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A biological survey of the Fitzgerald area, Western Australia. Part 6 : Terrestrial Mammals

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Brief descriptions of quadrat landform, soil and vegetation are listed in Appendices I and III. Table 4.4 is the key to these descriptions, including detailed descriptions in Part II. Locations of 'A' and 'B' quadrats are shown in Figure 6.1, mammals captured are listed in Table 6.1, and catch per 100 trapnights is shown in Table 6.2.

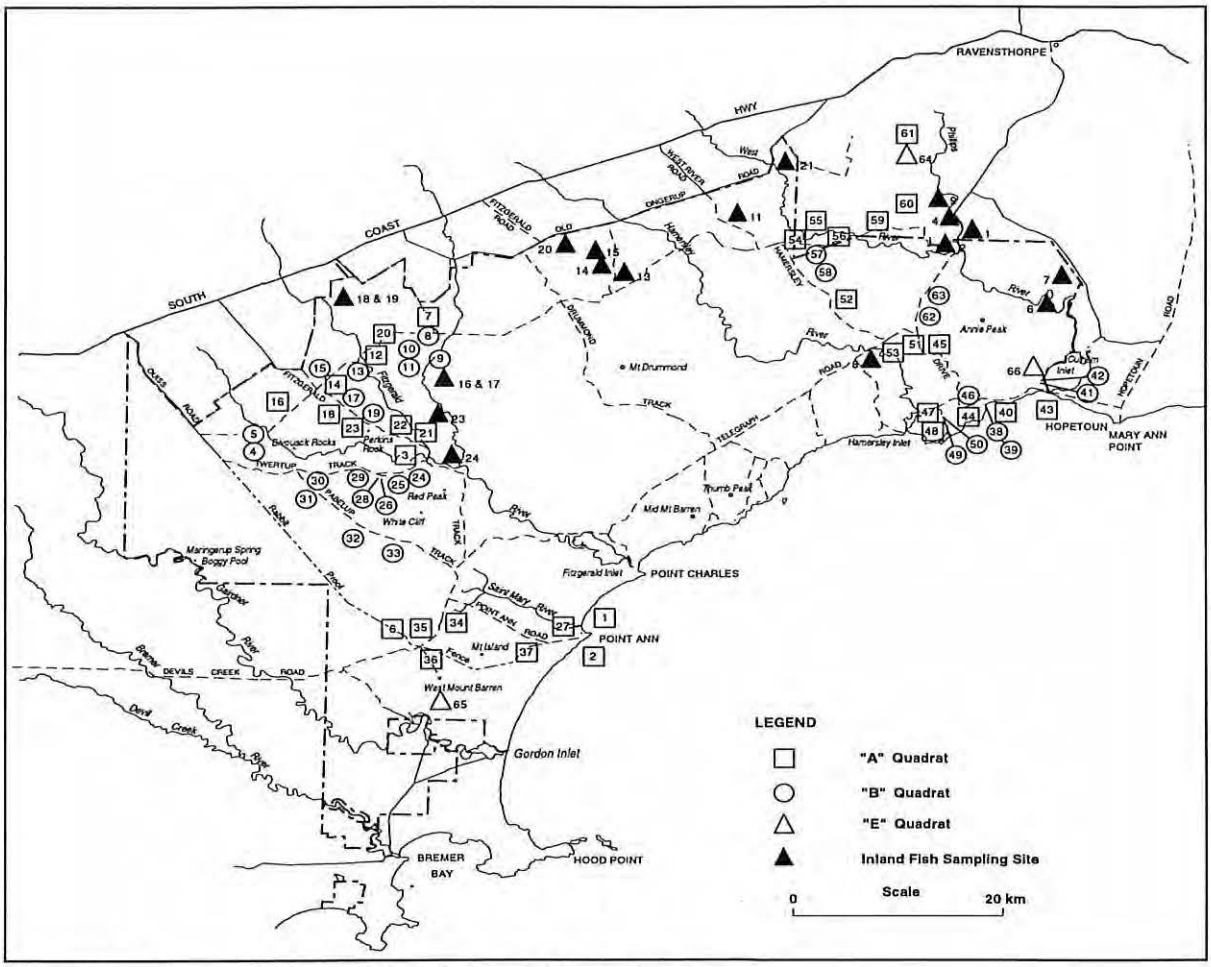

Figure 6.1 Locations of 'A', 'B' and 'E' quadrats and fish sampling sites.

TABLE 6.1

Mammals captured in 'A' and 'B'quadrats.

SPECIES: A = *Tarsipes rostratus*, B = *Cercartetus concinnus*, C = *Sminthopsis griseoventer*, D = *S. granulipes*, E = *Parantechinus apicalis*, F = *Rattus fuscipes*,G = *Pseudomys occidentalis*, H = *P. albocinereus*, I = *P. shortridgei*, J = *Mus musculus*, K = *Isoodon obesulus*.

Number of CAPTURES (excluding re-captures): Winter-spring before slash; followed by summer-autumn.

Phyl. schist = Phyllitic schist. Spongolite G = Spongolite gorge.

