
NSW Health

NSW Arbovirus Surveillance Program Annual report

2023-2024



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

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 Burrumattagal 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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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, 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), Kunjin (KUNV) and Japanese encephalitis viruses (JEV). 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 2023-2024 arbovirus season. It also provides a high level summary of human arbovirus notifications in NSW.

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 2023-2024 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 2023, the autumn, winter, and spring Nicholls' values, respectively, were 1010.20mm, 1014.00, and 1012.23. All these values were outside the range of past MVEV epidemic years.

Over 2020-2023, there were three consecutive La Niña events of above average rainfall across eastern Australia, which ended during early 2023. Over 2023-2024, the Southern Oscillation was neutral, meaning that rainfall patterns were closer to average. These conditions ensured that mosquito numbers during 2023-2024 were not extraordinarily high, as per the previous two seasons when outbreaks of JEV and MVEV occurred during 2021-2022 and 2022-2023, respectively. There were no detections of JEV or MVEV from the routine operations of the mosquito trapping and sentinel chicken components of the surveillance program this season. There were many detections of other arboviruses in mosquitoes, including 6 BFV and 13 RRV detections.

In the 2023-2024 arbovirus season, there were a total of 517 human notifications of RRV (43 confirmed and 474 probable cases) and 62 human notifications of BFV (5 confirmed and 57 probable cases). These numbers were lower than the 10-year average. There were no human cases of MVE, Kunjin or JEV.

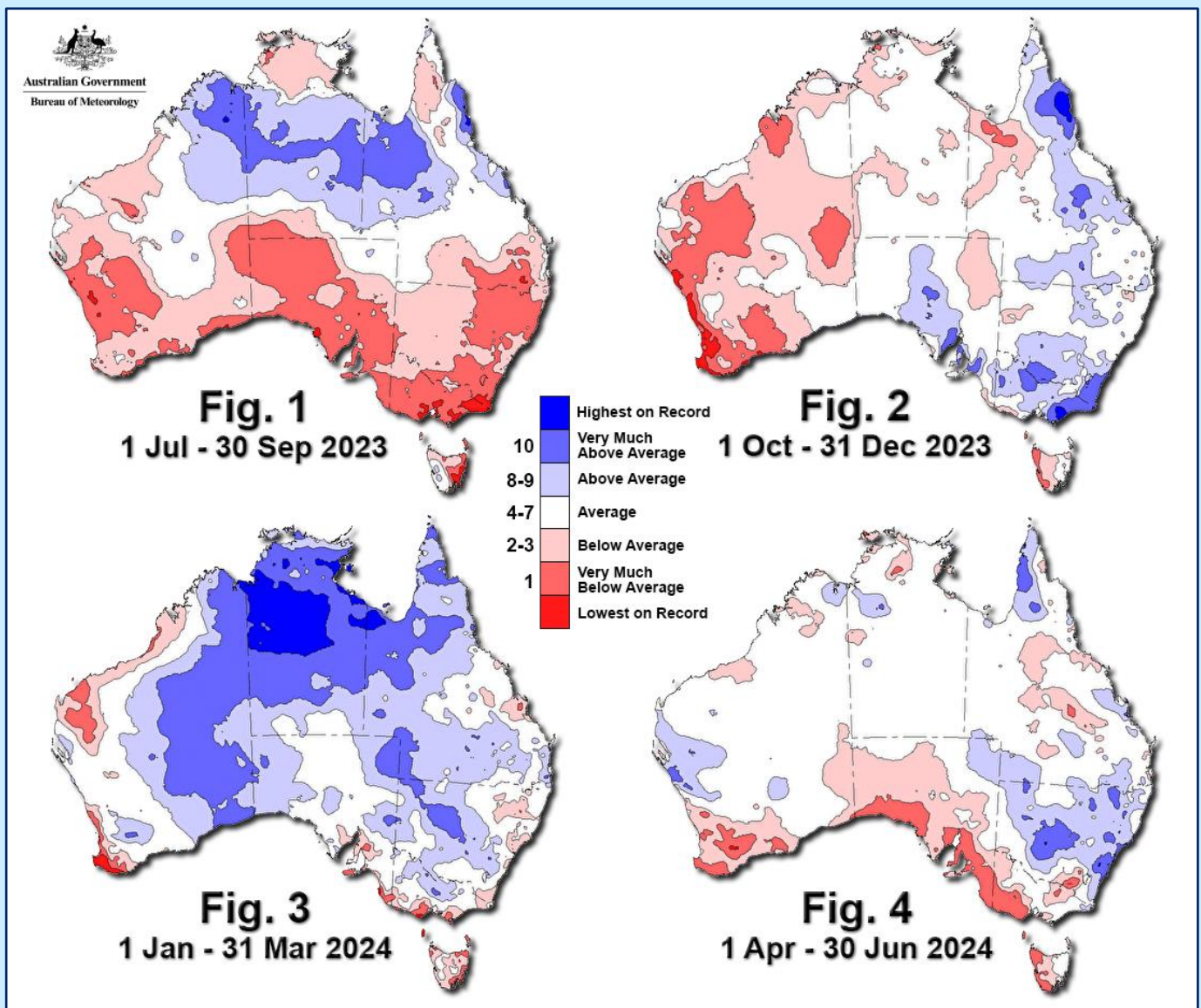
Weather data

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 2023-2024 season.

