NSW Health

NSW Arbovirus Surveillance Program Annual report

2020-2021

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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, 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 2020-2021 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 2020-2021 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 2020, the autumn, winter, and spring Nicholls' values, respectively, were 1010.67mm, 1012.70, and 1010.20. All but the spring values were within the range of values for past MVEV outbreak years, however there was no evidence for MVEV activity during the season.

The year of 2020 was a La Niña year, which is typically associated with wetter years. This was reflected in higher mosquito collections from the inland, almost six times greater than the total from the previous season on 2019-2020 (which experienced extreme drought).

There were 458 human notifications of RRV and 64 BFV human notifications from inland NSW, which is nearly half the number of notifications compared to the previous season but double the long-term averages (299 RRV and 27 BFV human notifications). There were no human cases of MVEV or KUNV. There were very few arboviral detections from mosquitoes in inland areas.

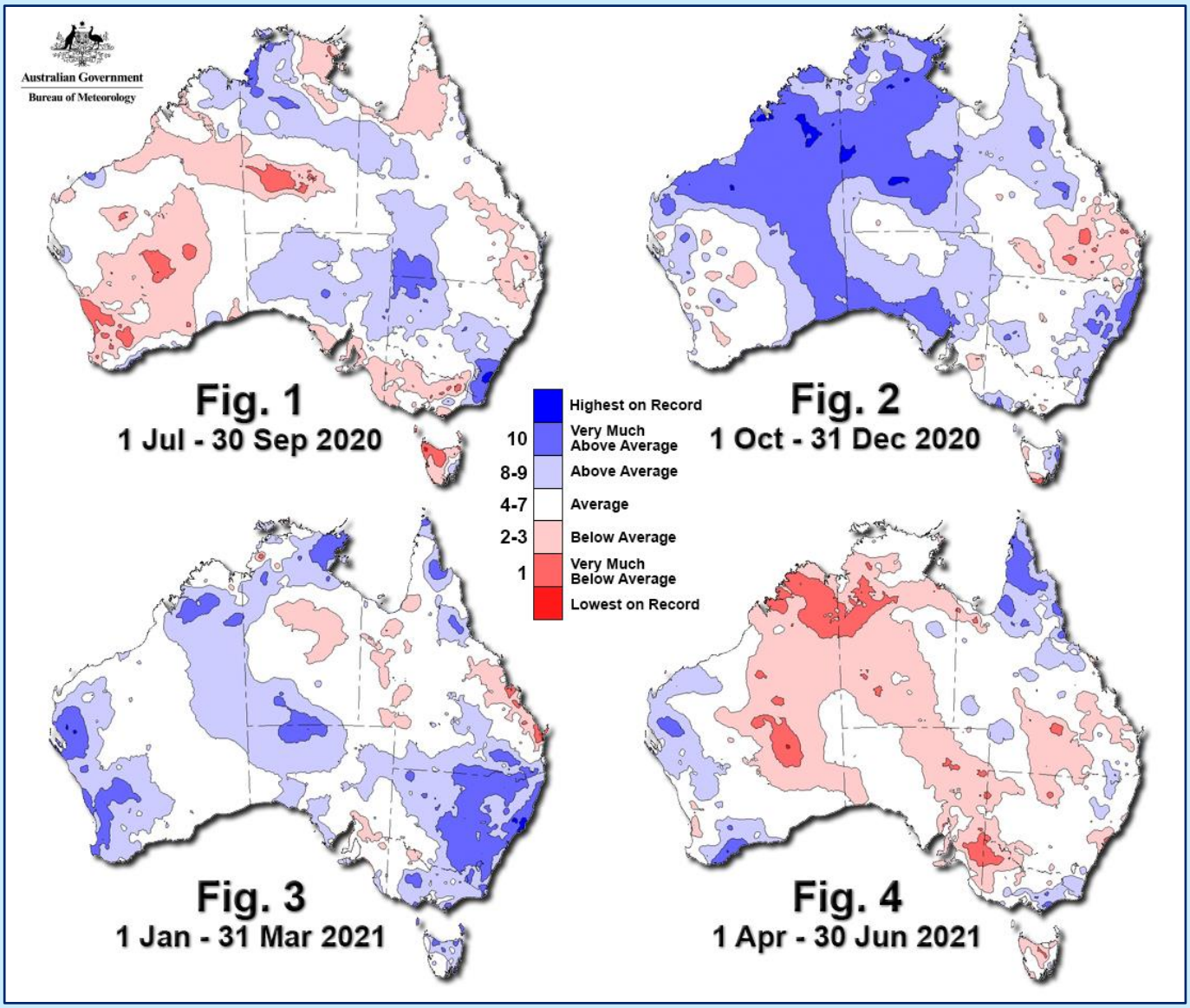
Very heavy coastal rainfall resulted in higher numbers of freshwater breeding mosquitoes in coastal areas, notably *Culex annulirostris*, but conversely, much smaller collections of *Aedes vigilax*. Overall, this season, collections in coastal areas were around 50% less compared to 2019-2020. There were 8 arboviral detections in coastal mosquitoes. There were 284 human notifications of RRV and 107 human notifications of BFV in coastal areas, less than a third of the previous season and below long-term averages of 537 RRV and 175 BFV human notifications.

