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INVESTIGATING THE EPIDEMIOLOGY OF A NEW DISEASE : VIRAL BLINDNESS IN KANGAROOS

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Une nouvelle maladie, la cécité virale des kangourous, s'est développée en Australie du sud sous forme épidémique depuis 1994. Plusieurs institutions, des éleveurs et des chasseurs se sont associés pour mieux comprendre la maladie. Les méthodes utilisées sont classiques. Une première enquête dans l'ouest des Nouvelles Galles du sud a montré qu'il s'agissait d'une seule et unique maladie, largement répandue. Les cas se définissent par la clinique. De façon plus participative, les recherches se sont poursuivies par un questionnaire envoyé aux éleveurs et chasseurs de kangourous de cette province. La maladie est définie en termes de répartition plutôt qu'en nombre de cas individuels, avec établissement de taux de morbidité. Une étiologie arbovirale est suspectée. Deux orbivirus ont été isolés. Dans un cas, le virus est issu du chorion et de la rétine et ressemble à du matériel récolté dans les années 1970. On a retrouvé du matériel génétique de ce virus dans des insectes de la même région.
Il y a beaucoup plus de séropositifs que de malades. La reproduction de la maladie a été réussie. La maladie est peut-être à médiation immunitaire. Il n'y a aucun lien avec l'Homme ou le mouton.

A NEW DISEASE IN KANGAROOS

In early 1994, livestock graziers, kangaroo shooters, and wildlife agencies began to report unexplained blindness in kangaroos over large areas of western New South Wales -NSW-.
Western grey (*Macropus fuliginosus*), red (*Macropus rufus*), eastern grey kangaroos (*Macropus giganteus*) and euros (*Macropus robustus erubescens*) were seen to move in unusual ways, and when disturbed, would hit objects normally avoided. Affected animals usually had no external eye damage, and remained healthy, but gradually lost weight over weeks, and were believed to die from starvation, dehydration, or trauma.

THE LEARNING COMMUNITY

There was concern about the problem among graziers, kangaroo shooters, the general community, and its media and agencies. Key interests involved were : *a need to care for and protect wildlife; concern for any possible threat to community health; curiosity about the nature and cause of the problem; concern for any possible threat to livestock health; responsibility of the veterinary profession to understand and manage animal health and welfare.*
A variety of people wanted to learn about the disease. Learning communities are coalitions of people wanting and able to contribute to an understanding of a problem. The epidemiologist can assist the formation of a learning community by identifying the community's interests and resources; developing methods to help people structure their observations of animal populations to effectively study the disease; facilitating communication; and developing partnerships to provide the necessary resources, knowledge and skills (Ison, 1993). Although no single person or agency had the resources to address this new disease, an effective learning community evolved to investigate the disease, including graziers and kangaroo shooters, and a variety of agencies. Its aims were to :

* *know more about the nature of the disease*
* *gauge the significance and importance of the disease, for kangaroos, livestock and people*
* *determine its causes, in epidemiological (and ecological) terms*
* *manage the disease and its implications appropriately*

PRELIMINARY INVESTIGATIONS

National Parks and Wildlife Service -NPWS- staff at Kinchega National Park near Menindee on the Darling River saw index cases in February, 1994. NSW Agriculture were asked to assist, as NPWS had neither veterinary nor epidemiological expertise. Similar reports came in from graziers, kangaroo shooters and agency staff from other western NSW locations. To gauge whether the problem was a single entity, and its distribution, NPWS and NSW Agriculture used a cross-sectional survey of occurrence and signs by fax and telephone of :

* *NPWS staff in western NSW*
c *NSW Agriculture field veterinarians throughout NSW*
* *veterinarians and rangers employed by a NSW grazier agency, Rural Land Protection Board -RLPB-*

1 NSW Agriculture, Rangelands Management Research and Advisory Unit, Cobar, Australia
2 NSW Agriculture, Elizabeth MacArthur Agricultural Institute, Camden, Australia
3 National Parks and Wildlife Service, Kinchega National Park, Menindee, Australia
4 University of New South Wales, Fowlers Gap Research Station, Broken Hill, Australia
5 University of Utrecht, Utrecht, The Netherlands
6 Australian Animal Health Laboratory, Geelong, Australia

This survey asked if blind kangaroos had been seen, and what species were affected. Similar clinical features were reported for grey and red kangaroos at most locations. No significant gross pathology was found on postmortem of affected animals. Histopathology revealed a chorio-retinitis.

