

AN OUTBREAK OF AUSTRALIAN ENCEPHALITIS IN WESTERN AUSTRALIA AND CENTRAL AUSTRALIA (NORTHERN TERRITORY AND SOUTH AUSTRALIA) DURING THE 2000 WET SEASON

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INTRODUCTION

Arbovirus encephalitis acquired within Australia, also known as Australian encephalitis (AE), is a potentially fatal disease of humans usually caused by the mosquito-borne flavivirus Murray Valley encephalitis virus (MVE). Occasional cases have been caused by the closely related Kunjin virus (KUN) but these tend to be less severe and the disease is now usually referred to as Kunjin virus disease. These viruses are usually active in northern Australia during the wet season (December to May) and MVE is known to be enzootic in the north Kimberley region of Western Australia (WA) and in the Top End of the Northern Territory (NT). *Culex annulirostris* skuse are the major vectors of both MVE and KUN and ardeid waterbirds are thought to be the main vertebrate hosts.

MVE has been responsible for a number of epidemics of encephalitis in SE Australia, the last being in 1974. From 1978 to 1999 all cases of MVE encephalitis have been reported from northern Australia, with the majority of these (30/48) being from WA. Most of these cases (25/30) were from the tropical Kimberley region, with only 3 reported from the Pilbara and 2 from the Gascoyne. Fourteen cases of AE have been reported from the NT during this period (Medical Entomology Branch, Territory Health Services [THS]).

Before the 2000 wet season, the southern limit of MVE activity in WA (detected by sentinel chicken seroconversions and human cases) was around the town of Carnarvon in the Gascoyne region. Therefore sentinel chicken flocks had been located within and outside these areas to allow us to ascertain the limits of spread of this virus. In the NT, MVE seroconversions occur in sentinel chicken flocks in most years, usually in the Top End region from Darwin to Katherine between February and June. Cases of AE have been reported from these areas. Activity is occasionally detected from the arid region in central Australia (NT) in the Alice Springs area. The last time this occurred was in 1997 when sentinel chickens seroconverted to MVE and a presumptive case of AE was reported from this arid region (Merritt et al. 1998).

During the 2000 wet season, northern and central Australia experienced exceptional weather conditions with record rainfall recorded in many areas. This led to extensive mosquito breeding, increased MVE transmission in the region and resulted in a number of MVE and KUN encephalitis cases being recorded from both WA and central Australia (southern NT and northern South Australia). An overview of the environmental conditions leading to this outbreak, vector numbers, results of sentinel chicken monitoring programs, symptoms and outcome of confirmed cases, and predictors for future outbreaks are presented in this paper.

ENVIRONMENTAL CONDITIONS

Heavy wet season rainfall was recorded in northern Australia in January and February 2000. Rains extended into central Australia in February with record rainfall recorded at Alice Springs in February (Bureau of Meteorology, Monthly Weather Review). Tropical cyclone Steve impacted on regions of Queensland, the NT and WA from 27th February to 11th March 2000. Cyclone Steve traversed the coastal areas of northern WA from 3rd to 9th March and caused heavy rainfall, which extended from the Kimberley through to the Murchison and Midwest regions. Although the system never reached "severe" intensity it was noted for its longevity and caused extensive flooding in northern WA. The highest rainfall on record (>decile 10) was recorded over most of northern WA and into some areas of central Australia in the six months from December 1999 to May 2000 (Fig 1).

