

The Distribution of the European Red Fox (*Vulpes vulpes*) in Western Australia

D.R. King* and L.A. Smith**

Abstract

The distribution of the Red Fox (*Vulpes vulpes*) in Western Australia is described from sight and bounty records. Foxes occur throughout the state with the exception of the North Kimberley and most offshore islands. Their current distribution is similar to that in 1934.

Introduction

The European Red Fox (*Vulpes vulpes*) was introduced into Victoria in the late 1860's (Troughton 1957) and from there it rapidly colonized most of Australia. Its westerly advance saw most of South Australia colonized by 1925 (Wood-Jones 1925) and in the same year it reached the Geraldton area on the mid-west coast of Western Australia (Long 1972).

Foxes were first reported in Western Australia in 1911-12 (Crawford 1912). They quickly penetrated the pastoral stations of the northeast interior reaching Sandstone in 1916, the mid-west coast in 1925 and by the early 1930's they had colonized the Southwest Division, northwest coast and southwest Kimberley (Long 1972).

The map of fox distribution given by Frith (1977) indicates that they occur throughout the Kimberley. The paucity of fox sightings in the Kimberley Division (one, and that in the extreme southwest Kimberley) during ten years (1970-1980) field work in that Division led one of us (L.A.S.) to question that assumption and eventually consider the distribution of the fox throughout Western Australia, particularly as much of the previously published data pertaining to the fox was based solely on Department of Agriculture bounty records. These were a compilation of data from political districts so many useful distributional data were lost.

Methods

Members of the Department of Ornithology and Herpetology at the Western Australian Museum have consistently recorded foxes during field trips from 1953 to the present (G.M. Storr 1953-1968 and L.A. Smith and R.E. Johnstone 1965 to the present). Almost all records were made driving in daylight and virtually no spotlighting was done from vehicles. Storr's, Smith's and Johnstone's diaries were searched for fox records.

* Agriculture Protection Board of Western Australia, Bougainvillea Avenue, Forrestfield, W.A. 6058.

** Western Australian Museum, Francis Street, Perth, 6000.

In 1981 an Agriculture Protection Board questionnaire was circulated to pastoralists, licensed kangaroo shooters and A.P.B. personnel (as an adjunct to a similar questionnaire about the distribution of the rabbit).

Other data were obtained from:

1. Western Australian Museum records.
2. A search of the more pertinent literature (Department of Fisheries and Wildlife Bulletins and Reports, Western Australian Museum faunistic reports and the Western Australian Naturalist).
3. Records of other Western Australian Museum staff.

Results and Discussion

The distribution of the fox in Western Australia is plotted in Figure 1. We do not believe that our search has netted all available fox records, but because the records span 70 years and the 1981 questionnaire results are similar to the total distribution shown we are confident the map is a faithful picture of the fox's distribution in Western Australia. What such a map does not show is the relative density of foxes when one area is compared with another, although some indication can be obtained from Figure 1 that the fox seems to be more common in coastal areas than in inland areas, and that it is absent from large areas of the Kimberley.

Storr, Smith and Johnstone's records were quantified by summing the number of kilometres travelled in the Northwest Division and counting the number of foxes seen. From this an index expressing fox population density within the Northwest Division was calculated for the Northwest Coastal Highway (Highway 1) and major routes west of it and the Great Northern Highway (Highway 95) and major routes east of it up to the Divisional boundary. On Highway 95, 4 foxes were seen in 16,411 kilometres travelled (0.2 foxes per 1000 km); on Highway 1, 39 foxes were seen in 21,676 km travelled (1.8 foxes per 1000 km). This gives some indication that fox densities are higher along the upper west and lower northwest coasts compared with the immediate hinterland.

Fox numbers at several sites in Western Australia have been reported to fluctuate considerably over time (Brooker 1977, King *et al.* 1981, 1983). Records of bonuses paid by the state government for foxes were examined to determine whether fluctuations differed between Divisions. The bonus scheme for foxes began in 1928 and ended in 1958, although payments continued to be made on some foxes (allegedly those killed up to 1958) until 1961.