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



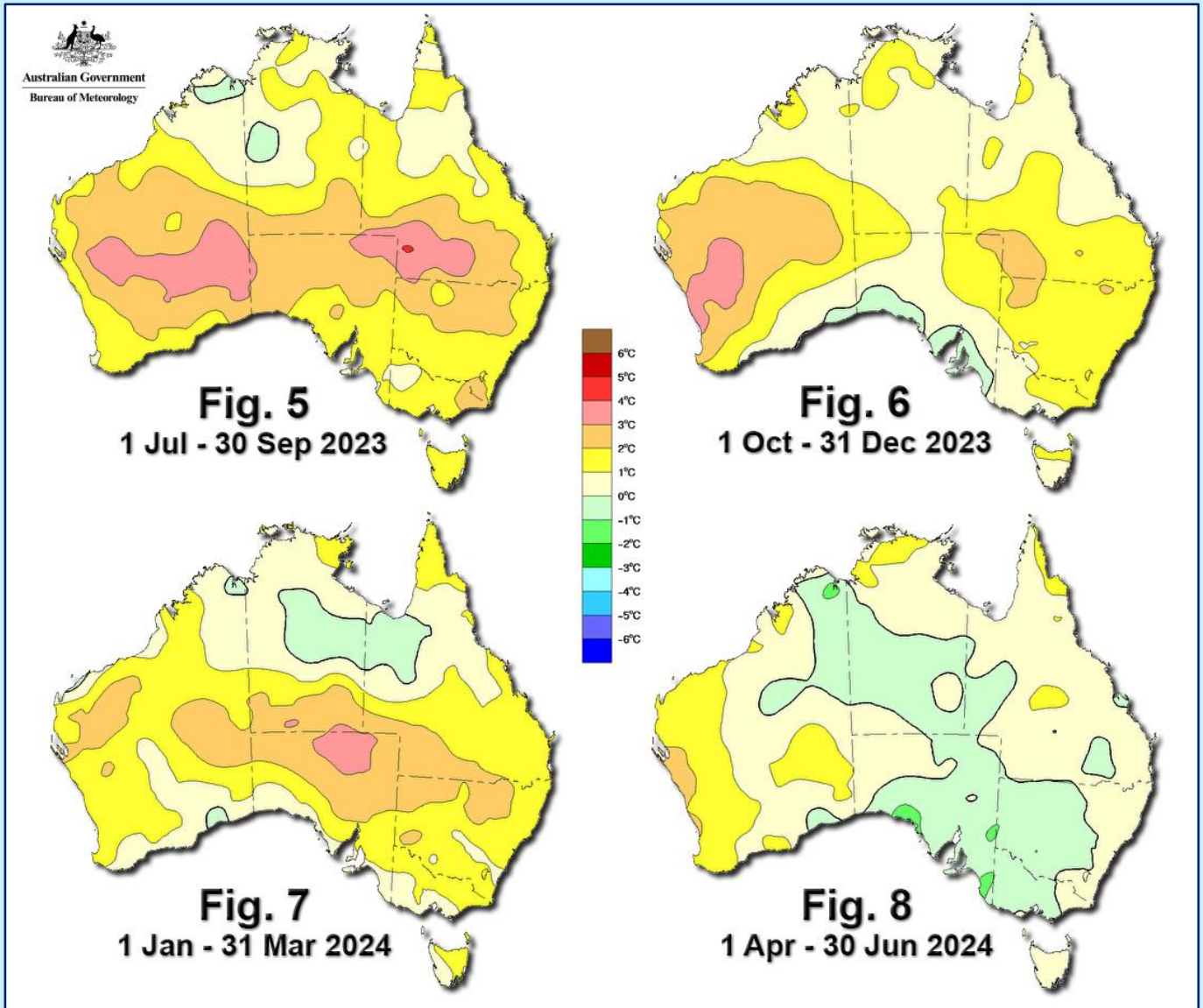
- **Figure 1: July 2023 to September 2023.** Rainfall was below average for most of NSW, with very much below average rainfall along the ranges, slopes and much of the coast (Figure 1).
- **Figure 2: October 2023 to December 2023.** Rainfall was mostly average in NSW. It was above average in the Murray and Murrumbidgee regions, and very much above average in the southeast corner of NSW.
- **Figure 3: January 2024 to March 2024.** Rainfall was above average across most of inland NSW. Rainfall was average to below average along the ranges and coast.

- **Figure 4: April 2024 to June 2024.** Rainfall was above average for most of NSW.

Temperature

Figures 5-8 provide an overview of Australian temperature anomalies (departures from the normal) for the 2023-2024 season.

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



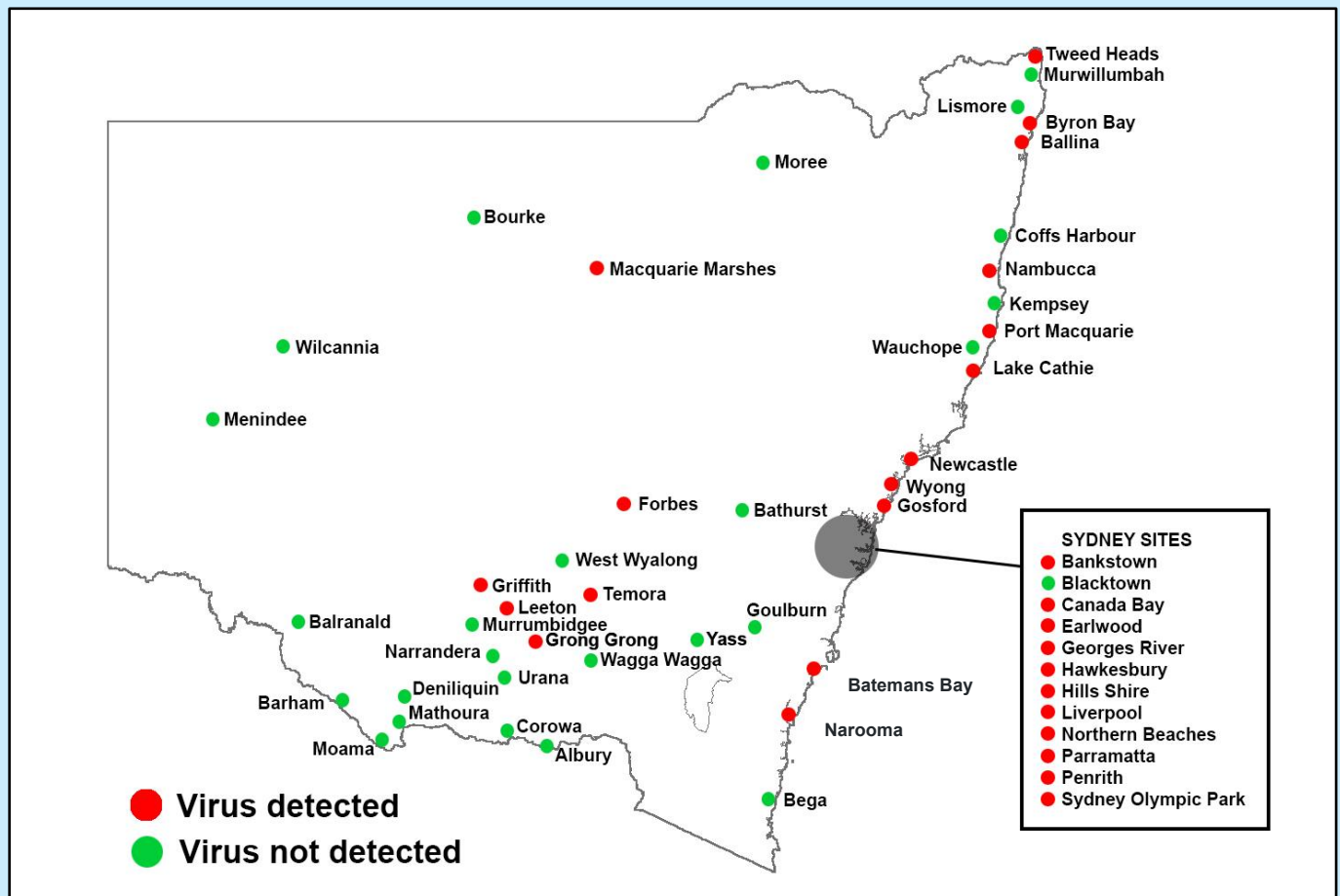
- **Figure 5: July 2023 to September 2023.** Temperatures were 1-2°C above average in NSW. Temperatures were warmer in the north of the state, up to 2°C above average.
- **Figure 6: October 2023 to December 2023.** Temperatures were around 1°C above average across NSW.
- **Figure 7: January 2024 to March 2024.** Temperatures were 1°C above average for most of NSW and up to 2°C above average in the northwest.
- **Figure 8: April 2024 to June 2024.** Temperatures were near average in NSW.

