Communicable Diseases Network Australia National Arbovirus and Malaria Advisory Committee annual report, 2006–07

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Abstract

This report describes the epidemiology of mosquito-borne disease in Australia for the mosquito-borne disease season 1 July 2006 to 30 June 2007, which was moderately low compared to previous seasons. Ross River virus (RRV) infections (55%), Barmah Forest virus (BFV) infections (29%) and overseas acquired malaria (11%) were the most common mosquito-borne diseases reported in 2006–07. The number, proportion and rate of national BFV notifications were the second highest on record since 1998–99. The Northern Territory reported the highest BFV notification rate this season. BFV notification rates were the highest in the 40–59 year age groups when compared to other age groups. The number, proportion and rate of RRV notifications were moderately low this season compared with previous seasons. The highest RRV rate was reported by Western Australia from the Kimberley region. The highest age-specific RRV notification rate was observed in the 40–59 year age groups. Locally acquired dengue virus notifications were low this season compared to previous seasons, with a small outbreak of dengue serotype 3 in 39 cases confined to the greater Townsville region. There were 640 notifications of malaria in 2006–07 of which none were reported as locally acquired. This was the third highest number of malaria notifications since 2001. *Plasmodium falciparum* was reported as the infecting species in 47% of the malaria notifications and *Plasmodium vivax* for 40% of cases. Young adolescents and adults in the 15–29 year age group had the highest number of cases accounting for 32% of notifications. Sentinel chicken surveillance data for flaviviruses and sentinel pig surveillance data for Japanese encephalitis virus are also reported. *Commun Dis Intell* 2008;32:31–47.

Keywords: arbovirus; Barmah Forest virus, chikungunya, dengue, disease surveillance; epidemiology, flavivirus, Japanese encephalitis, Kunjin, malaria, mosquitoes, Murray Valley encephalitis virus, Ross River virus, vectorborne disease

Introduction

This report describes the epidemiology of nationally notifiable mosquito-borne disease in Australia for the season 1 July 2006 to 30 June 2007.

The eight notifiable mosquito-borne diseases under national surveillance include the alphaviruses (Barmah Forest virus and Ross River virus), the flaviviruses (dengue, Japanese encephalitis, Kunjin, Murray Valley encephalitis and flavivirus not elsewhere classified), and malaria.

Alphaviruses are ribonucleic acid (RNA) viruses which cause disease epidemics characterised by fever, rash and polyarthritis. In Australia, Barmah Forest virus (BFV) infection and Ross River virus (RRV) infection are the alphaviruses of major public health significance. There are a variety of mosquito vectors which facilitate the transmission of these viruses in diverse environments (freshwater habitats, coastal regions, salt marshes, floodwaters, established wetlands and urban areas).[1,2] At this time, the alphavirus chikungunya virus has not become established in Australia despite its increased activity in southern Asia and the Indian Ocean over the past year, and its occasional diagnosis in returning travellers.

Flaviviruses are single-stranded RNA viruses, some of which are associated with epidemic encephalitis in various regions of the world. In Australia, the flaviviruses of public health importance are the dengue viruses (DENV) with frequent seasonal outbreaks,[3–6] Japanese encephalitis virus (JEV) with occasional outbreaks,[7–12] and sporadic cases of Murray Valley encephalitis virus (MVEV) or Kunjin virus (KUNV) infections.[13] The International Committee for Taxonomy of Viruses refers to Kunjin as a strain of West Nile virus (WNV)[14] and the Australian Kunjin strains are phylogenetically located in the WNV lineage 1, clade B.[15]

Malaria is caused by infection with a protozoan blood parasite from the genus *Plasmodium* that has been transmitted by a species of mosquito from the genus *Anopheles*. Malaria was eradicated from Australia in 1981 and Australia was certified malaria-free by the World Health Organization in

1983,[16] but the region of northern Australia above 19°S latitude in particular, remains receptive to malaria transmission. Since 1981, malaria acquired in Australia has been rare, but there have been several documented reports of outbreaks[17,18] and sporadic locally acquired cases in Queensland,[19,20] malaria acquired in the Torres Strait,[21] and the artificial induction of malaria by blood transfusion.[22]

Methods

Eight nationally notifiable mosquito-borne diseases were analysed for the seasonal period 1 July 2006 to 30 June 2007. Historical data from 2001, and in some cases from 1991, are also included for comparison. Data were extracted by diagnosis date from the National Notifiable Diseases Surveillance System (NNDSS) on 21 September 2007 and finalised with state and territory public health surveillance managers.

Epidemic curves by state or territory were produced for each of the eight diseases. Notifiable mosquito-borne disease activity is shown compared with a five-year mean for the same period, by jurisdiction. The rolling monthly mean was calculated for the mosquito-borne disease activity for the equivalent month over five years. The number of notifications and annual or annualised notification rates for locally acquired mosquito-borne disease were calculated using the December 2006 population estimates from the Australian Bureau of Statistics (ABS), for each year. Age– and sex-specific notification rates were calculated using age and sex population estimates for each jurisdiction.

A survey was conducted with state and territory surveillance managers and public health laboratories about imported cases of chikungunya virus infections during 2006–2007.

The geographical distribution of selected diseases was mapped using ArcGIS (ESRI, Redlands, CA, USA). Maps were based on the postcode of residence of each notification aggregated to the appropriate Statistical Division, and rates were calculated using the number of notifications (numerator) divided by the estimated 2006 ABS populations for each division (denominator).

Sentinel chicken surveillance data for flaviviruses and sentinel pig surveillance data for Japanese encephalitis virus are reported.

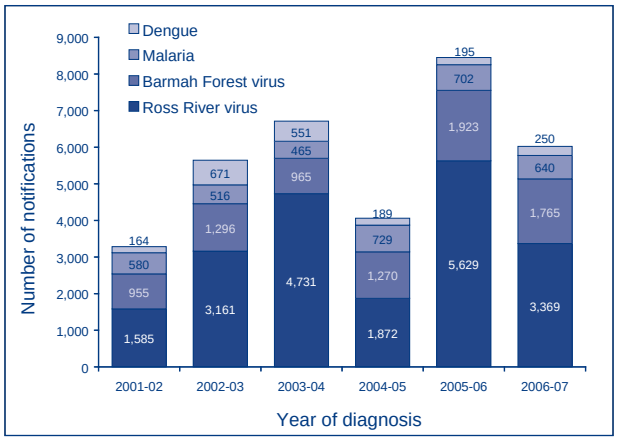
Results

Alphaviruses

During this reporting period, there were 5,134 alphavirus notifications (BFV and RRV) reported in Australia, which was a moderate season when compared with other seasons since 1995–96 (mean: 4,933, range: 612–8,422 notifications). The highest alphavirus season on record was observed in 1995–96. During 2005–06, Australia experienced the second highest alphavirus season on record with 7,552 notifications.

During 2006–07, RRV infections accounted for 55% (n=3,369) of notifications (Figure 1), which as a proportion of total mosquito-borne disease activity is moderately low when compared to previous seasons (range: 47–73%). The number and proportion of BFV notifications (n=1,765, 29%) were the second highest on record since 1998–99 and the BFV notification activity for 2006–07 was 1.4 times the five-year mean.

Figure 1. Notifications of select mosquito-borne diseases, Australia, 1 July 2001 to 30 June 2007, by season of onset



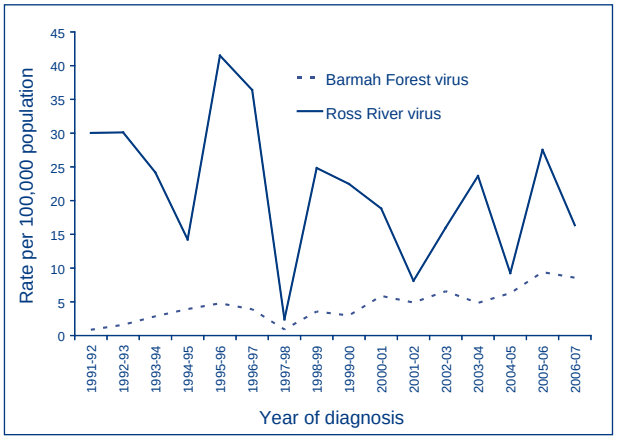
The crude annual BFV notification rate in 2006–07 of 8.6 cases per 100,000 population was the second highest notification rate since reliable reporting of this disease commenced in 1991 (Figure 2). The crude annual RRV notification rate was moderately low in 2006–07 (16.4 cases per 100,000 population) when compared to 2005–06 and other seasons in which there was significantly higher epidemic activity (1991–93, 1995–97, 1998–00, 2003–04).