The total number of foxes on which bonuses were paid in any year was influenced by a number of factors, many of which are more closely related to social and economic considerations than to the size of the fox population. In an attempt to minimise the importance of such factors, we have used the percentages of the total state bonus payments paid in different geographical areas rather than the actual numbers of bonus payments. The results are shown in Figure 2. The proportion of bonuses paid in the Northwest Division was highest during 1928-1935 when the colonization of the state by foxes which initially occurred through the pastoral areas was being completed (Gooding 1955, Long 1972). The proportion of bonus payments in the Eastern Division was also highest during the early 1930's and at the end of

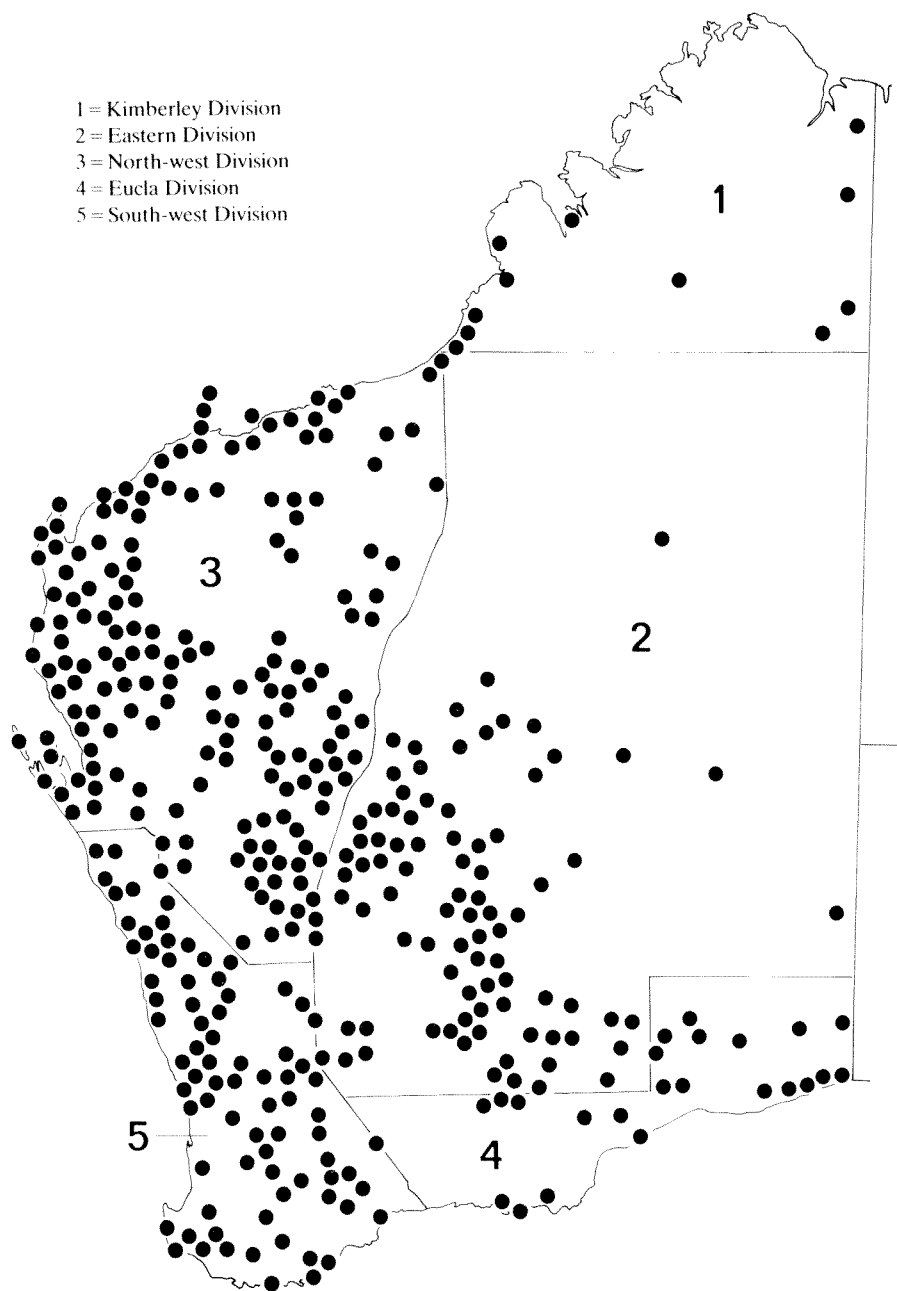
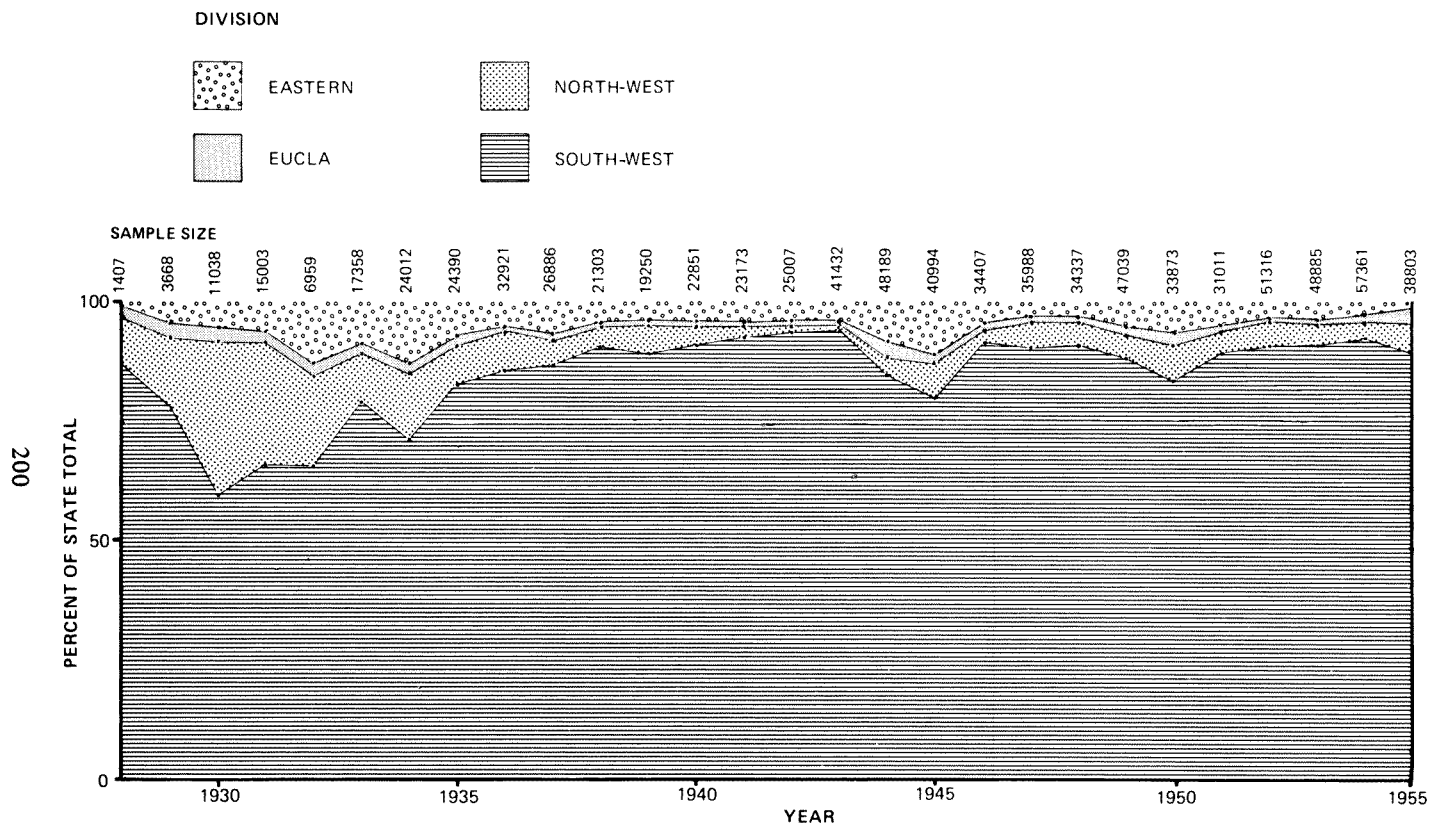


