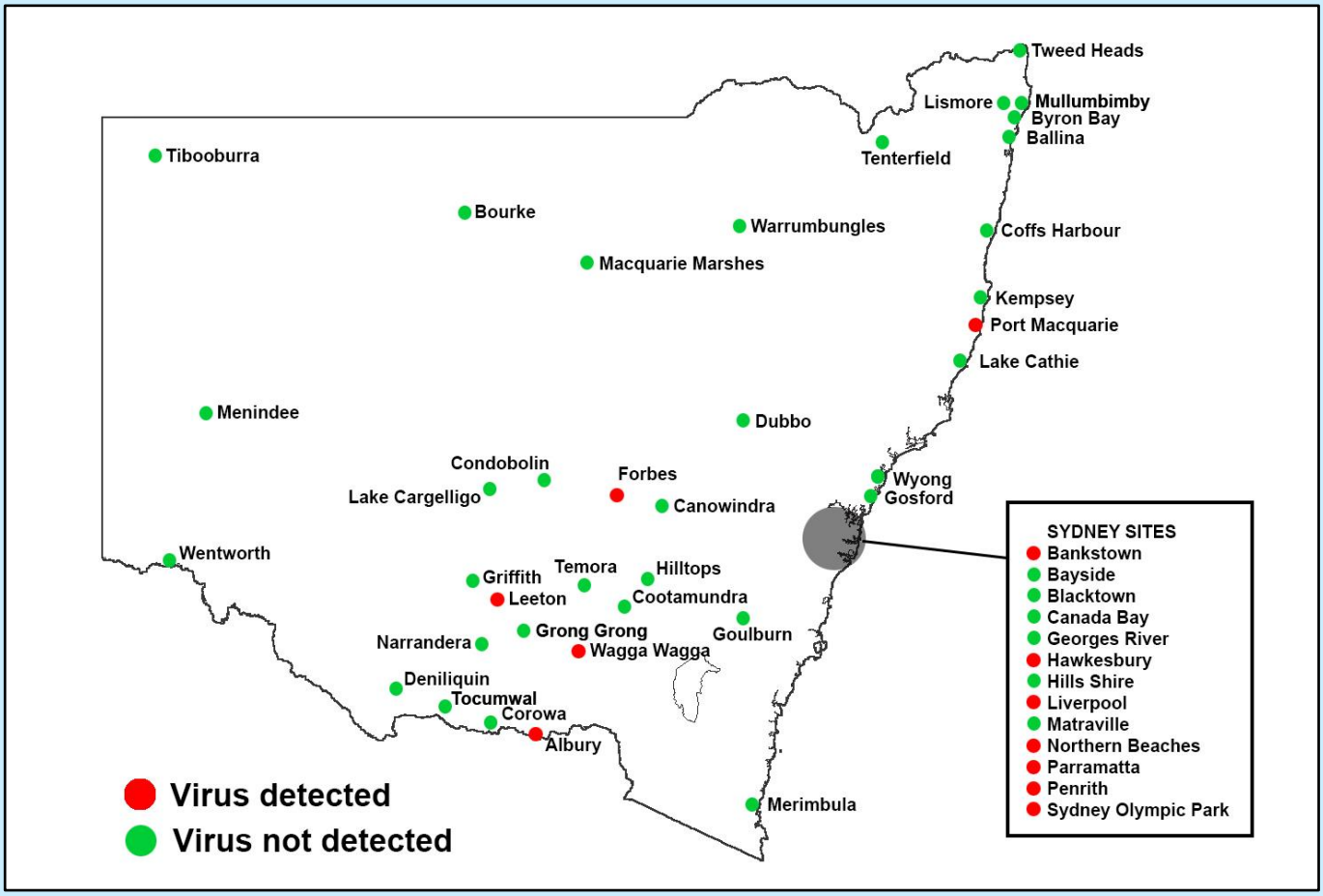
- **Figure 5: July 2021 to September 2021**. Temperatures were close to average for NSW.
- **Figure 6: October 2021 to December 2021**. Temperatures were close to average and slightly cooler than the previous three-month period.
- **Figure 7: January 2022 to March 2022**. Temperatures in the west of NSW were 1-2ºC above average. Elsewhere, temperatures were around normal to slightly below average.
- **Figure 8: April 2022 to June 2022**. Temperatures were around normal.

Mosquito trapping results

Mosquitoes are collected overnight in dry-ice baited Encephalitis Virus Surveillance type traps. They are then sent live in cool, humid Eskies via overnight couriers to the Department of Medical Entomology, NSW Health Pathology-Institute of Clinical Pathology and Medical Research, for species identification and arbovirus isolation.

In 2021-2022, the season started out with 66 mosquito trapping sites across 31 locations. This subsequently expanded with the implementation of enhanced JEV surveillance to include an additional 56 trapping sites across 19 locations, making a total of 122 trapping sites from 50 locations (Figure 9).

Figure 9: Mosquito trapping locations, NSW, 2021-2022



* For a comprehensive list of detected viruses in mosquitoes, please refer to Table 2

Mosquito counts

There were 189,246 mosquitoes representing 60 species collected. *Culex annulirostris* was the most abundant and most important of the inland mosquito species during the summer months. *Aedes notoscriptus*, *Culex annulirostris,* and *Culex orbostiensis* were the most numerous species on the coast. Table 1 provides a summary of results by virogeographical zones.

