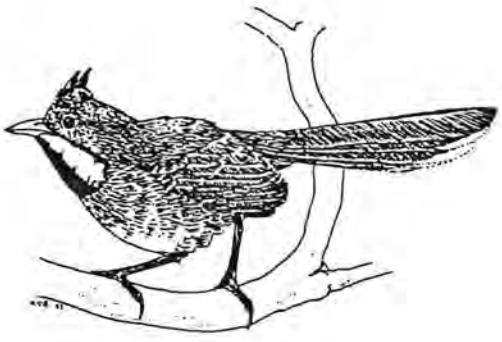
RESEARCH PLAN FOR THE WESTERN GROUND PARROT, WESTERN WHIPBIRD AND WESTERN BRISTLEBIRD

by

Peter G. Cale[1] and Allan H. Burbidge[2]

[1] 260 Selby Street,
Floreat Park WA 6014

[2] Department of Conservation and Land Management
Western Australian Wildlife Research Centre
PO Box 51
Wanneroo WA 6065



Western Whipbird
Psophodes nigrogularis nigrogularis

Report to Australian National Parks and Wildlife Service

ANPWS Endangered Species Program Project No. 228

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The views expressed herein are those of the authors, and not necessarily those of the Australian National Parks and Wildlife Service or of the Department of Conservation and Land Management.

TABLE OF CONTENTS

FORWARD

This Research Plan details the research required to effectively manage three endangered birds of the south coast of Western Australia. These birds, the western ground parrot (*Pezoporus wallicus flaviventris*), western whipbird (*Psophodes nigrogularis*) and western bristlebird (*Dasyornis longirostris*) have been considered in a single plan, because they overlap extensively in their distribution and have declined to their current status due to similar factors. Management of endangered species generally involves the management of their habitat and the extensive overlap in the distribution of these three species means that habitat management for one of these species could affect one or both of the other species. Integrated management for these species will therefore be necessary and so the research component of this management has been proposed with this in mind.

Two major areas, both of which are managed by the Department of Conservation and Land Management (CALM), are common to these species: Two Peoples Bay Nature Reserve (western bristlebirds and western whipbirds) and Fitzgerald River National Park (all three species). Two Peoples Bay Nature Reserve contains a fourth endangered bird (noisy scrub-bird), the management of which is a high priority in this reserve. It is essential that the management requirements of these four species in these two areas are considered together to ensure that management actions for one species are not detrimental to another. To date this has been successfully achieved at Two Peoples Bay Nature Reserve where species-specific management has been implemented, but some differences in the ecology of these species could lead to conflicting management actions. It is essential that sufficient information is obtained about the ecology of these species to determine which management actions may be in conflict and the possible consequences of this conflict. This is the purpose of this Research Plan.

Research Plans and Recovery Plans delineate, justify and schedule research and/or management actions necessary to support the recovery of an endangered or vulnerable species or ecological community. The attainment of objectives and the provision of funds is subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery Plans represent the position of the Department of Conservation and Land Management only after approval by the Executive Director, the National Parks and Nature Conservation Authority and the Minister.

Research Plans and Recovery Plans are subject to modification as dictated by new findings, changes in species' status and completion of research or recovery actions.

Summary

Western Ground Parrot

Current Status: Threatened species (W.A. Wildlife Conservation Act), not listed (ANZECC 1991), Endangered (Garnett 1992a,b), critical (draft IUCN categories). A reappraisal of current census data suggests that there is only one subpopulation of this subspecies that has more than 125 individuals and that there is a relatively high risk of >50% of the total population being lost in the next 5-10 years. Under the Mace and Lande (1991) criteria this places the western ground parrot in the critical category. Garnett (1992b) ranks the western ground parrot thirteenth in the conservation priority of all threatened bird taxa in Australia and its territories. The total population is estimated to be less than 400.

Habitat requirements and limiting factors: Currently restricted to very diverse, dry heaths that have not been burnt for at least 15 years. Past distribution and the habitat requirements of the eastern subspecies suggest that they may have used wetter heaths and sedgelands in the south west corner of the State. Post-fire age of the vegetation appears to be an important limiting factor, but over what range of post-fire ages this subspecies can persist is not known.

Research Plan objective: To provide sufficient information on the biology of *P. w. flaviventris* and the influences of potential causes of its decline, to create management prescriptions that will increase its survival chances and potentially increase its total population size.

Research criteria:

1. The identification and survey of all subpopulations of the western ground parrot.
2. The preparation of an interim Recovery Plan.
3. The implementation of a monitoring program to assess effects of changing post-fire age of habitat.
4. The determination of the effect of a fox control program on the size of subpopulations.
5.* The characterisation of micro-habitats (including dietary aspects).
6.* The determination of the breeding success and age structure.
7. The assessment of the feasibility of using translocation of ground parrots as a management tool.

* Meeting criteria 5 and 6 is dependent on the feasibility of the proposed projects.

Actions needed:

1. Survey of all known subpopulations.
2. Preparation of an interim Recovery Plan.
3. Monitoring of subpopulations in relation to changing post-fire age and a fox control program.
4. Research into micro-habitat requirements and breeding success.
5. Evaluation of the use of translocation for the management of this subspecies.

Estimated cost of research phase of recovery: 1993 prices in $000s/year; total cost (TC) and Other (O) = Endangered Species Program (ESP)/other external funds required (= TC - CALM contribution)

Actions	(1)		(2)		(3)		(4)		(5)		Total	
	TC	O	TC	O	TC	O	TC	O	TC	O	TC	O
1993	58	54	0	0	#	0	88	81	0	0	146 #	135
1994	0	0	9	0	49 #	46	88	81	*	*	146 *	127 *
1995	0	0	0	0	25 #	22	88	81	*	*	113 *	103 *
1996	0	0	0	0	49 #	46	88	81			137	127
1997	0	0	0	0	25 #	22	94	81			119	103
1998	0	0	0	0	49 #	46	0	0			49	46
1999	0	0	0	0	25 #	22	0	0			25	22
2000	0	0	0	0	49 #	46	0	0			49	46
2001	0	0	0	0	25 #	22	0	0			25	22
2002	0	0	0	0	56 #	46	0	0			56	46
Total	58	54	9	0	352 #	318	446	405	*	*	865 *	#777 *

Current input to the experimental fox baiting in Fitzgerald River National Park is about $19000 per year, about 70% of which is from external sources. This is additional to the amounts shown above. Current monitoring is concerned with threatened mammal species.

* Feasibility and cost of a translocation program will be assessed in year one. Because of the difficulties in catching birds and monitoring parent and new populations, together with the logistics of identifying suitable sites for translocations, the cost of carrying out such management is likely to be of the order of $100 000.

Biodiversity benefits: Habitat protection and management for the western ground parrot will help conserve a number of other organisms, especially those which require long-term protection from fire. In the Fitzgerald River National Park, these include the western bristlebird *Dasyornis longirostris*, western whipbird *Psophodes nigrogularis*, dibbler *Parantechinus apicalis* and western mouse *Pseudomys occidentalis*. Both Cape Arid National Park and Fitzgerald River National Park are very rich in plant species, a number of which are threatened or of restricted geographical occurrence.

Summary

Western Whipbird

Current Status: *P. n. nigrogularis*: Threatened (W.A. Wildlife Conservation Act), not listed (ANZECC 1991), Endangered (Garnett 1992 a,b), endangered (draft IUCN categories). Garnett (1992b) ranks this subspecies ninth in conservation priority of all Australian threatened bird taxa. *P. n. oberon:* Threatened (W.A. Wildlife Conservation Act), not listed (ANZECC 1991), Rare (Garnett 1992 a,b), endangered (draft IUCN categories). *P. n. oberon* is classified here as endangered because only two populations are believed to contain more than 125 birds.

