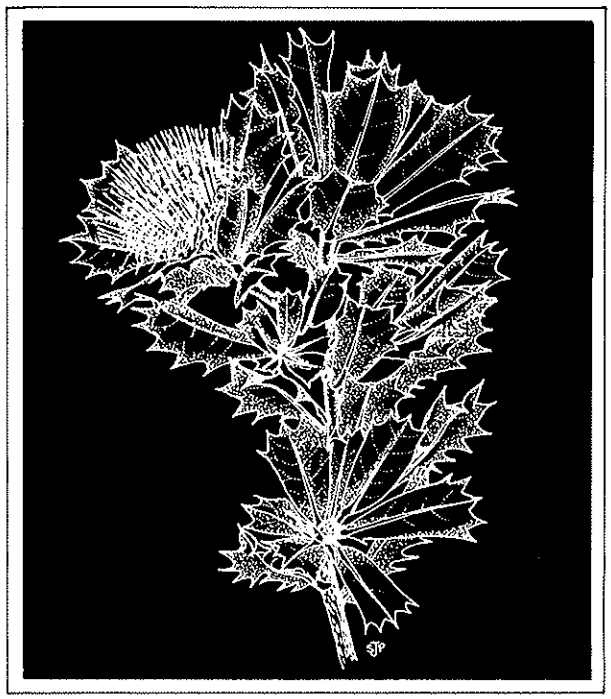
A Spring Reconnaissance Survey of the Flora and Fauna of the Southern Beekeepers Reserve



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SUMMARY

Three frog, eleven reptile, 56 bird and six native mammal species were recorded during a brief survey of the Southern Beekeepers Reserve near Cervantes in August 1985. An additional frog and four bird species were recorded at Dingo Swamp, which is within the boundaries of, but excised from the Beekeepers Reserve.

The vegetation varies from coastal dune vegetation through low coastal heath to floristically more diverse heath on sand over limestone, with *Banksia* woodland and isolated clumps of tuart (*Eucalyptus gomphocephala*) on the deeper sands.

Our record of *Vermicella littoralis* is a range extension south from Jurien Bay; our records of the plants *Olax aurantia* and *Caladenia crebra* are also southward extensions of range. Our data support previous suggestions that the Hill River area is an important vegetation interchange area, being near the boundary between the Irwin and Darling Botanical Provinces.

The Reserve has high nature conservation value in that it contains unusual species occurrences and poorly conserved vegetation types. Possible management problems are related to fire and feral bees, and an increasing number of vehicular tracks. Recommendations for further action are made.

INTRODUCTION

The Southern Beekeepers Reserve (↟30653) is at present an unvested 'C' class reserve. It is an area of 10 854 ha immediately north-east of Cervantes (30° 31'S, 115° 04'E) in the Shire of Dandaragan. It is near the northern end of the Darling Botanical District. The Reserve extends from the northern boundary of Nambung National Park north to the Hill River. Apart from one short section where it extends to the coast, it lies slightly inland and parallel with the coast (Fig. 1). It is at present reserved for the purposes of Apiculture and Conservation of Flora.

There appear to be no previous biological survey data from this Reserve. Beard (1979) mapped vegetation of the region at a scale of 1:250 000 and described vegetation associations discernible at a regional level. However, detailed work on the vegetation of the region is only available from further north (e.g. Griffin and Hopkins 1985) and from further south (Wanagarren Nature Reserve: Crook *et al.* 1984). Surveys of vertebrates have been undertaken in the proposed Mt. Leseur Reserve further north (Chapman *et al.* 1977) and south of the Moore River (WA Museum 1978).

The present survey was undertaken in order to gather information relevant to an assessment of the conservation value of the Reserve and to provide some base line data on which to base future management decisions. Biological data are required in order to make an informed decision as to future vesting of the Reserve, and are also necessary if future management incorporates conservation as one of its aims.

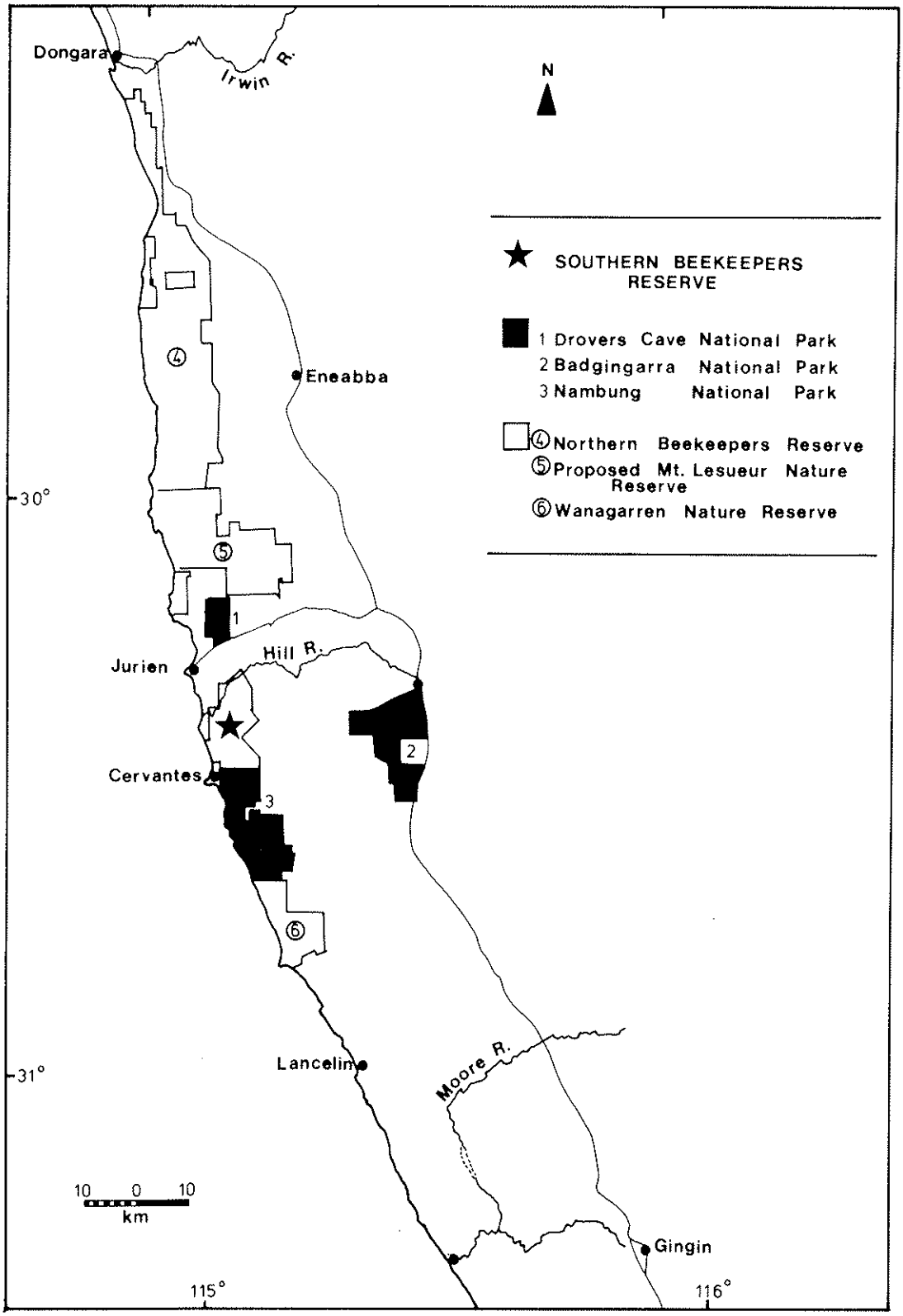

Figure 1

Location of the Southern Beekeepers Reserve and other reserves and localities.

SURFACE GEOLOGY AND LANDFORMS

Surface geology of this area consists entirely of Quaternary deposits (Lowry 1974). Most of the area is Pleistocene Coastal Limestone (Tamala Limestone of Playford *et al.* 1976) with the remainder being Recent (Holocene) sands.

Weathering of the coastal limestone (aeolian limestone and kankar) has resulted in a surface layer of leached quartz sands. In many areas the limestone is still outcropping amongst a thin layer of sand. In the area covered by the present survey, these sands are deepest on the Cervantes road near the eastern edge of the Reserve. This sand is part of the Spearwood Dune System of McArthur and Bettenay (1960).