Table 1: Mosquito trapping results by virogeographical zone, NSW, 2021-2022

Virogeographical zone	Total counts	Species collected
Inland	78,900 mosquitoes	26 species collected with: *Culex annulirostris* (64.6%) *Aedes thobaldi* (10.26%) *Anopheles annulipes* (4.2%) *Aedes notoscriptus* (4.8%) *Aedes vittiger* (3.0%)
Coastal	34,987 mosquitoes	48 species collected with: *Aedes notoscriptus* (19.4%) *Culex annulirostris* (15.5%) *Culex orbostiensis* (12.1%) *Aedes multiplex* (8.3%) *Mansonia uniformis* (6.6%) *Coquillettida linealis* (6.1%) *Aedes vigilax* (3.0%)
Metropolitan Sydney	75,359 mosquitoes	43 species collected with: *Aedes vigilax* (24.6%) *Aedes notoscriptus* (13.9%) *Anopheles annulipes* (10.1%) *Aedes procax* (8.4%) *Culex annulirostris* (7.8%) *Culex quinquefasciatus* (7.0%)

The below figures show mosquito trapping results by location and species type for the 2021-2022 arbovirus season. Mosquito abundances through the ASMMP are described and reported as:

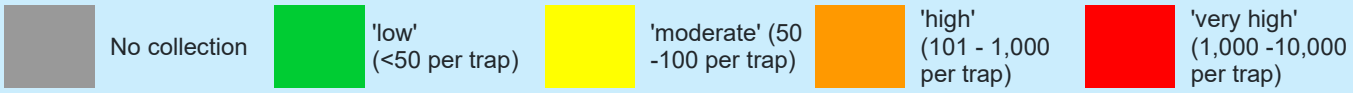


Figure 10: Number of mosquitoes trapped from the inland region (weekly location average)

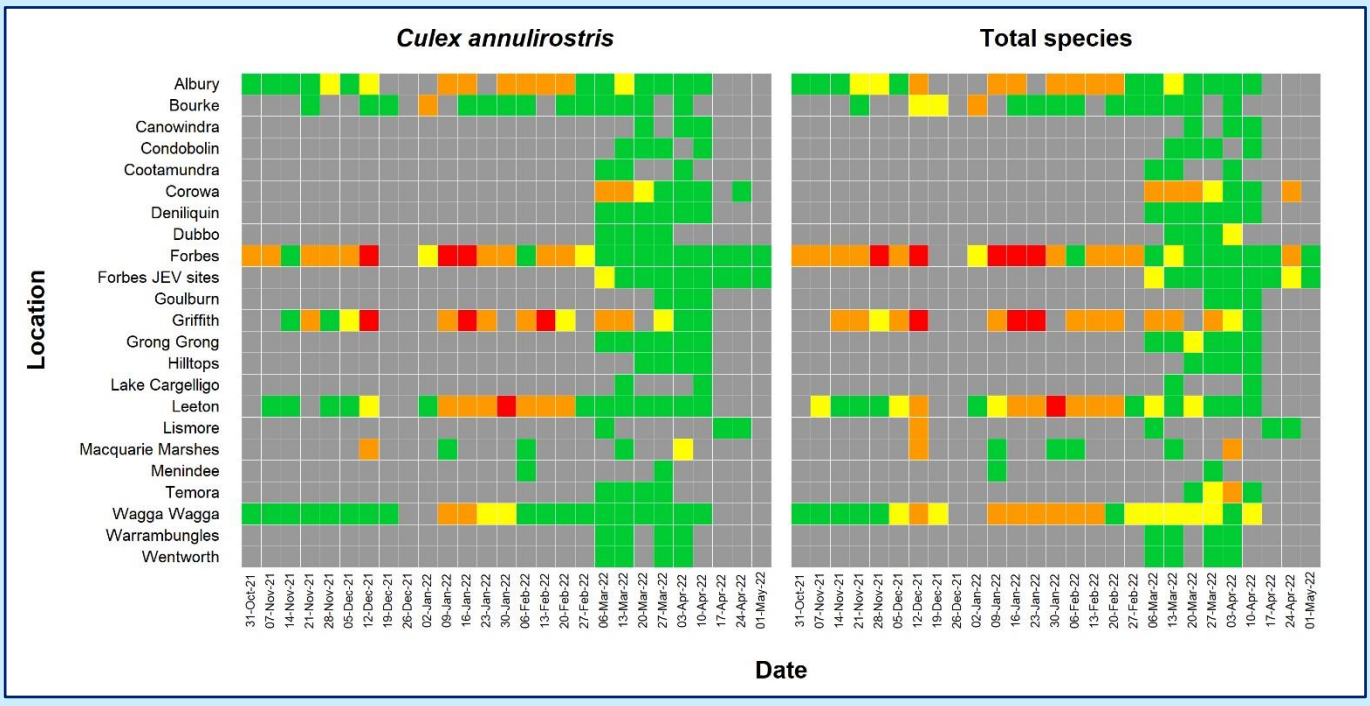


Figure 11: Number of mosquitoes trapped from the coastal region (weekly location average)