Mosquito trapping results

Mosquitoes are collected overnight in dry-ice baited Encephalitis Virus Surveillance 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 testing.

In 2023-2024, there were 113 mosquito trapping sites across 54 locations (Figure 9).

Figure 9: Mosquito trapping locations, NSW, 2023-2024



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

Mosquito counts

A total of 284,613 mosquitoes representing 67 species were collected. *Culex annulirostris* was the most abundant and most important of the inland mosquito species during the summer months. *Aedes vigilax*, *Culex annulirostris*, *Culex sitiens*, and *Aedes notoscriptus* 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, 2023-2024

Virogeographical zone	Total counts	Species collected
Inland	75,698 mosquitoes	26 species collected with <i>Culex annulirostris</i> (74.4%) <i>Anopheles annulipes</i> (9.8%) <i>Aedes vittiger</i> (5.0%) <i>Aedes notoscriptus</i> (4.1%) <i>Culex quinquefasciatus</i> (2.3%)
Coastal	129,275 mosquitoes	55 species collected <i>Aedes vigilax</i> (32.4%) <i>Culex sitiens</i> (14.4%) <i>Culex annulirostris</i> (11.4%) <i>Coquillettidia linealis</i> (11.3%) <i>Aedes notoscriptus</i> (9.1%) <i>Verrallina funerea</i> (6.6%) <i>Culex orbostiensis</i> (3.1%)
Metropolitan Sydney	79,640 mosquitoes	38 species <i>Aedes vigilax</i> (49.7%) <i>Culex annulirostris</i> (13.6%) <i>Aedes notoscriptus</i> (8.9%) <i>Anopheles annulipes</i> (6.1%) <i>Culex sitiens</i> (4.8%)

The below figures show mosquito trapping results by location and species type for the 2023-2024 arbovirus season. Mosquito abundances through the ASMMP are described and reported as:

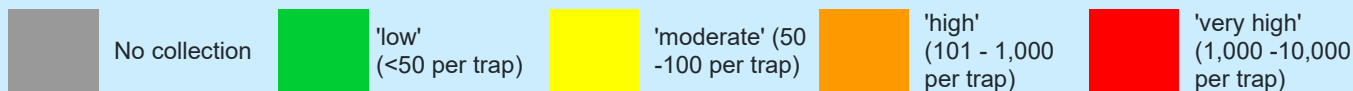


Figure 10: Number of mosquitoes trapped from the inland region (weekly location average)