Along the coast is a series of recent dunes, mapped by Lowry (1974) as Safety Bay Sand. This system includes the Quindalup Dunes of McArthur and Bettenay (1960) (Playford *et al.* 1976). The dunes of the Safety Bay Sand are chiefly rounded quartz grains and calcium carbonate grains, in some areas weakly lithified. In some parts of the Beekeepers Reserve (e.g. south from Site 1) these sands extend as north-south tongues overlying the older coastal limestone. Mostly, these dunes are stabilized by vegetation but mobile dunes occur in some areas (e.g. just west of Site 1 (Fig. 2 and background in Fig. 3, Pl. 2)).

METHODS

Field work was carried out between 23 and 28 August 1985, with opportunistic observations in February and September 1986.

Five sites were chosen for pitfall sampling of small ground dwelling vertebrates (Fig. 2). These sites were placed so as to provide an east-west transect through the major vegetation types represented in the study area. One pit line was placed at Site 1, and two pit lines at each of the remaining four sites. Each pit line consisted of five pits (60 cm deep by 12.5 cm diameter polythene pipe) spaced at 12 m intervals and connected by a drift fence. The fence was 50 m by 0.3 m, embedded in the ground for 3 to 5 cm, beginning one metre before the first pit, running across all pits in the line and ending one metre past the last pit. Each line was run for four nights. The total trapping effort was 180 pit trap nights.

Sampling for bats was limited. Bats were captured using 'harp' type bat-traps (Tidemann and Woodside 1978) set at the edges of the tuart clump in the vicinity of Site 1, and in the easternmost tuart clump near Site 5.

Intensive searches of 1.5 to 2.0 hours duration were made during the day near each site by three observers. During these searches, one observer recorded vegetation and soil characteristics, compiled lists of abundant or visually dominant plant species, and searched intensively for birds. The second observer searched intensively for reptiles and amphibians, while the third observer spent most time recording birds but also participated in searching for reptiles.

Opportunistic observations were made away from the five major sites, including along a short section of the Hill River on the northern boundary of the Reserve.

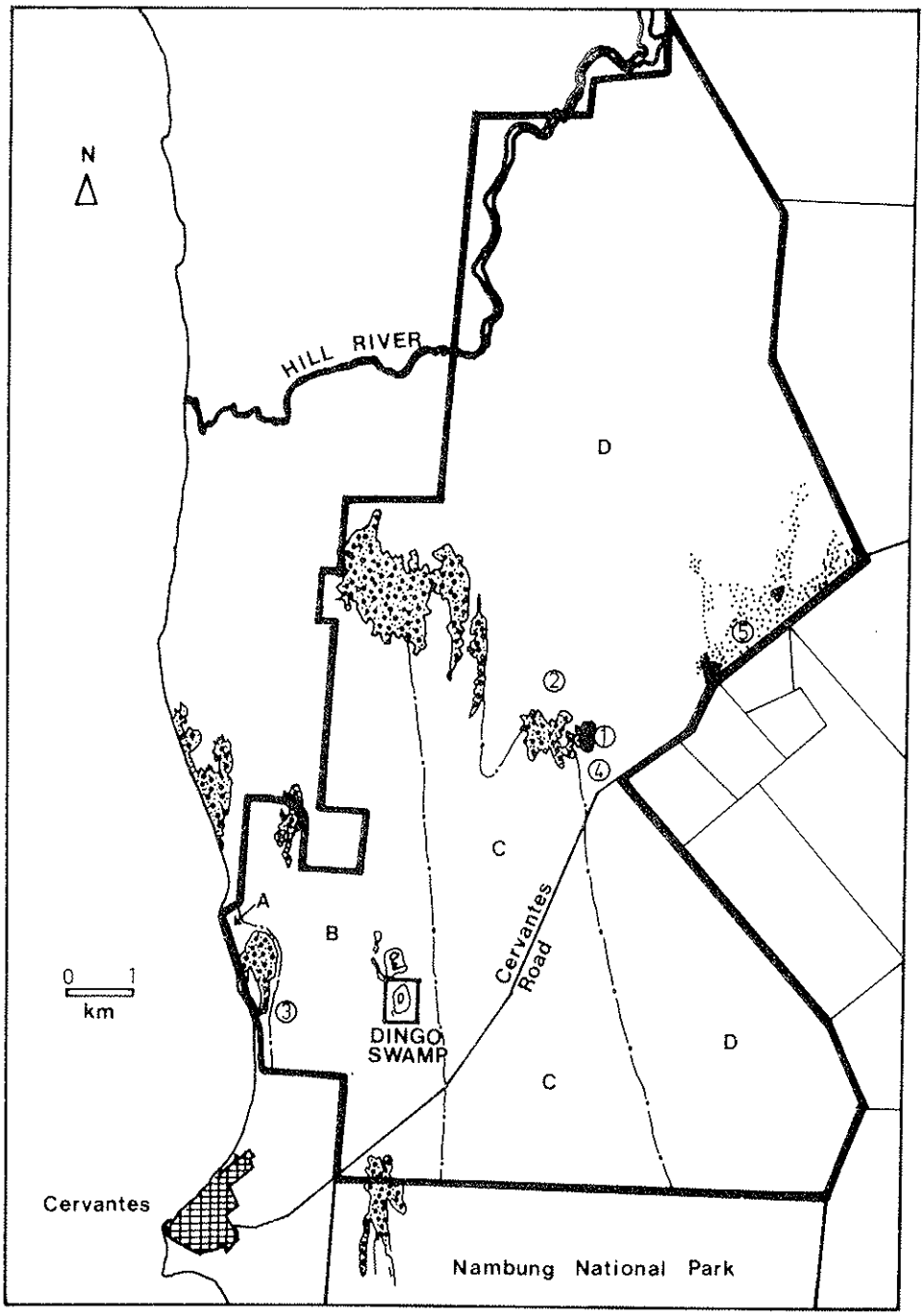

Figure 2

Distribution of vegetation formations and locations of trapping sites (1-5) within the Southern Beekeepers Reserve.

Spotlighting was done on foot with the use of headtorches in the tuart clump and in heath in the vicinity of Site 1, and by vehicle over the more accessible tracks throughout the Reserve. Spotlighting effort totalled seven hours.

Voucher specimens of vertebrates have been accessed by the W. A. Museum with registration numbers R93144-93157 (frogs and reptiles) and M25687-25694 (mammals).

At each trapline, vegetation was classified and described according to Muir's (1977) system. Plant specimens were collected opportunistically. No attempt was made to compile an exhaustive list. In addition, four 10 m x 10 m quadrats on the southern boundary of the Reserve were scored for vascular plant species presence. The quadrats were arranged in a west to east transect from ca.3 km to ca. 6 km east of Cervantes. This design was chosen in order to provide data comparable with those obtained in other studies (R.T. Wills, personal communication).

Boundaries of vegetation formations (Fig. 2) were determined subjectively to correspond with marked changes in vegetation structure and/or floristic composition. Botanical nomenclature is based on Green (1985). Plant voucher specimens (A. H. Burbidge collection numbers) have been lodged with the Western Australian Herbarium.

Maximum daily temperatures during the survey period ranged from 20.0° to 20.5°C (mean 20.3°C). Minimum nightly temperatures ranged from 2.5° to 16.0°C (mean 9.3°C).

RESULTS

VEGETATION AND FLORISTICS

Vegetation descriptions for each trap line site are given in Appendix I; these represent the major vegetation units in the Reserve.

The limestone outcrops and shallow sands support dense heaths (Sites 2 and 4 of the present survey (Fig. 2)) while woodlands occur on the deeper sands (Sites 1 and 5).

Most of the Southern Beekeepers Reserve is covered in dense heath. In the west this is a low coastal heath which is floristically relatively depauperate (e.g. Site 3, Figs 2, 3 (Pl. 3)). These heaths are dominated by *Acacia lasiocarpa, Melaleuca acerosa* and *Leptomeria spinosa*. Immediately west of this area is a corridor of recent dunes which support typical coastal vegetation such as *Atriplex cinerea*. Much of the eastern side of the Reserve supports heath which is taller and floristically more complex, occurring on shallow sands over limestone (Figs 2, 3 (Pl. 2, 4)). These heaths are dominated by several species of the following, depending on the site: *Hakea trifurcata, Dryandra sessilis, Acacia lasiocarpa, Eremaea* c.f. *pauciflora, Banksia prionotes, B. sphaerocarpa* and *Calothamnus quadrifidus*. Between these two areas is a region of intermediate floristic composition, occurring on a system of irregular and presumably more recent dunes. A small area near the eastern margin of the Reserve supports *Banksia* woodland (dominated by *B. prionotes* and *B. attenuata*) (including Site 5, Figs 2, 3 (Pl. 5)), and there are two clumps of tuart (*Eucalyptus gomphocephala*) over mixed understorey, particularly *Spyridium globulosum* and *Acacia rostellifera* (including Site 1, Figs 2, 3 (Pl. 1)).