For Sydney sites, mosquito numbers were also lower due largely to the lower collections of *Aedes vigilax* resulting from above average rainfall along the coast. There were only 6 arboviral detections in mosquitoes trapped in Sydney, and human notifications were slightly above the average with a total of 56 RRV and 8 BFV human 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.

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



Rainfall

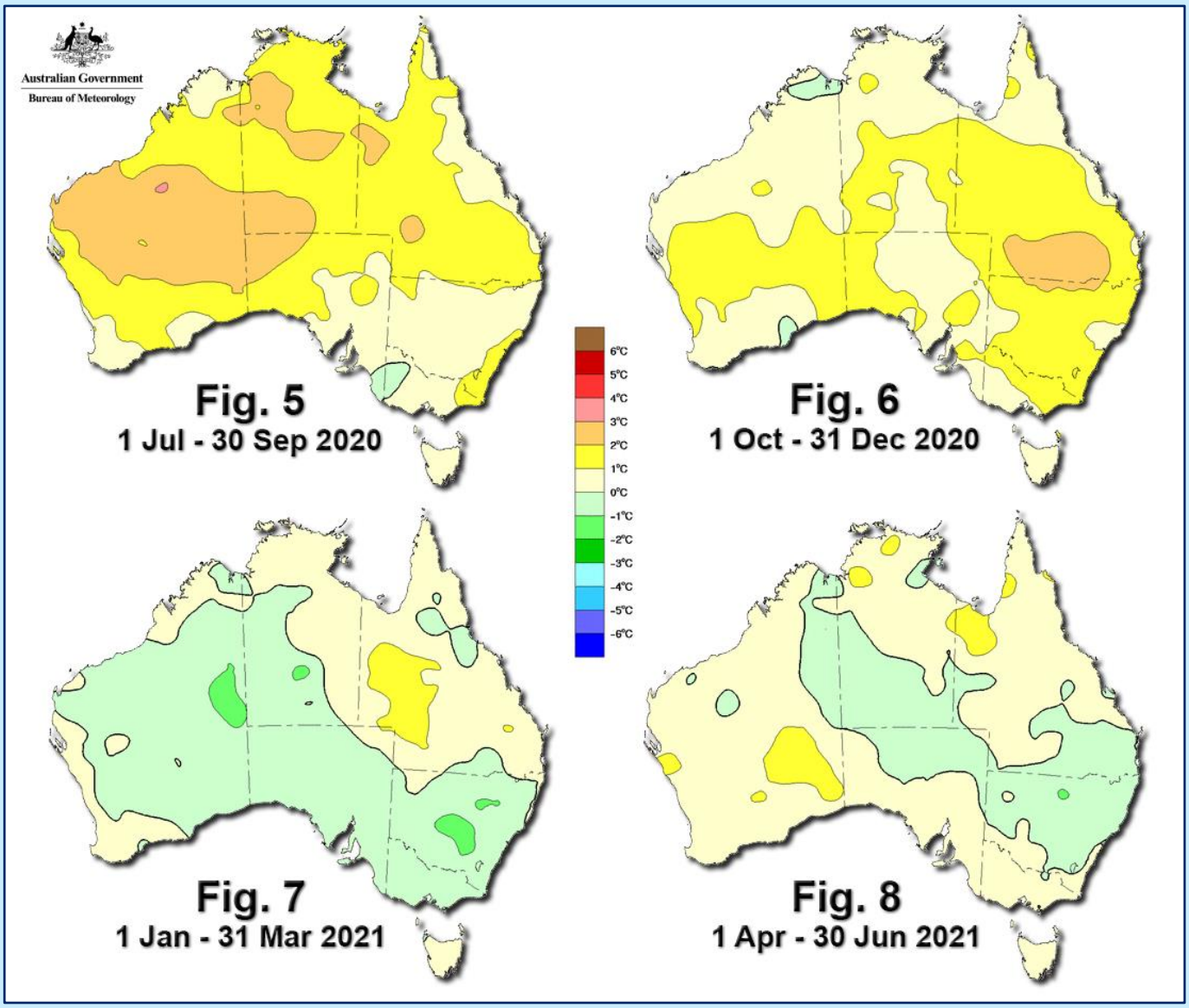
Figures 1-4 provide an overview of Australian rainfall deciles for the 2020-2021 season.

- **Figure 1: July 2020 to September 2020**. Rainfall was above average in the southeast and northwest of NSW, and average elsewhere.
- **Figure 2: October 2020 to December 2020**. Rainfall was above average along the NSW coast and tablelands districts, and very much above average along the mid to north coast. Inland regions experienced mostly average rainfall.
- **Figure 3: January 2021 to March 2021**. Rainfall was above average across the entire state, with the eastern half of NSW having very much above average.
- **Figure 4: April 2021 to June 2021**. Rainfall was mainly average for most of NSW and below average

in parts of the west.

Temperature

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



Figures 5-8 provide an overview of Australian temperature anomalies (departures from the normal) for the 2020-2021 season.