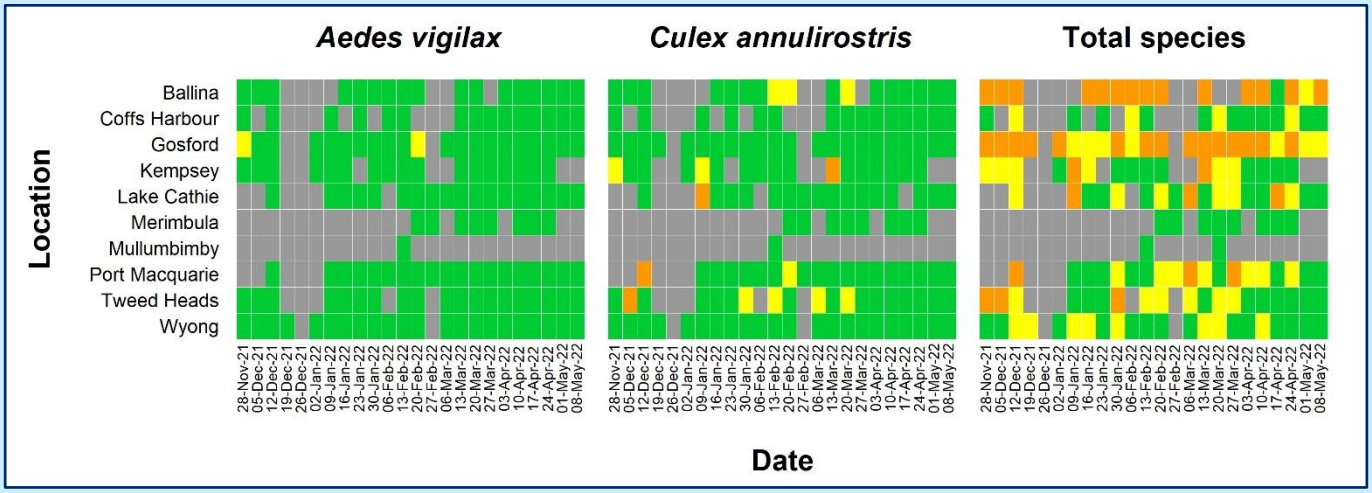
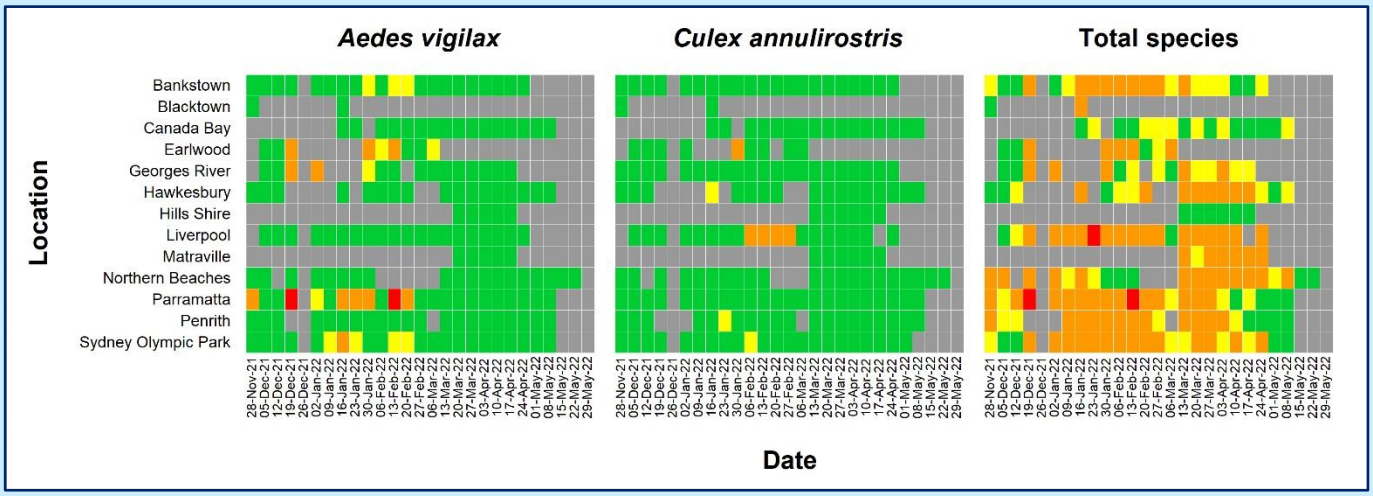


Figure 12: Number of mosquitoes trapped from the Sydney region (weekly location average)



Arboviral detections in mosquitoes

Viral detection in mosquitoes involves modern molecular techniques for identifying viral nucleic acid. From the mosquitoes processed, there were 32 detections including 2 Barmah Forest virus, 14 Ross River virus, 3 Edge Hill virus, 3 Japanese encephalitis virus, 4 Kokobera virus, and 7 Stratford virus (Table 2). Ten were from inland areas (1 Ross River, 2 Edge Hill, 3 Japanese encephalitis, and 4 Kokobera). There was 1 Ross River virus detection from the coast, and 21 detections (2 Barmah Forest, 12 Ross River and 7 Stratford) from Sydney locations. The three Japanese encephalitis viruses were detected during late season retrospective testing of preserved mosquito samples.