Figure 1 Distribution of the fox in Western Australia.



Distribution of the European Fox in Western Australia

Figure 2 Percentage of total number of foxes from each Division on which bonuses were paid in Western Australia between 1928 and 1958. Divisions as in Figure 1.

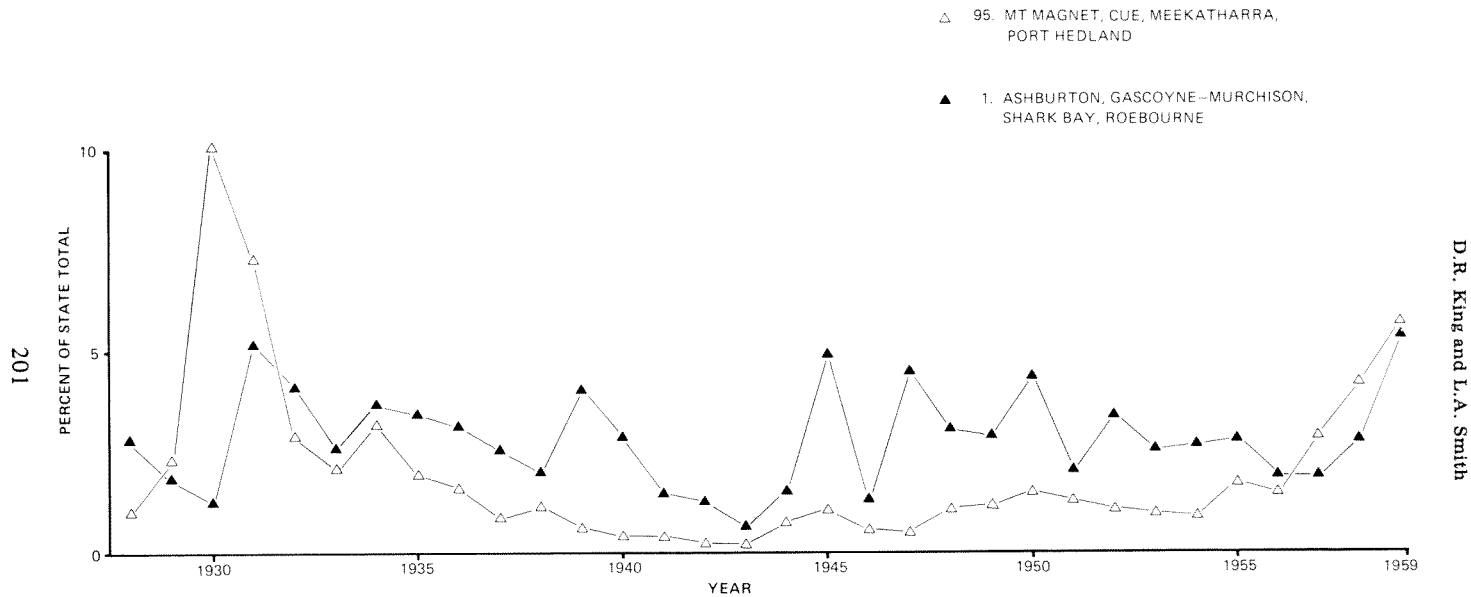


Figure 3

Percentage of total numbers of foxes on which bonuses were paid in Western Australia between 1928 and 1959 from those shires through which Highway 1(▲) and Highway 95(△) pass.