Habitat requirements and limiting factors: The structure of the vegetation appears to be the most important factor determining its suitability for the western whipbird throughout its range. They require a dense to mid-dense understorey of shrubs, sedges or tussock grasses, with a low open to mid-dense canopy. Fire appears to be the single most important limiting factor for the western whipbird in Western Australia. Western whipbirds in Western Australia appear to require vegetation that has not been burnt for at least 4-7 years and have been found in vegetation that has not been burnt for more than 40 years. It is possible that the post-fire age requirements of *P. n. nigrogularis* and *P. n. oberon* differ.

Research Plan objective: Firstly to determine if populations of western whipbirds in Western Australia belong to two subspecies as proposed by Schodde and Mason (1991). Secondly to provide sufficient information on these two subspecies (if they exist) for the creation of management prescriptions that will increase their survival chances and potentially increase their total population size.

Research criteria:

1. The identification and survey of all subpopulations of the western whipbird in W.A.
2. The assessment of the taxonomic status of this species in W.A.
3. The implementation of research programs to assess effects of changing post-fire age of habitat.
4. The determination of the effect of a fox control program on *P. n. oberon* populations.
5. The characterisation of micro-habitats of *P. n. oberon*.
6. The assessment of the feasibility of using translocation for *P. n. nigrogularis*.

Actions needed:

1. Survey of all known subpopulations of western whipbirds in Western Australia.
2. Assessment of taxonomic status of populations in Western Australia.
3. Monitoring of subpopulations in relation to changing post-fire age and a fox control program.
4. Research into micro-habitat requirements of *P. n. oberon*.
5. Evaluation of the use of translocation for the management of *P. n. nigrogularis*.

Estimated cost of research phase of recovery: 1993 prices in $000s/year; total cost (TC) and Other (O) = Endangered Species Program (ESP)/other external funds required (= TC - CALM contribution)

Actions	(1)		(2)		(3)		(4)		(5)		Total	
	TC	O	TC	O	TC	O	TC	O	TC	O	TC	O
1993	21	19	24	22	40.5	38	32	30	14	12	131.5	121
1994	21	19	24	22	21	20	32	30	54	50	152	141
1995	0	0	55	50	19	18	38	34	54	50	166	152
1996	0	0	0	0	21	20	0	0	0	0	21	20
1997	0	0	0	0	19	18	0	0	0	0	19	18
1998	0	0	0	0	21	20	0	0	0	0	21	20
1999	0	0	0	0	19	18	0	0	0	0	19	18
2000	0	0	0	0	21	20	0	0	0	0	21	20
2001	0	0	0	0	19	18	0	0	0	0	19	18
2002	0	0	0	0	25	20	0	0	0	0	25	20
Total	42	38	103	94	225.5	210	102	94	122	112	594.5	548

Biodiversity benefits: Habitat protection and management for the western whipbird will help conserve a number of other organisms, especially those which require long-term protection from fire. In the Fitzgerald River National Park, these include the western bristlebird *Dasyornis longirostris*, western ground parrot *Pezoporus wallicus flaviventris*, dibbler *Parantechinus apicalis* and western mouse *Pseudomys occidentalis*. The Manypeaks - Two Peoples Bay area is the only area where the noisy scrub-bird *Atrichornis clamosus* currently occurs. Several other endemic animals, some threatened, also occur in this area. Fitzgerald River National Park is very rich in plant species, a number of which are threatened or of restricted geographical occurrence.

Summary

Western Bristlebird

Current Status: Threatened (W.A. Wildlife Conservation Act), Vulnerable (ANZECC 1991), Endangered (Garnett 1992 a,b), apparently critical (draft IUCN categories). Application of the Mace and Lande (1991) criteria suggest that the status of the species is close to critical because the subpopulation at Two Peoples Bay is the only one likely to exceed 125 individuals. If the probability of this subpopulation being burnt out in the next 5-10 years is considered to be greater than 50%, then the status of the species would have to be considered critical. Garnett (1992b) ranks the western bristlebird ninth in the conservation priority of all threatened bird taxa Australia and its territories and the equal fourth most threatened full species.

Habitat requirements and limiting factors: Appear to require diverse heaths that have not been burnt for at least 5-10 years depending on moisture levels in the habitat. Post-fire age of the vegetation appears to be the single most important limiting factor. The maximum post-fire age at which vegetation retains its suitability is not known, but they are still found in areas that have not been burnt for up to 50 years, though densities may be lower.

Research Plan objective: To provide sufficient information on the biology of the western bristlebird and the influences of potential causes of its decline, to create management prescriptions that will increase its survival chances and potentially increase its total population size.

Research criteria:

1. The identification and survey of all subpopulations of the western bristlebird.
2. The implementation of monitoring programs to assess effects of changing post-fire age of habitat.
3. The characterisation of micro-habitats.
4. The assessment of the feasibility of using translocation as a management tool.

Actions needed:

1. Survey of all known subpopulations.
2. Monitoring of subpopulations in relation to changing post-fire age.
3. Research of micro-habitat requirements.
4. Evaluation of the use of translocation for the management of this subspecies.

Estimated cost of research phase of recovery: 1993 prices in $000s/year; total cost (TC) and Other (O) = Endangered Species Program (ESP)/other external funds required (= TC - CALM contribution)

Actions	(1)		(2)		(3)		(4)		Total	
	TC	O	TC	O	TC	O	TC	O	TC	O
1993	17	14	8	6	32	30	14	12	71	62
1994	0	0	0	0	32	30	54	50	86	80
1995	0	0	28	24	34	30	54	50	116	104
1996	0	0	0	0	0	0	0	0	0	0
1997	0	0	28	24	0	0	0	0	28	24
1998	0	0	0	0	0	0	0	0	0	0
1999	0	0	28	24	0	0	0	0	28	24
2000	0	0	0	0	0	0	0	0	0	0
2001	0	0	29	24	0	0	0	0	29	24
2002	0	0	0	0	0	0	0	0	0	0
Total	17	14	121	102	98	90	122	112	358	318

Biodiversity benefits: Habitat protection and management for the western bristlebird will help conserve a number of other organisms, especially those which require long-term protection from fire. In the Fitzgerald River National Park, these include the western whipbird *Psophodes nigrogularis*, western ground parrot *Pezoporus wallicus flaviventris*, dibbler *Parantechinus apicalis* and western mouse *Pseudomys occidentalis*. The Manypeaks - Two Peoples Bay area is the only area where the noisy scrub-bird *Atrichornis clamosus* currently occurs. Several other endemic animals, some threatened, also occur in this area. Fitzgerald River National Park is very rich in plant species, a number of which are threatened or of restricted geographical occurrence.

Western Ground Parrot
Pezoporus wallicus flaviventris North

1 Introduction

1.1 Taxonomy and Status

The ground parrot (*Pezoporus wallicus*) is endemic to Australia. Often it has been considered the sole member of the genus *Pezoporus* and part of a relict group including two other monotypic genera *Geopsittacus* (night parrot) from Australia and *Strigops* (kakapo) from New Zealand (Mathews 1917; Condon 1975; Forshaw 1981). However, Serventy (1953) considered *Pezoporus wallicus* and *Geopsittacus occidentalis* as members of the same genus as did Ford (1969), who considered the major differences between the two species to be simply a result of adaptations to their different environments. Recent DNA work (Leeton, Christidis and Westerman in prep.) is consistent with this latter view, suggesting that the ground parrot and night parrot are closely related, congeneric, and more closely related to *Neophema* than *Strigops*.

