Mosquito-borne viral diseases in the ACT

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There are numerous mosquito species in the ACT but the topography and climate in the ACT do not provide optimal conditions for mosquito activity; hence their numbers are relatively low. Some mosquitoes in the ACT are known vectors of mosquito-borne pathogens including Ross River and Barmah Forest viruses. However, given the relatively low numbers of mosquitoes, the incidence of mosquito-borne diseases is similarly low in the ACT. Travel of residents to regions of higher mosquito-borne disease risk, the abundance of suitable reservoir hosts (i.e. kangaroos) locally and the construction of wetlands in new residential developments may drive increasing mosquito numbers and mosquito-borne disease risk in the future.

Mosquito-borne disease in the ACT

Mosquitoes are not only a nuisance due to their biting effects but also have the potential to cause public health risks through the transmission of pathogens. Mosquito-borne diseases in Australia include Dengue fever, Murray Valley Encephalitis, Kunjin virus disease, Ross River (RRV) virus disease and Barmah Forest (BFV) virus disease. Dengue is the most important viral disease transmitted by mosquitoes affecting humans in a global context but, in Australia, local activity of Dengue is restricted to Queensland, where the only local vector, *Aedes aegypti*, is found. Cases of malaria, which is caused by a mosquito-borne parasite rather than a virus, are recorded in Australia in travellers who have returned from countries with ongoing transmission. Australia was declared free of malaria in the 1980s.

RRV and BFV are responsible for most mosquito-borne illness in Australia, with an average of 7,218 (5412 RRV and 1806 BFV) cases reported each year. Infection with these pathogens cause illness typified by symptoms that include fever, rash, joint pain and fatigue. Other arboviruses, such as Murray Valley Encephalitis Virus (MVEV) and Kunjin Virus (KUNV) are not very common but, in the case of MVEV, can cause potentially severe and sometimes fatal disease in Australia.

Over the course of the survey, a total of 594 mosquitoes representing 12 species were collected in 90 traps. The three most commonly collected mosquito species were *Aedes notoscriptus* (28.1 percent), *Culex annulirostris* (23.1 percent) and *Culex quinquefasciatus* (22.4 percent). All three mosquitoes are potential pest and vector (able to transmit disease) species. Overall, the survey confirmed low mosquito numbers in the ACT, compared to NSW. Most were collected with fewer than 10 mosquitoes per trap. There are likely to be more species that were not collected in this survey, associated with bushland areas throughout the region, but these are unlikely to pose any greater pest or public health risk.

Queenland and the Northern Territory carry the largest burden of mosquito-borne diseases in Australia, with favourable climatic and environmental conditions resulting in abundant mosquito populations and an extended mosquito season. In NSW, the ongoing focus of mosquito-borne disease risk is along the coast, with inland regions experiencing elevated risks only during periods of above average rainfall and subsequent flooding.

In the ACT, between 2006 and 2013 there were, on average, 11 cases of RRV, 4 cases of BFV and 13 cases of dengue virus disease notified each year. All dengue cases are in returned travellers. Overall, ACT has a lower incidence rate of arboviral disease notifications compared to the surrounding state of NSW. This is a reflection of the relatively low abundance of the mosquito population in the ACT.

Ross River virus disease

Over a 10-year period from 2006 to 2015, there were 110 cases of RRV infections notified (average 11 per year). Over this time period, the average rate of RRV notifications was 3.08 per 100,000 population per year. This was lower than the notification rates in neighbouring NSW and nationally. (Figure 1 on page 22)

Barmah Forest virus disease

There were 41 cases of BFV infections notified in the ACT from 2006 to 2015. The average rate of BFV was 1.15 per100,000 population per year. Similar to RRV, the notification rates of BFV were lower in the ACT compared to NSW and Australia (Figure 2 on page 22).

Dengue

From 2006 to 2015, there were 131 cases of Dengue notified in the ACT and all cases were associated with travel. In Australia, as discussed, local transmission of dengue viruses is limited to areas of North Queensland where the primary mosquito vector, *Aedes aegypti*, is present. Where place of acquisition was known, Dengue notifications in the ACT were overseas acquired. Nationally, most of the overseas-acquired Dengue cases between 1999 and 2012, were from Indonesia. Similarly, in the ACT the most common country of disease acquisition was Indonesia.