World War II. A similar pattern occurred in the Eucla Division. The high levels during the latter period were probably related to changes in the availability of rural labour at that time.

Throughout the entire period during which the bonus system operated, the majority of bonuses were paid on foxes killed in the Southwest Division. From 1935 to 1955, payments in that Division comprised 80-94% of all payments for the state (Figure 2). These figures probably reflect the population density of humans more than of foxes. From 1956 to 1959 that level diminished somewhat, but fox numbers in the Southwest appear to have increased in recent years. Between 1952 and 1968 large quantities of 1080 were used in the southwest for poisoning rabbits, and it has been suggested that fox numbers were reduced there at that time through secondary poisoning by feeding on the carcasses of the poisoned rabbits (King *et al.* 1981). Following a drop in the use of 1080 for rabbit poisoning during the late 1960's and early 1970's, fox numbers rose at two sites in the southwest (King *et al.* 1981).

The number of bonuses paid in the Kimberley Division was always very low. The maximum number was 69 in 1946, which was only 0.16% of the total for the state that year. They are not included in Figure 2.

A comparison of the yearly bonus payments as a percentage of the state total for the shires through which Highways 1 and 95 pass is shown in Figure 3. Between 1928 and 1959, in 25 of 31 years bonuses were paid on more foxes in the coastal shires, through which Highway 1 passes, than in the inland shires.

When the above data are considered with the various personal communications from pastoralists, farmers and Agriculture Protection Board doggers to Storr, Smith and Johnstone, the fox's distribution in Western Australia could be best summed up as common in the southwest and adjacent northeast interior (pastoral areas) and the upper west and lower northwest coasts; very common in the southeast, uncommon in the midwest interior; rare in the Great Victoria, Gibson and Great Sandy Deserts and the Pilbara highlands, upper northwest coast and south and east Kimberley; and absent from the Kimberley north and west of the King Leopold Ranges. There are nine insular records: Depuch, Legendre, Harry Rock (east end of Harry I.), Dolphin, Gidley, Keast, Hauy, Angel and Dirk Hartog Islands (Bill Williams, a Geraldton fisherman has seen one fox on Dirk Hartog Island - pers. comm. to G.M. Storr, 21 June 1959 although we know of no subsequent sightings there).

The distribution in Figure 1 is similar to that which the fox had attained by 1934 (Gooding, 1955). The failure of foxes to become established in the North Kimberley is consistent with their distribution in Queensland, where they do not extend north of approximately 19 degrees (Mitchell *et al.* 1982) and in the Northern Territory where they only occur in southern areas (Strahan 1983, Strong and Low 1983). There is apparently some barrier (probably climatic) to the expansion of foxes into the more northern parts of Australia.

This is of particular interest because of the detrimental effect that foxes are believed to have on medium-sized species of native mammals in other parts of Australia (Baynes 1979, Christensen 1980, King *et al.* 1981). Since the arrival of European man in Australia habitat modification by introduced grazing animals, clearing of natural vegetation, changes in the fire regime and competition with or predation by introduced mammals appears to have caused the decline of many species of native mammals. In most cases, where native species

have declined, a combination of several of these factors was probably involved and it is not possible to determine to what extent any of them were responsible.

In the south and east Kimberley (the Fitzroy and Ord Valleys) where grazing and burning has affected the environment and foxes occur, albeit in low numbers, a number of native mammal species have disappeared (Kitchener 1978, McKenzie 1981). In this area, foxes may have played a part in their disappearance. In the precambrian areas of northwest Kimberley (that area bounded by the King Leopold and Durack Ranges) where the fox is absent, all known species of native mammals have persisted despite the presence of introduced grazing animals and annual burning. Thus this region may continue to be a major refuge for native mammals as are the reserves of Bernier, Dorre and Barrow Islands, all of which are free of foxes.