North (1911) was the first to distinguish the Western Australian populations of *P. wallicus* as different from those in eastern Australia and Tasmania. He proposed them as a separate species, *P. flaviventris*, based on differences in plumage, with the western birds having broken barring on the under surface and a yellow lower breast and abdomen (North 1911). Mathews (1912) reduced *flaviventris* to subspecific level, describing it as "... not too well differentiated when South Australian specimens are considered." This classification has persisted despite a lack of data to support subspecific separation and the opinion of some authors that it is a poorly differentiated subspecies (Ford 1969; Forshaw 1981). No genetic investigations have been made on subspecific variation in this species and the morphometric investigations are based on few specimens and show little difference between the populations (Ford 1969; Forshaw 1981).

King (1979) considered *P. wallicus wallicus* as vulnerable to extinction and *P. w. flaviventris* as endangered. Since then, work on eastern Australian populations has shown that numbers of *P. w. wallicus* in Tasmania are high (Bryant 1991), and Garnett (1992a,b) no longer considers this subspecies as threatened, while *P. w. flaviventris* has been retained as an endangered subspecies. However, a reappraisal of available data (Watkins and Burbidge 1992 and section 1.2, below) suggests that the status of *P. w. flaviventris* is critical on the basis of the criteria of Mace and Lande (1991). On Garnett's (1992b) list of priorities of threatened birds of Australia and its territories, *P. w. flaviventris* is listed at number 13.

1.2 Distribution and Abundance

Historical

Historically the ground parrot was distributed on coastal mainland Australia from southern Queensland (as far north as Fraser Island) (McFarland 1991c) to Adelaide in South Australia (Condon 1942), and from Cape Arid to the Dongara-Watheroo area of Western Australia (Watkins 1985). In Tasmania the species was most commonly found in the south-west, but occurred throughout Tasmania, where suitable habitat existed (Bryant 1991).

In Western Australia, the ground parrot was first collected by John Gilbert near Perth in the 1840s (Ford 1969). The only other records from the west coast are nestlings in the Gould collection at the British Museum, recorded as taken from Wanyun Hills (Wongan Hills) and an adult from the Swan River collected by Dr. R.B. Sharpe (Salvadori 1891). Leake (1962) commented briefly about this species being a visitor to the eastern wheatbelt, where it fed in the vicinity of granite hills, but was not seen there after 1892. Several second hand reports from sandplain country between Dongara and

Watheroo up to the 1890s when the area was burnt out, were recorded by Ashby (1921). Ford (1969) noted second hand reports of this species being found in stunted heath in laterite hills between Jurien Bay and Badgingarra during the 1890s and 1900s. In addition, Gilbert recorded a name for this species from Aborigines resident to the north of Perth, as well as one from Aborigines resident in the Perth area (Gould 1865, Whittell 1951).

On the south coast the species was found by George Masters to be plentiful at King George Sound during the 1860s, where he collected several specimens (Ford 1969). A specimen was collected at Torbay by T.P. Draper in 1906 (Western Australian Museum). Whitlock (1914) recorded the species breeding in the Denmark area during the spring of 1912 and 1913. Information from local residents at the time suggested that it had declined in abundance (Whitlock 1914). S.W. Jackson saw one individual that he attempted but failed to collect, near Bow River (approximately 40 km west of Denmark) in October of 1912 (Whittell 1952). Baggs (1953) also recorded the species at Bow River during December of 1952. Other records were made in the Augusta area, at Torbay, and in the William Bay National Park (Watkins 1985). The last definite record west of Albany was at Torbay by A.R. Main who recorded the species there until 1983 (Watkins 1985).

To the east of Albany only one locality was recorded until the 1960s. This was on the eastern most extension of the Mt. Manypeaks range, where Mr. C. Allen received feathers of this species from fishermen that had shot several birds during the 1940s and where they considered it common (Ford 1969). Since the 1960s records from Two Peoples Bay, Cheyne Beach, and Cape Riche have been made (Watkins 1985). In 1965 Garstone (1977) recorded the species from the Cape Arid area and Mr. K. Newbey recorded it from the Fitzgerald River area (Watkins 1985). These two records extended the species range approximately 450 km to the east.

Current

Knowledge of the presence of ground parrots in an area is determined mainly by listening for their calls and by flushing parrots (Watkins 1985; McFarland 1989; Bryant 1991). Since ground parrots call for a limited period and the audibility of their calls is affected by weather conditions (McFarland 1989; Burbidge *et al.* 1989), determination of their absence from an area is not a simple matter. The estimation of ground parrot densities is even more difficult, because it is not known what proportion of the population calls and whether this proportion changes seasonally (Burbidge *et al.* 1989). However, Meredith *et al.* (1984) found that they could obtain consistent estimates of the number of birds calling in an area on consecutive days, suggesting a consistent proportion of birds were calling. They also found that density estimates determined from calling data and flushing data were comparable. Because of the uncertainty of these estimates they should be considered as an index of relative density not actual densities.

Historical records suggest that the current distribution of the ground parrot throughout Australia is more fragmented than it was during early European settlement. In Queensland the northern and southern limits of the species' range have contracted with most of the birds being restricted to Cooloola National Park and Fraser Island (McFarland 1991c). The current population in this State is estimated at 2900 birds with population densities ranging from 0.2-6.7 birds/10 ha (McFarland 1991c). No detailed survey has been conducted in NSW, but the ground parrot appears to be restricted to the Eden-Nadgee area, Barren Grounds and nearby areas and several isolated locations north of Sydney (Meredith 1984). In Barren Grounds the density of ground parrots in suitable habitat is approximately 2.0 birds/10 ha (Jordan 1984). In Victoria the species is now restricted to East Gippsland, Wilsons Promontory and the far south-west of the State (Meredith *et al.* 1984). The population in Victoria was estimated to be around 600 birds with population densities ranging from 0.4-5.0 birds/10 ha (Meredith & Isles 1980). In South Australia the ground parrot probably became extinct in the 1950s (Meredith 1984). The species is still widespread in the south-west of Tasmania, but has declined considerably in the northern and eastern regions including several islands (Bryant 1991). It is estimated that there are around 97 000 birds in Tasmania, with densities of 0.2-5.3 birds/10 ha (Bryant 1991).

Watkins (1985) conducted an extensive survey along the western and southern coasts of Western Australia from Cervantes to Cape Arid National Park and found ground parrots in only two areas, the Fitzgerald River National Park and the Cape Arid National Park. This work and further studies by Burbidge *et al.* (1989) determined that ground parrots are currently restricted to five subpopulations in the northern part of Fitzgerald River National Park and one population in Cape Arid National Park (Watkins & Burbidge 1992) (see Figure 1). The total population of ground parrots in Western Australia was estimated at 378 birds. This estimate was determined using an estimate of the density at one site (Short Road) and extrapolating to all known subpopulations, on the basis of the extent of suitable habitat associated with each of them (Watkins & Burbidge 1992). The estimate of population density for the Short Road subpopulation was 1-2 birds/40 ha, which is an order of magnitude lower than the densities found in eastern populations (Watkins & Burbidge 1992). Only three of the six known subpopulations were estimated to have greater than 50 birds (Watkins & Burbidge 1992). These population estimates in Western Australia are preliminary, because the true boundaries of the five subpopulations are not known and the estimates are based on data from the post-breeding period, when densities would be expected to be higher than prior to breeding.

Mace and Lande (1991) proposed that a species consisting of less than three subpopulations with greater than 125 individuals and with the risk of greater than 50% of the total population being lost in a 5-10 year period, constituted a species in a critical state. These criteria appear to be met for the western ground parrot (because of the risk from wildfires). In addition, the total population size is also extremely low, especially considering the doubts about the estimates by Watkins and Burbidge (1992).