QUAD-No.	LAND SURFACE	VEGETATION FORMATION	SPECIES A	B	C	D	E	F	G	H	I	J	K
1A	Coastal dunes	Heath	4/0	.	.	.	.	.	.	.	.	.	.
2A	Phyl. schist	Heath	6/2	.	.	.	.	.	.	.	.	.	.
3A	Riverine	Woodland	9/0	14/3	0/1	.	.	.	.	.	.	2/0	.
4B	"	"	.	0/1	0/2	.	.	.	.	.	.	0/1	.
5B	"	"	.	.	.	.	.	.	.	.	.	.	.
6A	Swamp	"	6/4	1/1	.	.	.	1/0	.	.	.	.	.
7A	Upland	VO mallee	19/9	.	3/2	.	.	.	.	.	.	1/1	0/1
8B	"	"	6/1	.	0/1	.	0/1	1/0	.	.	.	.	.
9B	"	Heath	3/2	.	1/0	.	.	.	1/0	.	.1/0	.	
10B	"	Shrubland	7/1	.	.	.	.	.	.	.	.	.	.
11B	"	"	0/1	.	1/0	.	.	.	.	.	.	1/0	.
12A	"	Heath		8/1	0/1	2/2	.	1/0	.	.	8/2	0/1	.
13B	"	VO mallee	4/2	.	.	.	.	.	1/0	.	.	.	.
14A	"	"	11/1	2/0	1/0	.	0/1	.	1/1	.	.	1/0	.
15B	"	Mallee	1/0	.	0/1	.	.	0/4	1/1	.	.	.	.
16A	"	Woodland	3/2	4/4	7/2	.	.	.	.	.	.	0/1	.
17B	"	VO mallee	15/0	.	.	.	0/1	.	.	.	.	2/0	.
18A	"	"	26/2	.	1/2	.	3/2	.	20/1	.	.	3/0	.
19B	"	"	1/0	1/0	.	.	0/1	.	2/0	.	.	.	.
20A	Spongolite G	"	29/9	1/0	2/1	.	.	.	1/3	.	.	.	.
21A	"	Mallee	7/7	6/1	5/4	.	.	0/1	1/0	.	.	7/0	.
22A	"	VO mallee	11/8	8/2	4/0	.	.	.	2/5	.	.	.	.
23A	"	"	22/7	.	.	.	.	.	.	4/3	.	4/1	.
24B	"	Mallee	.	2/0	0/1	.	.	.	.	.	.	.	.
25B	"	"	1/0	1/0	.	.	.	.	.	.	.	.	.
26B	"	Woodland	2/0	4/0	.	.	.	.	.	.	.	.	.
27A	"	VO mallee	11/3	.	2/2	.	.	1/0	.	.	.	.	.
28B	Marine plain	"	5/0	.	0/1	.	.	.	.	.	.	.	.
29B	"	Heath	1/0	.	.	.	.	0/4	.	.	.	.	.
30B	"	VO mallee	2/1	.	0/2	.	.	.	.	.	.	.	.
31B	"	Shrubland	1/0	.	.	.	.	1/1	.	.	.	1/0	.
32B	"	VO mallee	1/1	.	.	.	1/0	.	.	.	.	.	.
33B	"	"	0/2	2/0	1/0	.	.	.	.	.	.	.	.
34A	"	Mallee	8/6	0/1	.	.	.	5/0	.	.	.	5/0	.
35A	"	Shrubland	22/6	.	0/1	.	.	5/1	.	.	.	.	.
36A	"	Heath	5/12	.	.	.	.	1/3	.	.	.	.	.
37A	"	VO mallee	4/0	.	.	.	.	1/0	.	.	.	.	.
38B	Coastal dunes	Heath	16/4	.	0/2	.	.	1/0	.	.	.	.	.
39B	"	"	.	0/1	.	.	.	1/0	.	.	.	0/2	.
40A	"	VO mallee	14/15	.	1/2	.	.	1/3	.	1/0	.	.	.
41B	"	Heath	1/1	.	.	.	.	0/1	.	.	.	4/0	.
42B	"	Shrubland	5/0	1/0	.	.	.	0/1	.	.	.	1/0	.
43A	"	Mallee	1/2	.	.	.	.	1/0	.	.	.	1/0	.

TABLE 6.1 (continued)

QUAD-No.	LAND SURFACE	VEGETATION FORMATION	SPECIES A	B	C	D	E	F	G	H	I	J	K
44A	Phyl. schist	VO mallee	6/16	.	6/1	.	.	0/1	.	.	.	.	.
45A	Riverine	Woodland	1/11	5/1	.	.	.	.	.	.	.	.	.
46B	Marine plain	Heath	3/7	.	.	.	.	0/2	.	.	.	.	.
47A	Coastal dunes	VO mallee	13/10	.	3/3	.	.	0/5	.	8/3	.	.	.
48A	"	Woodland	5/0	13/1	1/4	.	.	0/1	.	1/4	.	.	.
49B	"	Heath	4/2	.	1/0	.	.	.	.	1/0	.	.	.
50B	"	"	"	.	1/0	0/2	.	.	.	.	.	.	.
.51A	Marine plain	VO mallee	4/4	.	1/1	.	4/2	2/6	.	.	0/1	.	.
52A	"	"	8/1	.	2/1	.	.	2/0	.	9/2	.	2/1	.
53A	Spongolite G	Mallee	16/10	.	0/2	.	.	.	.	.	.	.	.
54A	Upland	Heath	4/1	.	.	8/2	.	3/0	.	4/3	0/1	1/0	.
55A	"	VO mallee	14/4	.	.	2/1	.	1/0	.	7/1	.	.	.
56A	Marine plain	"	17/5	.	1/0	1/0	.	.	.	.	.	.	.
57B	"	"	2/1	1/0	0/1	.	.	.	.	.	.	.	.
58B	"	"	4/2	.	.	.	.	.	.	8/0	.	.	.
59A	Riverine	Woodland	0/1	2/8	.	.	.	.	.	.	.	0/1	.
60	Greenstone	"	2/2	1/10	.	.	.	.	.	.	.	0/1	.
61A	"	"	1/0	15/10	.	.	.	1/0	.	.	.	0/1	.
62B	Marine plain	VO mallee	2/4	.	.	.	.	0/1	.	.	.	.	.
63B	"	"	2/0	.	0/1	.	.	.	.	4/2	.	.	.

TABLE 6.2

Catch per 100 trapnights for 'A' quadrats only, mammals classified by land surface and vegetation formation.

SPECIES: A = *Tarsipes rostratus*, B = *Cercartetus concinnus*, C = *Sminthopsis griseoventer*, D = *S. granulipes*, E = *Parantechinus apicalis*, F = *Isoodon obesulus*. G = *Pseudomys albocinereus*, H = *P. occidentalis*, I = *P. shortridgei*, J = *Rattus fuscipes*, K = *Mus musculus*.

	SPECIES A	B	C	D	E	F	G	H	I	J	K
LAND SURFACE											
Coastal dunes	10.6	2.3	2.3	0	0	0	2.8	0	0	1.8	0.2
Greenstone	3.8	15.0	0	0	0	0	0	0	0	0.4	0.8
Marine plain	12.1	0.1	0.8	0.1	0.7	0	1.3	0	0.1	3.1	1.0
Phyllitic schist	13.3	0	2.9	0	0	0	0	0	0	0.4	0
Riverine & swamp	6.7	7.3	0.2	0	0	0	0	0	0	0.2	0.6
Spongolite gorge	19.4	2.5	3.0	0	0	0	1.0	1.7	0	0.3	1.7
Upland	14.9	1.3	2.6	1.5	0.8	0.1	3.0	2.7	0.1	0.5	1.2
VEGETATION FORMATION											
Woodland	2.6	9.8	1.6	0	0	0	0.5	0	0	2.5	0.5
Mallee	12.7	3.0	2.2	0	0	0	0	0.2	0	1.2	2.2
Very open mallee	17.3	0.2	2.2	0.3	0.8	0.1	2.4	2.2	0.05	1.4	1.0
Shrubland	23.3	0	0.8	0	0	0	0	0	0	5.0	0
Heath	9.3	0.1	1.1	1.4	0.1	0	2.4	0	0.1	1.1	0.3

ANNOTATED LIST OF EXTANT SPECIES

Mammals listed as 'rare and endangered' in this list are from Government Gazette, 8 April 1994. Generalized descriptions of distribution are from Strahan (1983). In Tables, 'SD' refers to Standard Deviation, and 'N' refers to number of observations.