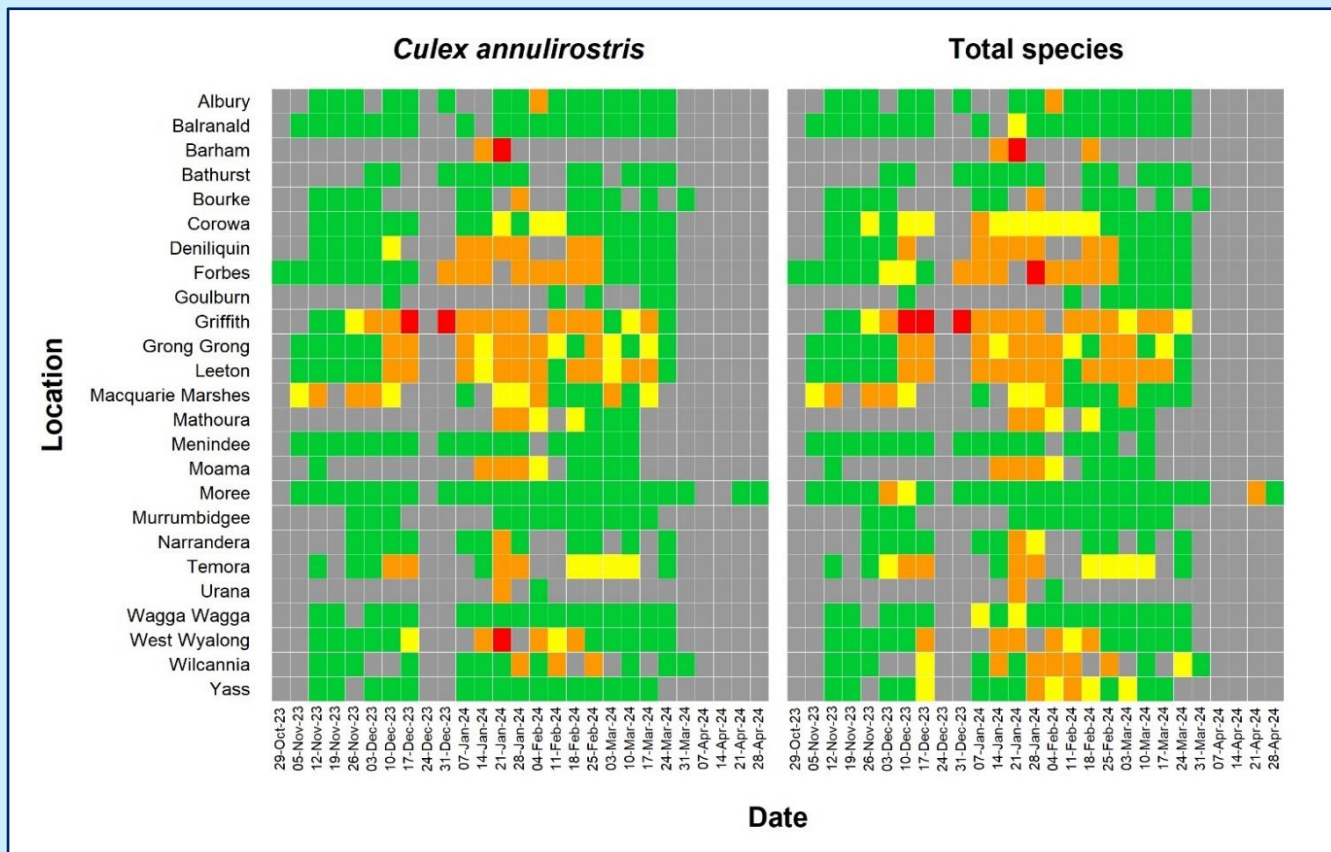


Figure 11: Number of mosquitoes trapped from the coastal region (weekly location average)

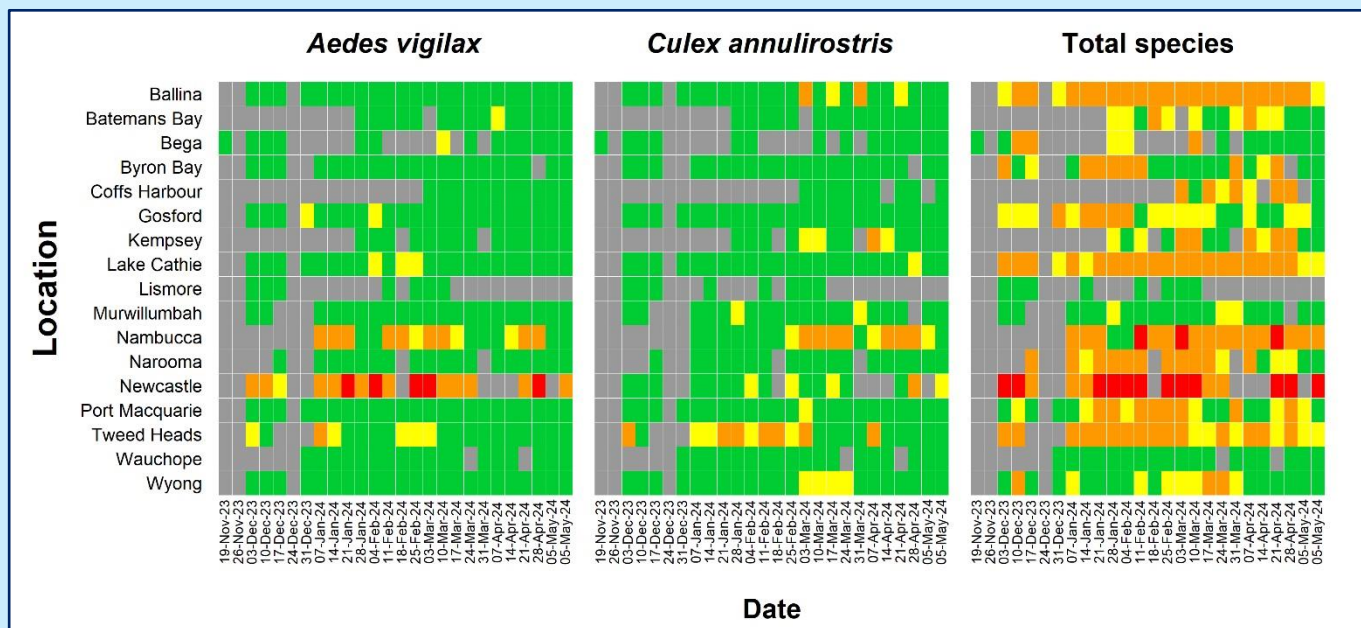
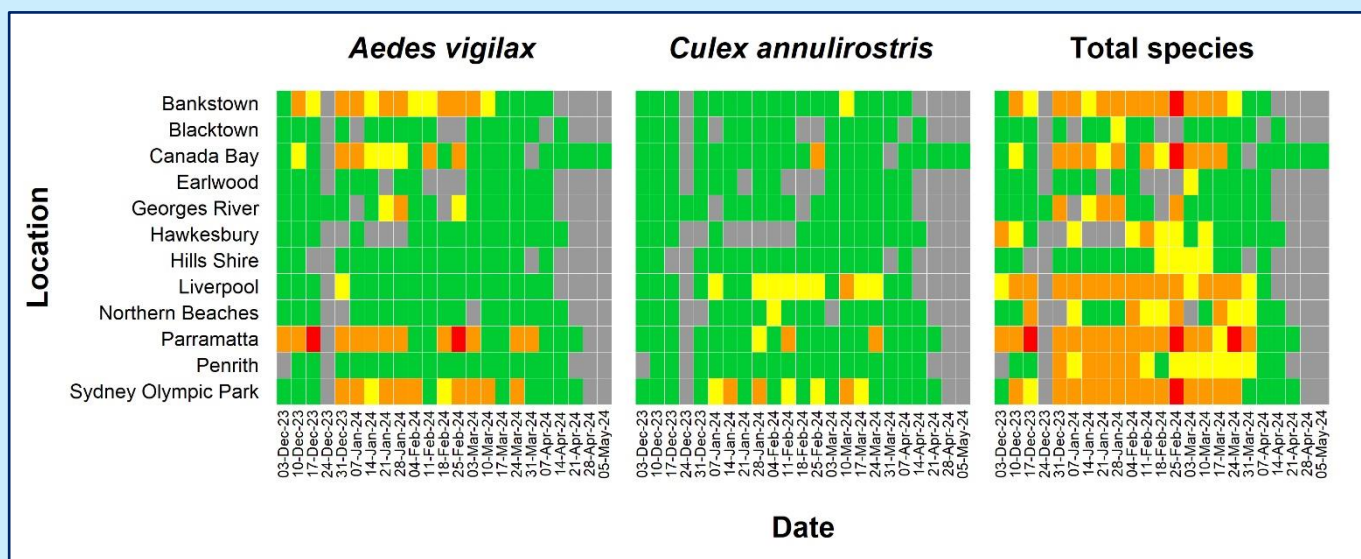


Figure 12: Number of mosquitoes trapped from the Sydney region (weekly location average)



Arboviral detections in mosquitoes

Viral detection in mosquitoes involves modern molecular techniques for identifying viral nucleic acid. From the mosquitoes processed, there were 87 detections including 6 Barmah Forest virus, 13 Ross River virus, 1 Sindbis virus, 33 Edge Hill virus, 10 Kokobera virus, and 24 Stratford virus (Table 2). Most detections (n = 75) were from the coastal region.