Barmah Forest virus infections

Figure 3 shows the epidemic curves of BFV notifications by month and season since 2002–03 with a rolling mean of BFV activity for the same month over five years. During 2006–07, there were 1,765 BFV notifications, the majority of which were reported by Queensland (n=875, 50%) and New South Wales (n=590, 33%). The peak number of notifications was observed in April 2007 (n=245) and was smaller than the previous peak month in 2003 and 2006. The most striking feature of the BFV season in 2006–07 was the unusually high and sig-

nificant notification activity occurring outside of the peak seasonal months, with notifications exceeding two standard deviations above the five year monthly rolling mean from July to October 2006. New South Wales, the Northern Territory, Queensland, and South Australia notified the majority of activity from June to October 2006, with between 25%–47% of their jurisdictional total for the season reported during this quarter. One explanation is that the laboratory-based notifications diagnosed from July to September 2006 may be the result of late onset or late presentations from possible exposure during the epidemic peak months in February–May 2006. Another possible explanation may be that climatic conditions were favourable for earlier than usual breeding of vectors leading to an earlier period for transmission.

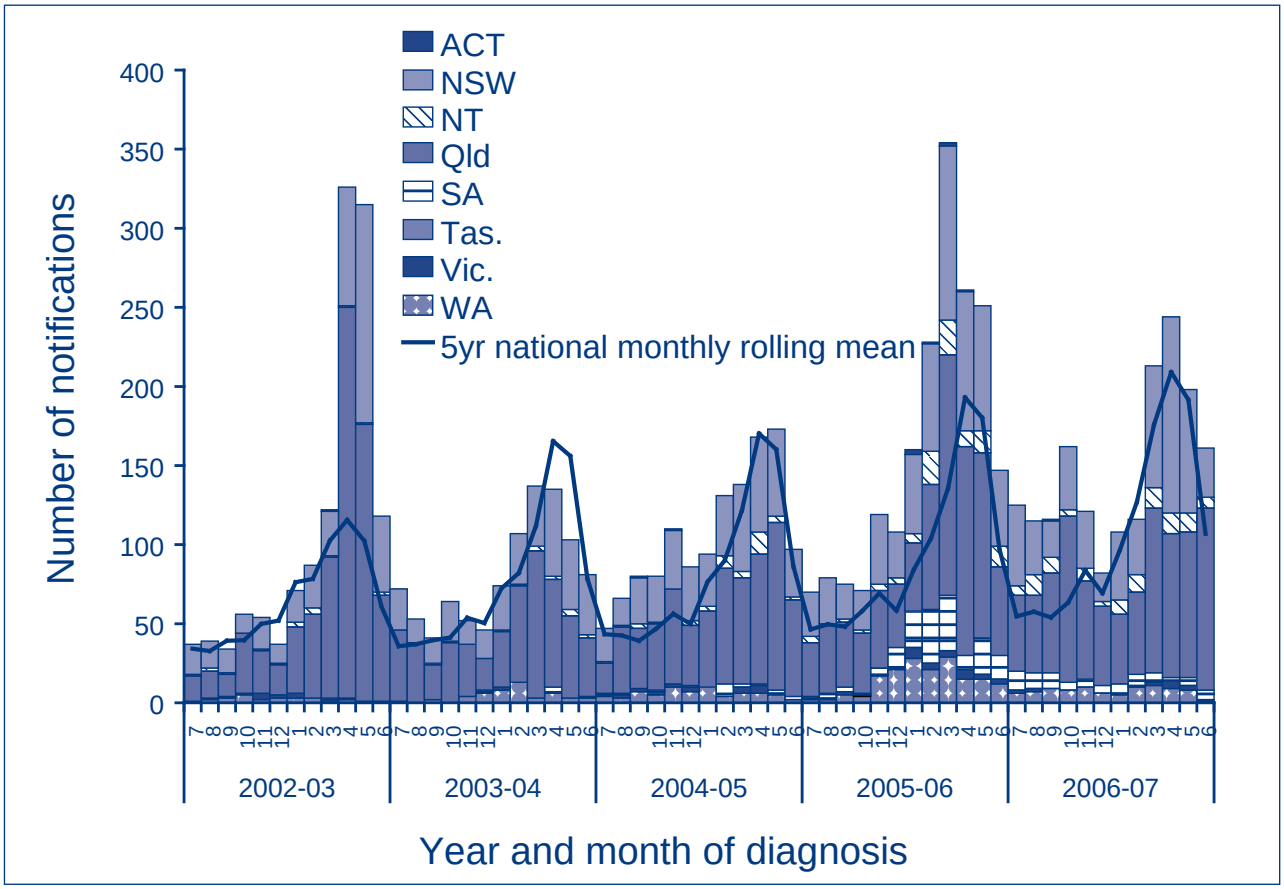
Figure 2. Crude annual notification rates for Barmah Forest virus and Ross River virus, Australia, 1 July 1991 to 30 June 2007, by season of diagnosis



During 2006–07, all jurisdictions except Tasmania and Victoria reported BFV activity above the five-year mean (Figure 4). The Northern Territory and South Australia notified more than two times the five-year mean and notifications from these jurisdictions have been increasing since the 2004–05 season (Figure 3).

Table 1 and Map 1 show that the highest rates of BFV notifications in Statistical Divisions during 2006–07 were reported from the Northern Territory (74.4 per 100,000 population), which excludes Darwin, Palmerston and Darwin rural areas (as there are only two Statistical Divisions in the Northern Territory). There is a higher rate of alphavirus notification in the Darwin rural area when compared with Darwin, with Palmerston having an intermediate rate (Peter Whelan, personal communication).

Figure 3. Epidemic curves of Barmah Forest virus infection notifications, Australia, 1 July 2002 to 30 June 2007, by month and season of diagnosis



Moderately high rates of BFV notification in Australia were reported from the Central West and Northern Statistical Divisions in Queensland, and the Mid-North Coast Statistical Division in New South Wales. The second highest BFV notification rate in New South Wales (45.9 notifications per 100,000 population) was reported in the South Eastern Statistical Division, and this was linked to

Table 1. Highest notification rates of Barmah Forest virus infection in select jurisdictions, Australia, 1 July 2006 to 30 June 2007, by Statistical Division of residence

Notifying jurisdiction	Statistical Division	Rate (per 100,000)	Notifications (n)	ABS population estimate
Northern Territory	Northern Territory*	74.4	69	92,733
Queensland	Central West	57.6	7	12,155
New South Wales	Mid-North Coast	51.1	152	297,409
Queensland	Northern	48.4	102	210,943
New South Wales	South Eastern	45.9	94	204,854
Queensland	Fitzroy	42.4	82	193,182
Queensland	Far North	37.7	92	243,948
Northern Territory	Darwin	34.2	39	113,955
New South Wales	Richmond-Tweed	33.8	77	227,815
South Australia	Murray Lands	31.9	22	69,066
Victoria	East Gippsland	13.1	11	84,222

* Excludes Darwin, Palmerston and Darwin rural area.

Map 1. Notifications and notification rates of Barmah Forest virus infection, Australia, 1 July 2006 to 30 June 07, by Statistical Division of residence