1.3 Breeding Biology

Little is known about the breeding biology of the ground parrot. The major study has been that by McFarland (1988; 1991b) in Queensland, with some observations having been made in New South Wales (Barren Grounds Bird Observatory, unpublished), Victoria (Meredith & Isles 1980) and Tasmania (Bryant 1991).

The breeding season in eastern Australia varies geographically, beginning earlier in northern latitudes (eggs: Queensland, July-November; NSW-Victoria, September-November; Tasmania, October-January) (McFarland 1988). The breeding season in Western Australia is not known clearly. Whitlock (1914) found a nest with three eggs in late November 1913 and one with two young chicks (a few days old) in late October 1912. However, Burbidge *et al.* (1989) found that in 1988, juvenile birds were common by late October. Based on the estimated age of these juveniles, Burbidge *et al.* (1989) suggested that the breeding season commenced at their study site in mid-late winter (June-August). The differences in egg laying found by Whitlock and Burbidge *et al.* suggest that either, the breeding season in Western Australia varies from year to year, or the records by Whitlock represent replacement or second clutches (Burbidge *et al.* 1989). The second possibility is consistent with the fact that Whitlock only searched for nests during spring and so could not have found nests earlier (Whitlock 1914). McFarland (1991b) found no evidence of double clutching in Queensland, but he did observe two cases of females re-nesting after abandoning earlier nests.

The clutch size of the ground parrot varies from two to six eggs with the majority having three or four (McFarland 1988). McFarland (1988) found that clutch size was consistent throughout eastern populations, except for Tasmania which had a higher mean clutch size. The data for Western Australia are limited to the two nests found by Whitlock (1914), which were a brood of two and a clutch of three.

In eastern Australia ground parrot eggs have an incubation period of 21-24 days and are incubated only by the female, which is fed by the male during this period. Chicks are continuously brooded by the female for the first 4 days after hatching and during the night for a further 2 days, and are capable of running by 18 days, though they usually remain in the nest for 24 days (range 18-28 days). After fledging juveniles remain near the nest for at least three weeks, but once they are capable of flying they

follow the adults (McFarland 1991b). No data on the chronology of breeding are available for *P. w. flaviventris*.

Estimates of fledging success from Victoria (56%; Meredith & Isles 1980) and Queensland (57%; McFarland 1991b) are similar and show that less than two thirds of eggs produced fledged young. Meredith and Isles (1980) found that one third of eggs were infertile in Victoria, but the level of infertility was lower (19%) in Queensland (McFarland 1991b). Predation and desertion caused the loss of 15% of eggs in Queensland and just under 10% of chicks died in the nest, all being the youngest and smallest members of the brood (McFarland 1991b). The mean fledging success in Queensland was 1.9 $\pm$ 0.3 fledglings per nest (McFarland 1991b). No data are available on the recruitment rate of juveniles. No aspects of the breeding success of *P. w. flaviventris* have been investigated.

1.4 Dispersal

The pattern of observations on ground parrots in non-breeding areas in Victoria, suggest that post-natal dispersal occurs during February to August (Meredith *et al.* 1984). These observations were in sub-optimal habitats like non-diverse *Juncus* sedgelands and alpine heaths, up to 220 km from the nearest known breeding areas (Meredith *et al.* 1984). Changes in the density of ground parrots in autumn and spring in Queensland and Tasmanian populations are considered to be the result of the autumn dispersal of juveniles and the spring movements of adults and sub-adults searching for breeding vacancies (McFarland 1991c; Bryant 1991). In Queensland these density peaks correspond to peaks in seed availability in most heaths (McFarland 1991c). Based on the failure to recapture banded chicks after four months of age, McFarland (1991d) argued that juveniles either have a high rate of mortality or have dispersed from the natal area by this time. However, this is based on a sample size of only 35 banded chicks of which only eight were recaptured during the first two months.

Little is known about dispersal in Western Australia, but Burbidge *et al.* (1989) found a 75% drop in the number of birds flushed/day between October-November and January-February. They suggested that this reflected the movement of juveniles out of the study area during this period. Movements of 2-3 km were observed in several radio-tracked young birds, in the second week of December (Burbidge *et al.* 1989).

Outside the Fitzgerald River and Cape Arid National Parks, all but three of the recent records (after 1970) of ground parrots were made between October and February, suggesting the possibility that these birds may be dispersing individuals. The three exceptions were those by M. Silberstein in William Bay National Park during June 1973, W. Okell in the Augusta area in mid-September 1980 and the records by A. Main at Torbay from 1971-1983 (Watkins 1985).

1.5 Habitat

The vegetation types used by ground parrots can be broadly characterised as sedgelands, temperate shrub heaths, temperate graminoid heaths or sub-tropical graminoid heaths (Meredith 1984). All have medium to high species richness except sedgelands that are frequently dominated by a single species, and all are similar structurally being low with dense vegetation cover (Table 1). However, all Western Australian sites show much higher plant species richness than any of the eastern Australian sites (Burbidge *et al.* 1989). Currently used sites in Western Australia receive somewhat lower rainfall than any of the eastern Australian sites (Table 1), but areas west of Albany known to have been used by ground parrots in the past have a rainfall (900-ca.1300 mm) comparable to sites used in eastern Australia.

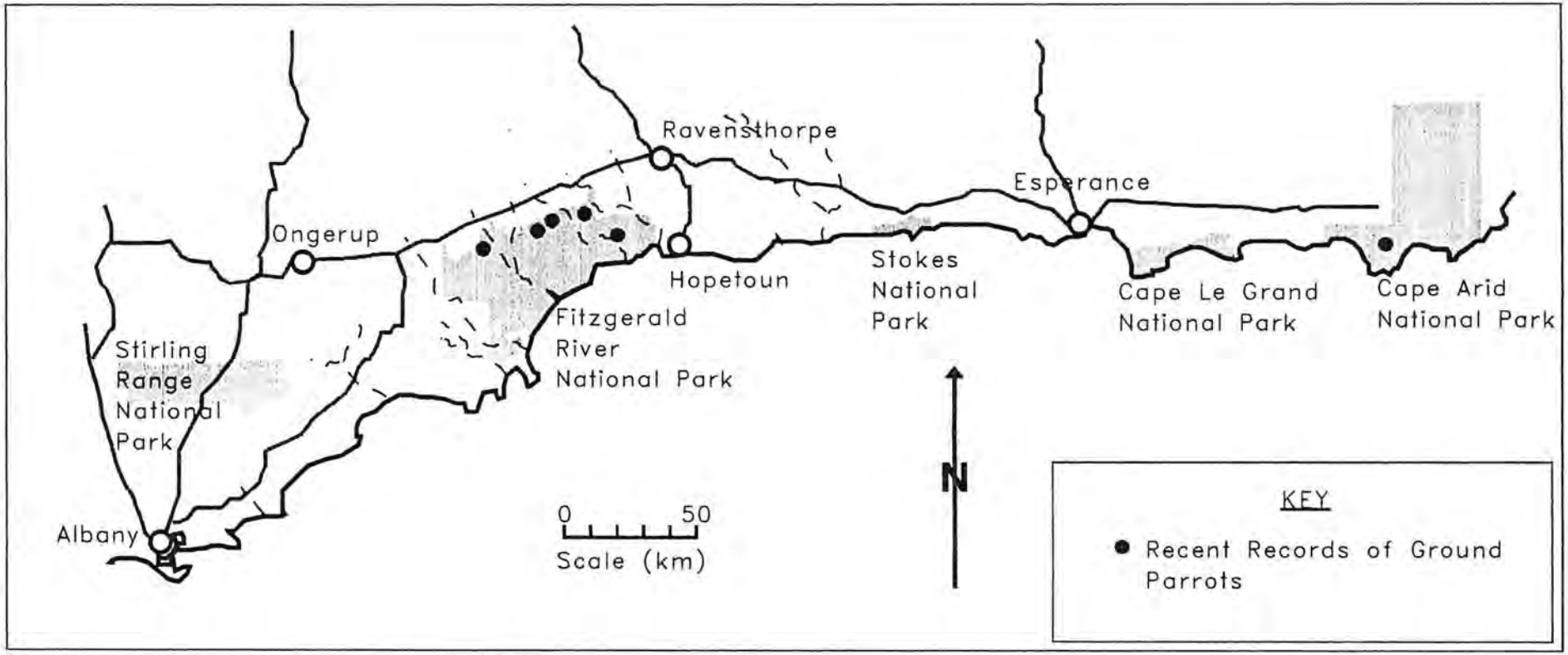

Figure 1: Current distribution of the western ground parrot.