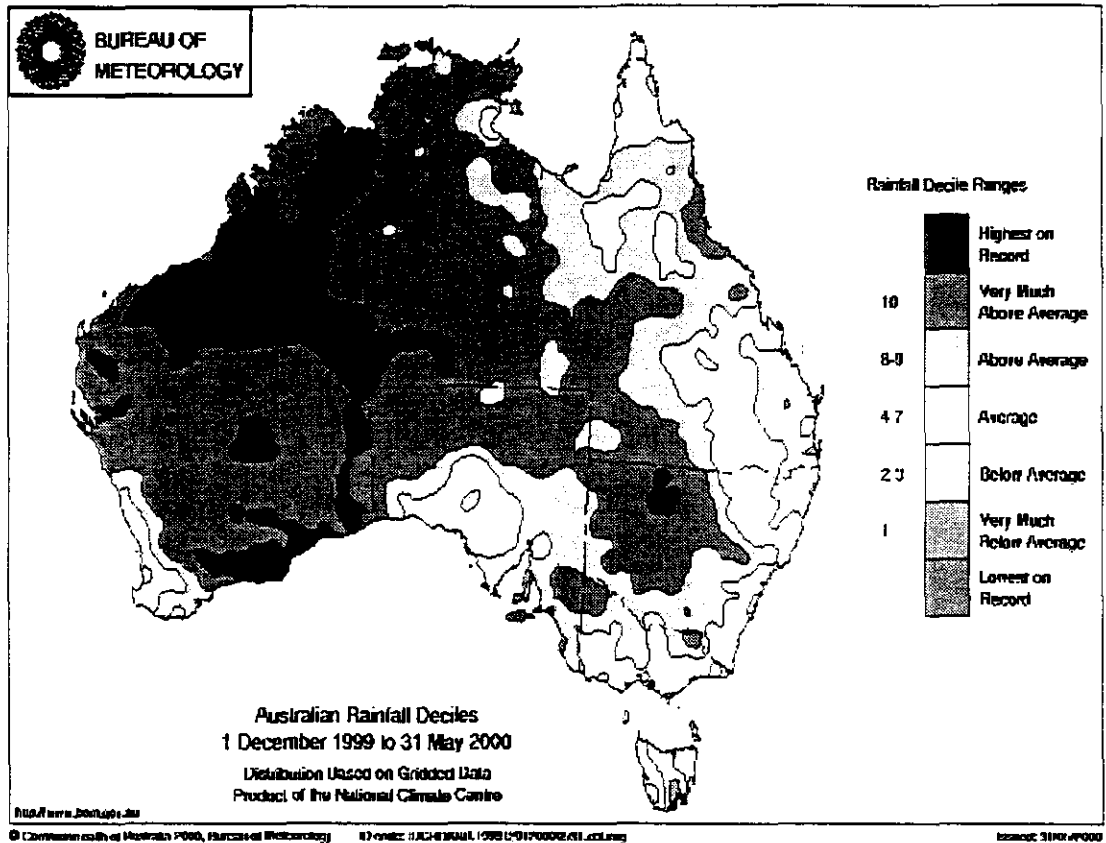


Figure 1. Rainfall patterns in Australia* (December 1999 to May 2000).

*From Bureau of Meteorology web site

SURVEILLANCE METHODS

Sentinel Chicken flocks

MVE was monitored during the 2000 wet season, in the north of WA and the NT, by detecting seroconversions in sentinel chicken flocks. In WA there were 28 flocks of 12 chickens each located at 19 towns, 2 Aboriginal communities and two large dams. Flocks were bled fortnightly from November 1999 to June 2000. Details of the WA sentinel chicken surveillance program is given elsewhere (Broom et al. 2000). In the NT there were 7 flocks of 12 chickens and the Department of Primary Industries and Fisheries officers or volunteers bled these monthly. Locations of all flocks are shown in Fig 2. All chicken blood samples from WA and the NT were tested at the Arbovirus Surveillance and Research Laboratory in Perth. The Medical Entomologists at the Health Department of Western Australia (HDWA) and THS were notified of any flavivirus positives within one or two days of completion of testing to enable mosquito control measures and/or to issue media warnings to residents living in risk areas.

Mosquito monitoring programs

Mosquito monitoring is carried out on a weekly basis at major population centres in the NT by the Medical Entomology Branch section of the THS using CO₂ baited EVS traps (Rohe and Fall 1979).

The mosquitoes are identified but not processed for virus isolation. In the Kimberley region of WA annual mosquito collections are carried out, late in the wet season, at all major towns and an Aboriginal community. Mosquitoes are identified and processed for virus isolation (methods described in Lindsay et al. 1993). Virus isolates are identified by fixed cell ELISA (Broom et al. 1998).