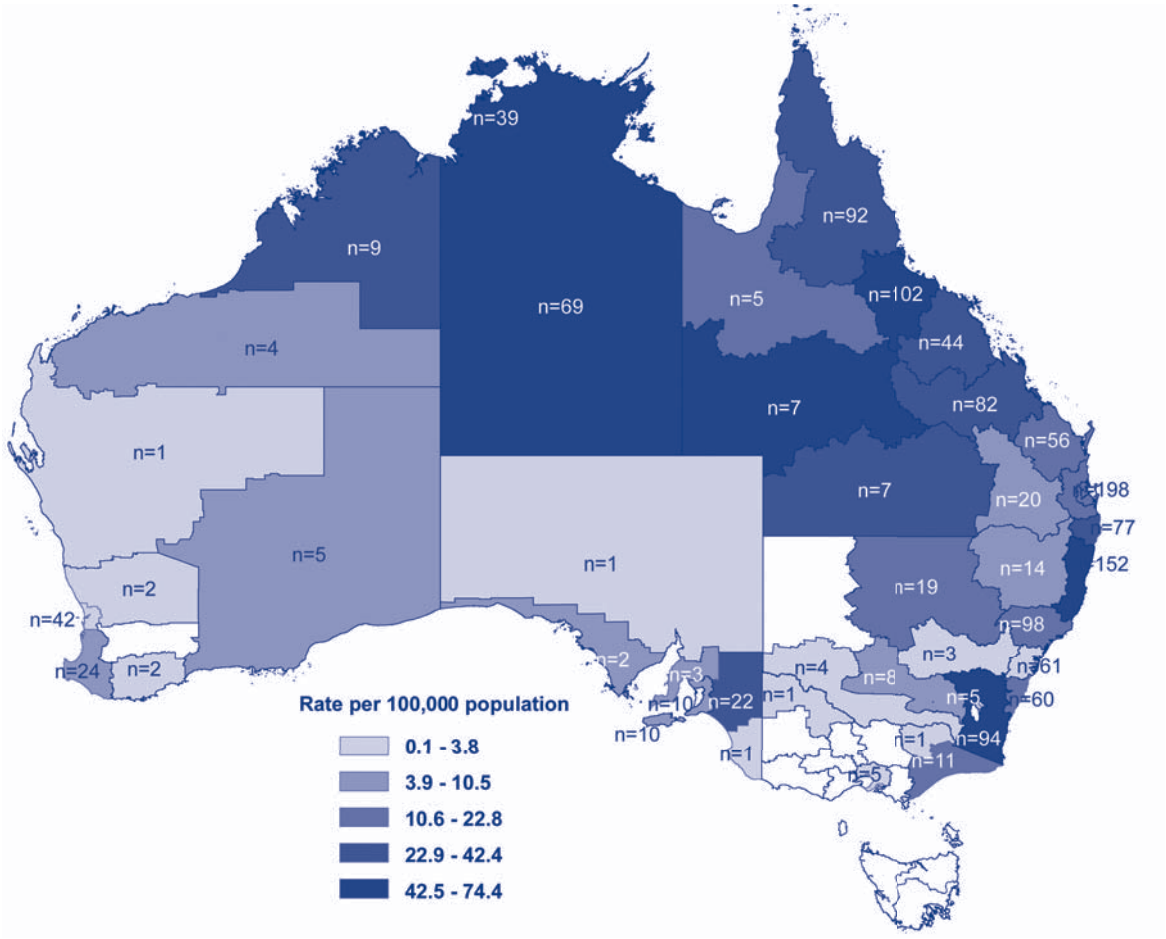
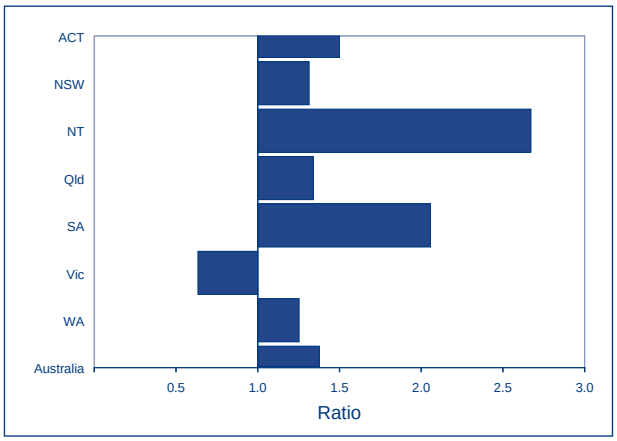


Figure 4. Ratio of Barmah Forest virus infection notifications to mean of previous five years, Australia, 1 July 2006 to 30 June 2007, by state or territory*

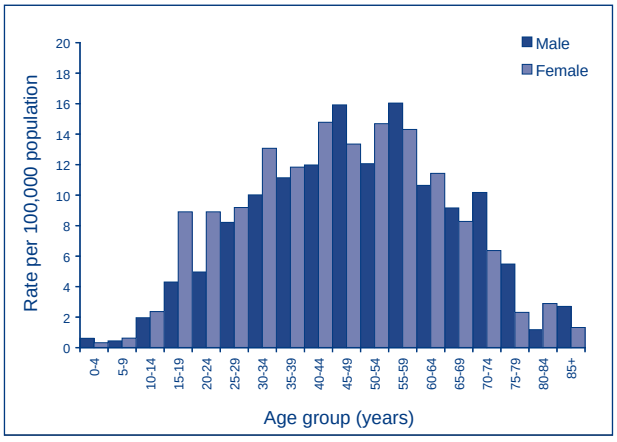


* Note: Tasmania not shown with only one Barmah Forest virus infections notification in 2005–06.

the largest documented outbreak of BFV along the South Coast, particularly the Eurobodalla region, which peaked in April 2007.[23]

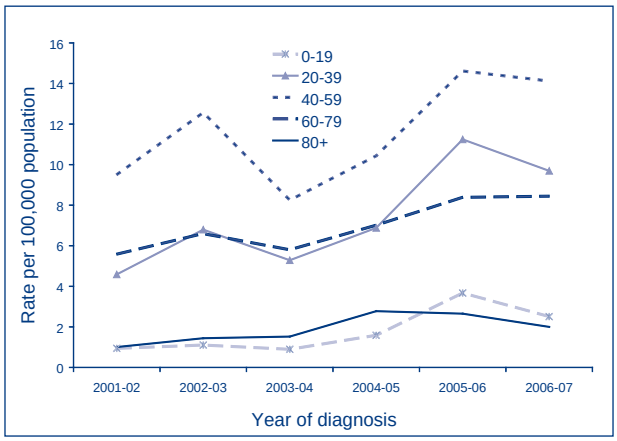
The national notification rate of BFV was highest in the 55–59 year age group (Figure 5). The highest notification rates in males were in the 55–59 year age group (16.5 cases per 100,000 population) and females in the 40–44 year age group (14.8 cases per 100,000 population).

Figure 5. Notification rate for Barmah Forest virus infections, Australia, 1 July 2006 to 30 June 2007, by age group and sex



With the exception of the 60–79 year age group, the age-specific rates of BFV notifications in 2006–07 decreased slightly when compared to 2005–06 (Figure 6). The BFV age-specific notification rates for all age groups in 2006–07 were still above the five-year mean.

Figure 6. Trends in Barmah Forest virus infection notification rates, Australia, 1 July 2001 to 30 June 2007, by age group



Ross River virus infections

During 2006–07, Australia experienced a moderately low RRV season (n=3,369) when compared to the previous five seasons (mean=3,395), similar to the low activity observed during the 2004–05 season. The majority of RRV notifications during 2006–07 were reported by Queensland (n=1,753, 52%), New South Wales (n=674, 20%) and Western Australia (n=397, 12%).

The monthly notifications of RRV were above the five-year monthly rolling mean at the start of the season in October and November 2006, but the numbers of notifications dropped well below the five-year monthly mean from December 2006 to April 2007 (Figure 7).

In contrast to last season, only four jurisdictions (the Australian Capital Territory, New South Wales, the Northern Territory and South Australia) reported RRV activity above the five-year mean for their jurisdiction (Figure 8).

Table 2 and Map 2 show that the highest rates of RRV notifications in Australia during 2006–07 were reported from the Kimberley region of Western Australia (242.6 notifications per 100,000 population), the Northern Territory (170.4 notifications per 100,000 population) and the Central West Statistical Division in Queensland (156.3 notifications per 100,000 population). Moderately high rates of RRV notification were reported in the Mackay, Far North and North West Statistical Divisions in Queensland, and the Wide Bay Burnett, North Western and Mid-North Coast Statistical Divisions in New South Wales.

Table 2. Highest notification rates of Ross River virus infection in select jurisdictions, Australia, 1 July 2006 to 30 June 2007, by Statistical Division of residence

Notifying jurisdiction	Statistical Division	Rate (per 100,000)	Notifications (n)	ABS population estimate
Western Australia	Kimberley	242.6	87	35,865
Queensland	South West	191.9	52	27,095
Northern Territory	Northern Territory*	170.4	158	92,733
Queensland	Central West	156.3	19	12,155
Queensland	Northern	147.9	312	210,943
Queensland	Fitzroy	102.0	197	193,182
Northern Territory	Darwin	92.1	105	113,955
Queensland	Mackay	71.9	109	151,572
Queensland	North West	66.6	23	34,558
New South Wales	North Western	63.7	76	119,276
Queensland	Far North	57.8	141	243,948
New South Wales	Mid-North Coast	55.5	165	297,409
Queensland	Wide Bay-Burnett	44.7	118	264,201
South Australia	Murray Lands	40.5	28	69,066
Victoria	Mallee	22.5	21	93,415

* Excludes Darwin, Palmerston and Darwin rural area.

Map 2. Notifications and notification rates of Ross River virus infections, Australia, 2006–07, by Statistical Division of residence