CASE DEFINITION

To facilitate communication, the case definition was derived from distinctive clinical signs observed. Kangaroos were said to be affected by this syndrome if : *when disturbed, they ran into objects they would normally avoid; they had nothing unusual about the appearance of their eyes; they moved in unusual ways; and observers considered kangaroos blind.* To differentiate other diagnostic possibilities, respondents were asked if kangaroos had any obvious eye problem (*such as tears or other discharge, swelling, cloudiness or whiteness*).

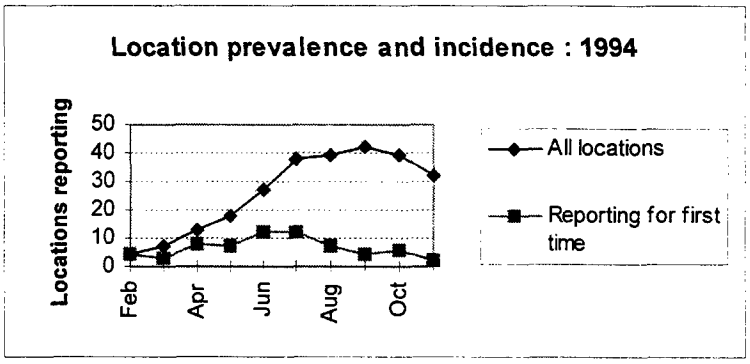
PARTICIPATIVE RESEARCH

Traditionally, investigating a new disease has been the domain of the "expert". Yet many people involved with a health problem have some expertise. If differences in people's knowledge, context, biases, skills and use of language can be managed inclusively, this diversity becomes an asset for a learning project.

As graziers and shooters were observing kangaroos for extended periods over large areas, their knowledge was invited through a cross-sectional postal survey of the far west of NSW by NPWS and NSW Agriculture. They were asked : *the numbers and type of kangaroos actually seen affected; which months blind kangaroos were seen; to estimate kangaroo populations and types* in the locations people were observing. Replies were received from 101 graziers and 31 kangaroo shooters. Half the respondents reported seeing blind kangaroos.

The survey provided location prevalence (*proportion of locations reporting blindness*) and incidence (*proportion of locations reporting blindness for the first time*) by month. See Figure 1. Estimates of morbidity were calculated as ratios of (*observer counts of blind kangaroos*) compared with their (*estimates of total populations*).

Figure 1



In working with graziers and kangaroo shooters, any observer bias needed to be considered. Graziers move around their properties in daylight hours, while kangaroo shooters travel in the evening and night. Kangaroo shooters use telescopic sights to aim at the animal's head, and were likely to observe the eyes more closely than graziers. Blind animals tend to ignore spotlights but might be startled by noise. During the day, kangaroos move away from both the sight and sound of people. Blind kangaroos tend to stand and locate using their hearing during the day, and were conspicuous because they did not react to objects they would normally see.

Comparison of grazier and shooter estimates gave similar spatial distributions of occurrence of blindness; graziers tended to see more blind greys; and shooters saw more external signs of eye damage. See Table 1. Similar numbers of males and females, and fewer immature kangaroos, were affected. Population estimates by respondents were considered reasonably accurate by NPWS. A reporting bias was considered likely, with more replies from locations with the disease.

Relatively few blind animals were seen compared with estimates of total populations. Large numbers of blind kangaroos were seen at some locations. As blind animals became more conspicuous, and stayed closer to water sources, detection rates may have increased. The proportion of the population of kangaroos in western NSW affected is estimated to vary between (*median morbidity ratios for all locations*), to (*median morbidity ratios for affected locations*) shown in Table I.