Table 2: Arboviral detections in mosquitoes, NSW, 2023-2024

Location	Site	Date	Viruses detected
Ballina	Lindsay Point	12 February 2024	Ross River
Bankstown	Picnic Point	30 January 2024	Edge Hill
Bankstown	Picnic Point	12 February 2024	Stratford
Batemans Bay	Apply Berry Place	6 February 2024	Edge Hill
Batemans Bay	South Saltmarsh	25 March 2024	Edge Hill
Batemans Bay	East Surfside	25 March 2024	Stratford
Batemans Bay	Apply Berry Place	3 April 2024	Stratford
Byron Bay	Ocean Shores	5 February 2024	Ross River
Byron Bay	Ocean Shores	12 February 2024	Ross River
Canada Bay	Powells Creek	29 February 2024	Edge Hill
Canada Bay	Powells Creek	13 March 2024	Edge Hill
Gosford	Empire Bay	3 January 2024	Edge Hill
Gosford	Empire Bay	16 January 2024	Edge Hill
Gosford	Empire Bay	7 February 2024	Edge Hill, Stratford
Earlwood	Turrella Reserve	11 April 2024	Edge Hill
Forbes	STP	30 January 2024	Kokobera
Forbes	STP	29 February 2024	Kokobera
Georges River	Alfords Point	30 January 2024	Edge Hill
Georges River	Picnic Point	7 February 2024	Edge Hill, Stratford
Georges River	Picnic Point	27 February 2024	Stratford
Georges River	Picnic Point	4 March 2024	Edge Hill
Georges River	Deepwater	11 March 2024	Edge Hill
Griffith	Melville Cr	19 February 2024	Kokobera
Griffith	Melville Cr	11 March 2024	Ross River
Grong Grong	Narrandera St	29 January 2024	Kokobera
Grong Grong	River Rd	26 February 2024	Ross River
Grong Grong	Narrandera St	4 March 2024	Edge Hill
Hawkesbury	North Richmond	6 February 2024	Stratford
Hawkesbury	North Richmond	26 March 2024	Stratford
Hawkesbury	North Richmond	16 April 2024	Stratford
Hills	Ted Horwood Reserve	29 February 2024	Stratford
Hills	Ted Horwood Reserve	6 March 2024	Stratford
Hills	Ted Horwood Reserve	11 April 2024	Stratford
Macquarie Marshes	Bluelight 1	22 February 2024	Kokobera

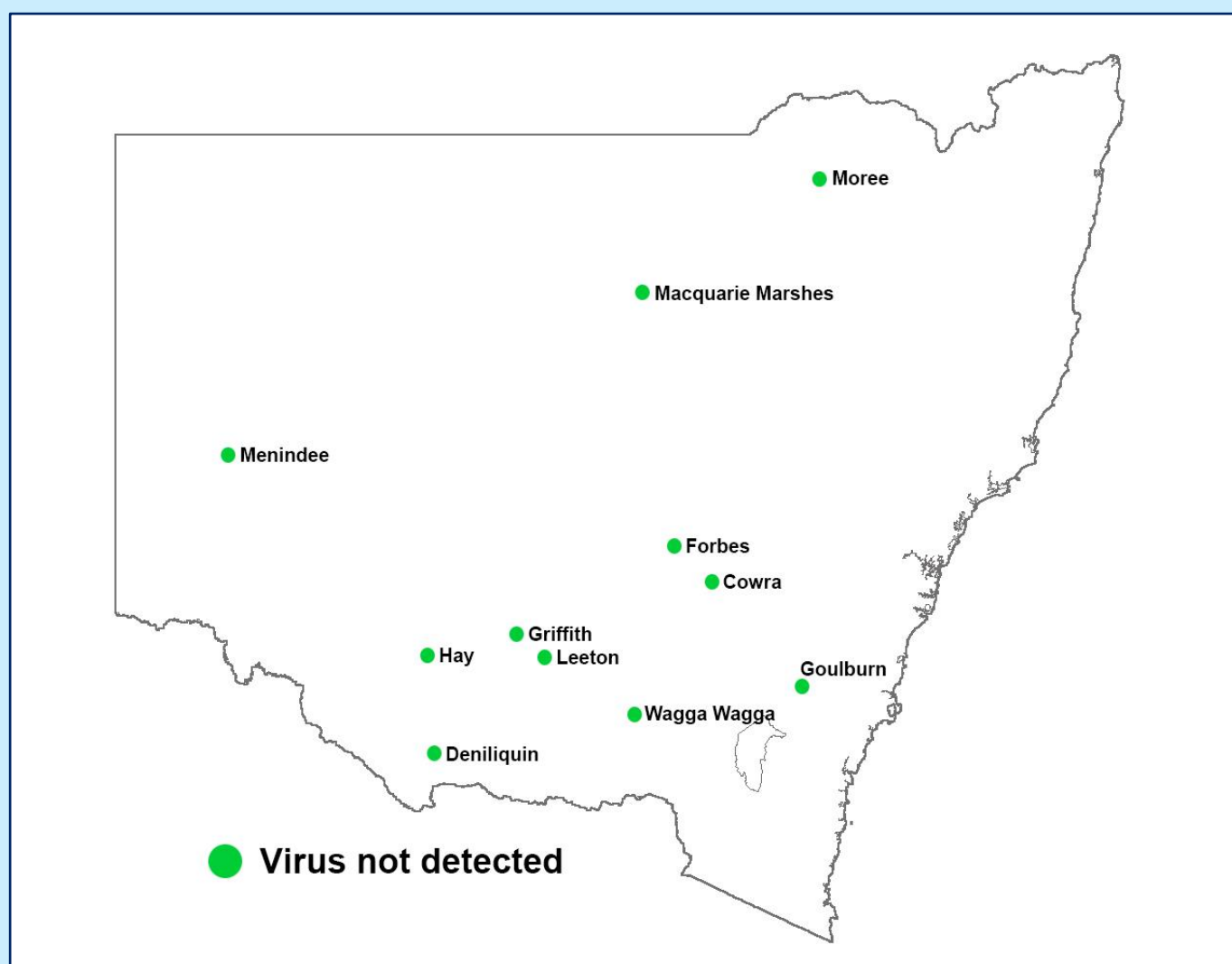
Location	Site	Date	Viruses detected
Macquarie Marshes	Bluelight 1	18 March 2024	Kokobera
Lake Cathie	Cowarra Creek	12 February 2024	Edge Hill
Lake Cathie	Cowarra Creek	26 February 2024	Stratford
Leeton	Farm 269	4 March 2024	Kokobera
Liverpool	Lt Cantello Reserve	11 March 2024	Edge Hill
Nambucca Heads	Gumma Rd	24 March 2024	Kokobera
Nambucca Heads	Gumma Rd	14 April 2024	Kokobera
Narooma	Ballingalla St	4 February 2024	Stratford
Narooma	Ballingalla St	7 April 2024	Stratford
Narooma	Ballingalla St	22 April 2024	Stratford
Newcastle	Maryland	23 January 2024	Edge Hill
Newcastle	Tomago	23 January 2024	Edge Hill
Newcastle	Maryland	6 February 2024	Barmah Forest, Edge Hill
Newcastle	Tomago	6 February 2024	Edge Hill, Stratford
Newcastle	Tomago	12 February 2024	Edge Hill, Stratford
Newcastle	Maryland	12 February 2024	Edge Hill
Newcastle	Tomago	27 February 2024	Barmah Forest, Ross River
Newcastle	Maryland	5 March 2024	Barmah Forest
Newcastle	Tomago	11 March 2024	Ross River, Edge Hill
Newcastle	Maryland	11 March 2024	Ross River, Edge Hill
Northern Beaches	Narrabeen	29 January 2024	Edge Hill
Northern Beaches	Warriewood	20 February 2024	Edge Hill
Northern Beaches	Narrabeen	13 March 2024	Edge Hill
Northern Beaches	Narrabeen	2 April 2024	Stratford
Parramatta	George Kendall Reserve	6 February 2024	Edge Hill
Penrith	Werrington	27 February 2024	Barmah Forest
Penrith	Werrington	5 March 2024	Ross River
Penrith	Emu Plains	26 March 2024	Stratford
Port Macquarie	Partridge Creek	8 April 2024	Barmah Forest
Sydney Olympic Park	Newington 2	29 January 2024	Edge Hill
Sydney Olympic Park	Newington 2	5 February 2024	Edge Hill, Stratford
Sydney Olympic Park	Newington 2	29 February 2024	Barmah Forest
Sydney Olympic Park	Has 2	10 March 2024	Edge Hill
Sydney Olympic Park	Has 2	18 March 2024	Edge Hill