Figure 3

Pl.1 Habitat at Site 1. Pl.4 Habitat at Site 4

Pl.2 Habitat at Site 2. Pl.5 Habitat at Site 5

Pl.3 Habitat at Site 3. Pl.6 Site 3 after the fire of January 1986

The list of 110 plant species recorded during the survey (Appendix II) is far from exhaustive. However, records of two species, *Olax aurantia* and *Caladenia crebra*, appear to be southward extensions of the known range of these species by 60 and 20 km respectively.

An extensive fire in late January 1986 had a devastating effect on the vegetation, completely defoliating all plants and killing many species (Fig. 3, Pl. 6). One result of this fire was that plant species abundances changed, sometimes radically, and some species, such as *Anthocercis ilicifolia* and *Senecio lautus*, became more prominent. Many of the species listed in Appendix II as being recorded in 'burnt heath' became more conspicuous, though not necessarily more abundant, after the 1986 fire.

The four 10 m x 10 m quadrats contained 19, 21, 22 and 27 vascular plant species, with species diversity increasing with distance from the coast.

FROGS AND REPTILES

Three frog and 11 reptile species were detected on the Reserve. These are listed in Table 1 along with site of capture and the number of captures of each species during the survey period. An additional frog species, *Litoria moorei*, was heard calling at Dingo Swamp (Fig. 2).

The species list is only a preliminary one given the short duration of the survey. Furthermore, negligible reptile activity was observed during the entire survey period, no doubt because of the cool and (occasionally) wet spring conditions which prevailed (maximum daily temperatures did not exceed 20.5°C).

Of the eleven reptile species recorded, only three (*Diplodactylus spinigerus, Lerista praepedita* and *Pogona minor*) were captured in pitfall traps (Table 1). Three additional species (*Pygopus lepidopodus, Tiliqua rugosa* and *Tympanocryptis adelaidensis*) were observed to be active during the survey period. The remaining five species were detected during the brief searches for herpetofauna. Two species, *Cryptoblepharus plagiocephalus* and *Gehyra variegata*, were detected only in woodland of *Eucalyptus rudis* fringing the Hill River on the northern edge of the Reserve. However, both could occur in the clumps of tuart woodland further south.

Limnodynastes dorsalis was a common and widespread frog on the Reserve. Since we did not mark individuals, the total number of pitfall captures of this species (Table 1) may not equate with the total number of individuals captured. However, a maximum of six individuals was captured in pitfalls in a single night's trapping (13 per cent trap return) and on a separate occasion, six individuals were recorded during 1.4 hours of spotlighting over a distance of 10 km.

BIRDS

A total of 56 bird species was recorded in the Reserve (Table 2). All species were within their known ranges. Five species were recorded breeding: Collared Sparrowhawk (nest with downy young), Brown Honeyeater (nest with two eggs), Tawny-crowned Honeyeater (newly fledged, dependent young), Australian Magpie (incubating eggs or small young) and Australian Raven (three nests, each with young almost ready to fledge). An additional three species (Australian Kestrel, Galah and White-backed Swallow) were thought to be nesting, but definite evidence was not obtained.

Table 1

Frogs and reptiles recorded in the Southern Beekeepers Reserve, August 1985.

Species	Site	Total Number Recorded		
		Pits	Diurnal Searches	Spotlighting
Frogs				
Heleioporus eyrei	5B	1	-	-
Limnodynastes dorsalis	2B, 3A, 3B, 4A, 4B, 5A, 5B	14	-	9
Pseudophryne guentheri	5B	1	1	-
Reptiles				
Cryptoblepharus plagiocephalus	Hill River	-	3	-
Ctenotus fallens	3B	-	1	-
Diplodactylus spinigerus	4B, Hill River	1	2	-
Gehyra variegata	Hill River	-	1	-
Lerista praepedita	1A	1	-	-
Omolepida branchialis	2A, 2B, 5B	-	8	-
Pogona minor minor	2A, 3B, 5A	3	-	-
Pygopus lepidopodus	3B	-	1	-
Tiliqua rugosa	1A	-	1	-
Tympancryptis adelaidensis	3B	-	1	-
Vermicella littoralis	2B, 5B	-	2	-

'Site' lists the traplines where species were captured by pitfall traps and/or during active searches in the vicinity of traplines. Hill River records are also indicated here. Descriptions of the vegetation at each trapping site are provided in Appendix I. Nomenclature follows Tyler *et al.* for frogs, Cogger (1975) for Gekkonidae and Pygopodidae, Storr (1967) for *Vermicella*, Storr *et al.* (1981) for Scincidae and Storr *et al.* (1983) for Agamidae.

Another four species (Australian Crake, Black-tailed Native-hen, Black-winged Stilt and Little Grassbird) were recorded only from Dingo Swamp. As the swamp appeared suitable for a number of other water bird species, further observations beyond our extremely brief visit would no doubt expand this list considerably.

Interestingly, despite the limited range of structural vegetation types occurring in the Reserve, three species of Fairy-wren (Splendid, Variegated and White-winged) were found.

MAMMALS

Six native and five introduced mammal species were recorded on the Reserve. These are listed in Table 3 according to presence at each of the five trapping sites.

The following section summarizes:

(1) trapping results for small mammals and bats (total number of individuals and number of each sex trapped);

(2) the habitat associations shown by each species, based on trapping success (small mammals) and observations (other mammals); and

(3) reproductive condition of small mammals (from external examination of animals in the field and internal examination of specimens) (see also Appendix III).

Table 2
Bird species recorded in the Southern Beekeepers Reserve, and sites at which each species was recorded. Nomenclature and order based on Blakers et al. (1984). (+ = present; B = breeding)

Species	Site 1	2	3	4	5	Burnt area	Other
Emu	+			+		+	Hill River
Great Cormorant							ocean beach
Pied Cormorant							over site 3
Australian Shelduck	+						
Pacific Black Duck							Hill River, Dingo Swamp
Collared Sparrowhawk	B						
Little Eagle			+				
Brown Falcon				+	+	+	
Australian Kestrel	B?		+	+	+		Hill River
Australian Crake							Dingo Swamp
Black-tailed Native-hen							Dingo Swamp
Banded Lapwing	+						
Black-winged Stilt							Dingo Swamp
Silver Gull			+				ocean beach
Brush Bronzewing			+				
Carnaby's Black-Cockatoo	+				+		

Galah	B?		+				Hill River
Port Lincoln Ringneck	+						Hill River
Pallid Cuckoo						+	
Fan-tailed Cuckoo	+					+	
Horsfield's Bronze-Cuckoo	+	+	+	+	+	+	
Shining Bronze-Cuckoo	+						low heath
Southern Boobook	+						
Barn Owl			+				
Tawny Frogmouth	+		+			+	
Australian Owlet-nightjar	+						
Laughing Kookaburra	+						Hill River
White-backed Swallow			B?				Hill River
Welcome Swallow			+			+	Hill River, Dingo Swamp
Richard's Pipit						+	Dingo Swamp, tracks, roads
Black-faced Cuckoo-shrike	+						
White-breasted Robin					+		Hill River
Golden Whistler	+				+		
Rufous Whistler	+				+	+	
Grey Shrike-thrush	+	+	+			+	Hill River
Grey Fantail	+		+	+		+	
Willie Wagtail			+				
Little Grassbird							Dingo Swamp
Splendid Fairy-wren	+						
Variegated Fairy-wren		+		+	+	?	
White-winged Fairy-wren		+	+	+			
White-browed Scrub-wren			+	+			beach dunes
Calamanthus		+					
Western Gerygone	+						Hill River
Inland Thornbill	+		+				
Yellow-rumped Thornbill	+						
Red Wattlebird	+						
Singing Honeyeater		+	+	+	+		Hill River, beach dunes
Brown Honeyeater	B	+		+	B	+	Hill River
White-cheeked Honeyeater				+			
Tawny-crowned Honeyeater		+	+	+		+	Hill River, B in low heath
Western Spinebill					+		
Mistletoebird	+						
Silvereye	+	+	+	+	+	+	Hill River
Australian Magpie-lark	+						
Black-faced Woodswallow		+				+	
Grey Butcherbird	+		+				
Pied Butcherbird	+						
Australian Magpie	B						
Australian Raven	B		+		+		Hill River

Additional species recorded during a brief visit, 6 February 1986:

White-faced Heron	near Dingo Swamp
Black-shouldered Kite	edge of burnt area
Australian Hobby (Little Falcon)	Site 1
White-fronted Chat	Site 2

Macropus fuliginosus Western Grey Kangaroo

Present at all trapping sites. Sightings and fresh scats were recorded on all parts of the Reserve traversed and across the range of vegetation types present, including near-coastal dunes. The largest congregations of kangaroos were seen on the south-eastern and southern boundary (adjacent to Nambung National Park) in areas of heath with abundant young post-fire regrowth (e.g. 17 individuals were seen in two hours of spotlighting over a distance of 10.6 km). The largest group encountered on the Reserve was nine individuals. Most sightings, however, were of individual animals.