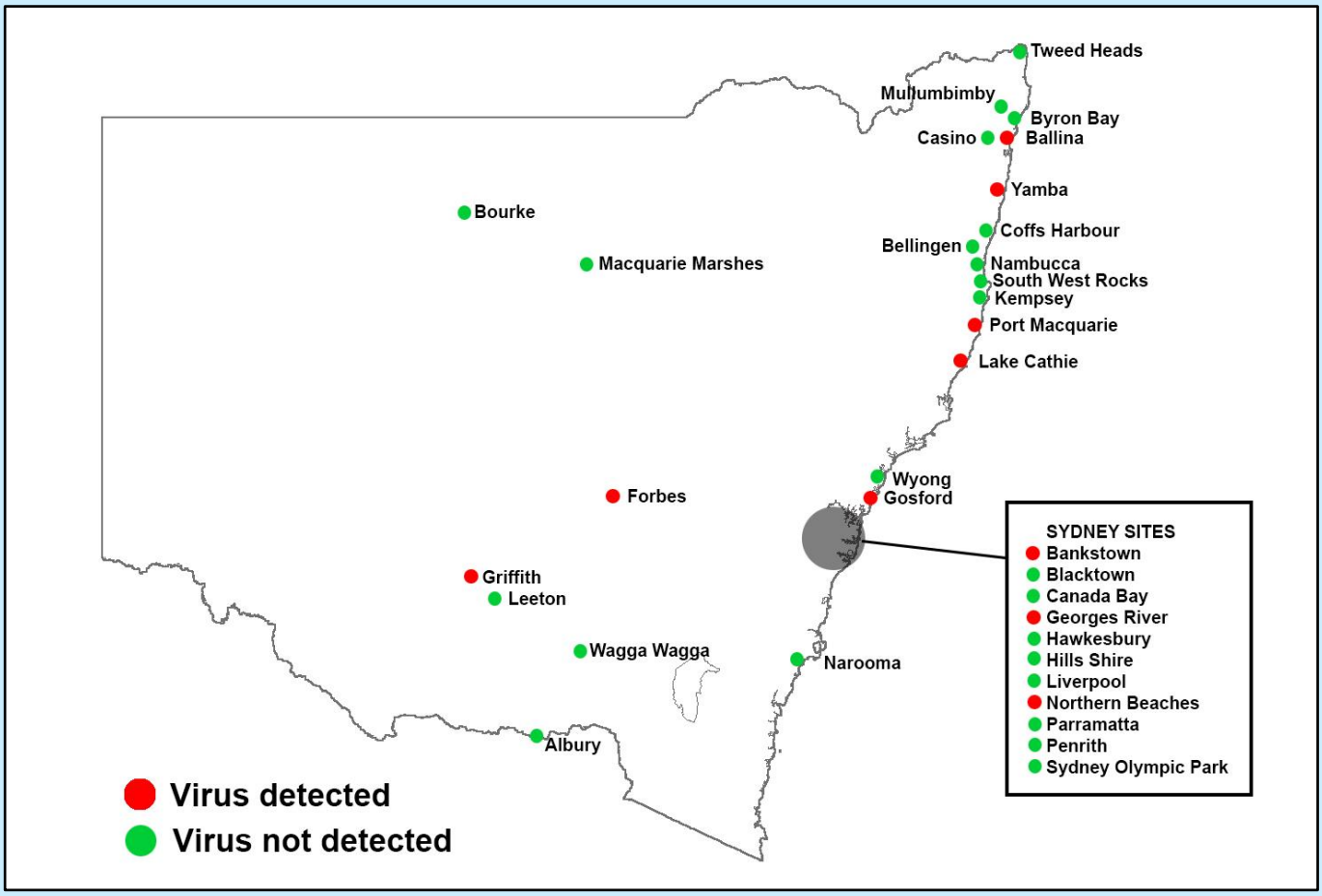
- **Figure 5: July 2020 to September 2020**. Temperatures were slightly above normal across most of NSW. It was warmer on the south coast with temperatures up to 1-2ºC above average.
- **Figure 6: October 2020 to December 2020**. Temperatures were 1-2ºC above average for almost the entire state.
- **Figures 7-8: January 2021 to June 2021**. Temperatures were up to 1ºC below average for most of NSW.

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 2020-2021, there were 68 mosquito trapping sites across 31 locations (Figure 9).

Figure 9: Mosquito trapping locations, NSW, 2020-2021



Mosquito counts

A total of 200,241 mosquitoes representing 62 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, Aedes notoscriptus*, and *Culex sitiens* 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, 2020-2021

Virogeographical zone	Total counts	Species collected
Inland	46,394 mosquitoes	21 species collected with: *Culex annulirostris* (65.8%) *Anopheles annulipes* (22.3%) *Aedes theobaldi* (4.0%)
Coastal	66,510 mosquitoes	56 species collected with: *Culex annulirostris* (34.3%) *Aedes notoscriptus* (11.2%) *Culex sitiens* (11.0%) *Aedes vigilax* (9.7%) *Aedes multiplex* (6.7%) *Verrallina funerea* (6.6%) *Culex orbostiensis* (5.3%)
Metropolitan Sydney	87,337 mosquitoes	40 species collected with: *Aedes vigilax* (60.3%) *Aedes notoscriptus* (8.4%) *Culex annulirostris* (7.3%) *Anopheles annulipes* (6.1%) *Coquillettidia linealis* (4.9%) *Aedes procax* (4.5)