Table 2: Arboviral detections in mosquitoes, NSW, 2021-2022

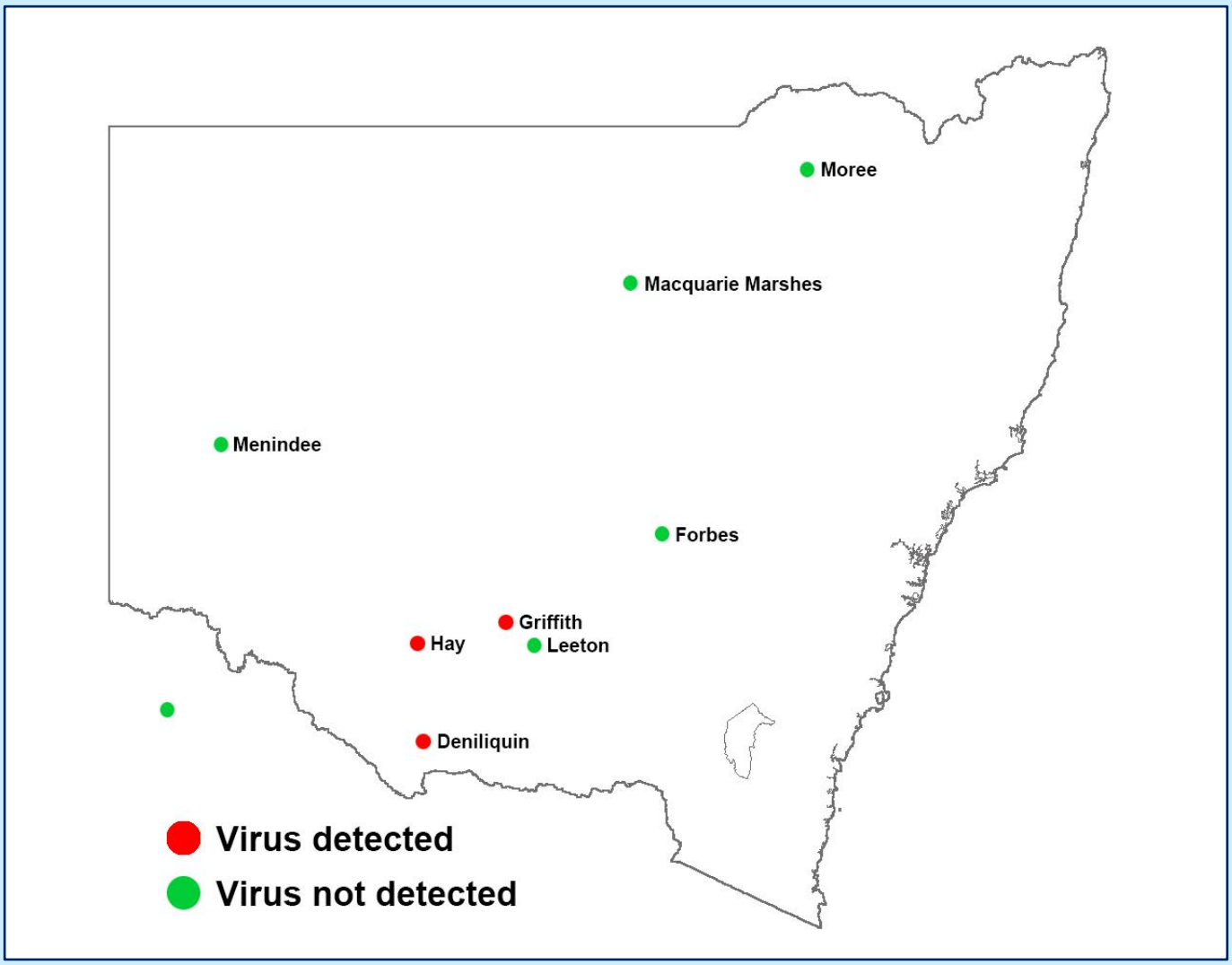
Location	Site	Date	Viruses detected
Albury	Kremur St	7 February 2022	Kokobera
Bankstown	Deepwater	8 February 2022	Ross River
Bankstown	Picnic Point	21 February 2022	Ross River
Bankstown	Picnic Point	28 February 2022	Ross River
Forbes	STP	10 January 2022	Ross River
Forbes	Tom's Lagoon	17 January 2022	Japanese encephalitis*
Forbes	Tom's Lagoon	24 January 2022	Japanese encephalitis*
Forbes	STP	31 January 2022	Kokobera
Forbes	Tom's Lagoon	15 February 2022	Kokobera
Forbes	Road Kill	14 March 2022	Kokobera
Hawkesbury	Yarramundi	29 March 2022	Ross River
Leeton	Almond Rd	14 February 2022	Edge Hill
Liverpool	Lt Cantello Res	22 February 2022	Ross River
Liverpool	Lake Moore	22 March 2022	Barmah Forest
Northern Beaches	Narrabeen	28 March 2022	Ross River
Northern Beaches	Narrabeen	4 April 2022	Ross River
Northern Beaches	Narrabeen	26 April 2022	Stratford
Northern Beaches	Narrabeen	2 May 2022	Barmah Forest
Northern Beaches	Narrabeen	11 May 2022	Ross River
Parramatta	Duck River	3 May 2022	Stratford
Parramatta	Duck River	8 May 2022	Stratford
Penrith	Emu Plains	11 January 2022	Ross River
Penrith	Emu Plains	25 January 2022	Ross River
Penrith	Werrington	25 January 2022	Ross River
Penrith	Werrington	15 February 2022	Ross River
Port Macquarie	Partridge Ck	26 April 2022	Ross River
SOPA	Nar 2	3 May 2022	Stratford
Wagga Wagga	North Wagga	10 January 2022	Japanese encephalitis*
Wagga Wagga	North Wagga	24 January 2022	Edge Hill

*The Japanese encephalitis viral detections were identified during retrospective testing of stored mosquito samples analysed during the latter part of the season.

Sentinel chicken surveillance results

There was a total of 8 flocks with 15 chickens in each flock located across NSW (Figure 13). The first bleed of the season was on 14 November 2021 and the last on 1 May 2022. The period of testing the sentinel chickens was extended this year with the Japanese encephalitis virus activity.

Figure 13: Sentinel chicken surveillance sites, NSW, 2021-2022



A total of 2,067 blood samples was received from all of the flocks in NSW during the season and tested for flaviviruses of public health concern. There were four Japanese encephalitis virus seroconversions in the sentinel chickens, which were detected during retrospective analysis of stored blood samples from earlier in the season (Table 3).

Table 3: Arboviral detections in sentinel chickens, NSW, 2021-2022*

Location	Date	Viruses detected
Deniliquin	6 March 2022	Japanese encephalitis
Griffith	9 March 2022	Japanese encephalitis
Hay	2 March 2022	Japanese encephalitis (x2)

*These positives were detected during retrospective analysis of stored blood specimens.

Human notifications of locally acquired arbovirus infections

All arboviral infections detected in humans are notifiable under the *NSW Public Health Act 2010*. The two most common locally acquired arbovirus infections notified in NSW are infections with Ross River virus (RRV) and Barmah Forest virus (BFV).

In the 2021-2022 mosquito season year there were 87 notifications of BFV infection and 681 notifications of RRV infection in NSW residents (Table 4). BFV and RRV numbers were lower than the 10-year average (Figures 14 and 15). There were 13 JEV confirmed cases and 1 MVE confirmed case reported during the season (Figures 16 and 17).