Table 1: Comparison of the climate (including mean annual rainfall) and vegetation communities used by ground parrots in different States of Australia.

State	Vegetation Type	Climate	Structure	Reference
Queensland	Graminoid heaths	Sub-tropical 1420 mm	0.5-2 m high >70% cover	McFarland 1989
Tasmania	Buttongrass Moorlands	Temperate 1600-2800mm	0.3-2.5 m high 30-90% cover	Bryant 1991
Victoria	Coastal heaths & sedgelands	Temperate 800-1200 mm	0.6-1 m high >70% cover	Meredith *et al.* 1984
Western Australia	Heaths	Temperate 400-500 mm	<0.5 m high >50% cover	Burbidge *et al.* 1989, unpubl.

Nest sites

In Queensland, McFarland (1991b) found nests only in the dry heath microhabitat identified in his study area, but these nest sites differed little from the surrounding vegetation with respect to structure and floristics. Nests were always under dense clumps of vegetation dominated by three plant species (*Empodisma minor*, *Xanthorrhoea fulv*a and *Banksia oblongifolia*), but these were not overtly different from other clumps in the heathland (McFarland 1991b). Nests were built on the ground in a dome cavity usually in a sward of *E. minor*, or in a clump of *X. fulva* and/or *B. oblongifolia*. The nest consisted of a scrape in the ground lined with sedge and rush leaves (McFarland 1991b). The nests of *P. w. flaviventris* found by Whitlock (1914) at Wilsons Inlet were both found under clumps of what he described as a prickly "dwarf" *Hakea* sp., and his brief description of their structure is consistent with the description by McFarland (1991b) for Queensland nests.

1.6 Diet

The ground parrot is a granivore, but shows little specialisation in seed preference (McFarland 1991a). In Queensland a total of 40 species of seed were found to be eaten, of which 34 species were identified at least to family. Nineteen were dicotyledonous species (Fabaceae, 6 species and Epacridaceae, 4 species) and 15 were monocotyledonous species (mostly Cyperaceae, 7 species and Restionaceae, 5 species). These 40 species represented 34% of the plant species found in the study area. The seeds taken were restricted in size to 0.6-7 mm, and excluded all seeds that were enclosed in a hard woody fruit (*ie. Petrophile*, *Banksia*, *Leptospermum* and *Hakea* spp.) (McFarland 1991a).

In Victoria 15 species of plant were identified as important food sources (Meredith *et al.* 1984). Of these 8 species belonged to the families Cyperaceae and Restionaceae. In some sedgelands (*Baumea juncea* sedgelands and *Leptocarpus tenax* sedgelands) the dominant species was considered the only available seed source.

In Western Australia 7 species of plant have been identified as food sources for ground parrots, based on observations and feeding evidence at sites where birds were flushed. These species were found in at least 30% and usually in more than 50% of vegetation quadrats (Burbidge *et al.* 1989). Green fruits still on the plants were being eaten from most of these species (Burbidge *et al.* 1989) and the somewhat succulent leaves of *Daviesia pachyphylla* were also observed being eaten (Newbey *et al.* 1983). These very limited observations suggest that ground parrots in Western Australia may be using more green fruit and vegetable material than birds in the east (Burbidge *et al.* 1989); this may be related to the drier nature of the currently used habitats in Western Australia.

1.7 Potential Causes of Decline

Two major factors have been implicated in the decline of ground parrots: clearing and the imposition of unsuitable fire regimes (Meredith *et al.* 1984; McFarland 1989; Watkins & Burbidge 1992; Garnett 1992a,b). Two other factors - predation by introduced predators and the changes in the vegetation brought about through dieback disease caused by fungi (*Phytophthora* spp.) - have been considered as potential threats to the survival of the western ground parrot (Watkins & Burbidge 1992; Garnett 1992a,b).

Response to fire

Investigation of the post-fire age of vegetation used by ground parrots suggests that the preferred fire age differs in different vegetation types (Meredith *et al.* 1984) and geographically (Meredith *et al.* 1984; Watkins 1985; Jordan 1987; McFarland 1989; Burbidge *et al.* 1989; Bryant 1991, 1992). In Queensland, McFarland (1989) found that ground parrot densities were highest in vegetation with a post-fire age of 5-8 years and that densities were lower in vegetation that had not been burnt for 15 years. He had insufficient data to assess the effect of vegetation older than 15 years on ground parrot densities. Jordan (1987) found comparable results at Barren Grounds NSW, with peak ground parrot densities occurring in vegetation 5-6 years post-fire and the absence of the species from vegetation older than 12 years post-fire. In Tasmania, Bryant (1991, 1992) found peak densities in vegetation 4-7 years post-fire, but unlike in other areas, vegetation that had not been burnt for more than 30 years still maintained relatively high densities of ground parrots.

Meredith *et al.* (1984) found that ground parrot density in sedgeland communities in Victoria was not correlated with post-fire age, but in heathland communities it was. The highest densities of ground parrots were found in diverse shrub heaths that had a post-fire age of 4-6 years, but no ground parrots were found in heaths that had not been burnt for 20 or more years. Graminoid heaths showed a different pattern with the highest densities being found in heaths with a post-fire age of 10-15 years, while in most areas that had not been burnt for 18 or more years, no ground parrots were found. They proposed that these observed correlations between ground parrot densities and the post-fire age of the vegetation, reflected a response by the ground parrot to changes in the density and seed production of sedges (a major component of their diet), after a fire.

The use of the correlation between post-fire age of the vegetation and the density of ground parrots in that vegetation has two major problems associated with it. Firstly, correlations do not indicate a cause and effect relationship between the two variables, and for ground parrot densities other factors not directly related to post-fire age of the vegetation, such as minor differences in habitat type or the effects of predators may be producing the observed correlations. The second problem is in determining which sites to include in the analysis. If a site has no ground parrots in it, it should be included in the analysis only if it is known that historically it supported a population of this species, otherwise it will confound the relationship between post-fire age and other factors. How sites used in the above studies were determined is not clear, so it is not possible to assess the reliability of these observed correlations. These problems are highlighted by the ten year study of Baker and Whelan (1992) who demonstrated that populations of ground parrots at a census site in Barren Grounds Nature Reserve did not decline after seven years post-fire in the way predicted from correlation studies (Jordan 1987).

In Western Australia insufficient work has been done to assess accurately the relationship between post-fire age of vegetation and its use by ground parrots. Two observations, however, suggest that the relationship may differ from that suggested for the eastern subspecies. Firstly, birds in the Short Road population at Fitzgerald River National Park, are still present in vegetation that has not been burnt for at least 20 years and possibly as long as 30 years (Burbidge *et al.* 1989). Secondly, in the Cape Arid National Park population, birds appear to be restricted to long unburnt areas and only occasionally utilise an adjacent area of habitat that was six years post-fire (Burbidge *et al.* 1989). Burbidge *et al.* (1989) suggested that the possible preference by *P. w.*

flaviventris for older vegetation than that used by *P. w. wallicus*, may be due to the slower growth rates of the vegetation in areas used by the parrots in Western Australia, due to a lower rainfall.