The below figures show mosquito trapping results by location and species type for the 2020-2021 arbovirus season. Mosquito abundances through the ASMMP are described and reported as:

No collection | 'low' (<50 per trap) | 'moderate' (50 -100 per trap) | 'high' (101 - 1,000 per trap) | 'very high' (1,000 -10,000 per trap)

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

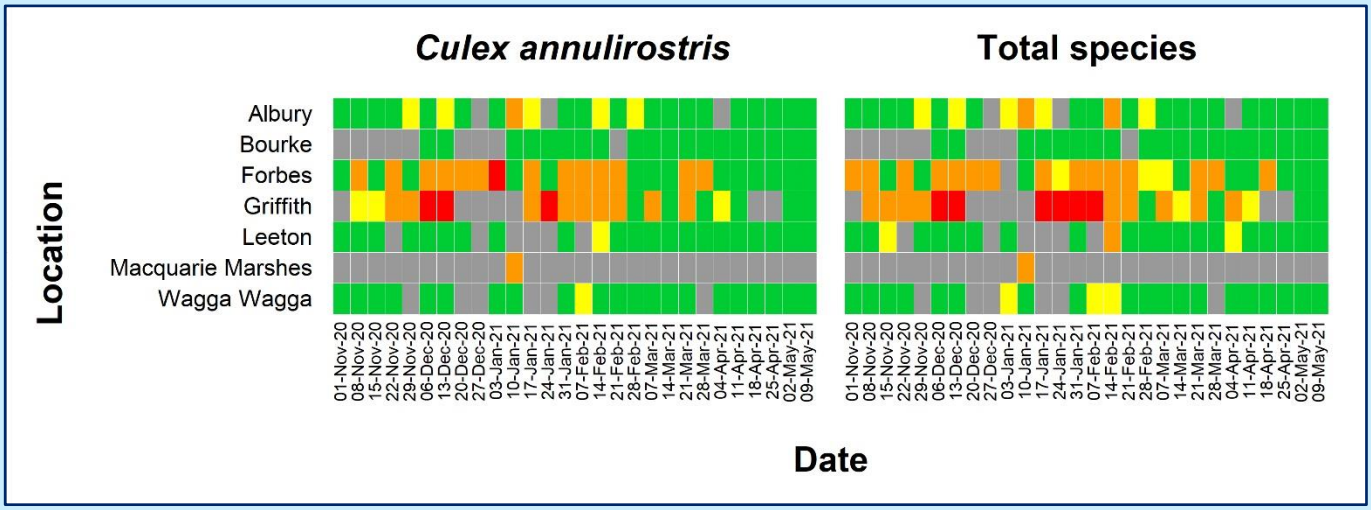


Figure 11: Number of mosquitoes trapped from the coastal region (weekly location average)