POTOROIDAE

BRUSH-TAILED BETTONG OR WOYLIE
Bettongia penicillata

Bettongia penicillata are known from a few individuals observed in October and November 1987 by Ray Smith and Steve Hopper and later by Mike Onus and myself in the north of FRNP. This general area is also where Tammars occur: it is upland landform dissected by Twertup Creek and its tributaries where woodland and *Eucalyptus platypus* thicket as well as dense mallee and shrubland occur in a tight mosaic. Low intensity buffer burning here has added to the environmental 'patchiness'. Five days trapping here with 10 Bromilow traps in November 1987 were unsuccessful. *Bettongia penicillata* is a gazetted 'Rare and Endangered' species.

MACROPODIDAE

WESTERN GREY KANGAROO *Macropus fuliginosus*

Macropus fuliginosus were widespread and moderately common in the FITZGERALD during the survey. No quantitative general estimates were made; an organized count was unsuccessful because of vagaries of weather, and using different vehicles. Quantitative data from the February 1985 wildfire (see Chapman and Newbey 1994) indicate a movement of animals into the burnt area within two weeks of the wildfire. Monitoring nine and 23 months post-fire recorded a subsequent decline.

Elsewhere in the FITZGERALD the largest group size was nine; this was at a long-abandoned farm, Parsons, on the Phillips River. Larger groups were seen on adjoining farmland. Observations suggest that kangaroos were equally abundant on most land surfaces except marine plain where they were less common.

On East Mount Barren kangaroos have not been observed above the wave-cut bench, however, in the Eyre Range they were present near the summit. Observed copulating in December and January and feeding on *Isopogon attenuatus* on one occasion.

M. fuliginosus are the largest common kangaroos over most of south-west WA. Their range extends east across the Nullarbor Plain into SA, Victoria, NSW and southern Queensland.

BRUSH WALLABY *Macropus irma*

Macropus irma were uncommon and apparently restricted to northern portions of the FITZGERALD during the survey. Only recorded 11 times, two pairs were included, all others were solitary. Recorded in woodland, mallee and shrubland approximately equally. Endemic in south-west WA, they are patchily distributed in dry sclerophyll forests and the wheatbelt from Esperance to Geraldton.

TAMMAR WALLABY *Macropus eugenii*

I was shown two sites in the FITZGERALD by Mr Don Reid of 'Jacup' where Tammars were present in the 1960s. We concluded they were still present on the basis of pads and runways, but probably scarce. Both sites were woodlands adjacent to thicket-like vegetation in creeks in the north of the FITZGERALD. Two Tammars were eventually seen in the same general area where woodland and dense mallee (*Eucalyptus annulata*) and *Allocasuarina campestris* ssp. *campestris* shrubland were in close proximity. At another site of similar general description some 25 km away, I located Tammar pads in a creek. A nearby Fox scat contained Tammar hair; predation is not necessarily implicated as scavenging can not be ruled out. These sites were all long unburnt, 29 and 37+ years; they have a tight mosaic of woodland and denser, low vegetation controlled by the presence of watercourses.

In WA the Tammar is gazetted 'rare and endangered'. It is known only from a few mainland localities in south-west WA; also present on Houtmans Abrolhos Islands and Recherche Archipelago. It also occurs in SA on Eyre Peninsular and Kangaroo Island.

PHALANGERIDAE

BRUSH-TAILED POSSUM *Trichosurus vulpecula*

The most usual habitat for *T. vulpecula* in the FITZGERALD is ferruginous sandstone breakaways on the edge of ancient river valleys supporting woodlands of either *Eucalyptus gardneri* or *E. astringens* on their rims and slopes. These sites combine shelter and trees in close proximity. They are also known from spongolite cliffs and larger, older woodlands of *E. occidentalis*. Females back-packing joeys were observed in December and April.

T. vulpecula has a wide but patchy distribution in Australia including the south-west of WA, central desert areas and much of the eastern States.

BURRAMYIDAE

WESTERN PYGMY-POSSUM *Cercartetus concinnus*

Cercartetus concinnus were widespread and fairly abundant in the FITZGERALD during the survey. They were present on all land surfaces except phyllitic schist (Table 6.2). Their preponderance on greenstone is owing to woodland being disproportionally trapped there. *Cercartetus* were the only marsupial trapped in primary dunes. It was present in all vegetation formations though principally an inhabitant of woodland and mallee (Table 6.2).

Percentages of females with pouch young per month were: August 8.3 per cent (N = 24), October 100 per cent (N = 1), November 33.3 per cent (N = 3) and March 14.3 per cent (N = 7). Another female with pouch young was Elliott-trapped in July. The recapture rate was 10 per cent, trap mortality 0 per cent, and weight data are presented below.

SEX	WEIGHT RANGE (g)	AVERAGE WEIGHT (g)	S.D. (g)	N
Females with PY	9.5-15.0	12.9	3.2	7
Females without PY	6.5-15.5	10.9	2.6	40
Males	5.5-14.0	9.9	1.7	85

PY = Pouch young

C. concinnus occurs widely in south-west WA and eastwards into the Goldfields; it also occurs in southern SA and western Victoria.

TARSIPEDIDAE

HONEY POSSUM Tarsipes rostratus

At the time of this survey *Tarsipes* were by far the most abundant and widespread mammal in the FITZGERALD. They were recorded from 58 of 63 quadrats. The only quadrats at which they were not recorded were primary and consolidated dunes, very open *E. occidentalis* woodlands and one inland mallee quadrat. *Tarsipes* were most abundant on spongolite land surface and shrublands of mixed *Banksia baxteri* and *B. coccinea* (Table 6.2). Animals were observed on the quartzite ranges; one was feeding on *Grevillea coccinea* near the summit of Annie Peak. They were also observed feeding on *G. tripartita* flowers in daylight at Mylies Beach.

Data in Figure 6.2 indicate that *Tarsipes* breeds throughout the year as indicated by Scarlett and Woolley (1980). Overall pouch young occupancy rate was 31.1 per cent. Recapture rate for females without pouch young was 4.8 per cent, and males 7.5 per cent. Trap mortality rate for females without pouch young was 5.0 per cent, and males 3.1 per cent. Weight data are presented below.

SEX	WEIGHT RANGE (g)	AVERAGE WEIGHT (g)	S.D. (g)	N
Females with PY	7.0-22.5	12.1	3.1	88
Females without PY	2.0-15.5	7.3	3.0	184
Males	2.0-12.0	6.7	1.9	332

PY = Pouch young

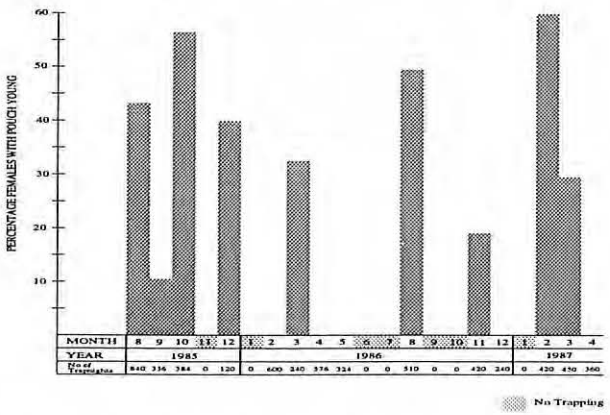

Figure 6.2 Percentage of female Tarsipes rostratus *with pouch young per month for survey of the FITZGERALD.*

PERAMELIDAE

SHORT-NOSED BANDICOOT *Isoodon Obesulus*

Isoodon obesulus are known only from two sites in the FITZGERALD. One was trapped by A.N. Start in dense *Banksia* scrub near West Mount Barren in 1976 (Kabay and Start)[1]. The present survey recorded a juvenile male at quadrat 7A in very open mallee on sandy loam.