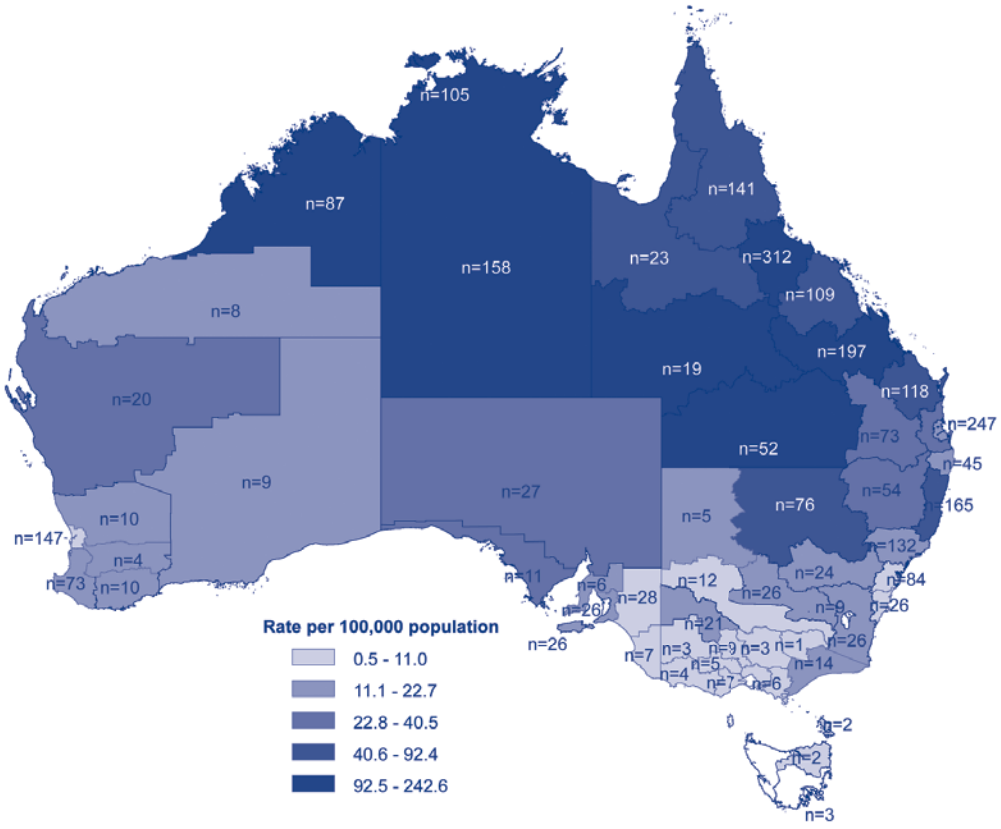


Figure 7. Epidemic curves of Ross River virus infection notifications, Australia, 1 July 2002 to 30 June 2007, by month and season of diagnosis

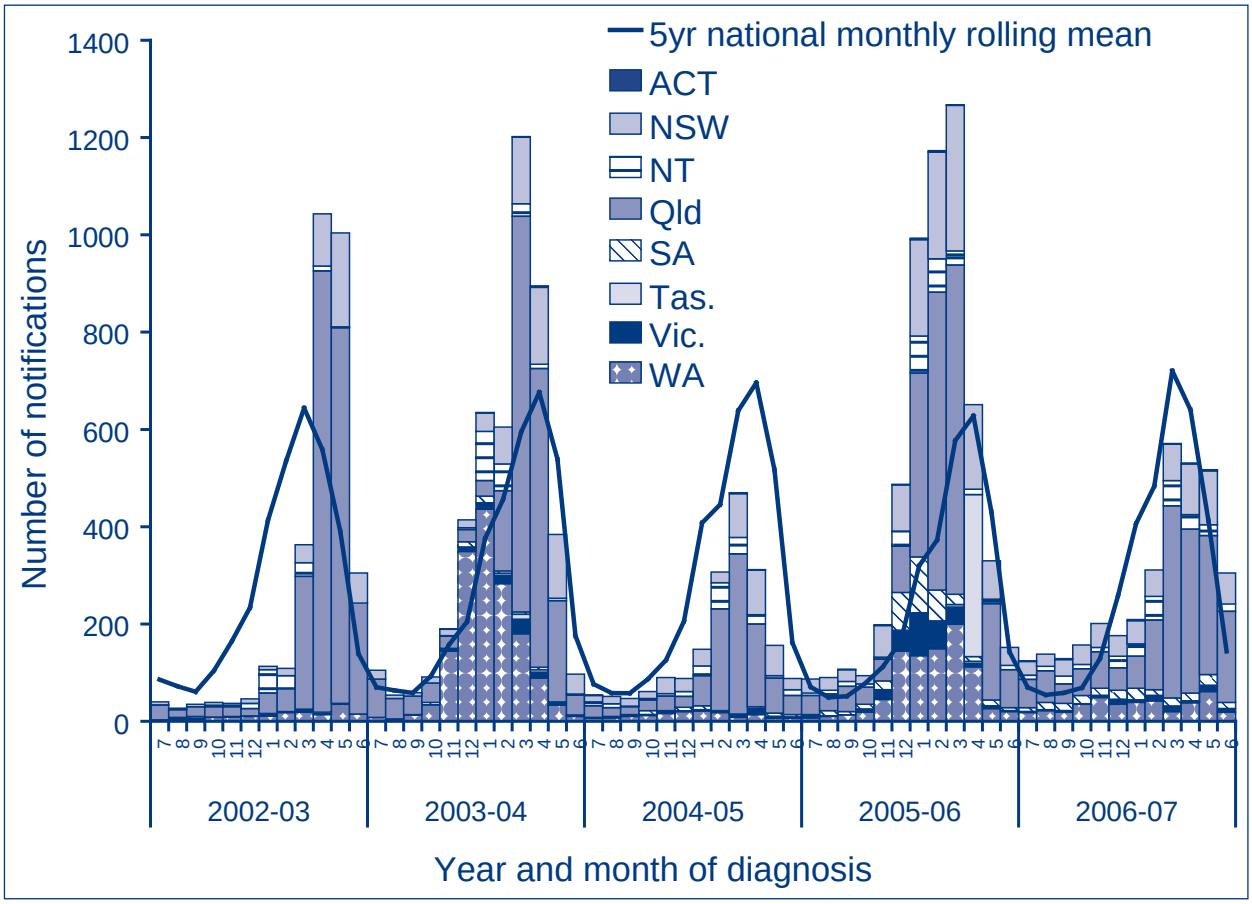


Figure 8. Ratio of Ross River virus infection notifications to mean of previous five years, Australia, 1 July 2006 to 30 June 2007, by state or territory

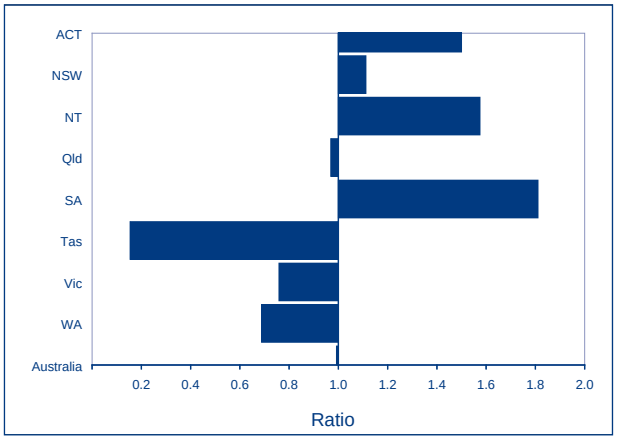
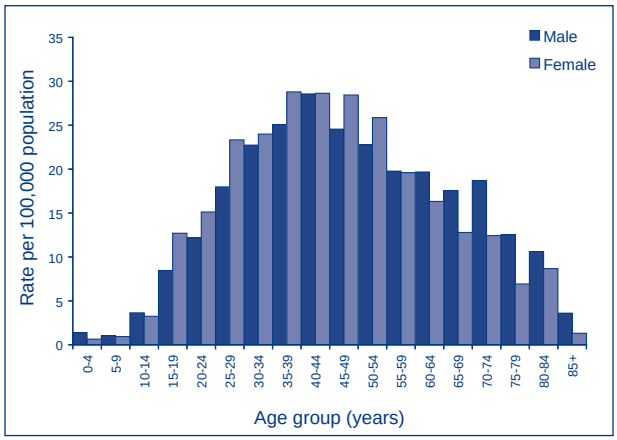


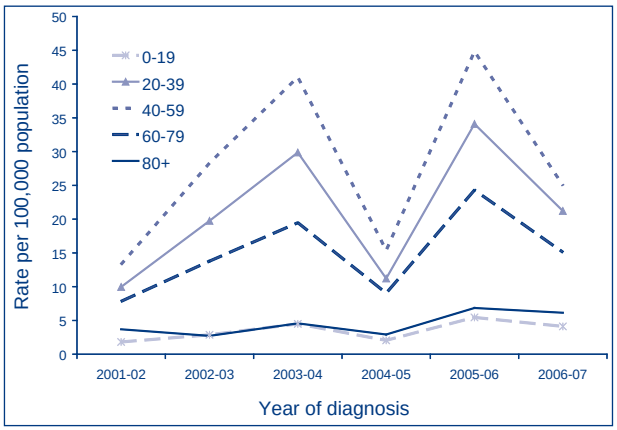
Figure 9. Notification rate for Ross River virus infections, Australia, 1 July 2006 to 30 June 2007, by age group and sex



The rate of national notifications for RRV was highest in the 40–44 year age group (Figure 9). Females in the 35–39 year age group (28.6 cases per 100,000 population) and males in 40–44 year age group (28.6 cases per 100,000 population) had the highest national age– and sex-specific notification rates.

The age-specific notification rates for RRV were lower for all age groups when compared to last season. The overall pattern of the susceptible age groups has not changed, with the 20–39 and 40–59 age groups recording the highest age-specific notification rates (Figure 10).