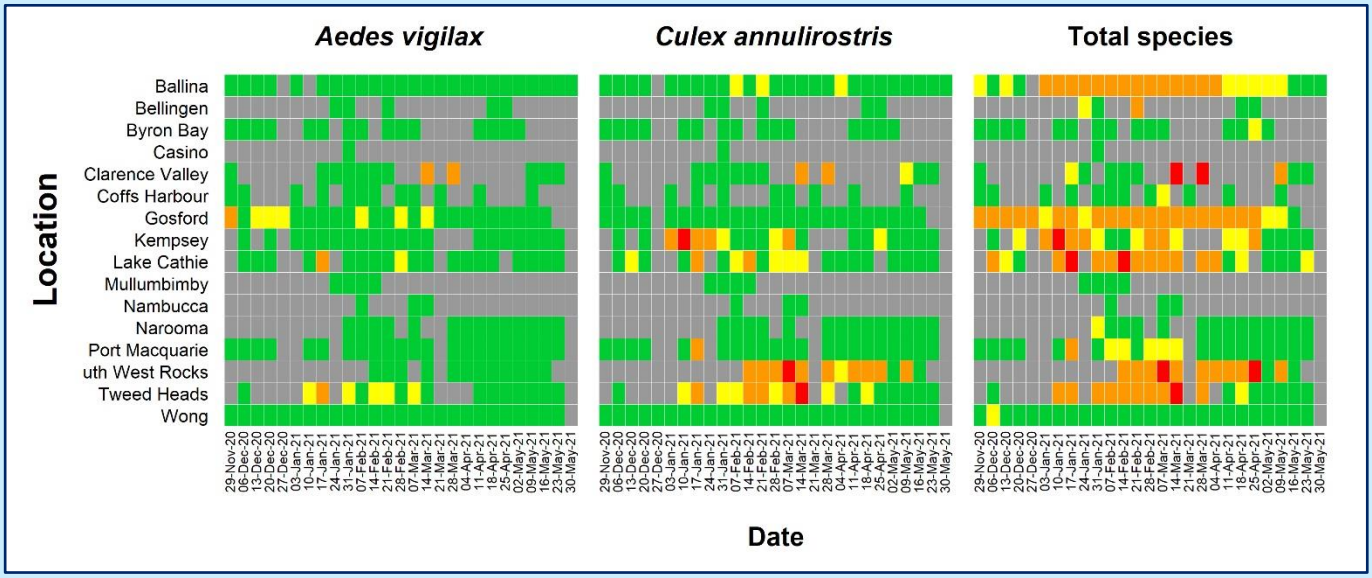
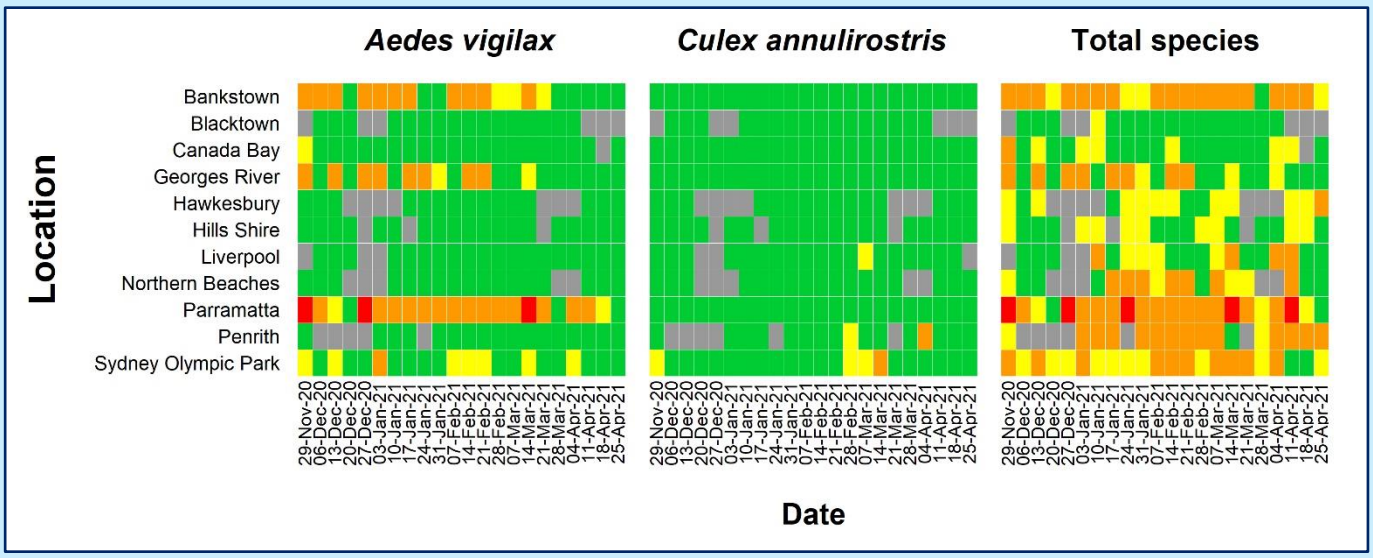


Figure 12: Number of mosquitoes trapped from the Sydney region (weekly location average)



Arboviral detections in mosquitoes

Viral detection in mosquitoes involves modern molecular techniques for identifying viral nucleic acid. From the mosquitoes processed, there were 18 detections including 1 Barmah Forest virus, 6 Ross River virus, 6 Edge Hill virus, 1 Kokobera virus, and 24 Stratford virus (Table 2). Most detections (n = 16) were from the coastal region.