Location	Site	Date	Viruses detected
Temora	Trungley Rd	29 January 2024	Kokobera
Temora	Trungley Rd	11 March 2024	Ross River
Tweed Head	Koala Beach	29 January 2024	Ross River, Edge Hill
Tweed Heads	Beltana Dr	19 February 2024	Sindbis
Tweed Heads	Beltana Dr	4 March 2024	Ross River
Tweed Heads	Koala Beach	4 March 2024	Stratford
Wyong	Pearl Beach	22 February 2024	Stratford
Wyong	Halekulani	25 March 2024	Ross River
Wyong	Pearl Beach	10 April 2024	Stratford

Sentinel chicken surveillance results

There was a total of 11 flocks with 15 chickens in each flock located across NSW (Figure 13). The first bleed of the season was on 28 October 2023 and the last on 27 March 2024.

Figure 13: Sentinel chicken surveillance sites, NSW, 2023-2024



A total of 2,378 blood samples were received from all of the flocks in NSW during the season and tested for flaviviruses of public health concern. There were no seroconversions in the sentinel chickens during the operation of the program. However, a sentinel chicken in the Menindee flock was positive for JEV from the first bleed and it is likely to have acquired the virus in Cowra prior to arrival in Menindee and prior to the start of the surveillance season.

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 RRV and BFV.

In the 2023-2024 arbovirus season there were a total of 517 human notifications of RRV (43 confirmed and 474 probable cases) and 62 human notifications of BFV (5 confirmed and 57 probable cases) (Table 3). BFV and RRV numbers were lower than the 10-year average (Figures 14 and 15). There were no human cases of MVE, Kunjin or JEV.

Figure 14: Ross River virus notifications over the last 10 years (July 2014 to June 2024) compared to 10-year average, NSW