Tarsipes rostratus Honey Possum

Fifteen individuals were captured in pitfall traps (Table 4): 11 females and 4 males. Two individuals (1 female, 1 male) were killed and their skulls partially eaten by a juvenile *Rattus fuscipes* captured in the same pitfall trap.

Highest trap successes (20 per cent) were recorded at Sites 4 and 1 (Table 4, Fig. 2). Site 4, (Dense Heath (nomenclature of Muir (1977)), was the tallest and oldest unburnt heath site. Site 1, a small isolated clump of tuart woodland, was surrounded by extensive Dense Heath of similar age to Site 4 and the high trap success for *Tarsipes* is probably attributable to the proximity of this vegetation. The species was absent from coastal Dense Low Heath in interdunal situations at Site 3.

Nine females showed reproductive activity, while two (one adult with an undeveloped pouch and one immature) were not reproductively active (Appendix III). Eight females had from one to four pouch young. Young were hairless and crown-rump lengths ranged from approximately 0.5 to 1.0 cm. One female had a developed pouch and was possibly pregnant.

Live weights of three males captured on the Southern Beekeepers Reserve were 7.4, 6.0 and 6.0 g. Data from several workers (Scarlett and Woolley 1980; Renfree *et al.* 1984) suggest that body weight and maximum scrotal length can be used as indicators of age and sexual maturity in male *Tarsipes*. On the basis of these data, males with weights greater than 7.5 g and scrotal lengths of 14.0 mm and above are classed as adults (sexually mature). One individual (7.4 g) captured in the present survey approximates this minimum adult weight. On the basis of weight, the other two males are tentatively classed as subadults, although overnight weight loss in traps is an unknown factor.

Pseudomys albocinereus Ash-grey Mouse

Twenty-two individuals were captured (Table 4): 8 females, 13 males and 1 not sexed (escaped).

The species was absent from the Low Woodland of tuart (Site 1), but was present at the other four sites. Highest trap success (30 per cent) was recorded at Site 3 in near-coastal Dense Low Heath in an interdunal situation (Table 4). Numerous burrow systems attributable to this species were observed throughout this site.

Reproductive data for both sexes are summarized in Appendix III.

Table 3

Mammals recorded on the Southern Beekeepers Reserve, August 1985. Presence at each of the five trapping sites is indicated. Detailed descriptions of vegetation at trapping sites are given in Appendix I. Taxonomic order follows Strahan (1983).

Species	Site				
	1 (Low Woodland of tuart)	2 (Dense Low Heath; Dense Heath)	3 (Dense Low Heath)	4 (Dense Heath)	5 (Sparse Low woodland of Banksia spp. over Low Heath and Heath)
Tarsipes rostratus	X	X		X	X
Macropus fuliginosus	X	X	X	X	X
Pseudomys albocinereus		X	X	X	X
Rattus fuscipes		X	X		
Tadarida australis	X				
Eptesicus regulus	X				
Mus domesticus	X	X		X	X
Oryctolagus cuniculus	X		X		X
Canis familiaris	(tracks)			(tracks)	
Vulpes vulpes	X				
Felis catus		(tracks)			

Table 4

Numbers of small ground mammals captured in pitfall traps at each sample site. Returns from A and B lines at each site have been combined. Figures in parentheses give percentage trap success at each site (100 x number of individuals captured / pitfall nights).

	SITE					
SPECIES	1	2	3	4	5	TOTAL NUMBER
Tarsipes rostratus	4(20)	2(5)	-	8(20)	1(2.5)	15
Pseudomys albocinereus	-	3(7.5)	12(30)	6(15)	1(2.5)	22
Rattus fuscipes	-	8(20)	1(2.5)	-	-	9
Mus domesticus	4(20)	1(2.5)	-	2(5)	8(20)	15
Number of pit trap nights	20	40	40	40	40	180

No females appeared to be reproductively active; none was palpably pregnant and all had small teats.

Chapman and Kitchener (1977) found that pregnant adults at Cockleshell Gully ranged in weight from 20.0 to 44.6 g. On this basis, three individuals captured by us were within this adult weight range. The remainder were subadults.

Adult males with scrotal testes, males with partially descended testes and subadults with abdominal testes were captured (Appendix III). These data suggest that, at the time of survey, some animals may have commenced breeding but that the majority had not and appeared to be just at the onset of achieving breeding condition. The majority of males with abdominal testes appeared to be young males approaching their first breeding season.

Rattus fuscipes Southern Bush Rat

Nine individuals were captured (Table 4) : 3 females, 5 males and 1 not sexed.

The species was detected only at Sites 2 (Dense Heath and Dense Low Heath) and 3 (coastal Dense Low Heath). Highest trap success (20 per cent) was recorded at Site 2.

Interestingly, of the nine individuals captured, five were juveniles. The rest were adults showing breeding condition or signs of having bred recently. Our data on the reproductive condition of females and the presence of juveniles in the trapped population suggest that births occurred in both winter and spring. One female had elongated teats and distended uteri,

suggestive of a post-lactating condition. Juveniles of 37.3 to 40.0 g were probably born in early to mid July (the gestation period of *R. fuscipes* is 22 to 25 days and young attain a weight of 25 to 30 g at about 30 days after birth (Watts and Aslin 1981)). The youngest juvenile (10.0 g) was probably born in early August. The presence of males with scrotal testes also suggests that the species was breeding during the survey period.

Tadarida australis White-striped Mastiff Bat

The characteristic vocalization of this species was heard once over Site 1.

Eptesicus regulus King River Eptesicus

Four individuals (3 females and 1 male) were captured in a bat trap set at Site 1, an isolated clump of tuart woodland. Body weights of females were: 5.4, 5.5 and 5.5 g. The male, 5.5 g, had abdominal testes.

Mus domesticus House Mouse

Fifteen individuals were captured : 4 females, 8 males and 3 not sexed.

The species was trapped at all sites except Site 3. Highest trap success (20 per cent) was recorded at Sites 1 and 5 (Table 4). Site 5, a stand of *Banksia* woodland, was close to cleared pasture to the south.

Reproductive data for both sexes are summarised in Appendix III.

The presence of a pregnant female, males with scrotal testes and very young juveniles (3.0 and 3.5 g) indicated that *Mus* was actively breeding during August in the Southern Beekeepers Reserve. There were also adult males with regressed testes (epididymal sacs distended but testes and epididymides abdominal), indicative of animals that had bred at least once prior to capture.

Oryctolagus cuniculus European Rabbit

Apparently uncommon on the Reserve. Live sightings, warrens, scrapings and fresh faecal pellets were seen at Site 1 in the tuart woodland and on adjacent dunes. Fresh diggings and faecal pellets were also present on dunes adjacent to Site 3.

Canis familiaris Dog

Fresh canine tracks were seen on vehicle tracks at Sites 2 and 5 on two separate occasions.

Vulpes vulpes European Fox

A fox was heard barking in dunes adjacent to Site 1.

Felis catus Domestic Cat

Fresh tracks were seen at Site 2.

DISCUSSION

VEGETATION AND FLORISTICS

Because we were working at a finer scale, we were able to recognize and map more vegetation units than was Beard (1979). Our Coastal Dense Low Heath and Dense (Low) Heath on irregular dunes are included in Beard's Guilderton System, and our heaths and woodlands on (shallow) sand over limestone are included in Beard's scrub-heath in his Jurien System.