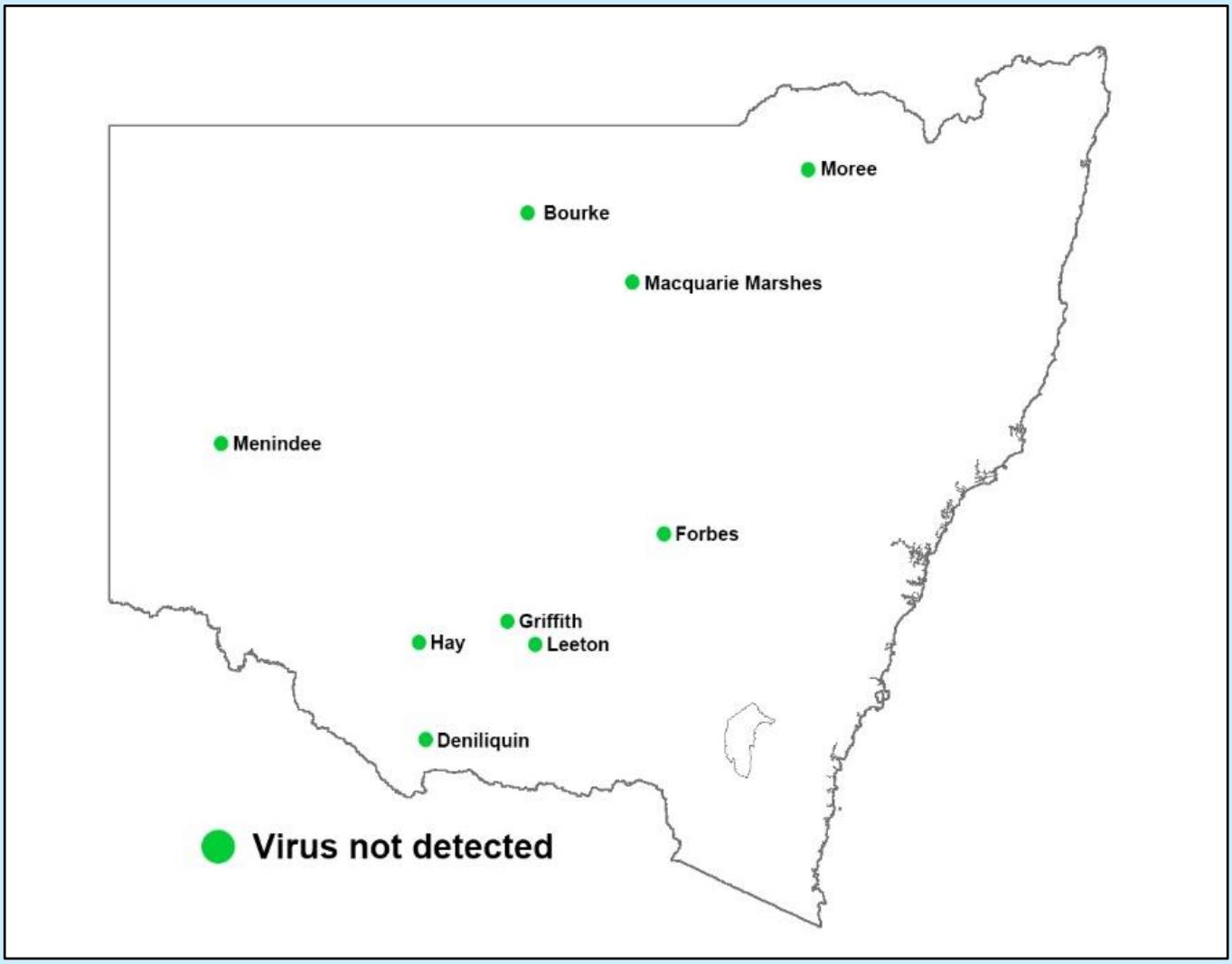
Table 2: Arboviral detections in mosquitoes, NSW, 2020-2021

Location	Site	Date	Viruses detected
Ballina	North Creek Rd	10 April 2021	Edge Hill
Bankstown	Picnic Point	25 March 2021	Stratford
Gosford	Empire Bay	2 March 2021	Edge Hill
Clarence Valley	Yamba	17 March 2021	Ross River, Edge Hill
Clarence Valley	Yamba	29 March 2021	Edge Hill
Forbes	STW	23 February 2021	Ross River
Forbes	Tom's Lagoon	20 April 2021	Edge Hill
Georges River	Alfords Point	5 January 2021	Stratford
Georges River	Alfords Point	24 March 2021	Stratford
Georges River	Alfords Point	7 April 2021	Stratford
Griffith	Hanwood	19 January 2021	Ross River
Griffith	Hanwood	24 February 2021	Kokobera
Lake Cathie	Wall Reserve	8 February 2021	Ross River
Lake Cathie	Wall Reserve	15 February 2021	Ross River
Northern Beaches	Narrabeen	25 February 2021	Barmah Forest
Northern Beaches	Narrabeen	10 March 2021	Edge Hill
Port Macquarie	Partridge Creek	8 February 2021	Ross River

Sentinel chicken surveillance results

There was a total of 9 flocks with 15 chickens in each flock located across NSW (Figure 13). The first bleed of the season was on 29 November 2020 and the last on 29 March 2021.

Figure 13: Sentinel chicken surveillance sites, NSW, 2020-2021



A total of 1,925 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.

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 2020-2021 arbovirus season, there were 179 notifications of BFV infection and 798 notifications of RRV infection in NSW residents (Table 3). BFV and RRV numbers were higher than the ten year average (Figures 14 and 15).

Figure 14: Barmah Forest virus notifications over the last 10 years (July 2011 to June 2021) compared to 10-year average, NSW