Although apparently rare in the FITZGERALD, *Isoodon* is relatively common along wetter parts of the south coast, e.g. at Cape Le Grand National Park (Kitchener *et al.* 1975). It is also known from drier country areas: the Ravensthorpe Range (Chapman)[2], and in 1984-85 several were killed on Highway One and observed on farms in the West River district. These recent sites are of considerable interest because WA Museum (WAM) records indicate a contraction of range into wetter parts of south-west WA.

Isoodon obesulus are still fairly common in wetter parts of south-west WA. They also occur in south-eastern SA, Victoria and Tasmania. Since the survey was conducted *I. obesulus* has been gazetted as 'rare and endangered'.

DASYURIDAE

WHITE-TAILED DUNNART *Sminthopsis granulipes*

Sminthopsis granulipes were only recorded from three close-by quadrats in the West River area: 54A, 55A and 56A. The former two were upland and the latter marine plain land surface. Vegetation formation was very open mallee, and heath in the case of 54A; all quadrats were on loamy sand. At 54A and 56A *S. griseoventer* were also present but there was only one record of each; *S. granulipes* were more abundant. The presence of juveniles (weight range 8.0-12.5 g (N = 8)) in November indicates recent breeding.

Sminthopsis granulipes are endemic in south-west WA, they occur north to Kalbarri, east to Lake Cronin and south to FRNP, where they are restricted and uncommon. Apart from a specimen from Ravensthorpe in 1925 (M711 in WAM) whose provenance is uncertain, the closest previous localities are Lake Grace and Lake Cronin. Recapture rate was 12 per cent, trap mortality 0 per cent, and weight data are presented below.

SEX	WEIGHT RANGE (g)	AVERAGE WEIGHT (g)	S.D. (g)	N
Females	8.0-22.5	12.4	5.2	6
Males	9.5-32.5	16.0	8.2	9

GREY-BELLIED DUNNART *Sminthopsis griseoventer*

Sminthopsis griseoventer were widespread and abundant in the FITZGERALD during the survey. They were present throughout, except apparently absent on

[1] Kabay and A. Start, unpublished. 'Results of the search for the Paloroo in the south west and south coast of Western Australia 1975-76'. Department Fisheries and Wildlife.

[2] A. Chapman (1984), unpublished. 'A vertebrate survey of the Ravensthorpe Range, Western Australia'. Department Fisheries and Wildlife.

greenstone and quartzite ranges. Trapping data indicate they were approximately equally abundant in all vegetation formations (Table 6.2). They were present on a wide variety of soil types from loamy sand to loam. Females with pouch young were recorded in August (N = 1) and October (N = 2). Recapture rate 5 per cent; trap mortality rate 1 per cent. Body weight data are presented below.

SEX	WEIGHT RANGE (g)	AVERAGE WEIGHT (g)	S.D. (g)	N
Females with PY	19.0-20.5	19.8	0.8	3
Females without PY	6.5-20.5	13.7	3.9	37
Males	7.5-30.5	18.4	5.8	47

PY = Pouch young

Until recently *S. griseoventer* were included in the wide ranging *S. murina*, which was recently revised (Kitchener *et al.* 1984). *Sminthopsis griseoventer* is endemic in south-west WA, with a predominantly coastal distribution north to Jurien Bay, east to Israelite Bay, with minor incursions into the Darling Range and southern Archaean shield near Borden.

Unlike other mammals, *S. griseoventer* appears to adapt well to relatively frequent burning in the FITZGERALD. Chapman[3] recorded it as more abundant in vegetation 5-years-old post-fire than in older vegetation. Additionally, it was recorded 23 months post-fire in central burn areas following the February 1985 wildfire (Chapman and Newbey 1994).

DIBBLER *Parantechinus apicalis*

The Dibbler is undoubtedly one of the FITZGERALD's most celebrated inhabitants. Its discovery in 1984 by Ranger G. Duxbury (Muir 1985a), was a major factor in implementing the present survey, which recorded 17 separate animals in eight separate locations (Table 6.1). Six of these were upland and two were marine plain land surface. All but one quadrat (in heath) were in very open mallee (Table 6.2). All quadrats were on loamy sand. In spite of the superficial similarity of the very open mallee quadrats accorded by a KSr upper stratum (Muir 1977), these quadrats differ considerably in density and composition of lower strata and they appear visually very different. The one factor they all have in common, apart from soil type, is that none had been recently burnt (Table 6.3).

[3] Chapman, unpublished. A fire-fauna study in Fitzgerald River National Park. National Parks Authority of Western Australia.

TABLE 6.3

Number of Dibblers trapped on different vegetation ages during survey.

Age since last burn as at 1987 and based on Muir (1985a).

QUADRAT No.	YEARS SINCE BURNT	No. OF DIBBLERS TRAPPED
32B	16	1
12A, 14A	>30	2
8B, 17B, 18A, 19B, 51A	>37	14

The presence of a juvenile male weighing 23.0 g and a female with 4 + 4 distended teats in August indicate that females give birth to young in the FITZGERALD in winter. Body weight data are presented below.

SEX	WEIGHT RANGE (g)	AVERAGE WEIGHT (g)	S.D. (g)	N
Females	39.0-76.5	59.6	16.0	5
Males	23.0-119.0	77.0	35.2	9

Dibblers were presumed extinct until 1967 when two were trapped at Hassell Beach (Morcombe 1967). In 1975 and 1976 two were found dead on farms at Jerdacuttup; these findings prompted further searching, including in FRNP, which proved unsuccessful (Woolley 1980). In August 1985 live populations were located as part of the present survey and in December 1985 another colony was discovered on Boullanger Island near Jurien Bay (Fuller and Burbidge 1987). FRNP offers the best long-term survival prospect for the Dibbler, which is gazetted 'Rare and Endangered'.

RED-TAILED WAMBENGER *Phascogale calura*

Phascogale calura were only recorded from one site in the FITZGERALD, though one was killed by a cat in Bremer Bay townsite in 1984 (M20937 in WAM). The survey site (FS136) was opportunistically trapped with Elliott traps because of the presence of only a small stand of *Allocasuarina huegeliana*, a species identified with the survival of *Phascogale* (Kitchener 1981). Two animals were trapped, a male (50.0 g) and a female (29.0 g) in December 1985.