A number of our plant species records are of interest. These include several range extensions. The record of the Arrowsmith spider-orchid, *Caladenia crebra*, represents a 20 km southerly extension of the known range of this species which has a total range extending only 120 km north from here in a narrow coastal strip (S.D. Hopper and A. Brown, personal communication May 1986). The previous most southerly record of *Olax aurantia* is some 60 km north, near Eneabba. The record of *Eucalyptus decipiens* is also of interest, being among the most northerly records for this species (this is the northernmost record of the southern subspecies (S.D.Hopper, personal communication May 1986)). There is only one record of tuart (*E. gomphocephala*) farther to the north, and this is a small clump, not well protected, near the Jurien Bay townsite. The record of *Halosarcia syncarpa* represents the most northern known locality for this species. Our record of *Leucopogon parviflorus* is the northernmost collection of this species in the State Herbarium, although it has been recorded a little further north in the Mt Leseur area (E. A. Griffin, personal communication). Our collection of *Drosera stolonifera* ssp. *humilis* is near the southern limit for this subspecies. *Myoporum apiculatum* is geographically restricted, having only been collected in the Jurien Bay to Lancelin area.

Some of the vegetation formations present in the Southern Beekeepers Reserve seem not to be well represented in conservation reserves. Coastal heaths are widespread in the adjacent Nambung National Park and in the Wanagarren Nature Reserve to the south (Fig. 1) (Crook *et al.* 1984). However, the heaths on limestone are only poorly represented in Nambung, occurring only in a small area in the north-east section (Beard 1979; B. Muir, personal communication 1986), and the heaths in Wanagarren have different dominants (for example, *Banksia* does not occur as a dominant) and are structurally different (Beard 1979; Crook *et al.* 1984). Heaths on limestone are widespread in the Northern Beekeepers Reserve (A24496). However, some of these heaths are floristically richer than those on the Southern Beekeepers Reserve - our quadrat data are similar to those from near Greenhead (Foulds and McMillan, n.d.) but show lower diversity than similar quadrats over most comparable parts of the Northern Beekeepers Reserve (R.T. Wills, personal communication). Furthermore, some species (e.g. *Eucalyptus decipiens* and *E. gomphocephala*) do not occur on the Northern Beekeepers Reserve.

The heaths on limestone in the Southern Beekeepers Reserve therefore represent vegetation associations which are intermediate in floristic composition between those north and south of here, and at present are only poorly represented in reserves, specially in conservation reserves.

FROGS AND REPTILES

With one exception, the three frog and 11 reptile species recorded on the Reserve are well within their known geographic ranges and all are well represented in the collections of the W. A. Museum from the west coastal sandheaths between the Moore and Murchison Rivers. Our records of *Vermicella littoralis* are the southern-most records of this species in the State, extending its known range south from the Jurien Bay region. Within its range which extends north to Point Cloates, the species is common (R. Johnstone, W. A. Museum, personal communication 1986).

Survey work by the W. A. Museum indicates that diverse frog and reptile faunas occur on the coastal sandheaths between the Moore and Murchison Rivers. Seven frog and 41 reptile species were recorded at the proposed Mt Leseur (Cockleshell Gully) Reserve in the Jurien Bay district in 1973 and 1974 (Dell and Chapman 1977). We recorded no species in the Southern Beekeepers Reserve which are additional to their list. Cockleshell Gully Reserve is somewhat larger than the Southern Beekeepers (18 312 ha vs 10 854 ha) and encompasses a wider array of habitat types, in particular dissected lateritic plateau and saltlake and samphire complexes, which are not represented in the latter Reserve. Nevertheless, 23 reptile and five frog species were recorded from sand habitats in the Coastal Belt on and just north of Cockleshell Gully Reserve, and an additional 13 species were recorded on colluvial sands derived from the lateritic plateau. We recorded three of these 13 species on coastal dune and subcoastal sandplain in the Southern Beekeepers Reserve (Appendix IV).

BIRDS

All species recorded were within their known ranges, and no rare species were recorded. Nevertheless, the Southern Beekeepers Reserve appears to support viable breeding populations of a wide range of birds. Most bird species were widespread throughout the Reserve, but the tuart clumps and Dingo Swamp represent sites of particular interest.

Trees along the Hill River (mostly *Eucalyptus rudis*) also are of some considerable value as they are the only trees for some distance and would constitute an important nesting site resource for many species, specially cockatoos. Suitable nesting sites for cockatoos are being rapidly depleted in Western Australia (Saunders *et al.* 1982).

We recorded rather fewer bird species (56 total, 51 terrestrial) than are known from the Cockleshell Gully area to the north of here (146 total, 86 terrestrial) (Dell and Johnstone 1977). This was because our survey was comparatively brief, of a much smaller area, and covered a smaller range of vegetation/landform types. Despite this, we recorded three bird species (Brush Bronzewing, Fan-tailed Cuckoo and Black-tailed Native-hen) not recorded by Dell and Johnstone (1977).

Although we did not record any Australian Bustards, anectdotal evidence obtained from local residents and campers suggests that the species may sometimes still occur here as a vagrant. A more interesting absence from our list, however, is the Blue-breasted Fairy-wren which has been collected near the mouth of the Hill River and near the mouth of the Namban River to the south, and which would be expected as a resident species. The Southern Emu-wren may

also be present, but was not recorded in our brief survey. Further observation may reveal the presence of these species in the Southern Beekeepers Reserve.

MAMMALS

Species Composition and Distribution

The six native mammals recorded are within their known geographic ranges and are well known elements of the mammal fauna of the coastal heathlands between the Moore and Murchison Rivers (Kitchener and Vicker 1981). There are no previous records for the Reserve. However, there is an early W.A.Museum specimen of *Macropus irma* from the Hill River district (Kitchener and Vicker 1981). To the north, at Cockleshell Gully Reserve, an additional five native mammals have been recorded : three small ground mammals, *Sminthopsis crassicaudata, S. granulipes* and *S. griseoventer* (D.J. Kitchener, personal communication 1986) and two bats, *Chalinolobus gouldii* and *Nyctophilus geoffroyi* (Chapman and Kitchener 1977). In addition, *Chalinolobus morio* has been collected at caves between Jurien Bay and the Gairdner Range (Kitchener and Vicker 1981), and there have been confirmed sightings of *Macropus irma* from Cockleshell Gully, Mt. Lesueur and Drovers Cave National Park (Chapman and Kitchener 1977). *Macropus irma* is infrequently recorded on the northern sandheaths and reaches highest population densities in open woodlands in the south-west. Although we did not see this species, we recorded probable *M. irma* tracks and faeces in *Banksia* woodland at Site 5. Noting its occurrence at localities north of the Southern Beekeepers Reserve, it may be present in low numbers on the Reserve, particularly in more remote areas, for example along the northern boundary and the Hill River.

Although three species of *Sminthopsis* were detected at Cockleshell Gully, only two, *Sminthopsis crassi caudata* and *S. granulipes*, were captured in the coastal belt (Quindalup and Spearwood Dune Systems). Both species were recorded from vegetation types which were similar to at least one trapping site in the Southern Beekeepers Reserve i.e. near-coastal Low Heath at Site 3.

In addition, *S. crassicaudata* was trapped in samphire at Cockleshell Gully. A small area of samphire flats occurs in the Dingo Swamp region of the Southern Beekeepers Reserve. However, the swamp is currently excised from the Reserve and we did not trap there.

Both *S. crassicaudata* and *S. granulipes* were uncommon at Cockleshell Gully. On the northern sandheaths, *S. granulipes* is at the western end of its range which is centred on the wheatbelt. It has been suggested that the presence of *S. crassicaudata* in the coastal heaths probably represents a recent invasion from the east of the coastal plain in association with the clearing of land for agriculture (Chapman and Kitchener 1977).

The third species, *S. griseoventer*, on available information, has not been recorded in the coastal belt. At Cockleshell Gully Reserve, *S. griseoventer* was trapped only in pockets of sandstone-derived sands (supporting Low Scrub over Low Heath) in the dissected plateau of the Gairdner Range. The species has also been recorded at Gingin and Badgingarra National Park (D.J.Kitchener, personal communication 1986) on the eastern edge of the coastal plain.

Breeding Patterns of Small Mammals

In this section, breeding data for the small mammals captured during the survey (*Tarsipes rostratus, Pseudomys albocinereus, Rattus fuscipes* and *Mus domesticus*) are discussed briefly in relation to the patterns of breeding shown by these species elsewhere in the south-west.

Tarsipes rostratus

Of the 11 females which we captured at the Southern Beekeepers Reserve, nine had small pouch young. This suggests that births probably occurred from early to mid August. The presence of a recently weaned juvenile of 6.0 g also suggests a mid-winter (June) birth (Renfree *et al.* (1984) found that juveniles were about 5.0 g at weaning and that the period from birth to weaning spans 56-63 days).