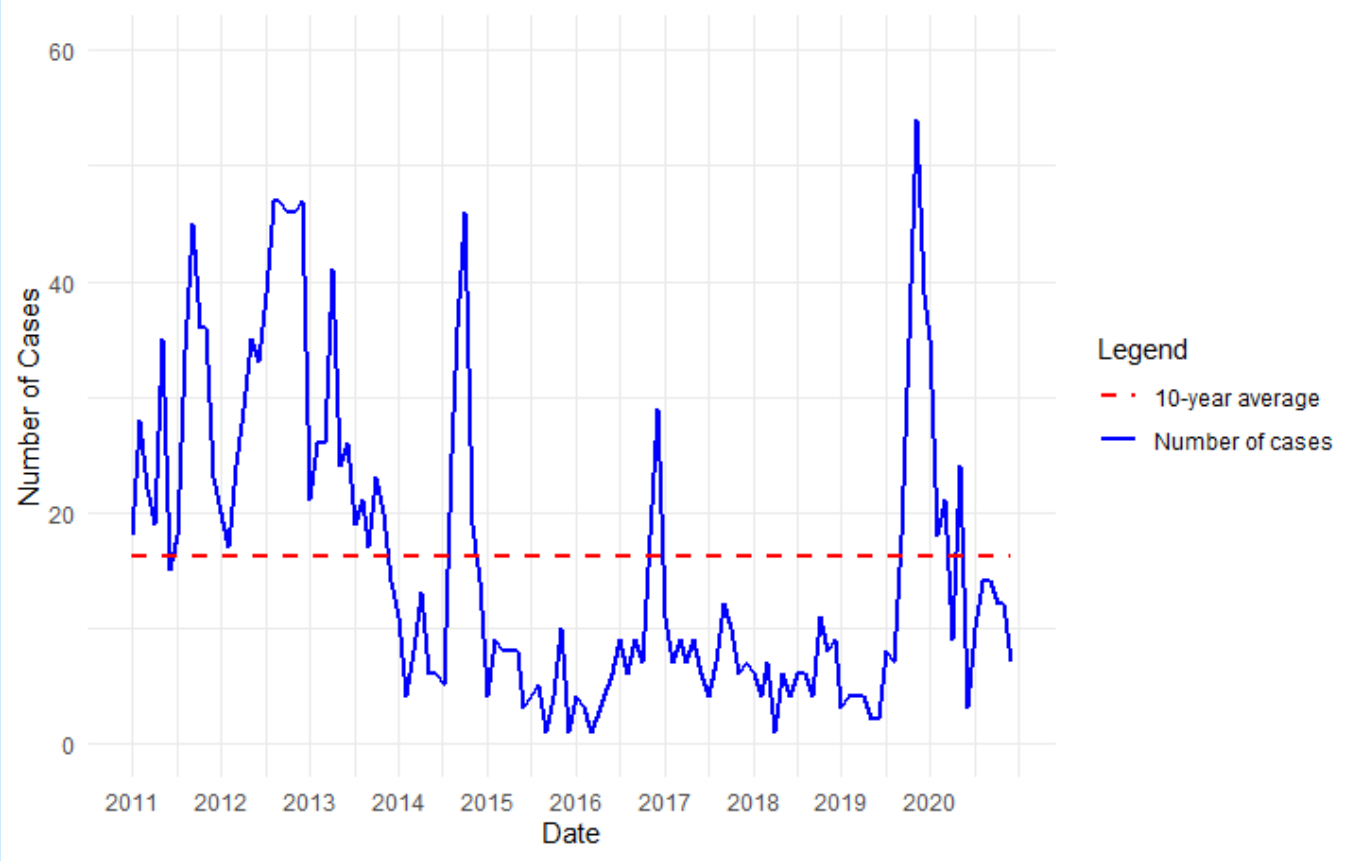
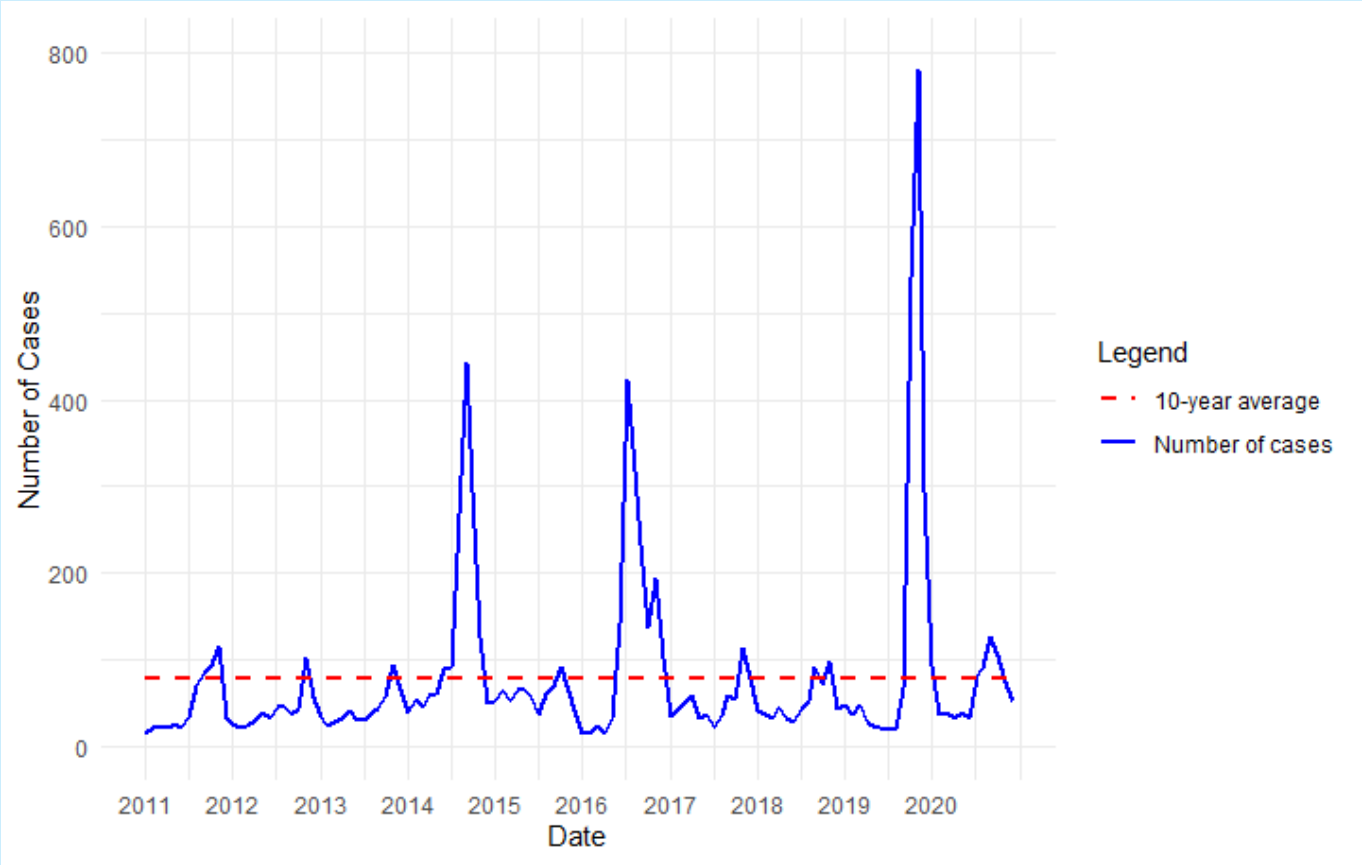