Other arboviruses of significance to human health

There were no notifications of human infection with MVEV, KUNV, or Japanese encephalitis virus in the ACT. Chikungunya and Zika are two other arboviruses of human health importance which have never been recorded in the ACT (see Hot issues on page 31).

Mosquitoes in the ACT

There are over 300 species of mosquitoes in Australia but only a small percentage of these pose a significant biting nuisance or public health risk. The diversity of these species can vary greatly across the country, as well as within regions, as a result of variable patterns of rainfall, temperature and, along the coast, tides.

In 2012/2013, a mosquito survey was undertaken in the ACT for the first time to determine the relative abundance, diversity and distribution of mosquitoes. Sampling of mosquitoes was done using carbon dioxide baited traps, in areas where there were actual or potential mosquito habitats as indicated by the presence of natural and/or constructed wetlands, bushland areas or extensive storm-water systems.

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Image: *Culex quinquefasciatus*. James Gathany, Public Health Image Library
The low abundance of mosquitoes is primarily due to the absence of significant wetland habitats and the generally dry conditions during the study period. Although there are large water bodies throughout the ACT, the majority of these do not provide suitable conditions for mosquitoes. The topography of the ACT limits opportunities for extensive inundation to occur after rainfall, as is the case for inland flood plain habitats. The low average temperature in the ACT also limits the period that mosquitoes are most active.

A limitation of the recent survey was that it was undertaken at a fixed time, thereby providing only a snapshot of the mosquito fauna during summer 2012/2013. The diversity and abundance of mosquitoes will vary from season to season, with rainfall and temperatures driving potential mosquito abundance. The greatest mosquito populations are likely to occur during summers with average to above average temperatures combined with above average rainfall, ideally distributed over the summer period (as opposed to a single substantial rainfall event).

**Implications for the ACT**

There are a number of conditions that are required for local transmission of arboviral diseases. These include adequate numbers of reservoir hosts (i.e. a long term source of a pathogen of an infectious disease), mosquitoes and the right climatic conditions. Although the mosquito population in the ACT is relatively low, there are known mosquito vectors of RRV and BFV, which may have the potential to trigger local outbreaks. The highest risk factors for this are climatic conditions, such as high rainfall and/or outbreaks of mosquito-borne disease in nearby regions of NSW. It is possible that infected people returning to the ACT could act as reservoir hosts, infect the local mosquito population and trigger clusters of locally acquired infection.

One critical issue for ACT is that there is an abundance of kangaroos close to residential areas. Macropods, including both kangaroos and wallabies, are considered the major reservoirs for RRV. Outbreaks of RRV disease rarely, if ever, occur in regions without the presence of macropod populations and they appear to be a critical component of RRV transmission cycles.
Preventing mosquito borne diseases
There are a number of ways to prevent mosquito-borne diseases. These include behavioural measures such as:

- Avoiding areas where mosquitoes are most active, particularly bushland and wetlands areas within two weeks of major rainfall;
- Avoiding being outside and unprotected at times where mosquitoes are most active (usually dusk and dawn);
- Applying topical insect repellent containing diethyltoluamide (DEET) or picaridin as a thin, even covering of all exposed skin when outdoors;
- Wearing light-coloured, loose fitting clothing and covered footwear when outside;
- Using flyscreens or sleeping under mosquito nets when camping; and
- Limiting sites where mosquitoes can breed around the house by discarding items that can hold water or emptying them regularly.

These preventive strategies are particularly important for people travelling to other parts of the country, or overseas, where mosquito activity is high. It is important that ACT residents are not complacent about mosquitoes as, despite relatively low populations at home, mosquitoes can be extremely abundant in nearby regions (e.g. coastal areas) due to differences in the environmental drivers of activity.

Additionally, with the increased number of constructed wetlands in the ACT associated with more recent urban developments, we may see a relative increase in mosquito activity in the future. Nuisance biting and disease transmission risks in the future can be mitigated through appropriate design of urban development and constructed wetlands. Many of the constructed wetlands within the ACT are currently in their infancy and aquatic and terrestrial vegetation has yet to become established. As this grows, there is the potential that suitable conditions for mosquitoes will occur.

Mosquito surveillance provides a useful way of monitoring mosquito activity. Given the low notification rates, the ACT does not currently have a surveillance system similar to the NSW Arbovirus Surveillance and Mosquito Monitoring Program that monitors mosquito activity in NSW.

References