Across its range, *Tarsipes rostratus* is now known to be a non-seasonal breeder, with births occurring throughout the year (Chapman and Kitchener 1977; Scarlett and Woolley 1980; Renfree *et al.* 1984). In a population on the south coast east of Albany, pouch young were found in every month of the year. However, apparently few were born in the summer months of December and January and there was an annual cycle of three equidistant peaks of breeding with the intervals between peaks closely approximating the minimum time required for birth and weaning of young (Renfree *et al.* 1984). At Cockleshell Gully, Chapman and Kitchener (*loc. cit.*) recorded females with pouch young in late October and May and suggested the main season of births extended from at least mid-autumn to mid-spring. Our data are consistent with the Cockleshell Gully data.

Pseudomys albocinereus

At the time of survey, it was apparent that the majority of animals had not commenced breeding but were at the onset of achieving breeding condition. This accords with the pattern of reproductive activity known for populations of *P. albocinereus* in the coastal western parts of its range, where breeding has been recorded from spring to early summer.

At Cockleshell Gully Chapman and Kitchener (1977) found pregnant females, including two with near term foetuses, in late October. At Cockleshell Gully and further inland at Watheroo, Morris and Bradshaw (1981) first observed males to have scrotal testes in August and suggested that reproductive activity probably commenced soon after August as young are born from late September to November.

Rattus fuscipes

Although limited, our data generally accord with the reproductive pattern shown by *R. fuscipes* at Cockleshell Gully. There, infrequent winter births were detected although the major period of births was from spring to early summer and the majority of births ceased well before mid-autumn (Chapman and Kitchener 1977). At Cape Le Grand on the south coast, the major period of births was found to be from late spring to early summer (Kitchener *et al.* 1975).

Mus domesticus

This species was actively breeding in the Southern Beekeepers Reserve during the survey period.

In the south-west, *Mus domesticus* has a distinct spring-summer breeding period, with some autumn breeding after favourable climatic conditions (Chapman 1981). At Cockleshell Gully a high incidence of breeding was recorded in both autumn and spring (May and late October), although it was unclear whether this was due to local effects such as high winter rainfall preceding the two survey periods (Chapman and Kitchener 1977). At Cape Le Grand National Park, *Mus* was breeding in December but had ceased by late April (Kitchener *et al.* 1975). Our data are consistent with other observations of active breeding in spring.

PROBABLE MANAGEMENT PROBLEMS

Fires

Extensive wildfires have occurred frequently in the two Beekeepers Reserves in recent years. The section of the Southern Beekeepers Reserve south of the Cervantes road was almost all burnt in autumn 1985 (Table 5). Almost all of the remainder was burnt in late January 1986, about five months after our survey. Reports from beekeepers claim that too-frequent fires are altering the vegetation, primarily by eliminating *Dryandra sessilis*, a species important to the beekeepers (R. Burking, personal communication; Davies 1987).

Tracks

Sites allocated to beekeepers in the past have often been away from existing tracks. Beekeepers have therefore had to make new tracks to get to their sites. Our observations suggest that additional tracks are still being made. This is not in the long term interest of either conservation or beekeeping.

Dieback

Apparent dieback (*Phytophthora*) symptoms have been observed in the Southern Beekeepers Reserve (R. Burking and B. Muir, personal communication), although this report has not been confirmed. However, *Phytophthora* spores could easily be transported into the area, as a number of vehicles come into the area from the forest areas in winter (R. Burking, personal communication). The risk of spread would be increased by any increase in the number of vehicle tracks in the Reserve.

Bees

We noted a number of feral bee (*Apis mellifera*) colonies during the course of our survey. It is widely held that introduced bees have a detrimental effect on native flora and fauna (e.g. Scheltema 1981; Matthews 1982 and references therein; Moore *et al.* 1983). Honeybees have been shown to compete with native bees for floral resources (nectar and pollen), to forage in ways unlikely to effect pollination of many native flora species, and, in high density, to be the likely cause of local extinctions of native bees (Pyke and Balzer 1985). Recently, it has been shown that honeybees may compete with honeyeaters and possibly other birds, depriving them of part of their nectar resource (Paton 1985, 1986). Honeybees may also compete directly with some native mammals, such as the honey-possum (*Tarsipes*), although no data appear to be available. Furthermore, there is some evidence (D. C. Paton, cited in Matthews 1982) that foraging by honeybees results in lowered seed set in the plants being visited. Reduction in seed set may result in lower levels of resources available for native seed predators (mostly

Table 5

Recent fire history of the Southern Beekeepers Reserve, as known at the time of the survey. Since the survey, almost all of the Reserve north of the Cervantes road was burnt in early February 1986. Almost the entire Reserve except for the mobile dunes and a small area of coastal Low Dense Heath was burnt between autumn 1985 and February 1986.

Landform	Vegetation *	Last Fire
Coastal dune	Coastal	no signs of fire
Consolidated dune	Low Dense Heath	" " " "
Mobile dunes	various (isolated patches)	" " " "
Limestone "plateau"	Heath	April or May 1985 (about 1/2)
	Dense Heath	ca. 1982 (about 1/2)
Deeper sands	Banksia woodland	no recent fires

* See Appendix I for more detail of individual sites.

invertebrates) and granivorous or omnivorous vertebrates (e.g. *Pseudomys albocinereus*) or may simply reduce the regenerative abilities of the plant species involved. Some of the possible effects may only be apparent in the long term. Although honeybees may have a detrimental effect on native bees and on the level of pollination of many native plant species, there is still a clear need for further research on the effects of varying densities of bees on the whole reproductive cycle of many native plant species, as well as effects on both vertebrate and invertebrate components of the native fauna (Bell 1987; Hopper 1987). Research should also be done to develop alternate (cultivated) floral resources for honeybees.

The Reserve has been used for some years by beekeepers, and is regarded as an important area for honeybees in spring (R. Burking, personal communication). The area has increased in importance in recent years due to the continued clearing of native vegetation for agriculture. Such clearing has been of long-term detriment to the bee-keeping industry in its present form in Western Australia.

One possible management strategy for the Reserve would be to vest and manage for both apiculture and flora conservation. In this context, it should be noted that, while honeybees may have a detrimental effect on native fauna and flora, this effect is far less than the loss of such regions of native bush to agricultural or urban development (Bell 1987).

RECOMMENDATIONS

1. In view of the interesting species occurrences recorded in this survey and the poor representation of limestone heaths in conservation reserves, the Southern Beekeepers Reserve has high nature conservation value. However, the Northern Beekeepers Reserve is apparently floristically richer than the Southern Beekeepers Reserve, is much larger (71 498 ha vs 10 854 ha) and includes large areas of limestone heaths. It therefore appears to have very high (regional) significance for nature conservation. Any decisions relating to vesting of Nature Reserves in this area should be made in the light of biological information from both the Northern and Southern Beekeepers Reserves.

2. As it would probably be impossible to eliminate feral bees from this area, and noting the dwindling resource available to beekeepers and the fact that this area has been an important area for beekeepers in the past, the Reserve should be vested for the combined purposes of flora and fauna conservation, and beekeeping (apiculture).

3. If the Reserve is vested in this way, then more stringent controls would be needed to restrict the escape of bees, to restrict formation of new tracks, and to restrict the occurrence of fire. These restrictions would need to be enforced. It should be noted that these restrictions would be in the long term interest of both conservation and beekeeping.

4. Dingo Swamp should be added to the Reserve in order to rationalize the Reserve boundary and to conserve this wetland which contributes to the diversity of species and habitats in the area.

5. If the Reserve is vested for conservation, then consideration should be given to monitoring the effects of feral bees on the native flora.

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APPENDIX I

Descriptions of trapping sites in the Southern Beekeepers Reserve. Nomenclature for vegetation description follows Muir (1977). (Muir's code is followed by a written description.)

Site 1: LAi.Sc

Low Woodland A of tuart (Eucalyptus gomphocephala) (10-15 m) over thickets (c. 2.5 m) of varying density dominated by Spyridium globulosum, Acacia rostellifera, Hakea trifurcata and H. prostrata with herbaceous layer (sparse) including Poa annua, Oxalis perennans, Solanum nigrum, Caladenia latifolia and Cassytha racemosa. Brown sandy-loamy soil with yellow sand at about 20 cm. This is one of several isolated clumps within an extensive area of heath.

Site 2A: SCd

Dense Low Heath C of predominantly Banksia prionotes, B. sphaerocarpa, Hakea trifurcata, Eremaea c.f.pauciflora and Acacia lasiocarpa with rare emergents of Xanthorrhoea sp., on light yellow-brown sand with yellow sand at about 15 cm.