They are now known only from several localities in the southern wheatbelt of WA. The FITZGERALD and Bremer Bay records are minor south-easterly extensions of range. Kitchener (1981) considered long-unburnt vegetation and presence of toxic plants (*Gastrolobium* and *Oxylobium* spp.) excluding grazing animals as factors in its local survival. *Allocasuarina huegeliana* is a fire-sensitive species (Hopkins 1985) and it regenerates well in the absence of fire (Muir 1985b). If *P. calura* is dependent upon small, scattered stands of *A. huegeliana* in the FITZGERALD, management for its survival should consider fire exclusion including control burning from these stands. *P. calura* is gazetted 'Rare and Endangered'. *Phascogale calura* once had an extensive though patchy distribution throughout much of arid and semi-arid Australia, including Victoria, SA and Northern Territory.

MURIDAE

WATER RAT *Hydromys chrysogaster*

Hydromys chrysogaster are known from several records in the Gairdner River and Wellstead Estuary. In 1976 one was netted in the Gairdner River near 'Quaalup' homestead. This record is the most easterly on the south coast of WA. In south-west WA *Hydromys* occurs

on most larger, permanent rivers and estuaries. It occurs widely in the eastern States and tropical north of Australia.

SOUTHERN BUSH RAT *Rattus fuscipes fuscipes*
Rattus fuscipes were widespread in the FITZGERALD during the survey. They were present from primary dunes to inland mallees on the Archaean shield. Nowhere are they particularly abundant; they show a slight preference for shrubland over woodland, heath and mallee. Of land surfaces they showed a preference for coastal dunes and marine plain, presumably on account of the deeper soils there (Table 6.2). Except for one capture on sandy loam (61A) all records (N = 118) were on loamy sand.

Except for three *Mus musculus* on East Mount Barren all Elliott trapping in quartzite ranges recorded only *R. fuscipes*. On Mount Bland and West Mount Barren *R. fuscipes* were very abundant as the data in Table 6.4 indicate.

TABLE 6.4

Elliott trapping success (no. trapped per 100 trap-nights) for *Rattus fuscipes* in quartzite ranges during survey (excluding recaptures)

SITE	PRE-SUMMER	POST-SUMMER
Mount Bland	45 per cent	NA
West Mount Barren	17 per cent	13 per cent
East Mount Barren	0 per cent	1.2 per cent

Additionally, 15 Elliott traps set for three nights near Annie Peak (Eyre Range) recorded a nil result. There is no obvious explanation for the disparity between Mount Bland, West Mount Barren and East Mount Barren, except that trapping was not contemporaneous. On the quartzite ranges *R. fuscipes* were significantly heavier than they were on other land surfaces (see below). This is a highly significant result (P = .001).

Recapture rates were 2.8 per cent pit-trapping and 15.2 per cent Elliott trapping. Trap mortalities were 2.8 per cent pit-trapping and 0 per cent Elliott trapping.

SEX	WEIGHT RANGE (g)	AVERAGE WEIGHT (g)	S.D. (g)	N
Females	16.0-123.0	68.3	30.1	66
Males	15.5-131.0	81.8	28.5	52

SEX	WEIGHT RANGE (g)	S.D. (g)	N (g)
Females (quartzite)	89.5	17.8	24
Females (other)	56.3	29.1	42
Males (quartzite)	99.9	20.9	24
Males (other)	66.2	24.9	28

The presence of juveniles - here defined as individuals weighing less than 40 g - between August and April, peaking in December, suggests a protracted breeding season, commencing earlier than that inferred for the species at Cape Le Grand National Park (Kitchener *et al.* 1975).

Data in Chapman and Newbey (1994) indicate that *R. fuscipes* was one of the few mammal species to survive the February wildfire.

Rattus fuscipes in WA has a predominantly coastal distribution with minor incursions into wet sclerophyll forest; it occurs north to Houtmans Abrolhos Islands and east to the Recherche Archipelago.

BLACK OR SHIP RAT *Rattus rattus*
In 1986 Ranger M. Lloyd killed a *R. rattus* at the ranger station on Quiss Road. His neighbour, Mr. W. Lullfitz who farms on the adjacent property, advised me that *R. rattus* first appeared on his farm in 1983. Both these sites are on National Highway One: it is possible that passing traffic, particularly carrying stock feed, was a factor in their dispersal. In the absence of any major habitat degradation or carriage of bulk stock feed through the FITZGERALD it is unlikely that this species will establish. However, now that it has been recorded in the district the spread of this pest is a contingency park managers should be aware of and guard against.

Rattus rattus has a peripheral distribution in Australia, i.e. only avoiding the semi-arid and arid zone. It was introduced in the very early days of European settlement.

WESTERN MOUSE *Pseudomys occidentalis*
Compared with *P. albocinereus*, *P. occidentalis* has an apparently restricted distribution in the FITZGERALD (Fig. 6.3). They occurred in a relatively small area in the north-west of the FRNP on upland and spongolite land surfaces (Table 6.1 and Fig. 6.3). Forty of the 41 captures were in very open mallee, the other was in mallee (Table 6.1). They occur on a broader spectrum of soil types than *P. albocinereus*. Thirty-three captures were on loamy sand, seven on fine sandy loam and one on sandy loam. Both recapture and mortality rates were 2.8 per cent. Body weight data are presented below.

SEX	WEIGHT RANGE (g)	AVERAGE WEIGHT (g)	S.D. (g)	N
Females	12.5-44.0	25.9	11.0	9
Males	13.5-39.5	26.8	7.2	27

P. occidentalis is endemic in south-west WA, it has a limited distribution in the south-east wheatbelt, north to Hyden, east to Ravensthorpe, and west to Tambellup. It occurs at its most southerly in the FITZGERALD.

Over most of their range *P. albocinereus* and *Pseudomys occidentalis* do not occur together. They are readily distinguishable from each other. *P. occidentalis* are larger and darker and they invariably occurred on

gravelly substrates while *P. albocinereus* occurred on deep sands. In the north-west of the FITZGERALD, particularly at quadrats 14A, 18A, 19B and 23A (Fig. 6.3) these differences are not so distinct. One or two specimens were taken from each quadrat for identification verification and the assumption made, perhaps without justification, that both species would not occur together at the same quadrat.

ASHY-GREY MOUSE *Pseudomys albocinereus*

Pseudomys albocinereus were the most widespread and abundant of three *Pseudomys* species in the FITZGERALD during the survey. They occurred on coastal dunes, upland, spongolite gorge and marine plain (see Fig. 6.3) in woodland, very open mallee and heath (Table 6.2). All captures (N = 75) were on loamy sand. The presence of juveniles weighing 7.0-11.5 g (N = 9) in November indicate breeding just prior to then. Recapture rate was 11.1 per cent and trap mortality rate was 3.7 per cent. Body weights are summarized below.