Figure 10. Trends in Ross River virus infections notification rates, Australia, 1 July 2001 to 30 June 2007, by age group



Chikungunya virus infections

In January and March 2005 there was a large epidemic of chikungunya virus infection on Comoros and Reunion Island, in the south-west Indian Ocean. Chikungunya virus subsequently spread to Mauritius, the Seychelles and Madagascar in 2006. Epidemics were also reported in India during 2005–2007 with well over a million cases from 13 states. The largest outbreaks were reported from Kerala state. Epidemic activity also occurred in Sri Lanka and the Maldives in 2006. At the time of writing there have been several large outbreaks reported from Indonesia and Malaysia.

The Northern Territory reported the first known imported cases of chikungunya virus infection (n=2) in 2004 (Peter Markey, personal communication), one of which was reported in a 30-year-old woman who most probably acquired the infection in East Timor.[24] Table 3 shows that there have been at least 30 cases of imported chikungunya infections diagnosed in Australia since 2006, with the majority detected by PathWest Laboratory Medicine, (Western Australia) (n=14); the Institute of Clinical Pathology and Medical Research, and Westmead Hospital, (New South Wales) (n=7); and the Victorian Infectious Diseases Reference Laboratory.[25] The majority of chikungunya virus infections were acquired in Sri Lanka (n=10), India (n=7) and Mauritius (n=6). There were no reports of cases imported from Indonesia during 2006–2007.

The National Arbovirus and Malaria Advisory Committee has recently developed a provisional national case definition for chikungunya virus infection (Appendix), which is pending endorsement from the Communicable Diseases Network Australia and Public Health Laboratory Network. It is important to note that at the time of writing, chikungunya is not nationally notifiable but is notifiable in New South Wales and the Northern Territory under the disease category arbovirus not elsewhere classified. The provisional case definition attempts to distinguish past and recent chikungunya infections from endemic Australian alphaviruses such as Barmah Forest virus and Ross River virus. As chikungunya is most closely related to the o'nyong-nyong virus and is a member of the Semliki Forest antigenic complex,[26] it is important to be aware of false-positive reactions with other arboviruses, particularly when travellers may be arriving from countries with endemic alphaviruses.

Flaviviruses

Table 4 shows human notifications of flavivirus infections from 1 July 2006 to 30 June 2007, by state or territory. There were 276 notifications of human

Table 3. Number of imported chikungunya cases to Australia (n=30), 2006–2007, by state or territory

Notifying jurisdiction	Cases	Year of diagnosis	Laboratory tests	Source	Country of acquisition
Western Australia	14	2006 (n=9) 2007 (n=5)	High HI, IgM pos (9), high rise HI, IgM pos (3), IgM only (2)	David Smith, PathWest Laboratory	India (4), Mauritius (3), Sri Lanka (2), China (1), overseas (2), unknown (2)
Victoria	8	2006 (n=5), 2007 (n=3)	PCR, then sequencing	Johnson et al,[25] Druce et al,[27] Liu et al,[28] James Fielding DHS	Sri Lanka (6), Mauritius (1), India (1)
New South Wales	7	2006 (n=4) 2007 (n=3)	Culture negative, negative for BFV, RRV, DENV, flavivirus by ELISA and neutralisation, IgM pos for chikungunya by IFA, high neutralisation titres and clinical histories	Linda Hueston, ICPMR	Mauritis (2) Seychelles (2) India (1) Sri Lanka (2)
Northern Territory	1	2007 (n=1)	DENV negative, flavivirus and chikungunya positive	Peter Markey, NT CDC DHCS	India (1)

flavivirus infection during 2006–07, the majority of which were locally acquired and imported DENV notifications.

The Sentinel Chicken Programme is a surveillance network involving New South Wales, the Northern Territory, Victoria and Western Australia, and is designed to detect flavivirus activity (including the endemic arboviruses MVEV and KUNV).[29]

Table 4. Number of flavivirus notifications, 1 July 2006 to 30 June 2007, Australia, by state or territory

State or territory	Notifications			
	DENV	Flavi NEC	KUNV	MVEV
ACT	2	0	0	0
NSW	72	0	0	0
NT	15	0	0	0
Qld	113	22	0	0
SA	12	0	0	0
Tas	0	0	0	0
Vic	8	3	0	0
WA	28	1	0	0
Australia	250	26	0	0

Northern Territory

The Northern Territory sentinel chicken program commenced in January 1992 and replaced an earlier program run by the Australian Quarantine and Inspection Service (AQIS). Sentinel chicken flocks in the Northern Territory are maintained, bled and analysed for flavivirus infection in a combined program between the Northern Territory Department of Health and Community Services, the Northern Territory Department of Primary Industry, Fisheries and Mines (DPIFM), and volunteers.

Sentinel chicken flocks are presently at Darwin urban (Leanyer), Darwin rural (Howard Springs), Beatrice Hill (Coastal Plains Research Station), Kakadu (Jabiru), Katherine, Nhulunbuy, Tennant Creek, Alyangula, Nathan River and Alice Springs (Ilparpa and Arid Zone Research Station).

DPIFM officers or volunteers usually bleed flocks once a month and the samples are sent to the DPIFM for specific testing for MVEV and KUNV. Sometimes for operational reasons, chickens are not bled during a schedule month and hence seroconversion shown in the next bleed could have occurred in the previous month. When chickens from a flock show new antibodies to MVEV during a prime risk period, a media warning is issued for the region for the risk period. These warnings advise the public of the need to take added precautions to avoid mosquito bites. Chickens are replaced at least annually and more frequently if birds die or if a large proportion seroconvert. They are well positioned to detect flavivirus activity near the principal towns of the Northern Territory and hence provide timely and accurate indication of risk to people in those towns.

In the 2006–07 season, MVEV activity was detected in Howard Springs in November, Adelaide River in June, Nhulunbuy in October and February, Katherine in February and May, Tennant Creek in April and Nathan River in May. The MVEV total seroconversions this season (n=11) was slightly less compared to last season (n=15), with most seroconversions this reporting period (n=3) occurring in Katherine and Nathan River, followed by the Nhulunbuy flock (n=2). Most seroconversion this season occurred in May (n=4), which is the month when the long-term seroconversion peak occurs, followed by February (n=3).

There were no seroconversions in the two Alice Springs flocks, most probably due to low seasonal vector numbers. In addition, the successful effluent swamp drainage and better effluent management from nearby sewage facilities in the Ilparpa area, have led to an overall reduction in vector numbers near the Alice Springs outskirts during summer. There were also no seroconversions in the Leanyer and the Alyangula flock. However, the Alyangula flock was last bled in February 2007, due to operational issues.

No human cases of MVEV disease were reported in the Northern Territory in 2006–07 and the last reported case was in March 2005, when a 3-year-old boy from a community in Arnhem Land had a relatively mild illness and made a complete recovery.

Kunjin virus activity was present throughout the Northern Territory, with seroconversions to KUNV in Darwin (Howard Springs) in June; Darwin (Leanyer) in April, May and June, Adelaide River in June; Nhulunbuy in October; Katherine in August, February, March and May; Tennant Creek in April; Jabiru in May and June; and Nathan River in August. The virus activity from July to October is probably a result of activity extending from the last arbovirus season rather than an indication of early activity this season. There has been a trend over the last 10 years to increasing numbers of seroconversions to KUNV, with this season's total (n=24) nearly double the number from last season (n=13) and the highest since the program started in 1992. Most seroconversions occurred in the Leanyer (n=6), Katherine (n=6) and Jabiru (n=5) flocks. Seroconversions mostly occurred this season in

May (n=9) and June (n=6), while the long term peak is also in May in the Northern Territory. The high number of seroconversions to KUNV was most likely due to significant late wet season rain in the Top End, leading to an extended period of relatively high *Culex* vector numbers.

The Northern Territory did not report any human cases of KUNV infection this season. The last reported KUNV case from the Northern Territory was in a 23-year-old female from Alice Springs in May 2001.

Western Australia

Sentinel chicken flocks in Western Australia are maintained, bled and analysed for specific antibodies to MVEV and KUNV in a combined program between The University of Western Australia, the Western Australian Department of Health (WA DOH), local governments and community volunteers. Twenty-eight sentinel chicken flocks are located at major towns and communities in the Kimberley, Pilbara, Gascoyne, Goldfields, Midwest and Central Coastal regions of Western Australia. Environmental health officers or trained volunteers take blood samples from the chickens each fortnight from December to June (the major MVEV 'risk' season) and monthly at other times. Samples are tested by the Arbovirus Surveillance and Research Laboratory at The University of Western Australia.[30] Sometimes for operational reasons, chickens are not bled fortnightly and a seroconversion detected in the next bleed may have occurred earlier.

With the exception of August, rainfall was generally above average and temperatures were usually average to above average in northern Western Australia between July and December 2006. Seasonal monsoonal rains occurred in January. The monsoonal period quietened in February before becoming active again in March and April, and a series of tropical cyclones also caused heavy widespread rainfall and flooding in the Kimberley, Pilbara and Gascoyne regions. Heavy rainfall in north-eastern parts of the Kimberley region continued into the late wet season in May and June.