Sources of Data

Apart from Western Australian Museum specimens and literature records (See (1) and (2) Methods) Figure 1 is based on the following records, listed in order of increasing latitude.

1. Those from the diaries of Western Australian Museum staff members (G.M. Storr, L.A. Smith, R.E. Johnstone, P. Griffin and J. Dell).

Kimberley Division: 23 km SSW of Frazier Downs HS.

North-West Division: 50 km SSW of Anna Plains, 10 km S of Sandfire Roadhouse, 10 km S of Cape Thouin, Mundabullangana, Leslie Salt Works, Warrawagine, 3 km SW of Karratha HS, 8 km SSW of Whim Creek, 45 km WSW of Karratha 2 km S of Fortescue River Crossing (NW Coastal Highway), 16 km NE of Mardie, 8 km S of North West Cape, 35 km S of Onslow, Mouth of Cane River, Learmonth, Bay of Rest, 16 km S of Koordarie, 12 km S of Minilya River Crossing, (NW coastal highway), Barrabiddy Creek (NW coastal highway), 2 km S of Booloogooro, 18 km S of Quobba, 40 km N of Carnarvon, 12 km N of Wooramel, 2 km ESE Nanga, Overlander Roadhouse, Hamelin, 15, 20 and 22 km S of Overlander Roadhouse, 24 km S of Meekatharra, Wannoo, and 7 km S of Wannoo, 10 and 50 km S and 11 km SSW of Tamala, 60 km S of Overlander Roadhouse, 5 km N of Nerren Nerren, 60-km NNW of Kalbarri, 27 km N of Mt Magnet, 15 km N of Mt Magnet, 5 km N of Paynes Find.

Eastern Division: 10 km NW of Gary Junction, Minnie Creek (near Yamarna HS), Winduldarra Rockhole, 30 km E of White Cliffs, 16 km W of Murrin Murrin, 6 km S of Jeedamya, 3 km S of Comet Vale, 10 km E of Karonie, Southern Cross District, 8 km E of Carrabin, Walgoolan, 2 km E of Burracoppin, 80 km SSE of Karonie.

Eucla Division: 10 km NE of Norseman, 8 km N of Norseman, 61 and 27 km E of Norseman, 8 km W of Balladonia, 64 km E of Balladonia, 56 km E of Madura, 47 km W of Eucla Pass, 19 km E of Mt Baring.

South-West Division: 20 km N of Galena, 7 km N of Galena, Kalbarri, 17 km SSE of Kalbarri, 17 km E of Port Gregory, 8 km N and 5 km S of Northampton, 17 km N of Geraldton, 5 km S of Greenough, 7 km NE of Morawa, 6 km W of Mingenew, 6 km W and 3 km E of Irwin, 2 km NNW of Dongara, 40 km N of Mingenew, 8 km NW of Three Springs, Knobby Head, 3 km N of Eneabba, 1 km N of Coorow, 8 km N of Marchagee, Green Head, Cockleshell Gully, 8 km N of Watheroo, 1 km S of Pithara, 3 km N of Coomberdale, 2 km N of Miling, Wialki, 8 km W of Bindi Bindi, 11 km S of Walebing, 8 km N of New Norcia, Lake Brown and 16 km S, 1 km S of Bindoon, 6 km SW of Merredin, 16 km S of Gingin, 1 km W of Baandee, Northam, 3 km W of Tammin, Woorloo, Guildford, Leighton, 3 km S of Wandering, 24 km E of Pingelly, Kondinin, 8 km NNW of Williams, Piesseville, 11 km NW of Katanning, 54 km NNW of Mt Barker, Manjimup, Donnelly River, Cheyne Beach, Granite Peak, Parry Inlet.