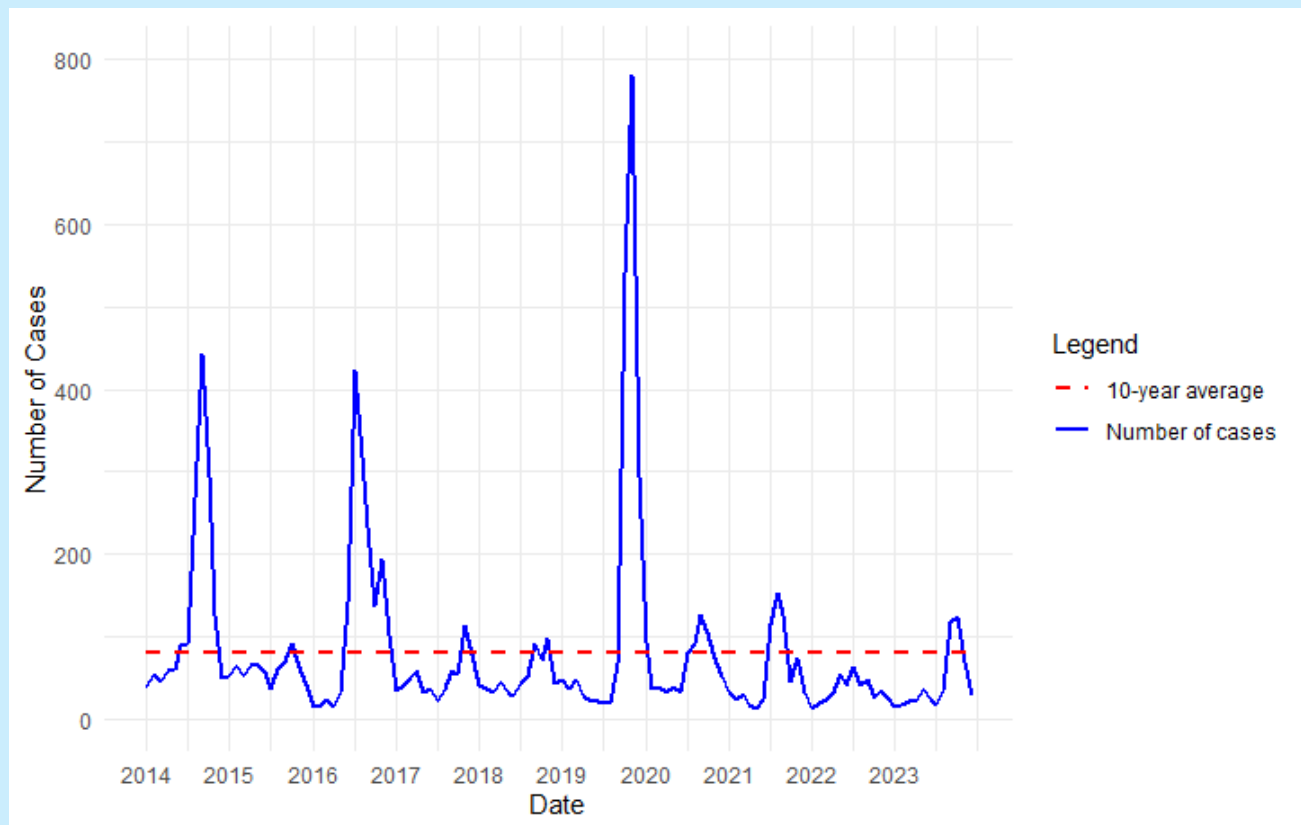


Figure 15: Barmah Forest virus notifications in NSW over the last 10 years (July 2014 to June 2024) compared to 10-year average

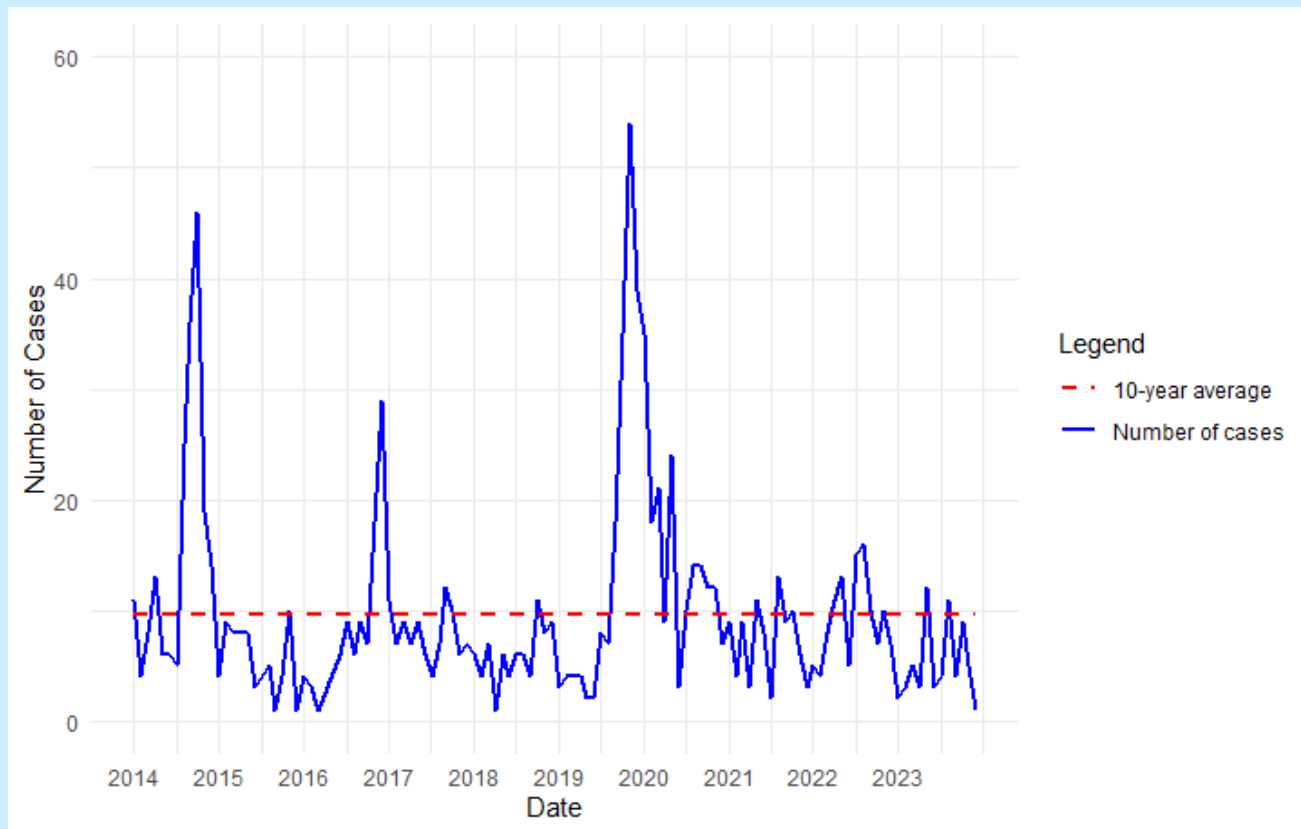
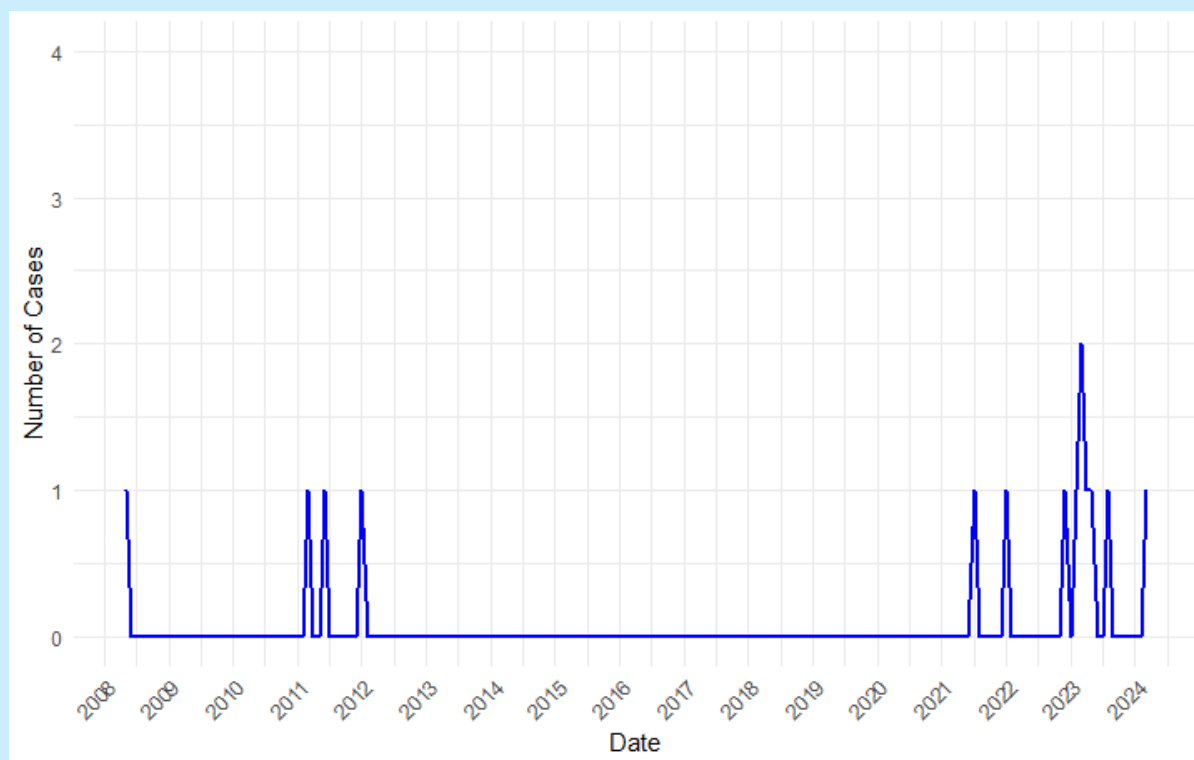