A total of 3,405 serum samples from the 27 flocks located in Western Australia were screened for antibodies to flaviviruses during 2006–07. Seroconversions to flaviviruses were detected in 68 (2.0%) of the samples. Thirty-six seroconversions detected between July and September 2006 were associated with a prolonged period of activity extending from the 2005–06 wet season, possibly due to continued rainfall in northern Western Australia in July 2006. The majority of these seroconversions were due to MVEV activity (n=22), and to a lesser degree KUNV activity (n=7).

The first activity associated with the 2006–07 wet season was detected in January when KUNV was simultaneously detected at Kununurra in the north-east Kimberley region and in the Ophthalmia sentinel chicken flock near Newman in the Pilbara region. MVEV activity was first detected in April at Wyndham and Halls Creek in the north-east and south-east Kimberley region, respectively, and in the sentinel chicken flock at Marble Bar in the north-east Pilbara region in June 2007. A total of 32 flavivirus seroconversions were associated with the 2006–07 wet season. Most of these flavivirus seroconversions were due to KUNV activity (56%), whilst MVEV accounted for 25% of the flavivirus seroconversions. Seroconversions continued in Kimberley and Pilbara sentinel chicken flocks beyond June 2007, possibly facilitated by continued late wet season rainfall in northern Western Australia in May and June 2007. No flavivirus activity was detected south of Newman in the Pilbara region in 2006–07. The level of MVEV activity was substantially lower than the previous year, however the level of activity of KUNV in sentinel chickens was greater, particularly in the Kimberley region. Unidentified flavivirus infections were detected at several locations in the Kimberley and Pilbara regions. These are possibly due to activity of other flaviviruses that are occasionally isolated from mosquitoes collected in northern Western Australia.

The WA DOH initially issued health warnings of increased risk of KUNV to residents and visitors to northern Western Australia on 15 February 2007, following seroconversions to KUNV in the east Kimberley and east Pilbara regions. An additional warning was issued on 3 May 2007 advising residents and travellers to the north-east Kimberley region of the increased risk of MVEV after seroconversions to MVEV were detected in sentinel flocks in this region. A third warning was issued on 25 June 2007 following continued detections of MVEV and KUNV in the Kimberley and east Pilbara regions, including the first activity for the season at Marble Bar. No locally-acquired flavivirus human cases were reported from Western Australia during the 2006–07 season.

New South Wales

Samples from four sentinel chicken sites were tested weekly for KUNV and MVEV antibodies in New South Wales over a six month period in 2006–07.[23] There were no seroconversions to MVEV or KUNV during this period. There were no human cases reported from New South Wales for either MVEV or KUNV. The last reported case of KUNV from New South Wales was notified in May 2001 in a 58-year-old female from Griffith. There have been no recorded cases of MVEV to date in NNDSS from New South Wales.

Victoria

Samples from sentinel chicken flocks located throughout northern inland Victoria (10 sites along the Murray River, Map 3) were tested weekly for flavivirus antibodies from 6 November 2006 to early March 2007. No KUNV or MVEV activity was detected in any of the samples. There were no human cases of KUNV or MVEV reported from Victoria during 2006–07. The last reported case of KUNV infection in Victoria was in October 2004. There have been no recorded cases of MVEV in NNDSS from Victoria.

Queensland

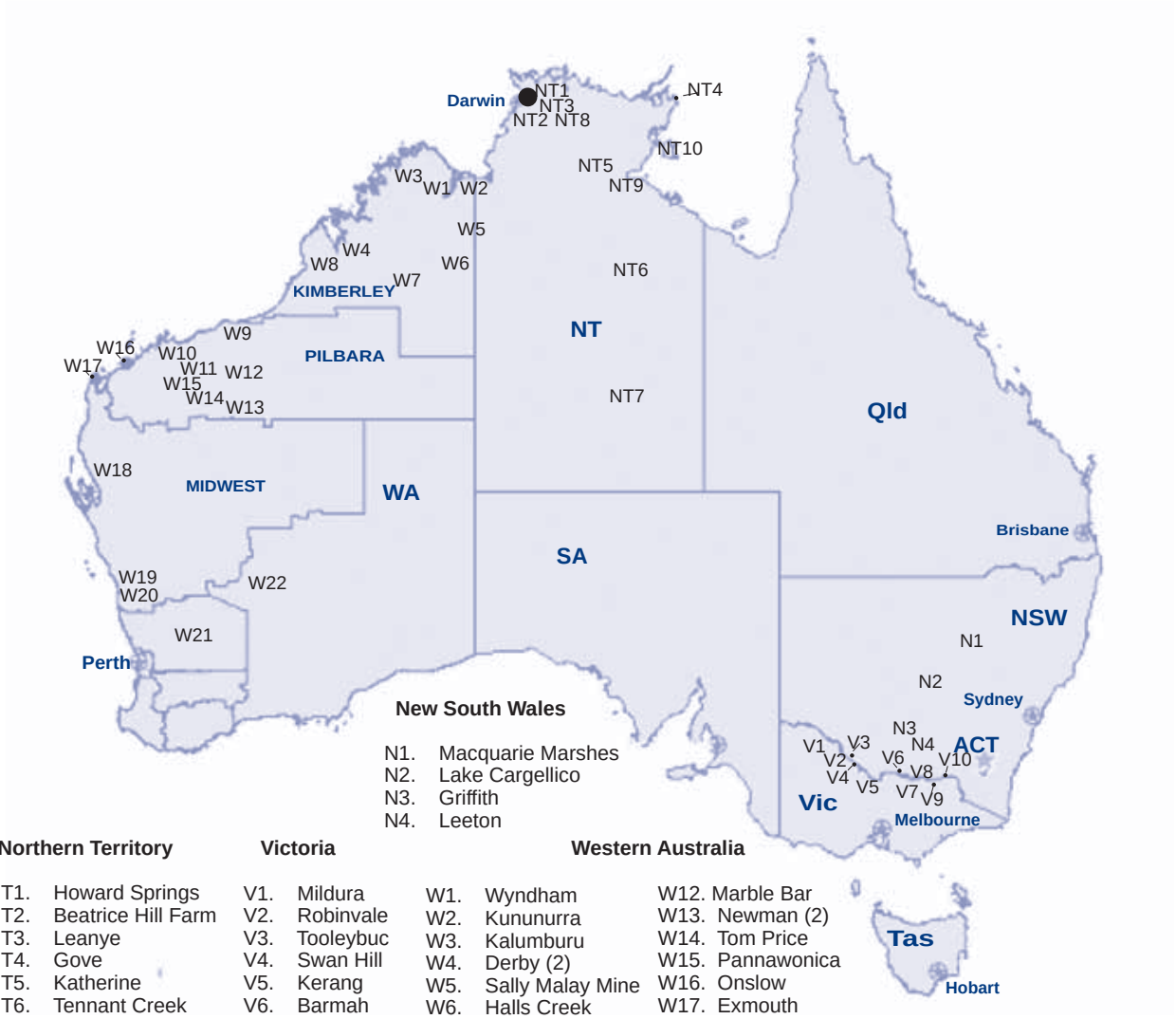
There were no sentinel chicken flocks in Queensland during 2006–07 although flocks were maintained in 2002–03. There were no cases of KUNV or MVEV reported by Queensland during 2006–07. The last reported cases of KUNV from Queensland were three sporadic cases notified in July 2004, December 2004, and February 2005. The last reported MVEV case from Queensland was in a 3-year-old boy from Mount Isa in 2001.

Japanese encephalitis virus infections

Japanese encephalitis virus appears nearly annually in the Torres Strait in far northern Queensland and surveillance has involved the use of sentinel pigs that develop detectable viraemia and antibody titres to JEV.

AQIS, through its Northern Australia Quarantine Strategy program, conducted monitoring for JEV for the 2007 wet season using sentinel pigs at Injinoo airport, Northern Peninsula Area, Cape York. The five sentinel pigs did not seroconvert

Map 3. Sentinel chicken testing sites, Australia 2006–07



Northern Territory

NT1. Howard Springs
NT2. Beatrice Hill Farm
NT3. Leanye
NT4. Gove
NT5. Katherine
NT6. Tennant Creek
NT7. Alice Springs (2)
NT8. Jabiru
NT9. Nathan River
NT10. Alyangula

Victoria

V1. Mildura
V2. Robinvale
V3. Tooleybuc
V4. Swan Hill
V5. Kerang
V6. Barmah
V7. Toolamba
V8. Barooga
V9. Retherglen
V10. Wodonga

Western Australia

W1. Wyndham
W2. Kununurra
W3. Kalumburu
W4. Derby (2)
W5. Sally Malay Mine
W6. Halls Creek
W7. Fitzroy Crossing
W8. Broome (2)
W9. Port Hedland
W10. Karratha
W11. Harding Dam (2)
W12. Marble Bar
W13. Newman (2)
W14. Tom Price
W15. Pannawonica
W16. Onslow
W17. Exmouth
W18. Carnarvon
W19. Geraldton
W20. Dongara
W21. York
W22. Leonora

and there was no evidence of transmission of JEV to the mainland in 2007 (based on results of testing at Queensland Health Scientific Services and the CSIRO Australian Animal Health Laboratory).