Care must be taken in interpreting the current information from Western Australia because it is not known how the current densities of ground parrots compare with the carrying capacity of Western Australian heaths. The absence of ground parrots from some areas may be due to insufficient birds to colonise them, as has been found for the western bristlebird at Two Peoples Bay (Smith 1987), rather than some deficiency in the habitat.

Predation

Mattingley (1918) and Edwards (1924) recorded that the ground parrot has a powerful scent that was easily found by dogs, and Mattingley noted that quail shooter's dogs frequently ran down and captured ground parrots. This together with the terrestrial habits of the bird, suggests that the ground parrot could be particularly susceptible to predation by foxes and feral cats. Although there are records of ground parrots being taken by these species (Mattingley 1918; Fletcher 1927; Jordan 1989), there are no data on the level of predation or its effects on populations. McFarland (1989) did not consider predation to be a major problem for ground parrots at densities of predators or parrots normally encountered in Queensland, but stated that they may prevent or slow down the recolonisation of small areas of suitable habitat after fire. No data are available on predation in Western Australia, but due to the very low number of ground parrots in this State, and the known effects of foxes on ground-dwelling mammals (eg Kinnear *et al.* 1988), it must be considered a potential threat.

Influence of Dieback Disease (Phytophthora spp.)

Dieback disease caused by introduced *Phytophthora* spp. has been considered a potential threat to ground parrot populations (Garnett 1992a,b). Work by Wills (in press) on the effects of *Phytophthora cinnamomi* on heath communities in the Stirling Ranges National Park, indicates that the disease causes changes in plant community structure and composition. In heaths in the Stirling Ranges, *Phytophthora* infections are associated with a general decline in total projective foliage cover, due mainly to the loss of many woody perennials. An increase in the cover of sedges (Cyperaceae and Restionaceae) may also occur. Changes in floristic composition were also observed, primarily through a decline in woody perennials of the Proteaceae. Such changes could have adverse effects on ground parrot habitat.

The effect of such changes on ground parrots is unknown and cannot be assessed without better information on the habitat requirements, diet and population densities of *P. w. flaviventris*, as well as better knowledge of the effects of *Phytophthora* in vegetation types used by ground parrots.

1.8 Existing Conservation Measures

In 1988, approximately 100 000 ha of land on the northern boundary of the Fitzgerald River National Park was added to the park (Watkins & Burbidge 1992). This area holds most of the known subpopulations of the western ground parrot. All the known subpopulations of this subspecies are now protected in National Parks (Fitzgerald River National Park and Cape Arid National Park).

Although no specific fire management guidelines have been proposed for the ground parrot, the major subpopulations in the Fitzgerald River National Park occur in several habitat management cells that are protected by wide, open-edged buffers. Within these cells prescribed burning will occur only after assessment of the risk to rare fauna and it will be attempted to keep wildfires confined to a single cell (Moore *et al.* 1991). These management prescriptions provide considerable protection for ground parrots in this National Park. No management plan exists for Cape Arid National Park, but interim guidelines have been produced that identify the area where ground parrots occur and classifies it as a no planned burn area.

Dieback disease caused by *Phytophthora* has been identified as the greatest threat to the Fitzgerald River National Park and management/research prescriptions to reduce the threat of this disease have been implemented (Moore *et al.* 1991). These prescriptions will provide ground parrot habitat with the best available protection from this disease.

A fox baiting program has been initiated in part of the Fitzgerald River National Park, to assess the effects of reducing the numbers of this introduced predator on small mammal populations (Moore *et al.* 1991). The Fitzgerald Track subpopulation of ground parrots is within the baited area and current monitoring of this subpopulation should assist in an assessment of the effect of fox baiting on ground parrots.

Two research programs on the western ground parrot have been completed (Watkins 1985; Burbidge *et al.* 1989). The first funded by the Department of Conservation and Land Management and carried out by the RAOU identified all the currently known populations of the western ground parrot (Watkins 1985). The second project - a joint program between CALM and the World Wildlife Fund (Australia) - provided preliminary information on the habitat preferences and daily movement patterns of western ground parrots (Burbidge *et al.* 1989). In addition to this information the second project found that capturing and radio-tracking western ground parrots was feasible (Burbidge *et al.* 1989). Based on information from both projects Watkins and Burbidge (1992) produced an estimate of the total population numbers for the western ground parrot (see 1.2 for details).

1.9 Research/Management

The current status of the western ground parrot is uncertain but appears to be critical. It is therefore not feasible to follow a recovery schedule of research followed by management, based on the information gained by that research. Management to protect the current areas where ground parrots occur must be initiated immediately after these areas have been identified. This can be done in an interim Recovery Plan that would integrate management and research actions. Initially this management would involve protecting these areas from known or suspected causes of the subspecies' decline, such as fire, predation by introduced predators, dieback disease (*Phytophthora* spp.) and the investigation of the use of manipulative management actions such as translocation. This management would run concurrently with research projects designed to determine the size and population trend and information on the biology and habitat requirements relevant to the management of the subspecies. The management must be flexible enough to allow changes based on the information found by this ongoing research. After a period of five years a Recovery Plan would be prepared based on data produced from the research proposed in this Research Plan.

The research proposed in this plan can be divided into three components: the population survey which will provide baseline data on the population size and distribution of the subspecies; the long term monitoring of the identified subpopulations, that will enable an assessment of the impact of management prescriptions; and finally research into the micro-habitat requirements and population dynamics of the subspecies. If feasible, this final project would be completed in approximately five years, and would provide information on the health of existing subpopulations and criteria for determining areas of habitat where expansion of the population (either natural or through translocation), may be possible.

An understanding of the relationships between and genetic structure of subpopulations are desirable for informed management of a taxon which occurs in such small numbers. However, such studies have not been proposed for the western ground parrot. Capturing ground parrots is expensive (especially when in low densities as in Western Australia) and the probability of obtaining sufficient birds for appropriate genetic analyses is very low. Costs of appropriate genetic analyses are also high and total costs are therefore prohibitive. Furthermore, management action for the western ground parrot is urgently needed and the priority management actions are unlikely to be influenced by the results of genetic investigations. However, all ground parrots which

are caught for research or management reasons should be sampled for genetic material (eg blood) to allow future genetic analyses.

The use of captive breeding as a means of increasing the population of western ground parrots has not been considered in this plan. This is because translocation is considered the most effective use of resources for manipulating population size and subpopulation structure and dispersion. As described in recent guidelines (eg Primate Working Group 1992), captive breeding should only be considered after evaluation of a number of factors, and including a population viability analysis, which is not yet available for ground parrots.

2 Research Objective and Criteria

2.1 Objective

To provide sufficient information on the biology of *P. w. flaviventris* and the influences of potential causes of its decline, to create management prescriptions that will increase its survival chances and increase its total population size.

Because of the critical status of *P. w. flaviventris* the chronology of research and management should not be research followed by management; the urgency of the situation requires that both run concurrently.

2.2 Criteria

The criteria for successfully achieving the objective of this research plan are:

1. The identification, mapping of the boundaries and determination of the relative density of all subpopulations of the western ground parrot.

2. The preparation and implementation of an Interim Recovery Plan that would run for five years.

3. The implementation of a monitoring program to assess changes in the relative density of western ground parrots with changes in post-fire age of their habitat.

4. The determination of the effect of an introduced predator control program on the relative density of western ground parrot subpopulations.