Figure 14: Barmah Forest virus notifications over the last 10 years (July 2012 to June 2022) compared to 10-year average, NSW

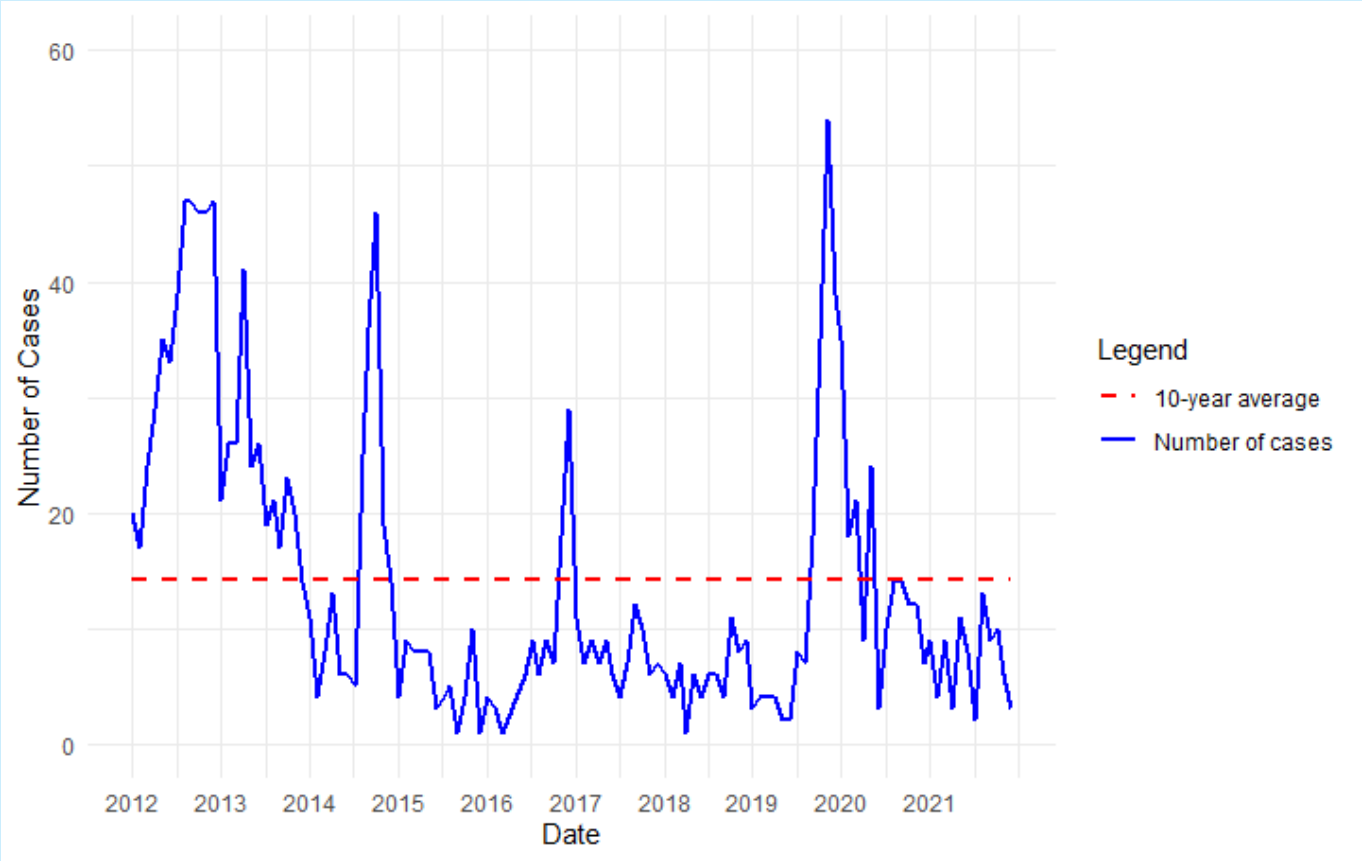
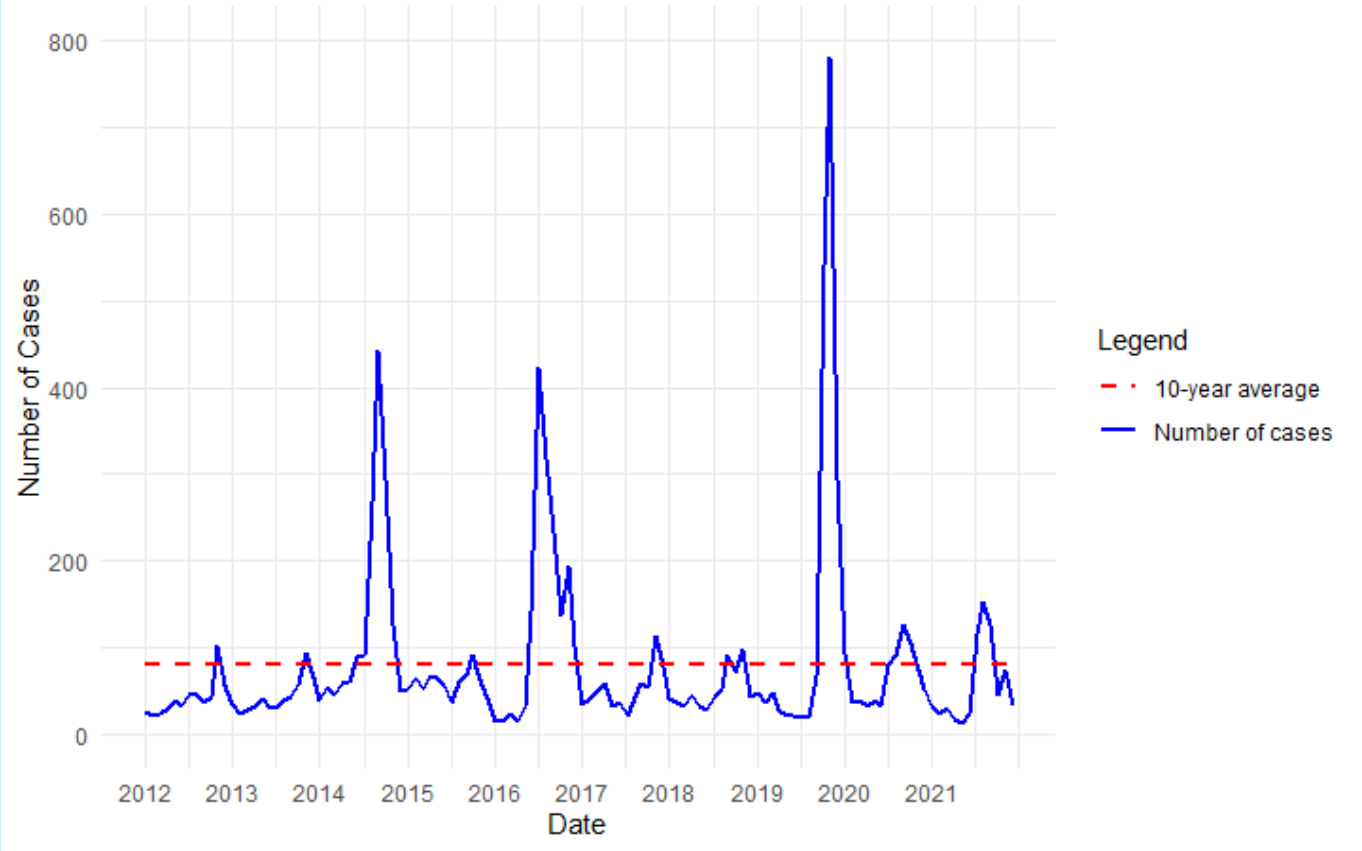