Site 2B: SBd

Dense Heath B similar to Site 2A, but taller, specially Banksia prionotes which was more common than at 2A. Hakea trifurcata less common than at 2A.

Further down the slope, limestone rocks appear at the surface, and the heath is lower (30 to 40 cm) and sparser (<70 per cent cover) i.e. Low Heath D. Vegetation of this type is much more common. B. prionotes is much less common here, while H. trifurcata is more common. Other species which appear here include Dryandra nivea, D. sessilis, and Grevillea thelemanniana.

Sites 3A and 3B: SDd

Dense Low Heath D, less than 0.5 m, dominated by Acacia lasiocarpa, Melaleuca acerosa and Leptomeria spinosa with Cassytha racemosa and Leucopogon parviflorus also present. On white sand with pale clay at about 30 cm.

Sites 4A and 4B: SBd

Dense Heath B of Acacia lasiocarpa, A. spathulifolia, Hakea trifurcata, Dryandra sessilis, Calothamnus quadrifidus and

Banksia sphaerocarpa on light brown sand with yellow sand at about 20 cm.

This community is very like that at Site 2, but has not been burnt so recently and is taller.

Site 5A: LBi.SCc

Sparse Low Woodland B of Banksia prionotes and B. attenuata over Low Heath C of mixed shrubs including B. sphaerocarpa, Acacia sp., Eremaea ?violacea and Calothamnus quadrifidus, on brownish-white sand (very shallow) over yellow sand.

Site 5B: LBi.SBc

Sparse Low Woodland B of Banksia prionotes with scattered B. attenuata and Eucalyptus todtiana and scarce B. menziesii over Heath B, taller than at Site 5A but of similar floristic composition, on soil like at Site 5A.

APPENDIX II

List of plant species collected in the Southern Beekeepers Reserve. Nomenclature and order are based on Green (1985). Species recorded in the recently burnt areas (C and D of Fig. 2) are listed as occurring in 'burnt heath'.

Species	Collection Number (A.H.Burbidge)	Site(s)
ZAMIACEAE		
Macrozamia riedlei (Fisher ex Gaudich.) C. Gardner	-	2,5
POACEAE		
Poa annua L.	-	1
Spinifex longifolius R.Br.	3914	Dunes
Stipa elegantissima Labill.	4003	Burnt heath
Stipa ?hemipogon Benth.	3998	Burnt heath
CYPERACEAE		
Lepidosperma angustatum R.Br.	4004	Burnt heath
?Lepidosperma tenue Benth.	-	Dingo Sw.
Mesomelaena graciliceps (C.B.Clarke)K.L.Wilson	3985	S.boundary
Schoenus sp.	-	Burnt heath
DASYPOGONACEAE		
Acanthocarpus preissii Lehm.	3997	Burnt heath
XANTHORRHOEACEAE		
Xanthorrhoea sp.	-	5
PHORMIACEAE		
Dianella revoluta R.Br.	-	1
ANTHERICACEAE		
Thysanotus sp.	-	Burnt heath
HAEMODORACEAE		
Anigozanthos humilis Lindley	-	5

Conostylis candicans Endl. ssp. nov.	3915	Dunes
Conostylis teretifolia J.W.Green	3904	5
Conostylis sp. 2	-	5
Haemodorum sp.	-	Burnt heath
IRIDACEAE		
Patersonia sp.	-	Burnt heath
ORCHIDACEAE		
Caladenia crebra A.S. George	3902	5
Caladenia latifolia R.Br.	3925	1
CASUARINACEAE		
Allocasuarina humilis (Otto & Dietr.) L. Johnson	-	1,4,5
Allocasuarina lehmanniana (Miq.) L. Johnson	-	1,3
PROTEACEAE		
Banksia attenuata R.Br.	-	5
Banksia menziesii R.Br.	-	5
Banksia prionotes Lindley	-	2,5
Banksia sphaerocarpa R.Br. var sphaerocarpa	3932	1,2,4,5
Dryandra nivea (Labill.) R.Br.	-	1,5
Dryandra sessilis (Knight) Domin.	-	1,2,4,5
Grevillea thelemanniana Huegel	3923	2
Hakea prostrata R.Br.	-	1,5
Hakea trifurcata (Smith) R.Br.	-	1,2,4,5
Hakea sp.	-	5
Stirlingia latifolia (R.Br.) Steudel	-	5
SANTALACEAE		
Leptomeria spinosa (Miq.) A.DC.	3909	3
Leptomeria sp.	3993	Burnt heath
OLACACEAE		
Olax aurantia A.S.George	3945	Hill R.
LORANTHACEAE		
Nuytsia floribunda (Labill.) R.Br. ex Fenzl.	-	Heath
POLYGONACEAE		
Muehlenbeckia adpressa (Labill.) Meissner	3999	Burnt heath

CHENOPODIACEAE		
Atriplex cinerea Poiret	-	Dunes
Halosarcia indica (Willd.) Paul G. Wilson ssp. bidens (Nees) Paul G. Wilson	3920	Dingo Sw.
Halosarcia syncarpa Paul G. Wilson	3944	Dingo Sw.
GYROSTEMONIACEAE		
Tersonia cyathiflora (Fenzl.) A.S.George	3990	Burnt heath
AIZOACEAE		
Tetragonia decumbens Miller	3942	Dunes
PORTULACACEAE		
Calandrinia brevipedata F. Muell.	4000	Burnt heath
Calandrinia sp.	4011	Tuart woodland
RANUNCULACEAE		
Clematis microphylla DC	-	3
LAURACEAE		
Cassytha racemosa Nees	3927	1
BRASSICACEAE		
Heliophila pusilla L.f.	3910	3
DROSERACEAE		
Drosera macrantha Endl.	3986	S.boundary
Drosera stolonifera Endl. ssp. humilis Planch.	4012	Tuart woodland
MIMOSACEAE		
Acacia lasiocarpa Benth. var. lasiocarpa	3907,3917,3922,3930	2,3,4,5
Acacia ligulata Cunn. ex Benth.	3911	3
Acacia rostellifera Benth.	3928	1
Acacia spathulifolia Maslin	3921,3931	2,4
Acacia truncata (Burm.f.) Hort. ex Hoffsgg.	3918	Dunes
Acacia xanthina Benth.	3933	Hill R.
Acacia sp. 1	3906	5
PAPILIONACEAE		
Gompholobium aristatum Benth.	3994	Burnt heath
Hardenbergia comptoniana (Andrews) Benth.	4013	Heath, Tuart woodland

Isotropis cuneifolia (Smith) Benth.	3989	Heath
Kennedia coccinea Vent.	4010	Burnt heath
Kennedia prostrata R.Br.	-	1
Oxylobium reticulatum Meissner	-	3
Sphaerolobium macranthum Meissner	3991	S.boundary
Templetonia retusa (Vent.) R.Br.	3913	3
OXALIDACEAE		
Oxalis perennans Haw.	3924	1
RUTACEAE		
Diplolaena microcephala Bartling in Lehm.	3905	5
Eriostemon spicatus A.Rich.	4005	Burnt heath
EUPHORBIACEAE		
Phyllanthus calycinus Labill.	4002	3,burnt heath
STACKHOUSIACEAE		
Stackhousia monogyna Labill.	-	S.boundary
RHAMNACEAE		
Spyridium globulosum (Labill.) Benth.	3919,3926	1, Dunes
STERCULIACEAE		
Lasiopetalum c.f. oppositifolium F.Muell.	4007	Burnt heath
Thomasia c.f. macrocalyx Steudel in Lehm.	4006	Burnt heath
DILLENIACEAE		
Hibbertia hypericoides (DC) Benth.	-	5
Hibbertia sp.	3912	3
VIOLACEAE		
Hybanthus calycinus (DC ex Ging.) F.Muell.	-	Burnt heath
MYRTACEAE		
Calothamnus quadrifidus R.Br.	-	4
Chamaelaucium uncinatum Schauer	-	Burnt heath
Eremaea c.f. pauciflora (Endl.) Druce	3943	2
Eremaea ?violacea F.Muell.	-	5
Eucalyptus decipiens Endl.	3901	5
Eucalyptus gomphocephala DC	3900	1,5
Eucalyptus rudis Endl.	3934	Hill R.
Eucalyptus todtiana F. Muell.	-	2,5
Hypocalymma linifolium Turcz.	3916	5