SEX	WEIGHT RANGE (g)	AVERAGE WEIGHT (g)	S.D. (g)	N
Females	10.5-28.5	20.3	5.5	26
Males	10.5-37.5	26.1	8.2	28

Pseudomys albocinereus is endemic in south-west WA, it occurs in a broad arc between Shark Bay and Israelite Bay.

HEATH MOUSE *Pseudomys shortridgei*

The simultaneous rediscovery of *P. shortridgei* in WA in the Ravensthorpe Range and the FITZGERALD was a highlight of the present survey. As well as adding substantially to the conservation value of the FRNP, the rediscovery combined elements of coincidence and serendipity and is a good example of how science works (see Baynes *et al.* 1987).

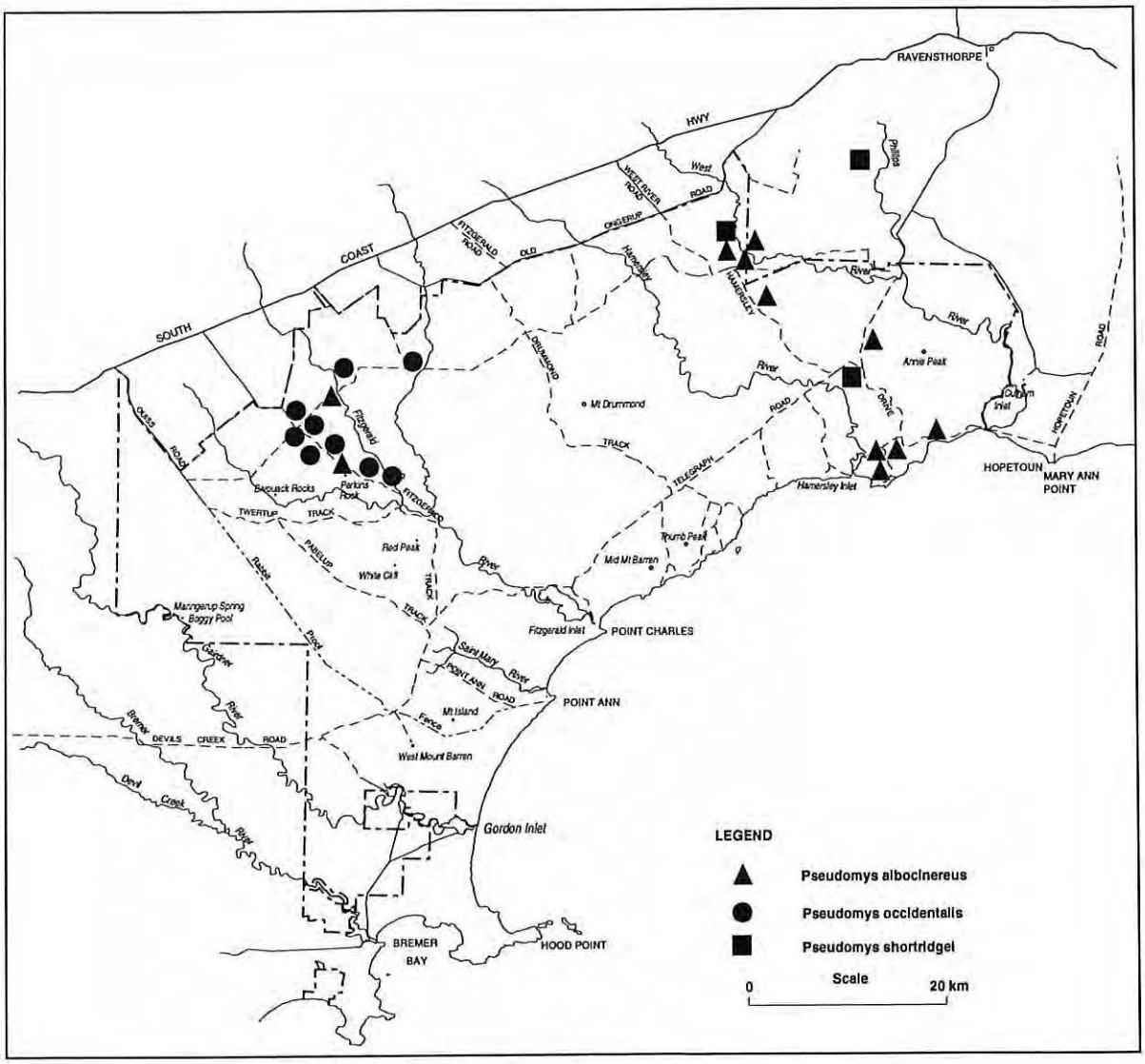

Figure 6.3 Recorded Locations for Pseudomys *species in the FITZGERALD.*

Pseudomys shortridgei are known from two quadrats within FRNP (Fig. 6.3) and one in the Kybulup Reserve. These quadrats were very open mallee on marine plain with loamy sand (51A), heath on upland with loamy sand (54A) and mallee on greenstone with sandy loam (64E). The physical environments of these quadrats have very little in common except that at 1987 none had been burnt for 37+ years. At all these quadrats *P. shortridgei* were trapped alongside *Rattus fuscipes* and at 54A *P. albocinereus* were also present (see Fig. 6.3). This is of considerable ecological interest, see Discussion below. Body weights were:

Male 54.5, 62.0, 57.0 g
Female 57.0 g

Prior to this rediscovery, *P. shortridgei* were presumed extinct in WA, as they had not been reported since 1931. They were discovered in western Victoria in 1961. The Victorian and WA populations are quite separate and appear to exhibit important ecological differences, particularly with respect to tolerance to fire. They are gazetted 'Rare and Endangered' species.

MITCHELL'S HOPPING MOUSE *Notomys mitchellii*

Notomys mitchelli appears to be a rare species in the FITZGERALD. There is one record; an animal which survived a wildfire in February 1985 was drowned during mopping-up operations in *Eucalyptus occidentalis - Allocasuarina huegeliana* woodland along Calyerup Creek just off the western boundary of FRNP.

Further north *N. mitchellii* is a widespread and common species on wheatbelt reserves. The nearest previous record to FRNP is Lake Magenta Nature Reserve. They also occur in southern SA, north-west Victoria and south-west NSW.

HOUSE MOUSE *Mus musculus*

In the FITZGERALD *M. musculus* were relatively uncommon during the survey. They were trapped less frequently than *Rattus fuscipes, Pseudomys albocinereus* or *P. occidentalis.* This is in marked contrast to the often encountered situation in south-west WA where *M. musculus* are the most widespread and abundant of small mammals (Chapman 1981). In the FITZGERALD they were recorded in low numbers, on all land surfaces (except phyllitic schist) from coastal dunes to the furthest inland quadrats. They were recorded in all vegetation formations except shrubland. Ninety-three per cent of all records (N = 63) were on loamy sand; one each on sandy loam, loam and medium clay. Body weight data are summarized below.