Figure 15: Ross River virus notifications over the last 10 years (July 2012 to June 2022) compared to 10-year average, NSW



Murrumbidgee LHD reported the highest number of RRV notifications (198), followed by Hunter New England (137) and Western NSW (117). Coastal regions, such as the Mid North Coast (43 RRV) and Northern NSW (40 RRV), showed moderate activity. BFV notifications were highest in Northern NSW (32), with the Mid North Coast (14) and Hunter New England (22) also contributing significantly.

Inland regions generally had higher numbers of RRV notifications, while BFV notifications were more evenly distributed across inland and coastal regions. Metropolitan Sydney LHDs recorded low notifications, with a maximum of 20 RRV cases and 4 BFV cases in Northern Sydney residents.

Table 4: Barmah Forest and Ross River virus human notifications in NSW by local health district and virogeographic region, 2021-2022

Local health district	Virogeographic region	Ross River virus notifications	Barmah Forest virus notifications
Murrumbidgee	Inland	198	4
Hunter New England	Inland	137	22
Western NSW	Inland	117	3
Mid North Coast	Coastal	43	14
Northern NSW	Coastal	40	32
Far West	Inland	31	1
Illawarra Shoalhaven	Coastal	30	4
Central Coast	Coastal	24	2
Northern Sydney	Metropolitan Sydney	20	4
Southern NSW	Inland	17	1

South Eastern Sydney	Metropolitan Sydney	9	0
Nepean Blue Mountains	Metropolitan Sydney	7	0
Western Sydney	Metropolitan Sydney	4	0
Sydney	Metropolitan Sydney	3	0
South Western Sydney	Metropolitan Sydney	1	0
TOTAL	**ALL REGIONS**	**681**	**87**

* Human cases are assigned to LHDs based on the individual's residential address, not the location where the infection was acquired.

Figure 16: Japanese encephalitis virus notifications in NSW over the last 10 years (July 2012 to June 2022)