There were no human cases of JEV in Australia during 2006–07. The last reported JEV case was in February 2004, when Queensland Health notified that a 66-year-old male acquired JEV from Papua New Guinea. There have been nine other cases of JEV reported to NNDSS since 1995, although JEV was not nationally notifiable until 2001. Four of these notifications were reported in Torres Strait Islanders from the Badu Island community, two of which were fatal (1995). Another locally-acquired JEV case was reported in a resident from the mouth of the Mitchell River, Cape York Peninsula, Queensland in 1998. The remaining four cases were reported as acquired from overseas countries.

Flavivirus infections (not elsewhere classified)

There were 26 flavivirus (not elsewhere classified or NEC) notifications during the 2006–07 season, the majority of which were reported by Queensland. Of the 26 flavivirus NEC notifications, five were due to Kokobera infection with the virus unidentified for the remaining 21 notifications. The importation status was reported in four notifications with two acquired in Australia, and one each from Uruguay and Indonesia. The country of acquisition was not reported for the remaining 22 notifications.

Dengue virus infections

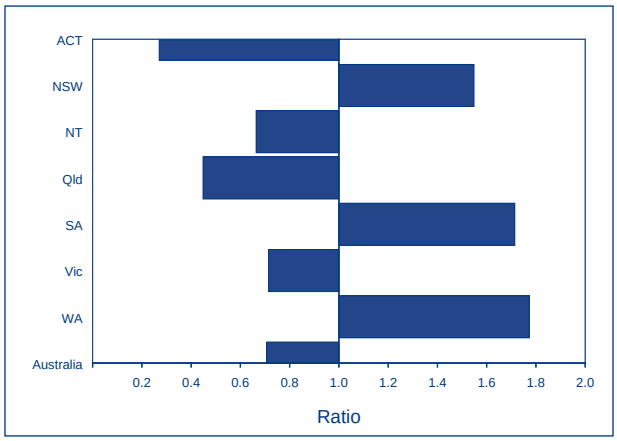
There were 250 notifications of DENV infections during the 2006–07 season. Table 5 shows that the cases were mainly from Queensland (n=113, 45%), New South Wales (n=72, 29%) and Western Australia (n=28, 11%).

Table 5. Number of dengue notifications, Australia, 1 July 2006 to 30 June 2007, by state or territory

Notifying jurisdiction	n	% of total
ACT	2	1
NSW	72	29
NT	15	6
Qld	113	45
SA	12	5
Tas.	0	0
Vic.	8	3
WA	28	11
Total	250	100

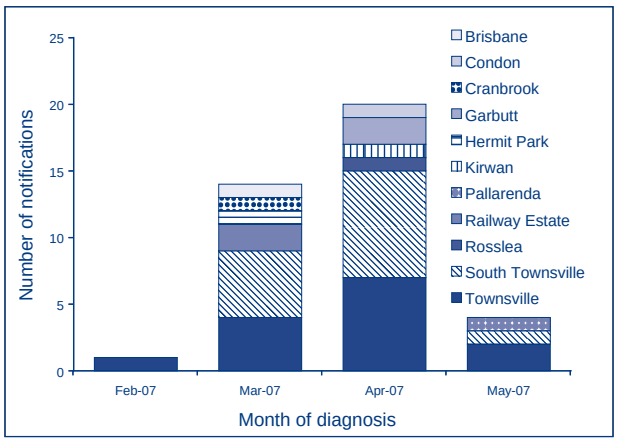
Notifications from New South Wales, South Australia, Victoria and Western Australia exceeded the five-year mean in each jurisdiction (Figure 11), reflecting an increase in imported cases of dengue virus from overseas countries or from Queensland.

Figure 11. Ratio of dengue virus infection notifications to mean of previous five years, Australia, 1 July 2006 to 30 June 2007, by state or territory



Queensland reported that of the 113 DENV notifications, only 39 were acquired locally. Figure 12 shows that the local outbreak of DENV this season began in February and peaked in April 2007. The notifications were reported in residents mainly from the Townsville area. One resident of Brisbane acquired the infection in Townsville (Christine Selvey, personal communication.) The DENV serotype for this outbreak was Type 3 in 67% of notifications (n=26 of 39) and the serotype was not typed in the remaining 13 cases.

Figure 12. Epidemic curve of locally-acquired dengue notifications (n=39), 1 July 2006 to 30 June 2007, by month of diagnosis and residential location



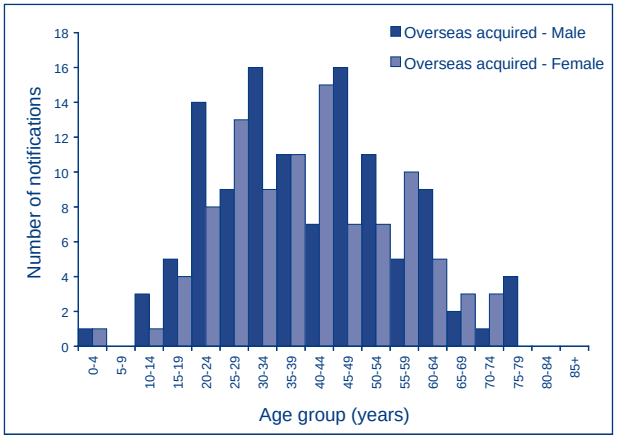
For DENV notifications which were acquired overseas (Table 6), the country of acquisition was reported to NNDSS in 20% of notifications (n=42 of 211). Indonesia, the Philippines, and Thailand were the most frequently reported country in which DENV infection was acquired. The most commonly reported dengue serotype acquired overseas was Type 1 (n=25), Type 2 and 3 (n=16 each). The dengue serotype was not supplied in 72% of the overseas-acquired dengue notifications (n=152 of 211).

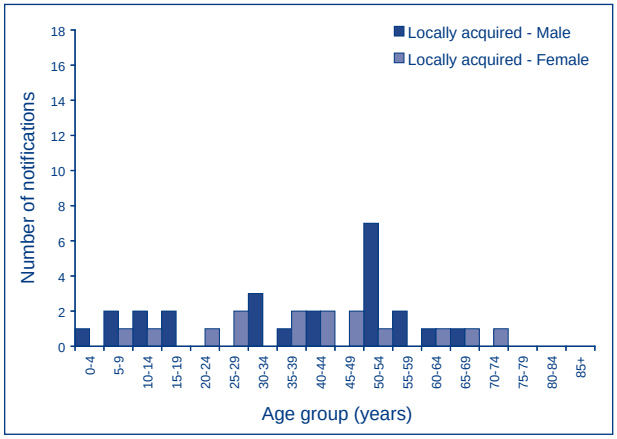
Figure 13 shows that imported DENV notifications in Australia were most frequently reported across the 20–49 year age groups (n=136, 64%) whereas in locally acquired cases from Queensland, notifications were scattered across age groups with a significant peak in the 50–54 year age group (n=8, 10%), which were mostly male (n=7).

Table 6. Dengue notifications, Australia, 1 July 2006 to 30 June 2007, by serotype and country of acquisition

Country of acquisition	Total	Serotype				
		Not typed	Type 1	Type 2	Type 3	Type 4
Country unknown	169	138	14	8	8	1
Australia	39	13	0	0	26	0
Indonesia	7	4	1	1	0	1
Philippines	6	1	1	1	3	0
Thailand	6	1	0	3	2	0
Cook Islands	4	0	4	0	0	0
India	3	2	0	1	0	0
Papua New Guinea	3	2	0	1	0	0
Fiji	2	0	2	0	0	0
Samoa	2	2	0	0	0	0
Sri Lanka	2	1	1	0	0	0
Bangladesh	1	0	0	1	0	0
Cambodia	1	0	0	0	1	0
Mexico	1	0	1	0	0	0
Pakistan	1	0	0	0	1	0
Singapore	1	1	0	0	0	0
South America	1	0	0	0	1	0
Vietnam	1	0	1	0	0	0
Total	250	165	25	16	42	2

Figure 13. Dengue notifications, locally acquired and imported cases, 1 July 2006 to 30 June 2007, by age group and sex

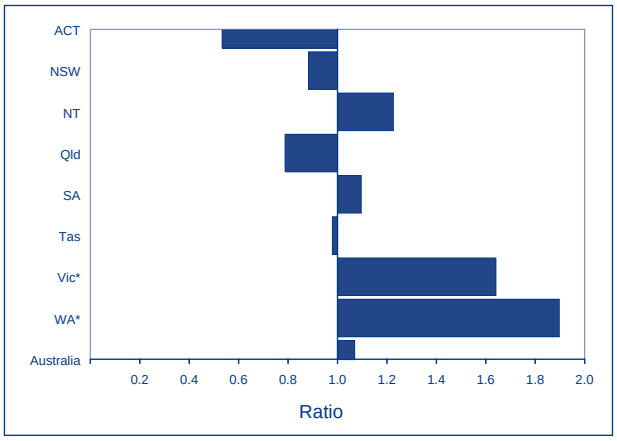




Malaria

There were 640 notifications of overseas-acquired malaria in Australia in the period 1 July 2006 to 30 June 2007 with no reports of locally-acquired malaria. The majority of malaria notifications were reported by Queensland (28%, n=177, Table 7), Victoria (20%, n=177), New South Wales (19%, n=119) and Western Australia (17%, n=107). The number of malaria notifications reported from Victoria and Western Australia exceeded two standard deviations above their five-year average (Figure 14).