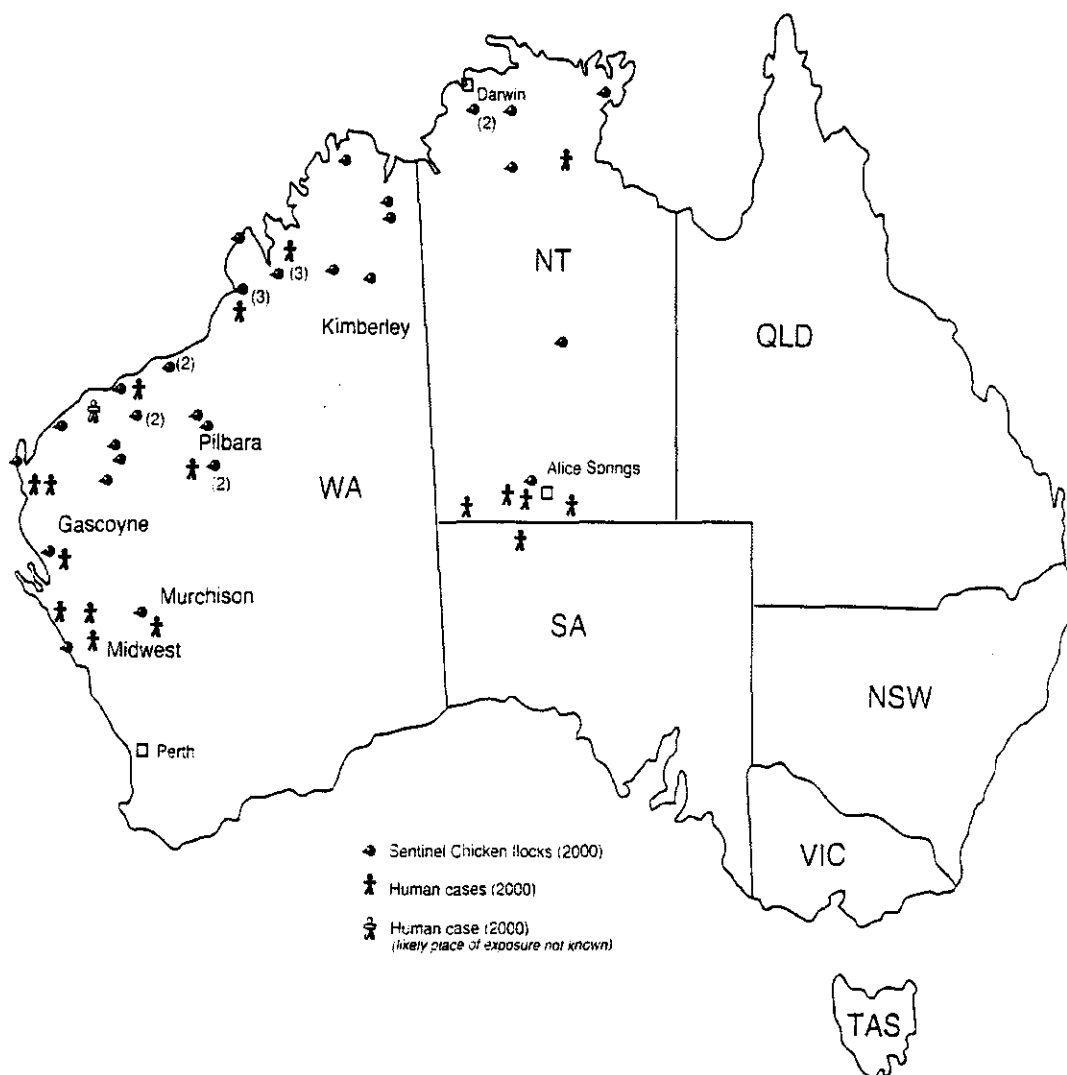


Figure 2. Map of Australia showing locations of sentinel chicken flocks and human cases of AE and Kunjin virus disease in WA and NT in 2000.

RESULTS

Sentinel Chicken Seroconversions

Activity of MVE during the 2000 season was first detected in sentinel chicken flocks in the Kimberley and Pilbara regions of WA in January and near Darwin in the NT in February. Health warnings were issued in both regions in January. Widespread MVE activity was detected soon after, with seroconversions detected in chicken flocks throughout the Kimberley, Pilbara, Gascoyne and Murchison regions of WA (Table 1) and in Alice Springs and Tennant Creek in the NT (Table 2). Activity continued until June in northern WA, and both central Australia and the Top End of the NT. Additional health warnings were issued in both WA and the NT when MVE activity increased significantly in one region or if it was detected in a new area.

In April 2000, MVE activity was detected in a sentinel chicken flock located in the Mid-west region (only 380km north of Perth). This is the furthest south the virus has ever been detected in WA.

Table 1. Number of flavivirus seroconversions in sentinel chickens in 5 regions of Western Australia during the 2000 wet season. (Figures in brackets represent KUN seroconversions).