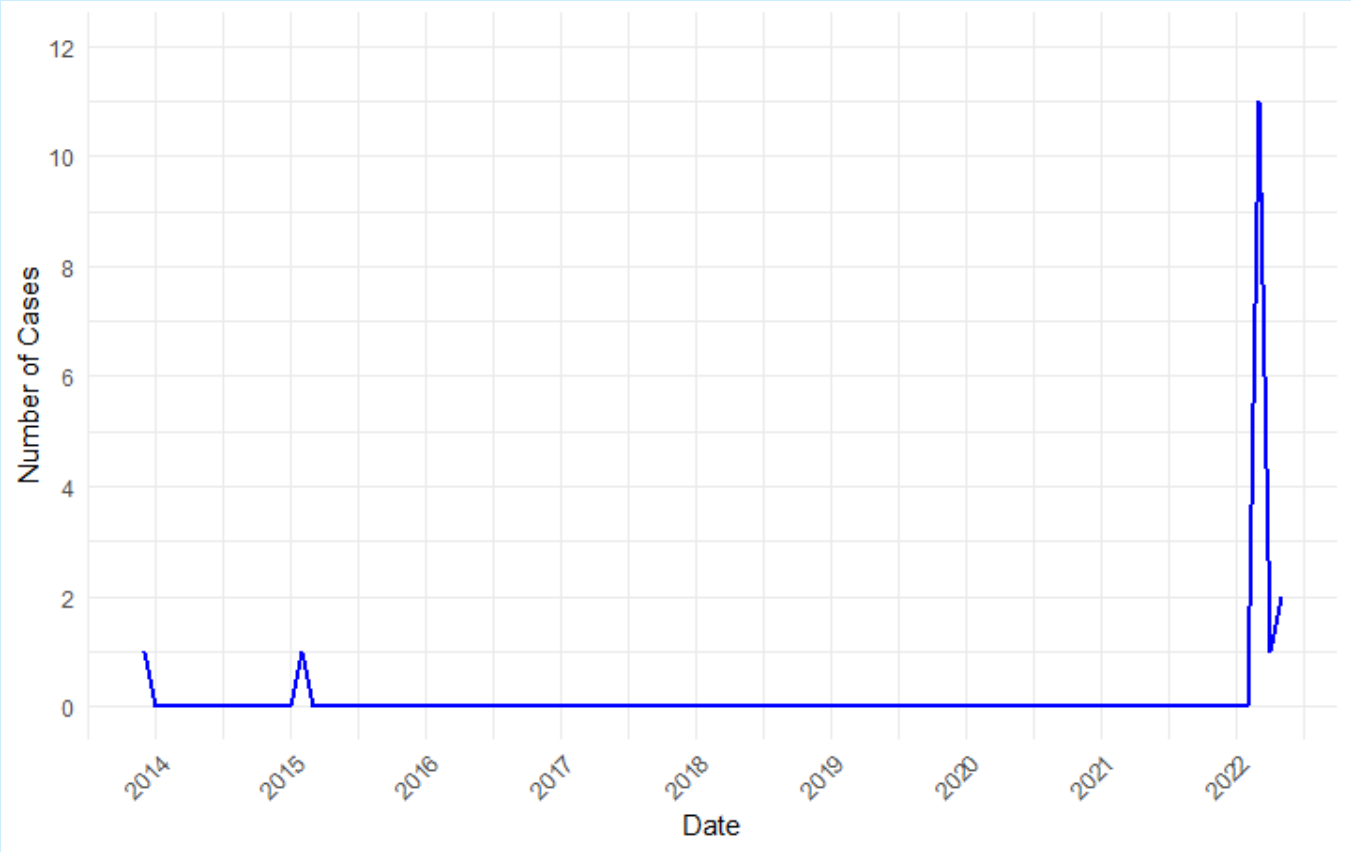
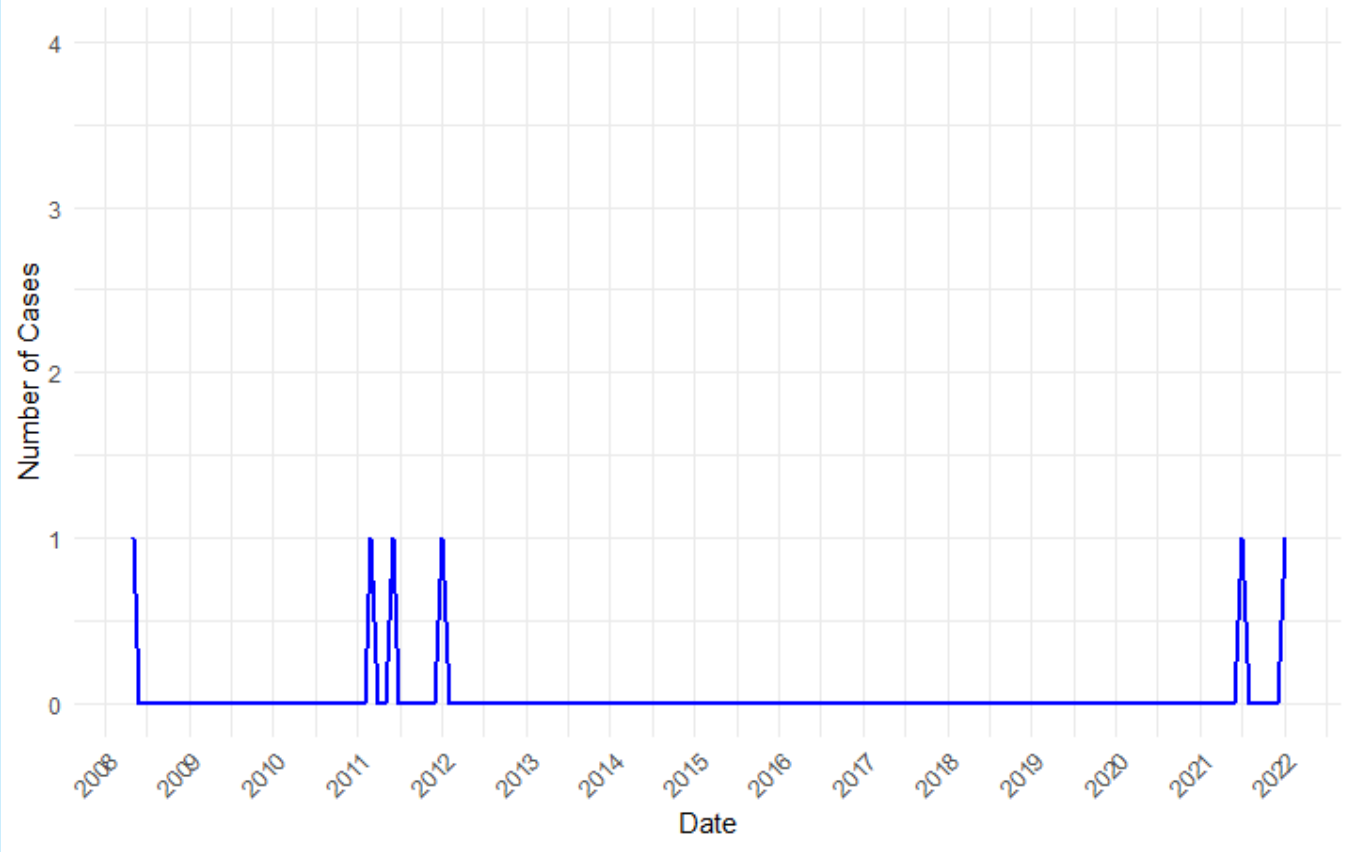


Figure 17: Murray Valley encephalitis virus notifications in NSW over the last 10 years (July 2012 to June 2022)



For further information on surveillance for human infections with vector-borne diseases, including exotic arbovirus infections, see the following:

- NSW Health Vector-borne diseases reports
- NSW Health Notifiable diseases data (and select the relevant disease).

Exotic mosquito detections at first points of entry

The Australian Government Department of Agriculture, Fisheries and Forestry (DAFF) is responsible for monitoring, surveillance and management of exotic mosquitoes at first points of entry including major Australian ports such as airports and approved arrangement facilities. The exotic mosquito species *Aedes aegypti* and *Aedes albopictus* both pose a serious biosecurity risk to Australia being major vectors of serious arboviral diseases including Dengue, Yellow Fever, Zika, and Chikungunya viruses. Table 5 shows detections for the period July 2021 to June 2022.