Figure 16: Murray Valley encephalitis virus notifications since 2008, NSW



RRV notifications were highest in the inland regions, with Hunter New England reporting 155 cases and Northern NSW in the coastal region with 117 cases. Hunter New England had the greatest number of BFV notifications (17) followed by Northern NSW and Mid North Coast, with 15 and 16 cases, respectively. Metropolitan Sydney areas, such as Western NSW and Northern Sydney, reported fewer cases of both viruses. In August 2023, a case of Murray Valley encephalitis was notified in a 82-year-old NSW resident from Ballina. The infection was acquired in the Kimberley region of Western Australia.

Table 3: Barmah Forest and Ross River virus human notifications in NSW by local health district and virogeographic region, 2023-2024

Local health district	Virogeographic region	Ross River virus notifications	Barmah Forest virus notifications
Hunter New England	Inland	155	17
Northern NSW	Coastal	117	15
Mid North Coast	Coastal	67	16
Western NSW	Metropolitan Sydney	39	2
Murrumbidgee	Inland	35	3
Southern NSW	Inland	25	1
Northern Sydney	Metropolitan Sydney	14	1
Central Coast	Coastal	11	1
Nepean Blue Mountains	Metropolitan Sydney	11	1
South Western Sydney	Metropolitan Sydney	8	3
Far West	Inland	7	1
Illawarra Shoalhaven	Coastal	7	0
South Eastern Sydney	Metropolitan Sydney	7	0
Sydney	Metropolitan Sydney	7	1

Western Sydney	Metropolitan Sydney	7	0
TOTAL	ALL REGIONS	517	62

* Human cases are assigned to LHDs based on the individual's residential address, it is often difficult to determine where the infection was acquired, as exposure may occur in various locations visited by the individual.

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).

Japanese encephalitis virus

The first outbreak of Japanese encephalitis virus disease on the mainland of Australia occurred over the summer of 2021-2022 and largely centred on southeastern Australia. Between then and the 2023-2024 arbovirus season, there have been no detections of JEV through the NSW Arbovirus Surveillance Program. Between the 2021-2022 and 2023-2024 arbovirus seasons, there was one human case of JEV (October 2022).

One sentinel chicken which was located at Menindee seroconverted to JEV in the initial bleed in mid-December 2023. It is likely the virus was acquired prior to the chicken arriving at Menindee, possibly from Cowra where the birds were purchased. As the chicken was a young bird, this suggests the JEV activity was very recent. This case follows on from last year when a Pacific Black duck from the lower Murrumbidgee tested positive to JEV via molecular tests in January 2023, indicating recent viral acquisition. Elsewhere in the country, there were a series of JEV positive pigs from the Northern Territory, while a number of chickens seroconverted to JEV from flocks located in the [Kimberley region of Western Australia](#) during November 2024.

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 4 shows exotic mosquito detections at first points of entry for the period July 2023 to June 2024.

Table 4: Detections of exotic mosquitoes at first points of entry in NSW, July 2023 to June 2024

Date	Mosquito species	Sex	Location	Origin*
29 December 2023	<i>Aedes aegypti</i>	Female	Sydney International Airport	Bangkok - Thailand
29 January 2024	<i>Aedes aegypti</i>	Female	Sydney International Airport	Bali - Indonesia
24 April 2024	<i>Culex pipiens</i>	Females	Sydney International Airport (in air cans)	Shanghai - China
24 April 2024	<i>Aedes aegypti</i>	Female	Sydney International Airport	Pacific Islands

*Origin determined through population analyses.

Following 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 previous seasons of 2021-2022 and 2022-2023 saw widespread outbreaks of JEV and MVEV, respectively, across southeast Australia. These outbreaks were associated with La Niña years, with 2022-2023 being the third consecutive La Niña year, which have in the past always been years of major MVEV activity.

For 2023-2024, the Southern Oscillation was more neutral, typical of an average rainfall year, which was the case for the season, and neither MVEV model was suggestive of an MVEV epidemic. The very dry winter months meant that mosquito numbers were relatively low during the start of the season, minimising arbovirus cycles and subsequent activity, particularly across inland regions, where few arboviruses were detected. Even though MVEV was not detected this season, the possibility of vertical transmission to the progeny cannot be excluded, which may result in localised activity during times of above average rainfall, as has happened in previous years.

During wet years, the number of the saltmarsh mosquito, *Aedes vigilax*, tends to be lower. For example, less than 10,000 specimens were trapped during the 2022-2023 season, and only 1,000 during 2021-2022. In contrast, for 2023-2024, more than 40,000 *Aedes vigilax* were collected. This is reflected in the higher number of arboviral detections this season. During the 2023-2024 season, notified human cases of RRV and BFV were below the 10-year average. No human cases of MVE, Kunjin or JEV were notified in NSW.

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.