SEX	WEIGHT RANGE (g)	AVERAGE WEIGHT (g)	S.D. (g)	N
Females	4.5-19.0	11.1	4.4	24
Males	4.5-18.5	12.9	3.9	39

Using data for wheatbelt and west coast areas (in Chapman 1981) where *M. musculus* were much more abundant, females are significantly lighter ($P < .001$) in the FITZGERALD but the difference is not significant for males ($P > 0.05$)

Mus musculus is a worldwide species probably originating in Asia. It occurs throughout Australia except the tropical north.

MOLOSSIDAE

WHITE-STRIPED MASTIFF BAT *Tadarida australis*

Tadarida australis has a distinctive call; I heard it on many occasions in many places in the FITZGERALD. It appears not to hibernate in winter.

VESPERTILIONIDAE

GOULD'S WATTLED BAT *Chalinolobus gouldii*

Two specimens have been collected in the FITZGERALD; at both Hunter River and Middle Mount Barren, in 1970. Apparently uncommon, presumably on account of the scarcity of trees.

TACHYGLOSSIDAE

ECHIDNA *Tachyglossus aculeatus*

Tachyglossus aculeatus were widespread but uncommon in the FITZGERALD during the survey. They were recorded on all land surfaces except marine plain. They are most likely to be seen on spongolite and ferrugineous sandstone breakaways and rockpiles along margins of river valleys, wide gorges and inlets.

CANIDAE

RED FOX *Vulpes vulpes*

Foxes were present throughout the FITZGERALD during the survey. Abundance is difficult to assess; I saw only seven live foxes in 51 weeks in the field, indicating very low density. However, fox pads were observed almost everywhere I looked on tracks and firebreaks, and scats were frequently found. From discussions with farmers and Agricultural Protection Board personnel, I believe that foxes were far more abundant on farms than in the FITZGERALD. However, the following data indicate the seriousness of the fox threat to fauna in the FITZGERALD. Three freshly-dead foxes were examined in the course of the survey; stomach contents were:

No 1.
4 x *Tarsipes rostratus* (Honey Possum)
1 x *Varanus rosenbergi* (Southern Monitor)
1 x *Phylidonyris novaehollandiae* (New Holland Honeyeater)
1 x *Ramphotyphlops australis* (Blind Snake)
No 2.
1 x *Tarsipes rostratus*
1 x unidentified bird
- insects and vegetation
No 3.
1 x *Notechis curtus* (Snake)
1 x Unidentified bird

Other prey species determined from scat analysis were Rabbit, House Mouse, Bush Rat, Tammar and Dibbler (see Muir (1985a)). Southern Monitors, as well as unidentified bird feathers, featured prominently in scats. One Fox with a sense of style deposited a scat largely composed of lunch wrap on the highest point of East Mount Barren, indicating that rubbish is scavenged. Foxes were observed digging out burrows of Rainbow Bee-eaters and Yellow-rumped Pardalotes. These data are largely non-quantative, however, they do indicate that foxes in high numbers would be a serious threat to fauna.

The Fox apparently followed the Rabbit into WA across the Nullarbor Plain *ca.* 1910. It is a relatively recent arrival, and now occurs throughout Australia except the far north.

FELIDAE

CAT *Felis catus*
Feral cats were present throughout the FITZGERALD; fortunately they were scarce; four were recorded in the course of the survey. The recovery of a tabby kitten from Quoin Head in 1987 indicates that a feral population is present. There are no data on predation or stomach contents for FRNP.

Cats were introduced into WA in the early days of settlement, *ca.* 1830. They rapidly established feral populations and now occur throughout Australia.

LEPORIDAE

RABBIT *Oryctolagus cuniculus*
Rabbits were present, although in low numbers, throughout the FITZGERALD during the survey. Most, but not all, records were in loam soils along major rivers and creeks. Most observations were of solitary animals indicating a low density at present. Square-tailed Kites, Goannas and Foxes are predators of rabbits in the FITZGERALD.

At low densities rabbits are unlikely to do much damage to vegetation; the exception is in coastal habitats where rehabilitation is attempted.

PAST MAMMAL FAUNA OF THE FITZGERALD IN HISTORIC TIMES

In addition to mammals still present, some species have disappeared only in the last 50 years and should be considered part of the modern fauna.

RABBIT-EARED BANDICOOT OR BILBY *Macrotis lagotis*
Ranger G. Keen of 'Quaalup' homestead, quoting sources from the McGlade family who were the original settlers' retainers informed me that this species was present along the Gairdner River near 'Quaalup' in the 1920s. Other evidence indicates that even later they were present further upstream at Marningerup Spring.

The Bilby was once widespread in semi-arid Australia including the WA wheatbelt. They now survive only in some isolated populations in the arid zone.

DINGO *Canis familiaris*
There is little doubt that the Dingo was formerly widespread and abundant in the FITZGERALD. They are mentioned historically, e.g. Hassell (1975), and indeed the place name Twertup means 'place of the wild dog'. The FITZGERALD was extensively 'dogged' in the 1950s and '60s. Conversations with Mr. D. Reid of 'Jacup' indicate they were quite common up to then.

I could find no evidence during 1985-87 that this readily visible species was still present. The last sighting I am aware of was made by Ranger G. Keen near 'Quaalup' in 1976. However, as Dingoes are quite common in the north of the Ravensthorpe Shire and one was shot on a farm near the Park boundary in 1986, it is quite possible that Dingoes could re-establish themselves in the FITZGERALD.

Another component of the mammal fauna for which data are available is the pre-European fauna. These are species which were present prior to European settlement of WA; they included many species which have declined enormously in range over much of Australia (see Discussion below). These data are from a bulk collection of owl and Dingo accumulated bones, which exclude *Mus musculus*, from Jonacoonack Rock in FRNP. Identification and interpretation is by A. Baynes, who will separately publish these data. Additionally, *Parantechinus apicalis* and *Potorous platyops* in Table 6.5 are from material in the Eyre Range and *Dasyurus geoffroii, Pseudocheirus peregrinus* and *Macropus irma* are recorded by Butler and Merrilees (1971).

DISCUSSION

Present Mammal Fauna of the FITZGERALD

With 20 species of native mammal, including five gazetted 'Rare and Endangered', the FITZGERALD has more species than any other conservation reserve in south-west WA. Considering many species are remnants of a once widespread and rich fauna occurring in the wheatbelt (see below), the FITZGERALD is one of the most important conservation reserves on mainland WA. Its high conservation potential is owing to its large area and the lack of any widespread habitat degradation, including too-frequent burning and grazing by introduced stock. Although feral Cats and Foxes are present, most species, except perhaps the Tammar and Brush-tailed Bettong which are vulnerable (see below), will probably withstand predation if other agencies of attrition are minimized.