Region	No of flocks	MONTH (2000)					
		January	February	March	April	May	June
Kimberley	11	5*	7 (2)#	6 (3)	16 (1)	17 (3)	5 (2)
Pilbara	14	4	16	36	40 (5)	18 (2)	18 (5)
Gascoyne	1	0	0	1	2	3	0
Murchison	1	0	0	1	0	0	4
Midwest	1	0	0	0	4	4	0
TOTALS	28	9	23 (2)	44 (3)	62 (6)	42 (5)	27 (7)

* MVE seroconversions, ()# KUN seroconversions.

Table 2. Number of flavivirus seroconversions in sentinel chickens in the Northern Territory during 2000. (Figures in brackets represent KUN seroconversions).

Region	Flocks	January	February	March	April	May	June
Darwin	3	0	3*	0	1 (2)#	0	3
Katherine	1	0	0	0	1	1	0
Arnhem	1	0	0	0	0	1	3
Barkly	1	0	0	2 (2)	(3)	6	0
Alice Springs	1	0	0	3	0	1	1 (1)
TOTALS	7	0	3	5 (2)	2 (5)	9	7 (1)

* MVE seroconversions, ()# KUN seroconversions.

Human cases of MVE/KUN encephalitis

The sentinel chicken activity was followed by widely distributed human infections. The first case of MVE encephalitis was a young boy who contracted the disease in the Pilbara region of WA in early March. There were eleven additional cases of human MVE or KUN recorded in WA, acquired in the Kimberley, Pilbara, Gascoyne, Murchison and Midwest regions. Nine of the cases developed encephalitis and one died. The outcome of two of the AE cases caused by MVE is still poor with continued ventilation. The KUN case from Carnarvon was non-encephalitic, with a date of onset in May (Table 3). The most likely place of exposure and expected outcomes are indicated (Fig 2, Table 3). The cases have largely been non-Aboriginal adult visitors or residents. Of particular concern is the occurrence of two cases in the Midwest, some 500km south of the previous southernmost case of AE in WA.

Table 3. Details of WA flavivirus cases during the 2000 wet season#.

Case	Age	Sex	Race	Location	Date of onset	Symptoms	Outcome	Virus
1	10m	M	A	Pilbara	6/3/00	encephalitis	Improved	MVE
2	15yr	F	A	Kimberley	Early March	non-encephalitic	Good	MVE
3	55yr	M	C	Mid-west	8/4/00	encephalitis	Poor	MVE
4	32yr	M	C	Murchison	20/4/00	encephalitis	Good	MVE
5	25yr	M	C	MW → Kimberley	25/4/00	encephalitis	Poor	MVE
6	41yr	F	C	Pilbara	28/4/00	encephalitis	Improved	MVE
7	69yr	M	C	Mid-west	3/5/00	encephalitis	Improved	MVE
8	61yr	F	C	Mid-west	5/5/00	encephalitis	Good	MVE
9	64yr	M	C	Gascoyne/Carnarvon	Mid-April	encephalitis	Good	MVE
10	55yr	M	C	Gascoyne/Carnarvon	Mid-April	non encephalitic	Good	MVE
11	79yr	F	C	Kimberley	8/5/00	encephalitis	Died	MVE
12	37yr	F	C	Gascoyne/Carnarvon	May	non-encephalitic	Good	KUN

M – male, F – female, yr – years, m – months, A – Aboriginal, C – Caucasian

Information correct at time of writing.

Three cases of MVE encephalitis and one case of KUN encephalitis, all in Aboriginal people, were reported from the Alice Springs region of the NT (Fig 2). In addition, one case of encephalitis was reported from northern South Australia for which tests were unable to separate whether it was MVE or KUN. This is the first time in 26 years that confirmed cases have occurred in the dry inland region of central Australia, although a presumptive case was described in 1997 (Merritt et al. 1998). All cases from central Australia had encephalitic symptoms and were in Aboriginal people (Table 4).

Table 4. Details of central Australian cases of MVE/KUN encephalitis during the 2000 wet season.

Case	Age	Sex	Race	Location#	Date of onset	Symptoms	Outcome	Virus
1	69yr	M	A	400 km SW Alice Springs	25/03/00	encephalitis	Poor	MVE
2	4m	F	A	60 km SE Alice Springs	27/03/00	encephalitis	Poor	MVE
3	3m	M	A	140 km W Alice Springs	3/4/00	encephalitis	Good	MVE
4	31yr	M	A	northern S Australia	13/4/00	encephalitis	Good	MVE/ KUN
5	4yr	M	A	140km W Alice Springs	3/4/00	encephalitis	Good	KUN

M – male, F – female, yr – years, m – months, A – Aboriginal.