Table I

Morbidity ratio[1] estimates for graziers and shooters in affected locations

Type of Kangaroo	Type of Observer	No. Observers	Mean Morbidity Ratio[1]	Median Morbidity Ratio[1]
Grey	Grazier	45	3.8	1.1
Grey	Shooter	10	0.7	0.6
Red	Grazier	23	0.2	0.07
Red	Shooter	9	0.2	0.04

[1] *Ratio of (*blind animals observed*) to (*estimate of total population*) - ratio per 100 animals*

AETIOLOGY

The disease had been seen on a wide variety of land types and pastures, suggesting that plant toxins or other nutritional agents were unlikely to be the cause. Key findings were considered to be : *index cases were found close to major surface waters; the disease had appeared over a very large area simultaneously after northerly rains had broken a long dry period; and no infectious agent had been found in initial laboratory investigations.* An arboviral aetiology was suspected both on epidemiological and pathological grounds. However, *no viral agents were isolated from cases seen in 1994; animals gradually became blind over weeks or months, more slowly than expected with an infectious agent; new cases were occurring in winter, long after peaks in insect activity.*

In early 1995, the disease appeared in new locations in western NSW and in other states, again sometime after summer rains. The disease was found in two locations with captive, isolated, well-nourished kangaroos. Two Orbiviruses were isolated from affected animals at different locations by different laboratories : Wallal and Warrego viruses. Their genetic structure was determined. The Wallal virus structure was relatively novel.

This virus was located in chorio-retinal tissue from affected animals. A histopathology slide from a case of kangaroo chorio-retinitis seen in the early 1970s was found to have the same RNA structure as cases in 1994/95. Insects trapped as part of the National Arbovirus Monitoring Program at Menindee and Bourke on the Darling River were found to have the Wallal virus. Culiciodes species carrying the Wallal virus included one believed to be predominantly a bird feeder.

Antibody tests were developed for both viruses. Wildlife agencies and veterinary laboratories in southern states collaborated in a serological survey of grey kangaroos for Wallal and Warrego viruses. Both viruses were found to infect about (20-100)% of normal animals in affected areas, but Wallal virus was not present or uncommon in unaffected areas.

To understand aetiology better, reproduction of the disease was attempted with normal captive animals being exposed to the two viruses. Chorio-retinitis was reproduced in 3 of 8 inoculated animals. Wallal virus only was detected in the retina of affected animals. Disease was not observed until after seroconversion. It was hypothesised that the disease may be immune-mediated, and while Wallal virus was shown to be a necessary disease agent, interaction with Warrego virus infection could not be ruled out.

OTHER STUDIES

A postal survey of licensed graziers and shooters throughout NSW was conducted in July 1995. Blindness in kangaroos in either 1994 or 1995 was reported by 349 of the 773 (45%) replies. Total populations estimated were 990,000 greys; 610,000 reds; 73,000 euros; and 18,000 wallabies. Up to 40% of the population at some locations were reported to be blind. The survey demonstrated the dissemination of the disease, its prolonged course, and that it was widespread, although relatively uncommon in the total NSW population. The 1995 pattern of increasing location prevalence over autumn to a peak and plateau in winter, then decline, was similar to 1994. Morbidity estimates for 1995 were broadly similar to 1994.

Routine aerial population surveys by NPWS indicated no significant change in kangaroo populations that could be related to viral blindness. A case study of radio-tracked grey kangaroos in a defined population under ecological study, and that became infected, found temporal and spatial patterns of disease similar to those derived from grazier and shooter postal surveys. Changes in behaviour and home range were seen before affected animals showed evidence of blindness. Blindness developed at different rates. Over time, kangaroos adapted their behaviour to being blind.

A shooter with an unusual unilateral eye problem was found not to have been exposed to either virus. Normal sheep and cattle sampled had titres to both viruses. Opportunistic pathologic examination of sheep and cattle found blind in areas with affected kangaroos did not reveal any changes of chorio-retinitis. Stratified analyses of 1995 survey data showed blindness reported in livestock was not significantly associated with occurrence of blindness in kangaroos.

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