TABLE 6.5

Mammal species present in FITZGERALD area prior to European settlement.

A = Recorded in present survey.
B = Species presently at risk with conservation priority in brackets from Table 9 in Burbidge and McKenzie 1989.

SPECIES	A	B
Dasyurus geoffroii	.	.
Parantechinus apicalis	X	X(4)
Antechinus flavipes	.	.
Phascogale calura	X	X(2)
Antechinomys laniger	.	.
Sminthopsis granulipes	X	.
Sminthopsis murina (group)	X	.
Isoodon obesulus	X	X(5)
Perameles bouganville	.	.
Cercartetus concinnus	X	.
Trichosurus vulpecula	X	.
Pseudocheirus peregrinus	.	.
Tarsipes rostratus	X	.
Potorus platyops	.	.
Bettongia penicillata	X	X(1)
Lagostrophus fasciatus	.	.
Macropus eugenii	X	X(4)
Macropus irma	X	X
Pseudomys albocinereus	X	.
Pseudomys occidentalis	X	X(6)
Pseudomys shortridgei	X	X(2)
Notomys sp. cf. *mitchellii*	X	X(2)
Rattus fuscipes	X	.
Rattus tunneyi	.	.
Nyctophilus geoffroyi	.	.

Fortuitously, the fauna survey took place when small mammals were abundant. The reasons for this are not known; it may be part of an intrinsically determined population cycle or it may be a delayed response to the breaking of the drought of 1980-82. It would be an unwarranted assumption that the high levels of small mammals encountered during this survey will be maintained.

Consideration of land surface occupancy of mammals in the FITZGERALD (Table 6.2) indicates convincingly that the upland has the richest fauna followed by marine plain and spongolite gorge. Add to the 11 species trapped on upland the Tammar and Red-tailed Wambenger and it is apparent that here is a single land surface of enormous importance. Faunal richness here is probably associated with three factors. The upland corresponds with the Archaean shield which here is the southern edge of the wheatbelt and its associated fauna. Habitats here exist in a tight mosaic of soil/vegetation types conferred by the presence of granitoid outcrops and numerous minor watercourses. Additionally, some soils here are not as extensively weathered and leached as on the marine plain, therefore would have a greater capacity to maintain nutrients.

My local zoogeographic model sees the north of the FITZGERALD as a small remnant of a formerly widespread and rich faunal area, the WA wheatbelt, see for example Kitchener *et al.* (1980b, 1982). It was the source area for much of the present fauna. Even today there is probably a dispersal of species from the upland onto the marine plain and elsewhere. The presence of *Pseudomys occidentalis* at quadrats 21A and 22A indicate that river valleys might be corridors for this dispersal.

With a relatively complete mammal fauna the FITZGERALD offers the opportunity for ecological studies which are not available elsewhere in south-west WA. On the fragmented conservation reserves in the WA wheatbelt the usual situation is to have, for example, a situation where one species of *Pseudomys* pairs with an ecologically vicarious species with either habitat or geographic replacement from one reserve to another. A similar situation applies to *Notomys* spp. and *Sminthopsis* spp. (see Appendix I in Kitchener *et al.* 1980b).

In the FITZGERALD, although one species is usually numerically dominant, mammal species are more ecologically tightly packed. As many as six species can be recorded in one trapline (Table 6.1) including two species of *Sminthopsis* and *Pseudomys*. A rewarding area for investigation would be competition between *Rattus fuscipes* and *Pseudomys shortridgei* as they always occur together, sometimes with an additional *Pseudomys* species as well.

Mammal Fauna of the FITZGERALD and its Recent Changes

The pre-European fauna (Table 6.5) indicate that the FITZGERALD once had a rich fauna with affinities with the semi-arid zone. For example, the past faunas of both Cape Arid and Cape Le Grand areas which are, and presumably were, wetter areas, do not include drier country species such as *Phascogale calura*, *Antechinomys laniger* and *Perameles bougainville* (Baynes 1987), which were all present at the FITZGERALD. This is an important biogeographic result, because when the total vertebrate fauna here is considered (see below), faunal richness is owing to a blending of semi-arid and mesic components. It is a faunal 'cross-roads' in a north-south and east-west direction.

The pre-European fauna of the FITZGERALD included *Rattus tunneyi* and *Antechinus flavipes* at their most easterly point in south-west WA.

Unlike bird and reptile species the mammal species of the WA wheatbelt have declined considerably since European settlement. For example, Kitchener *et al.* (1980b) record that of 43 species originally present 42 per cent are extinct in the region. Faunal change is a complex process involving the interaction of many factors, and different agencies will be operative at different points in time.

Table 6.5 presents a list of past and present mammals in the FITZGERALD. On present knowledge of the existing fauna it indicates a 40 per cent loss of species. This is consistent with overall loss of 42 per cent for the wheatbelt but compares favourably with other areas for which data are available:

AREA	LOSS OF MAMMAL SPP. (%)	DATA SOURCE
Extreme south-west	45	Archer and Baynes (1972)
Swan Coastal Plain Cockleshell Gully area	63	Kitchener *et al.* [a] Chapman *et al.* (1977)

[a] D.J. Kitchener, A. Chapman and G. Barron, unpublished: Mammals of the northern Swan Coastal Plain, *In* Faunal studies of the northern Swan Coastal Plain. WA Museum.

However, unlike all these areas, the remaining fauna discussed here is on one piece of land, managed by a single authority.

Implications for Management

Burbidge and McKenzie (1989) have devised a category based on body weight, habitat utilization and biogeography to determine mammal species at risk in Australia. Of the 20 species still present, eight are at risk according to this hypothesis (Table 6.5). It should be noted that *Notomys mitchelli* and *Isoodon obesulus* appear to be rare in the FITZGERALD even if not elsewhere.

Now that the habitat of these species has been legally secured by the northern extension of FRNP, the two main agencies of attrition are predation by Foxes and Cats and inappropriate fire regimes. As the northern boundary now adjoins cleared farmland along the Old Ongerup Road there is an obligation to guard against Fox infiltration of bush areas. This could occur at the completion of lambing or when other food, e.g. Rabbits, become less available to Foxes on farms.

There is a strong positive correlation from this survey between presence of rare fauna and time elapsed since last burnt (see also Muir 1985a and b; Kitchener 1981). However, for some fauna it is possible that some burning is required not only to protect critical areas but also to maintain the mosaic of environmental 'patchiness' required for some species. See Christensen (1980b) for the Tammar situation elsewhere in south-west WA. Considerably more research on rare fauna occurrence in the FITZGERALD and 'fine-tuning' of fire-age maps is required before any further burning in this general area is undertaken.

A recommendation arising from this survey which is addressed in General Conclusions and Implications for Management is that the northern extension be zoned a 'fauna priority conservation area' where fauna conservation, including manipulative management if necessary, is the primary objective of management.