Table 5: Detections of exotic mosquitoes in NSW, July 2021 to June 2022

Date	Mosquito species	Sex	Location	Origin*
3 September 2021	*Aedes aegypti*	Female	Wharf	USA
24 November 2021	*Aedes aegypti*	Female	Airport	Kuala Lumpur, Malaysia
8 December 2021	*Aedes aegypti*	Female	Airport	Bangkok, Thailand
13 January 2022	*Aedes aegypti*	Female	Approved arrangement facility	Kuala Lumpur, Malaysia

14 January 2022	*Aedes aegypti*	Female	Airport	Fiji
27 January 2022	*Aedes aegypti*	Female	Approved arrangement facility	Kuala Lumpur, Malaysia
8 February 2022	*Aedes aegypti*	Female	Approved arrangement facility	Kuala Lumpur, Malaysia
1 March 2022	*Aedes aegypti*	Female	Approved arrangement facility	Kuala Lumpur, Malaysia
28 March 2022	*Aedes aegypti*	Female	Approved arrangement facility	Kuala Lumpur, Malaysia

*Origin determined through population analyses

Following the detections of exotic mosquitoes, insecticidal control and enhanced surveillance are undertaken as per the Australian Government Department of Health (2017), '*Response Guide for Exotic Mosquito Detections at Australian First Points of Entry*'.

Insecticidal control includes the use of thermal fogging along with residual surface sprays in the areas where the detections occurred. The enhanced surveillance includes the placement of additional mosquito traps and increased checking of the traps up to 40 days post detection of the exotic mosquitoes. These measures help ensure that Australia remains free of *Aedes albopictus* and insecticide resistant strains of *Aedes aegypti*.

Discussion

The JEV first outbreak of JEV in southeastern Australia occurred early in 2022. Previously, JEV had been detected in Australia from the Torres Strait islands in 1995 and resulted in one death. Later JEV spread to the mainland, with one human case from the Mitchell River area on Cape York. However, the virus had not previously been recorded further south.

In February 2021, localised JEV activity occurred in the Tiwi Islands, north of Darwin in the Northern Territory. There was one death, and from this case the virus was identified as the G4 genotype of JEV, a variety rarely recorded. It was this genotype that was identified in southeastern Australia in 2022.

This season was the second consecutive La Niña year, which is always associated with above average rainfall, as was observed. Often consecutive La Niña years result in MVEV activity, however there was no evidence of the virus this season. During wet consecutive years, opportunistic movements of birds occur from the north of the country, which travel south as the wet weather brings enhanced feeding grounds. This can result in the virus being moved southwards.

As JEV had never before been recorded in the south of Australia, no laboratory was testing for the presence of the virus as part of routine environmental surveillance in mosquitoes and sentinel chickens. When a rise in pig foetal deaths and stillborn piglets was observed in large commercial piggeries, animal health experts tested for the virus. Staff from the NSW Department of Medical Entomology collaborated closely with animal health workers to produce the guide '*Integrated Management Principles for Piggeries*'. Other health actions included active mosquito management on affected piggeries and restriction of pig and pig sperm movements.

A number of other health actions were also initiated in response to the outbreak and a One Health approach was taken. The Commonwealth and States and Territory Governments purchased JEV vaccines which were made available for high-risk individuals. The Commonwealth Government also funded states including NSW to conduct enhanced arbovirus surveillance across affected regions, which resulted in the number of trap sites being doubled for NSW and to invest in enhanced geospatial surveillance of arboviruses in NSW. In addition, the Commonwealth Government's funding supported NSW to enhance public health communications, purchase essential supplies to ensure sustained laboratory capacity and capability to test for JEV in humans, and distribute repellents to affected communities.

Laboratory tests were expanded to include testing for JEV in environmental surveillance samples and all previous samples from the season were analysed for JEV. This retrospective testing identified JEV in mosquitoes from Forbes and Wagga in collections dating from mid-January, and from chickens that were bled during early March. Mosquito collections from the enhanced surveillance mostly produced 'low' mosquito numbers with no detections of JEV during prospective (i.e. routine) testing.

In Australia, there were 45 confirmed human cases of JEV and 7 deaths as a result. In NSW, there were 13 human cases and 2 deaths. Around one third of the confirmed cases where in the 60-79 year age group, and more than half were in the 50-79 year age group. Outdoor activities including camping, water sports, or living on rural properties were the most likely pathways to exposure to JEV infected mosquitoes. The highest number of cases occurred around the Corowa area along the Murray River. Feral pigs across inland NSW could act as both a reservoir and amplifying host in future JEV activity. Continuing monitoring and testing of all samples for JEV is now routinely undertaken within the NSW Arbovirus Surveillance Program.

In spite of the La Niña year and above average rainfall, mosquito numbers from the inland were not extraordinarily high. While the total collected (78,000 mosquitoes) was much higher than previous drought affected years, the total trapped represented a mostly average mosquito season, with relatively few arboviral detections (Figure 10). There were 13 JEV and 1 MVE human cases in inland areas.

For the coast, the continual wet weather ensured that numbers of *Aedes vigilax* were among the lowest ever recorded. For most mosquito species, higher rainfall leads to increased mosquito numbers as larval habitat availability increase. However, the converse occurs for saltmarsh mosquitoes, where continual rains means that the saltmarsh habitats remain wet, preventing the required drying maturation period for the egg stage, and the flooded wetlands allows greater access to hatched larvae by aquatic predators. Consequently, this season experienced low numbers of *Aedes vigilax*, with just over 1,000 specimens trapped and only two weeks producing 'moderate' collections (Figure 11). The composition of the coastal traps was dominated by freshwater breeding species, notably *Aedes notoscriptus*, *Culex annulirostris*, *Culex orbostiensis*, *Aedes multiplex*, and *Mansonia uniformis*. Normally, *Aedes vigilax* is the most common species trapped along the coast.

The Sydney locations also tended to have a higher abundance of freshwater mosquitoes. For most years, *Aedes vigilax* makes up around 50-60% of the collections, whereas it comprised less than 25% of overall catches this season.

RRV and BFV human notifications were lower than the 10-year average for the inland, coastal and Sydney regions.

Acknowledgements

The NSW ASMMP is funded and supported by the Environmental Health Branch at the NSW Ministry of Health. The program would not be possible without the support of Health Pathology NSW in processing and testing samples and organisations and individuals involved in mosquito trapping and sentinel chicken surveillance including, public health units, local councils, and various community members. The Animal Ethics Committee at Westmead Hospital approved the sentinel chicken component of the program. The exotic mosquito data is courtesy of the Australian Government Department of Agriculture, Fisheries and Forestry.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