Figure 14. Ratio of malaria notifications to mean of previous five years, Australia, 1 July 2006 to 30 June 2007, by state or territory



* Above two standard deviations.

Figure 15 shows that the 2006–07 reporting period was the third largest for malaria notifications since 2001–02.

Overall, malaria notifications were highest in the young adult 20–24 year age group (Figure 16). This trend was also observed in 2005–06 and in years prior to 2004–05 (Figure 17).

Figure 15. Number of notifications of malaria, Australia, 2000 to 2006, by year of onset

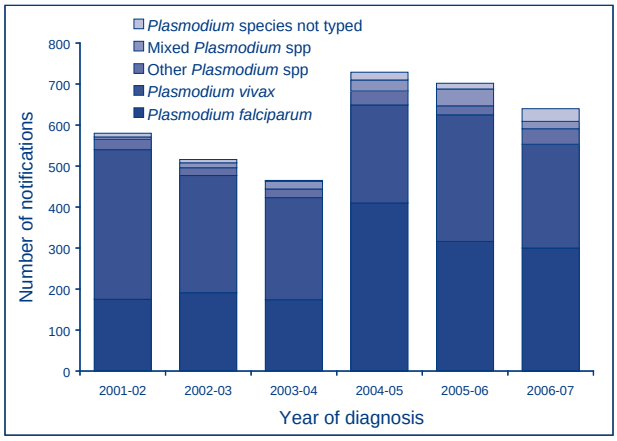


Figure 16. Number of imported malaria notifications, Australia, 1 July 2006 to 30 June 2007, by age group and sex

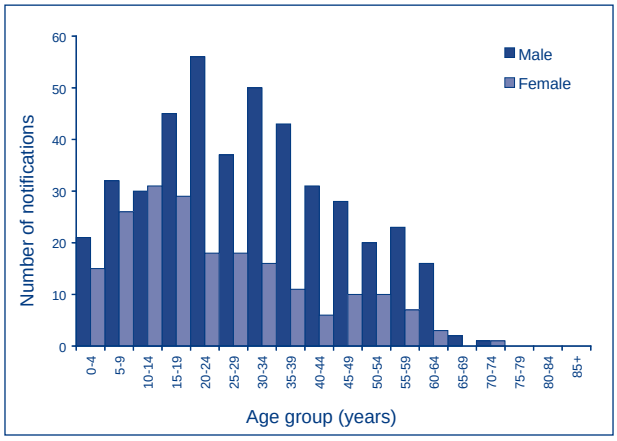


Figure 17 shows that since 2000–01 there has been a steady increase in the proportion of children under the age of 15 years notified with malaria, starting at 7% in 2000–01 and peaking in 2004–05 at over 30% (n=260). In 2006–07 the proportion of notifications in children aged under 15 years has dropped slightly to 25% but this proportion remains the second highest for this age group over

Table 7. Malaria notifications in Australia, 1 July 2006 to 30 June 2007, by parasite type

Parasite type	Type %	ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Australia
Plasmodium falciparum	47	2	48	36	77	21	13	40	63	300
Plasmodium vivax	40	5	56	14	87	6	5	69	11	253
Other *Plasmodium* spp	6	1	9	0	10	1	0	9	8	38
Mixed *Plasmodium* spp	3	0	1	0	3	2	0	9	3	18
Plasmodium species not typed	5	0	5	1	0	2	1	0	22	31
Total	100	8	119	51	177	32	19	127	107	640

Figure 17. Trends in the age distribution of malaria notifications, Australia, 1 July 2000 to 30 June 2006, by age group

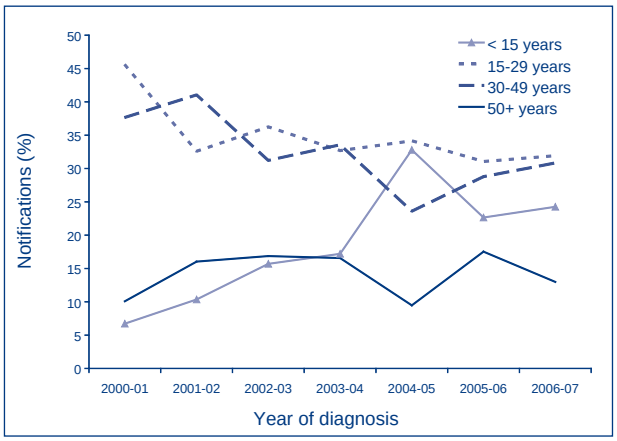
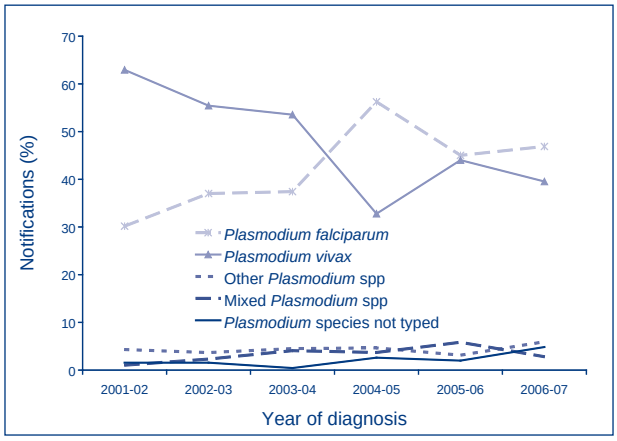


Figure 18. Trends in malaria notifications, by infecting species and year of onset



the past seven years. This trend in malaria notifications from young children has been discussed elsewhere and is related to refugee arrivals.[29]

The infecting *Plasmodium* species were reported for 95% of malaria notifications in 2006–07 (Table 8). The majority of the 640 malaria notifications were due to *P. falciparum* (47%, n=300) and *P. vivax* (40%, n=253) while other *Plasmodium* species and mixed *Plasmodium* species infections accounted for 6% and 3% respectively.

Figure 18 shows that in 2006–07 the proportion of notifications due to *P. falciparum* malaria (47%) increased slightly from last year (45%) and the number of *P. falciparum* malaria notifications was up 1.4 times from the five-year mean for the same species.

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Table 8. Malaria notifications in Australia, 1 July 2001 to 30 June 2007, by parasite type

Infecting species	Year of diagnosis						Last 5 year mean	Ratio 06/07 5 year mean
	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07		
Plasmodium falciparum	175	191	174	410	316	300	253.2	1.2
Plasmodium vivax	365	286	249	239	309	253	289.6	0.9
Other *Plasmodium* spp	25	19	21	34	22	38	24.2	1.6
Mixed *Plasmodium* spp	6	12	19	27	41	18	21.0	0.9
Plasmodium species not typed	9	8	2	19	14	31	10.4	3.0
Total	580	516	465	729	702	640		

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Appendix. Provisional case definition for chikungunya virus infection (Communicable Diseases Network Australia and Public Health Laboratory Network endorsement still pending)

Reporting

Only confirmed cases should be notified

Confirmed case

A confirmed case requires either:

Laboratory definitive evidence

OR

Laboratory suggestive evidence AND epidemiological evidence AND clinical evidence.

Laboratory definitive evidence

1. *Isolation of chikungunya virus*

OR

2. *Detection of chikungunya virus by nucleic acid testing*

Laboratory suggestive evidence

1. *Seroconversion or a significant rise in antibody level or a fourfold or greater rise in titre to chikungunya virus, in the absence of a corresponding change in antibody levels to Ross River virus or Barmah Forest virus*

OR

2. *Detection of chikungunya virus-specific IgM,[1] in the absence of IgM to Ross River virus or Barmah Forest virus*

Epidemiological evidence

1. *A history of travel to a chikungunya affected area[2] within the two weeks prior to the onset of illness*

Clinical evidence

1. *Arthralgia OR myalgia OR rash*

Note

1. An IgG level should always accompany and IgM as this may help to interpret the significance of a single IgM. If IgM only is detected it is important that a convalescent sample is collected to test for seroconversion.
2. These may vary but include (at the time of writing) parts of Africa (including South Africa, Uganda, Congo, Nigeria, Ghana, Zimbabwe, Senegal, Burkina Faso, the Central African Republic, Cameroon, Guinea-Bissau), South East Asia (including Cambodia, Indonesia, Malaysia, Philippines and Timor Leste), islands in the Indian Ocean (La Réunion, Madagascar, Mauritius, Mayotte, Seychelles) and the Indian-sub-continent (including Pakistan and India).