Melaleuca acerosa Schauer	-	3
Melaleuca huegelii Endl.	-	Dingo Sw.
APIACEAE		
Trachymene pilosa Smith	-	Tuart woodland
EPACRIDACEAE		
Leucopogon parviflorus (Andrews) Lindley	4008	3,heath
Lysinema ciliatum R.Br.	-	3
CHLOANTHACEAE		
Pityrodia sp.	4014	Tuart woodland
LAMIACEAE		
Hemiandra pungens R.Br.	-	3
SOLANACEAE		
Anthocercis ilicifolia Hook. ssp. ilicifolia	-	Burnt heath
Anthocercis littorea Labill.	-	3
Solanum nigrum L.	-	1
MYOPORACEAE		
Eremophila glabra (R.Br.) Ostenf.	3908	Near 3
Myoporum apiculatum A.DC.	-	Dunes
	3935	Tuart patch
GOODENIACEAE		
Dampiera linearis R.Br.	4009	Burnt heath
Lechenaultia ?formosa R.Br.	4001	Burnt heath
Scaevola ?canescens Benth.	-	5
Scaevola crassifolia Labill.	-	3
Scaevola thesioides Benth.	3996	Burnt heath
STYLIDIACEAE		
Stylidium affine Sonder (coastal form)	-	Near 4
Stylidium brunonianum Benth. subsp. brunonianum	-	5
ASTERACEAE		
Brachycome iberidifolia Benth.	3903	5
Olearia axillaris (DC) F.Muell. ex Benth.	-	3
Olearia rudis (Benth.) F.Muell. ex Benth.	3929	4
Senecio lautus G.Forster ex Willd.	3995	Heath
Waitzia citrina (Benth.)Steetz	3984	S.boundary

APPENDIX III

Live weights and reproductive data for four small mammal species - *Tarsipes rostratus*, *Pseudomys albocinereus*, *Rattus fuscipes* and *Mus domesticus* - from the Southern Beekeepers Reserve, August 1985. (WAM = Western Australian Museum.)

Tarsipes rostratus

Females

Field No.	Pouch condition / No. of young	Live Wt (g)	Comments (cr = crown-rump of young (mm))
1	not developed	10.0	Adult
2	dev / 2	10.3	cr = 9.1
3	dev / 1 or 2	-	cr = ca. 5
4	dev / 4	-	
5	dev / 2	9.5	
6	dev / 0	9.0	?pregnant
7	dev / 3	11.0	cr = ca. 10
8	dev / 2	12.0	cr = 8
9	dev / 2	11.8	cr = 5
10	not developed	6.0	immature
11	dev / 2	13.2	cr = ca. 5

Pseudomys albocinereus

Females :

WAM Acc-. ession No./ Release No.	Live Wt. (g)	Vagina	Teats	Uterine horns Condition	Diam(mm) L	Diam(mm) R	Comment
M25689	16.0	imperforate	small (button)	Smooth	0.7	0.8	Subadult, non-parous
1	15.9	"	"				Subadult
2	16.6	"	"				"
3	16.9	"	"				"
4	15.0	"	"				"
5	21.9	"	"				? Adult
6	21.2	"	"				? Adult
7	20.7	"	"				? Adult

Appendix III (cont.).

Pseudomys albocinereus

Males :

WAM Accession No./ Release No.	Live Wt. (g)	Testes	Testis Length(mm) R	L	Comment
M25690	32.8	1 Scrotal	10.5	10.9	Adult -?breeding
M25691	20.4	Abdominal	10.5	10.2	Subadult
M25692	-	Abdominal	12.0	11.6	"
M25693	26.9	Scrotal	11.2	11.5	Adult - breeding
1	29.2	Half scrotal			Adult at onset of breeding
2	33.0	Half scrotal			" "
3	27.5	Half scrotal			" "
4	33.0	Half scrotal			" "
5	27.0	Scrotal			Adult -?breeding
6	24.8	Abdominal			Subadult
7	17.5	Abdominal			"
8	20.4	Abdominal			"
9	15.3	Abdominal			"
10	17.5	Abdominal			"
11	-	Abdominal			"

Rattus fuscipes

Females :

WAM Accession No./ Release No.	Live Wt. (g)	Vagina	Teats	Uterine horns Condition	Diam(mm) L	R	Comment
M25687	78.0	Perforate	Distended (3-4 mm)	Striated, distended Placental scars	2.1	2.5	Adult, post-lactating
1	70.0	Perforate	Enlarged (2-3 mm)				Adult
2	37.8	Imperforate	Small				Juvenile

Appendix III (cont.).

Rattus fuscipes

Males :

WAM Accession No./ Release No.	Live Wt (g)	Testes	Comment
M25688	19.0	Abdominal	Juvenile
1	37.3	Abdominal	Subadult
2	40.0	Abdominal	Subadult
3	56.1	Scrotal	Adult - ?breeding
4	77.0	Scrotal	Adult - ?breeding

One individual not sexed - 33.0 g, Subadult

Mus domesticus

Females :

WAM Accession No./ Field No.	Live Wt. (g)	Vagina	Teats	Uterine horns Condition	Diam(mm) L	R	Comment
M25694 (BKM5)	6.0	Perforate	Minute	Smooth	0.5	0.8	Subadult, non-parous
M25694 (BKM6)	11.0	Perforate	Elongated	-	-	-	Adult, parous
M25694 (BKM16)	12.5	Perforate	Very enlarged	Striated, 3 uterine swellings in right horn	1.7	1.7	Pregnant
M25694 (BKM17)	-	Imperforate		Minute			Juvenile

Appendix III (cont.).

Mus domesticus

Males :

WAM Accession No./ Field No.	Live Wt. (g)	Testes	Testis Length(mm) R	L	Comment
M25694 (BKM2)	10.0	Scrotal	3.9	3.9	Adult, breeding
M25694 (BKM3)	10.0	Scrotal	3.9	3.9	Adult, breeding
1	15.9	Abdominal -regressed			Adult, non-breeding
2	-	Abdominal			Adult, non-breeding
3	-	Abdominal			Adult, non-breeding
4	15.5	Abdominal -regressed			Adult, non-breeding
5	13.0	Scrotal			Adult, breeding
6	12.0	Scrotal			Adult, breeding

Three juveniles, which were not sexed, weighed 3.0, 3.5 and 5.5 g respectively.

APPENDIX IV

List of frogs and reptiles recorded at Cockleshell Gully Reserve (1973 and 1974) from Chapman et al.(1977) and on the Southern Beekeepers Reserve in August 1985. Cockleshell Gully records are from the coastal belt and adjacent colluvial sands.

Species	Cockleshell Gully Reserve		Southern Beekeepers Reserve (Preliminary list)
	Safety Bay Sands and Spearwood Dunes	Plateau-derived sands	
Litoria moorei	x		
Ranidella pseudinsignifera	x		
Heleioporus albopunctatus	x	x	
Heleioporus eyrei	x	x	x
Limnodynastes dorsalis	x	x	x
Neobatrachus pelobatoides	x		
Pseudophryne guentheri		x	x
Crenadactylus ocellatus	x		
Diplodactylus alboguttatus		x	
Diplodactylus spinigerus	x	x	x
Diplodactylus vittatus		x	
Gehyra variegata	x	x	x
Phyllodactylus marmoratus		x	
Phyllurus milii	x		
Aclys concinna		x	
Delma grayii	x	x	
Delma fraseri	x		
Lialis burtonis	x	x	
Pygopus lepidopodus	x	x	x
Tympanocryptis adelaidensis	x	x	x
Ctenophorus maculatus		x	
Pogona minor	x	x	x
Cryptoblepharus plagiocephalus	x	x	x
Ctenotus fallens		x	x
Ctenotus lesueurii	x		
Ctenotus impar		x	
Egernia kingii	x		
Egernia multiscutata bos		x	
Egernia napoleonis		x	
Lerista planiventralis		x	
Lerista praepedita	x		x
Menetia greyii	x	x	

Appendix IV (cont.).

Species	Cockleshell Gully Reserve		Southern Beekeepers Reserve (Preliminary List)
	Safety Bay Sands and Spearwood Dunes	Plateau-derived Sands	
Morethia lineoocellata	x		
Morethia obscura		x	
Omolepida branchialis (a)			x
Tiliqua occipitalis	x	x	
Tiliqua rugosa		x	x
Varanus gouldii	x		
Notechis curtus	x	x	
Pseudonaja nuchalis	x		
Demansia reticulata	x		
Vermicella littoralis	x		x
Vermicella bimaculata		x	

(a) *Omolepida branchialis* was detected at Cockleshell Gully in the Coastal Belt but only in salt-lake samphire mosaics.