2. Positive answers to the Agriculture Protection Board's questionnaire were received from the following pastoral stations:

Kimberley Division: Ivanhoe, Waterbank, Thangoo, Gordon Downs, Sturt Creek, Anna Plains.

North-West Division: Mandora, Boodarie, Yarrrie, Wallareena, Indee, Tabba Tabba, Macroy, Karratha, Sherlock, Warambie, Cooya Pooya, Pyramid, Mardie, Yaraloola, Urala, Coolawanyah, Hooley, Minderoo, Cane River, Nanutarra, Giralia, Bullara, Ningaloo, Exmouth Gulf, Uaroo, Ethel Creek, Cardabia, Winning, Towera, Mia Mia, Warroora, Sylvania, Prairie Downs, Lyndon, Edmund, Wandagee, Gnaraloo, Williambury, Weelarana, Bulloo Downs, Mt Vernon, Mt Augustus, Booloogooro, Cooralya, Mardathuna, Yinnetharra, Boolathana, Kumarina, Brickhouse, Mulgul, Mooka, Callagiddy, Jimba Jimba, Bidgemia, Ella-Valla, Milgun, Mt Clere, Landor, Dalgety Downs, Marron, Towrana, Bryah, Wahroonga, Erong Springs, Yarlalweelor, Carey Downs, Meedo, Doolgunna, Wooramel, Mt Gould, Moorarie, Beringarra, Milly Milly, Mooloogoo, Carbla, Hamelin, Talisker, Nookawarra, Killara, Belele, Mileura, Carrarang, Yoothapinna, Sherwood, Muggon, Prairie Downs, Norie, Annean, Pollele, Madoonga, Hillview, Boolardy, Wooleen, Yarrabubba, Coodardy, Nallan, Murgoo, Austin Downs, Yallalong, Yarraquin, Woolgorong, Wandarrie, Wondinong, Mt Farmer,

Distribution of the European Fox in Western Australia

- Wynyango, Yuin, Winson, Boogardie, Hy Brazil, Yoweragabbi, Murrum, Challa, Meeline, Talling, Kirkalocka, Nalbarra, Boodanoo.
- Eastern Division: Glenayle; Earacheedy, Wongawol, Paroo, Milrose, Lake Violet, Millbillillie, Lake Way, Wonganoo, Yeeleerie, Yakabindie, Yandal, Lake Mason, Banjawarn, Bandy, Wooylgoo Spring, Black Hill, Pinnacles, Atley, Braemore, Bulga Downs, Yuinmery, Sturt Meadows, Mertondale, Mt Weld, Clover Downs, Minara, Cashmere Downs, Glenorn, Yundamindra, Kookynie, Walling Rock, Yerilla, Jeedamya, Mendleyarri, Menangina, Pinjin, Gindalbie, Mt Vettters, Mungari, Mt Burgess, Golden Valley, Woolibar, Madoonia Downs.
- Eucla Division: Kybo, Rawlinna, Fraser Range, Boonderoo, Wanteen, Koojarra, Kinclaven, Arubiddy, Kanandah, Gunadorah.
3. Agriculture Protection Board personnel have recorded foxes at the following localities:
- Kimberley Division: Nita Downs.
- North-West Division: Pardoo, De Grey Station, Mundabullangana, Burrup Peninsula, Dolphin I., Angel I., Mt Edgar Station, Millstream, Yalleen, White Springs, all East Pilbara Stations, Skull Springs, Peedamulla, Mulga Downs, Koordarrie, Roy Hill, Juna Downs, Middalya, Minnie Creek, Gifford Creek, Moogooree, Cobra, Mt Phillip, Mt Sandiman, Cooralya, Mingah Spring, Mooloo Downs, Three Rivers, Winderie, Edaggee, Neds Creek, Trilbar, Innouendy, Peron, Yaringal, Buttah, Nanga, Tamala, Mindbinia, all stations west and south of Mt Magnet, Narndee, Dromedary Hill, Pullagaroo.
- Eastern Division: Carnegie, Jundee, Gidgie, Leinster Downs, Depot Springs, Albion Downs, Barwidgee, Weebo, Dandaraga, Eristoun, Mavis Rock, Kirgella Rock.
- Eucla Division: Moopina, Deakin, Forrest, Mundrabilla.
- South-West Division: Fitzgerald River Inlet.
4. The results of the Agriculture Protection Board's questionnaires show that foxes have not been recorded from the following locations:
- Kimberley Division: Doongan, Carlton Hill, Drysdale River, Ord River irrigation area, Gibb River, Lissadell, Beverley Springs, Mabel Downs, Bedford Downs, Country Downs, Napier Downs, Kimberley Downs, Lansdowne, Yeeda, Alice Downs, Springvale, Nicholson, Myroodah, Fossil Downs, Luluigui, Moola Bulla, Sophie Downs, Qunbun Downs, Ruby Plains, Christmas Creek, Cherrabun, Coronado.
- Eastern Division: Billiluna, Balgo Mission, Cunyu, Nambi.
- North-West Division: Turee Creek, Wanna, Doorawarrah, Meeragoolia, Faure Island.