Figure 15: Yearly Ross River virus notifications over the last 10 years (July 2011 to June 2021) compared to 10-year average, NSW



The notifications for RRV and BFV show clear differences across LHDs. Inland areas had the most RRV human cases notified (458 in total), with Murrumbidgee (173 cases) and Hunter New England (164 cases) having the highest numbers. BFV cases were less common in these areas, with Hunter New England reporting the most (52 cases). Coastal regions also had significant activity in 2020-2021, with 284 RRV and 107 BFV cases. Northern NSW (126 RRV, 47 BFV) and Mid North Coast (114 RRV, 48 BFV) were the main contributors. Metropolitan Sydney had much lower human cases notified, with 56 RRV and 13 BFV cases, mainly in Northern Sydney and Nepean Blue Mountains.

Table 3: Barmah Forest and Ross River virus human notifications in NSW by local health district and virogeographic region, 2020-2021

Local health district	Virogeographic region	Ross River virus notifications	Barmah Forest virus notifications
Murrumbidgee	Inland	173	0
Hunter New England	Inland	164	52
Northern NSW	Coastal	126	47
Mid North Coast	Coastal	114	48
Western NSW	Inland	75	6
Southern NSW	Inland	36	5
Central Coast	Coastal	23	7
Illawarra Shoalhaven	Coastal	21	5
Northern Sydney	Metropolitan Sydney	17	5
Nepean Blue Mountains	Metropolitan Sydney	16	2
South Eastern Sydney	Metropolitan Sydney	12	1
Far West	Inland	10	1
Sydney	Metropolitan Sydney	5	0
South Western Sydney	Metropolitan Sydney	4	0
Western Sydney	Metropolitan Sydney	2	0
TOTAL	**ALL REGIONS**	**798**	**179**

* 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).

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.

In recent years, there have been numerous detections of exotic mosquitoes across Australian ports. However, for July 2020 to June 2021, there were no exotic detections in New South Wales. Across the country, the number of exotic detections declined during the COVID-19 pandemic as there was a dramatic decline in international flights and therefore a reduced risk of the introduction of exotic mosquitoes.

Discussion

The climatic conditions leading up to 2020-2021 was a period of average to above average rainfall across the state. The coastal strip experienced particularly heavy precipitation late in 2020. The first three months of 2021 were especially wet, with above average rainfall across most of the state. Despite these conditions, and the fact that 2020 was a La Niña year, neither the Forbes nor the Nicholls hypotheses were suggestive of a potential MVEV epidemic for the 2020-2021 season. MVEV activity was not detected in either the mosquitoes or the sentinel chickens, and no human notifications of the disease were reported.

Much of the above average rainfall across the inland occurred well into the start of 2021, too late to dramatically influence the mosquito numbers across the region. Overall numbers of mosquitoes trapped (46,394) in 2020-2021 were much higher than during 2019-2020 (7,382). However, 2019-2020 experienced severe drought resulting in some of the lowest collections to date for the history of the arbovirus program. The overall collections for 2020-2021, were still relatively low, which was reflected in the few arboviral detections and the average number of human notifications.

For most mosquito species, higher rainfall results in increased mosquito numbers as larval habitat availability increase. However, the converse occurs for saltmarsh mosquitoes, where continual rainfall means that the saltmarsh habitats remain wet, preventing the required drying maturation period for the egg stage, and more access to hatched larvae by aquatic predators. Consequently, this season experienced much lower numbers of *Aedes vigilax*, with *Culex annulirostris* being more predominant. The number of mosquitoes trapped along the coast this season were half the number of mosquitoes trapped the previous season, and arboviral activity was minimal. There were 8 arboviral detections and human cases were well below average.

Similarly, Sydney sites produced fewer mosquito numbers, around one third of that yielded in 2019-2020. Arboviral detections were few and human notifications were around average.

Acknowledgements

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