Mosquito Collections

The average number of *Cx. annulirostris* mosquitoes per trap collected at Alice Springs in the period January to June 1998 and 1999 was 8 and 25 respectively. In the 2000 period, there was an average of 827 *Cx. annulirostris* recorded per trap. This dramatic increase was a result of record rainfall in the region in February and facilitated MVE/KUN transmission. In WA, mosquitoes were collected in both the Kimberley and Pilbara regions in March/April 2000. The majority of these mosquitoes are yet to be identified and processed for virus isolation, but on initial inspection these traps did contain large numbers of *Cx. annulirostris* mosquitoes.

DISCUSSION

Record wet season rainfall was recorded in many areas of northern Australia, central Australia and areas south of the Kimberley region of WA during the 2000 wet season. As a result of these exceptional weather conditions, mosquito breeding and MVE activity increased. The virus activity was recorded in areas where the virus was only rarely recorded or had not previously been found. MVE activity was detected as far south as the Murchison and Midwest regions of WA for the first time. Sentinel chicken activity in Tennant Creek and Alice Springs in the NT is relatively rare and is usually associated with northwest monsoon activity. It is this northwest weather that may blow infected mosquitoes into the Barkly or central Australia area, and enable local amplification with increased vector numbers associated with flooding. Sentinel chicken seroconversions occurred before the onset of human cases in both WA and the NT. Health warnings had been issued to residents living in areas of MVE activity before human cases were reported.

The nine cases of MVE encephalitis reported this year from WA equals the number reported in 1993, the previous largest outbreak recorded in WA. However, the 1993 cases all occurred in the tropical Kimberley region of WA and the majority (5/9) were in Aboriginal people. The cases this year were from areas south of the endemic Kimberley region (Pilbara, Gascoyne, Murchison and Midwest) and were mainly (8/9) in non-Aboriginal residents or travelers in the area. This apparently southerly movement of virus is of concern, as these areas are more highly populated and the majority of residents have not previously been exposed to MVE. It has been shown that MVE probably persists in the desiccation resistant eggs of *Aedes* mosquitoes in some arid areas of north western Australia (Broom et al. 1995). The virus may have been “seeded” in the Murchison and Midwest regions of WA and if rainfall events like those in 2000 are repeated it is possible that MVE virus will be re-activated in these regions and cases of potentially fatal encephalitis could occur. As was seen this year, the epidemic activity will likely cause disease largely in non-Aboriginal adults living in or visiting these areas. This will be in addition to the ongoing risk to residents, especially young Aboriginal children, and visitors within the enzootic areas.

Five cases of MVE/KUN encephalitis were reported from central Australian in 2000, 4 from NT and one from South Australia. The MVE encephalitis case reported from a South Australian Aboriginal community is the first that has been reported outside WA, the NT and Queensland since 1974. AE cases in these arid regions of central Australia are rare, with only one previous confirmed case reported in 1974 and one presumptive case in 1997. When cases occur in new regions it is important that they are diagnosed correctly and that people living in these areas are warned of the health risk so that they can take adequate avoidance or self protection measures.

The NT sentinel chicken monitoring program did provide an early warning of possible increased MVE activity by detecting seroconversions in late March. This was however preceded by significantly increased numbers of *Cx. annulirostris* mosquitoes in the region in February 2000 and illustrates that high summer rainfall and above average numbers of *Cx. annulirostris* mosquitoes could be a good early warning of AE risk in central Australia. The central Australian cases all occurred in Aboriginal people living in remote communities. These communities did receive television warnings and health clinics were alerted, but there may have been less self protection or avoidance measures taken. There is therefore a need to increase the awareness of people living in remote communities about the threat of mosquito-borne diseases and to develop a system whereby timely, appropriate health warnings can be issued to "at risk" Aboriginal communities. The Arbovirus Surveillance and Research Laboratory and the Regional Public Health Units in WA are working to improve the MVE warnings they currently send out to remote Kimberley and Pilbara Aboriginal communities. A similar program could probably be adopted for use in the NT and possibly in the north of South Australia.

The extensive MVE activity seen this year highlights the need for efficient surveillance programs in northern Australia. It is difficult to determine how many of cases of AE are prevented by the early warning of MVE activity given by these surveillance programs but we feel that the results are essential to reduce the impact of this disease in "at risk" populations. In addition it is essential that sentinel chicken flocks in WA and NT are located both in areas where MVE is seasonally detected and also in areas outside the limits of known activity.

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