5.* The characterisation of the micro-habitats used by western ground parrots in at least some of the known subpopulations.

6.* The determination of the dietary preferences of western ground parrots and how they change spatially and temporally.

7.* The determination of the breeding success and age structure of each known subpopulation of the western ground parrot.

8. The assessment of the feasibility of using translocation as a management tool for western ground parrots (Dependent on the findings of the population survey).

* Meeting criteria 5,6, and 7 is dependent on the feasibility of the proposed projects, which will be assessed in the first year of their implementation.

3 Research Actions

3.1 Population Survey

3.1.1 Determination of subpopulation boundaries

Watkins and Burbidge (1992) identified five closely associated subpopulations in the Fitzgerald River National Park, and one population in the Cape Arid National Park. Mapping the boundaries of these subpopulations is essential for effective research/management actions to be implemented.

The boundaries of all known subpopulations will be determined by mapping the outer limits of calling birds in each area. Other potential areas in Fitzgerald River National Park and Cape Arid National Park will be investigated and the boundaries of any newly found subpopulations will be mapped. If possible this work will be carried out just prior to and during the breeding season to reduce the chances of erroneous boundaries being determined due to dispersing juveniles. Because parts of Fitzgerald River National Park are periodically closed to prevent the spread of dieback disease, the exact timing of these censuses will be determined by when access to the subpopulations is possible. The initial determination of boundaries will be completed in one year, but two yearly monitoring of subpopulation boundaries should be conducted as part of an assessment of the trend in the population size of the subspecies and for assessing their response to changing post-fire age (see 3.3) and predator control (see 3.4).

Additional censusing after juveniles have fledged may identify areas used by ground parrots as temporary habitats. This will be valuable in identifying areas that with management may become suitable for the expansion of the subspecies. It will also provide information on the dispersal behaviour of the subspecies. The feasibility of finding such areas if they exist is not known, so a yearly review of this additional censusing should be carried out to assess whether it should be continued.

Mapping of boundaries will occur concurrently with determination of relative abundance, and so costs are included in that section.

3.1.2 Determination of relative density for subpopulations

Once the boundaries of all subpopulations are identified, estimates of the density of birds within each subpopulation are needed to determine the status of the subspecies and to assess the trend in population size with time.

It is probably not possible to get reliable estimates of the density of western ground parrots (Watkins & Burbidge 1992). However, an index of relative density can be determined by censusing the number of calling birds (Watkins & Burbidge 1992). This technique requires that several assumptions be made about the proportion of the population that calls and whether this proportion is constant. In Victoria, Meredith *et al.* (1984) found that estimates based on calling birds were consistent from one census to another and that they were comparable with estimates made from flush rate data. These estimates should therefore be a reliable index of the relative density of birds in an area and it is the technique that will be used in this program.

Another problem with this census work is that ground parrots call for only a limited period (approximately 90 minutes) before dawn and after dusk. This means that a large number of field days are required to accumulate sufficient information for accurate measures of relative density.

The censuses of calling birds will be conducted concurrently with the mapping of subpopulation boundaries. As with the boundary mapping project assessment of changes in relative density after juveniles have fledged will provide valuable information on population dynamics.

Mapping and censusing will require four persons for four months, vehicle usage and on-site accommodation for this period, miscellaneous consumables including aerial photographs, together with supervisory and administrative costs.

Cost:	1993
CALM	4000
Other	54000
Total Cost	58000

3.2 Interim Recovery Plan

Because of the estimated low numbers of western ground parrots and the uncertainty of these estimates it is essential that some interim management prescriptions are implemented as soon as possible. The purpose of these management prescriptions will be to reduce the chances of the remaining subpopulations suffering declines and allow scope for the natural expansion of these subpopulations. For each subpopulation, these prescriptions will address fire protection, possible introduced predator control, hygiene prescriptions for *Phytophthora* spp., the use of manipulative management (translocation), and any other issues relevant to the specific areas.

The Fitzgerald River National Park Management Plan (Moore *et al.* 1991) already has general prescriptions relating to these issues and has included scope for specific management of areas for the endangered flora and fauna that occur there. Cape Arid National Park does not have a management plan, but interim guidelines for the park's management have been written and these do consider issues relevant to the management of ground parrots in the park. It will be the purpose of this interim Recovery Plan to integrate the requirements of the ground parrot with the management planned for both parks and the research proposed in this report.

The interim Recovery Plan will run for five years during which time an assessment of the population trend of the subspecies could be made (see 3.1), collection of data on the subspecies' habitat requirements and population dynamics (see 3.5) will be completed, and preliminary data on the subspecies' response to changing post-fire age (see 3.3) and reduced predation by introduced predators (see 3.4) will be available. The interim Recovery Plan will also implement a program for investigating the use of more manipulative management prescriptions such as translocation (see 3.6).

Costs include the time of CALM regional and research staff, travel between Perth and regional centres concerned, travel allowance and production of a written plan. Other than translocation, implementation is not likely to result in new costs, as the purpose of the interim plan is to direct and guide present management until research findings are assessed and resultant recommendations can be implemented.

Cost:	1993	1994
CALM		9000
Other		--
Total Cost		9000

3.3 Response to Fire

Fire has been identified as the major threat to the survival of *P. w. wallicus* (Meredith *et al.* 1984, McFarland 1989). Preliminary data for *P. w. flaviventris* suggest that it is also a major threat to this subspecies, but that its post-fire age requirements may differ from those of *P. w. wallicus*.

Determining the age after fire at which vegetation becomes suitable for ground parrots and the length of time for which it remains suitable is essential for the proper long term management of the species. In the eastern states this has been assessed by determining the correlation between the fire age of many areas and the relative density of ground parrots in those areas (see 1.7). This is not possible for *P. w. flaviventris*,

because there are insufficient subpopulations to assess this correlation. Monitoring changes in the relative density of the current subpopulations with increasing post-fire age and determining the post-fire ages at which vegetation is colonised by *P. w. flaviventris* is the only feasible means of gaining information on the post-fire age requirements of this subspecies.

3.3.1 Monitoring changes in relative density with changing post-fire age

All known subpopulations of the western ground parrot will be monitored every two years to establish the current boundaries of the subpopulations and the relative density of ground parrots within each (see 3.1). For logistic reasons, censuses of the Cape Arid National Park subpopulation will be done in alternate years to the censusing of the Fitzgerald River National Park subpopulations. In addition, monitoring of areas where ground parrots were known to have occurred previously or that contain vegetation similar to that in areas where ground parrots currently occur, will also be carried out to determine at what post-fire age they are used by ground parrots.

One of these additional sites will be the part of the Short Road subpopulation in the Fitzgerald River National Park that was burnt in the 1989 fire (Moore *et al.* 1991). Vegetation plots have already been established in the burnt and unburnt areas of this subpopulation. Structural and floristic changes in the vegetation will be monitored every year in these plots and in similar plots established in each of the monitored areas, to determine the vegetation's response to fire. Another area where ground parrots are not currently resident that will be included in this monitoring is an area of vegetation that has not been burnt for six years in the Cape Arid National Park, where ground parrots have been observed foraging by Burbidge *et al.* (1989). Further areas in both National Parks will also be found for this project including, if possible, areas that are isolated from existing subpopulations. This would enable an assessment of the effects of isolation on recolonisation.