Acknowledgements

We are grateful to G.M. Storr, R.E. Johnstone, J. Dell and P. Griffin who gave us access to the data in their field notes, to J. Kinnear and K. Morris of the W.A. Department of Fisheries and Wildlife to all those who replied to the questionnaires circulated by the Agriculture Protection Board.

References

- Baynes, A. (1979). Analysis of a late quaternary mammal fauna from Hastings Cave, Jurien, W.A. Unpublished Ph.D. Thesis, University of Western Australia.
- Brooker, M.G. (1977). Some notes on the mammalian fauna of the western Nullarbor Plain, Western Australia. *West. Aust. Nat.* 14:2-15.
- Christensen, P.E.S. (1980). A sad day for native fauna. *For. Focus* 23:3-12.
- Crawford, A. (1912). Report of the Chief Inspector of Rabbits, 1911-12. Reprint, A.P.B. Res. Library.
- Frith, H.J. (1977). Wildlife Conservation. Angus and Robertson, Sydney.
- Gooding, C.D. (1955). The vermin bonus system in Western Australia. Part 1 - the distribution of payments. *J. Agric. West. Aust.* (Series 4) 4:433-439.
- King, D.R., Oliver, A.J. and Mead, R.J. (1981). *Bettongia* and fluoroacetate: a role for 1080 in fauna management. *Aust. Wildl. Res.* 8:529-836.
- King, D.R., Wheeler, S.H. and Schmidt, G.L. (1983). Population fluctuations and reproduction of rabbits in a pastoral area on the coast north of Carnarvon, W.A. *Aust. Wildl. Res.* 10:97-104.
- Kitchener, D.J. (1978). Mammals of the Ord River Area, Kimberley, Western Australia. *Rec. West. Aust. Mus.* 6:189-219.

- Long, J.L. (1972). Introduced birds and mammals in Western Australia. *West. Aust. Agric. Prot. Board Tech. Ser.* No. 1.
- McKenzie, N.L. (1981). Mammals of the phanerozoic West Kimberley, Western Australia: biogeography and recent changes. *J. Biogeog.* 8:263-280.
- Mitchell, J., Merrell, P. and Allen, L. (1982). Vertebrate pests of Queensland. Stock Routes and Rural Lands Protection Board Report.
- Strahan R. (1983). *Complete book of Australian mammals.* Angus and Robertson, Sydney.
- Strong, B.W. and Low, W.A. (1983). A short note on the distribution of the fox (*Vulpes vulpes*) in the southern Northern Territory. *N.T. Nat.* No. 6 : 20-23.
- Troughton, E. (1957). *Furred animals of Australia.* Angus and Robertson, Sydney.
- Wood-Jones, F. (1925). *The mammals of South Australia.* (Reprinted 1969). (Govt. Printer, Adelaide).