Costs include employment of four temporary consultants for three months to census birds in Fitzgerald River National Park and one month in Cape Arid National Park, plus vehicle, on-site accommodation and consumable costs. Costs vary between years because sampling occurs in Cape Arid National Park and Fitzgerald River National Park in alternate years. A botanist is required for one month each year, together with vehicle, on-site accommodation and consumable costs.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
a) Monitoring										
CALM	--	2000	2000	2000	2000	2000	2000	2000	2000	4000
Other	--	41000	17000	41000	17000	41000	17000	41000	17000	41000
b) Vegetation sampling										
CALM	--	1000	1000	1000	1000	1000	1000	1000	1000	6000
Other	--	5000	5000	5000	5000	5000	5000	5000	5000	5000
Total Cost	--	49000	25000	49000	25000	49000	25000	49000	25000	56000

3.4 Predation by Introduced Predators

Ground parrots are ground breeding and foraging birds that may have a strong scent. This suggests that introduced predators such as foxes and cats could be a threat to the survival of this species. Kinnear (1991) has argued that the only way to investigate effectively the impact of a predator on a species is to remove the alleged predator and monitor the response of the species in question. This approach has the added advantage that it is the management action that will eventually be implemented if these predators are found to threaten the species and so will have immediate beneficial effects on the study population.

A 1080 baiting program to control foxes has been implemented in one half of the Fitzgerald River National Park. This baited area contains one of the four main subpopulations (Fitzgerald Track subpopulation) of ground parrots in the park and so

provides an opportunity to investigate the impact of fox control on ground parrot populations. One potential problem of such programs is that feral cats may not be controlled and may increase in numbers (J. Short[1] *personal communication*, J.A. Friend[2] *personal communication*), at least in arid areas where vegetation density is low. Since feral cat numbers are not being monitored at present, this cannot be assessed in Fitzgerald River National Park.

All subpopulations within the park will be monitored regularly with respect to the boundaries of the subpopulations and their relative density for an assessment of the effects of fire on this subspecies (see 3.3). These data can be used to assess the effects of the 1080 baiting program. In addition, fox numbers are being monitored (by J. Kinnear) to determine the effectiveness of the baiting program. The costs of monitoring ground parrots are outlined in section 3.3 and the fox baiting is currently being done under other funding. The proposed interim recovery plan (3.2) will address this question further in the light of the preliminary results from the baiting program.

The problem with this method of assessing the influence of predators is that the influence of other factors that are also changing in these populations (*ie* increasing post-fire age) and differences in subpopulations cannot be separated from the effects of predators. Replication of baited and unbaited subpopulations will help to alleviate some of these problems, but there are currently insufficient subpopulations of this subspecies for replication to be used effectively.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
a) Monitoring										
CALM	**CALM CONTRIBUTION TO FOX CONTROL ***									
Other	See section 3.3									
b) Vegetation sampling										
CALM	See section 3.3									
Other	"									
Total Cost										

* Current input to the experimental fox baiting in Fitzgerald River National Park is about $19000 per year, about 70% of which is from external sources. Current monitoring is concerned with threatened mammal species.

3.5 Micro-habitat Requirements and Population Dynamics

The projects proposed in this section will be carried out by a single person employed full time for this purpose, with additional help for limited periods of time. Since these projects are integrated, they have a number of overlapping costs. These are detailed in the first project (3.5.1) and the costings detailed under the other projects includes only additional expenses unique to that project.

The feasibility of the projects proposed in this section is not known and each will be assessed after the first year to determine if they should be continued.

3.5.1 Micro-habitat requirements

Information on which micro-habitats within a heathland are used by breeding western ground parrots, how this changes with time (daily and seasonally) and the size of an individual's home range will enable better interpretation of this subspecies' response to fire and better formulation of criteria for assessing the suitability of vegetation not currently used by this subspecies.

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1 Dr J. Short, CSIRO Division of Wildlife and Ecology, LMB No 4, Midland, WA 6056.

2 Dr J.A. Friend, Dept CALM, WA Wildlife Research Centre, PO Box 51, Wanneroo, WA 6065.

Radio-tracking work by McFarland (1991a) on *P. w. wallicus* in Queensland and that by Burbidge *et al.* (1989) on thirteen *P. w. flaviventris* (3 adults and 10 juveniles) from the Short Road subpopulation, show that this technique can be used successfully to determine micro-habitat use by ground parrots.

One potential problem in using this technique for *P. w. flaviventris* still needs to be assessed. The majority of individuals caught by Burbidge *et al.* (1989) were juveniles and no birds were caught in the last three week field trip possibly due to a change in behaviour of juvenile birds or dispersal of birds away from the site. Because of this it is still not certain whether adult *P. w. flaviventris* can be caught in sufficient numbers for an adequate assessment of micro-habitat requirements to be made. McFarland (1991d) found that two capture techniques - using a group of people to flush birds into mist-nets and catching flying birds at dusk in mist-nets - produced similar catch rates of around 10 birds/100 net hours (one net hour equals one standard mist-net set for one hour). McFarland found that he could increase the catching rate of the first technique by placing nets around nests, but his catch rate of 92 birds/100 net hours for this technique did not consider the time required to find the nests. Given that population densities of *P. w. flaviventris* are estimated to be an order of magnitude lower than in Queensland (Watkins & Burbidge 1992), where McFarland conducted his study, an estimated catch rate in the order of 1 bird/100 net hours would appear likely for current *P. w. flaviventris* subpopulations. Though Burbidge *et al.* (1989) did not determine catch rates directly, an estimated catch rate from their data appears to be of this order of magnitude. This indicates the large effort involved in capturing sufficient birds for research purposes. The feasibility of capturing sufficient adult birds to do this study needs to be assessed after the first year of the project.

The radio-tracking project conducted by Burbidge *et al.* (1989) will be repeated at different times of the year to assess the micro-habitat requirements of *P. w. flaviventris*. This project includes vegetation sampling at sites identified as areas used by ground parrots from the radio-tracking data. This sampling will be included with the sampling of fixed plots proposed in 3.3 and will attempt to classify the vegetation both structurally and floristically and determine the relative level of seed availability in the sites.

For capture and radio-tracking, costs include employment of one full-time consultant zoologist, vehicle usage, travel/camping expenses, consumables (including radio transmitters), supervision and administration. Several assistants will also be required for particular periods (total of three months each). Vegetation sampling requires a consultant botanist for two months, vehicle usage, travel/camping expenses, consumables, supervision and some assistance and administration.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
a) capture & radio-tracking.										
CALM	5000	5000	5000	5000	5000					
Other	72000	72000	72000	72000	72000					
b) vegetation sampling.										
CALM	2000	2000	2000	2000	8000					
Other	9000	9000	9000	9000	9000					
Total Cost	88000	88000	88000	88000	94000					

3.5.2 Diet

Information on which seed types are used by *P. w. flaviventris* and how the use of different seed types differs both seasonally and within different vegetation types will provide valuable information that will help in the interpretation of the subspecies'

response to fire and their micro-habitat use. It could also be of value in determining the effects of vegetation changes caused by *Phytophthora*.

McFarland (1991a) found that flushing crops with a warm saline solution was the most effective way of obtaining dietary information for ground parrots. Meredith *et al.* (1984) used an emetic (Ipecac) to obtain crop samples. Neither report on whether these techniques caused any fatalities, but the literature suggests that saline flushing is probably the safest of the two methods (see Ford *et al.* 1982). Burbidge *et al.* (1989) searched sites where birds had been flushed for evidence of foraging and this proved successful, though it may be biased toward seed plants that are already known to be part of the species' diet and/or which show obvious signs of foraging (D. Watkins[3] *personal communication*).

A combination of crop samples taken by the flushing method, from birds caught for radio-tracking purposes (3.5.1) and searches of areas where birds are flushed or recorded by radio-tracking, for evidence of foraging, will be used to determine the diet of *P. w. flaviventris*. Reference seed samples will be collected from all potential food plants during the vegetation sampling of micro-habitats (see 3.5.1).

Because the birds used in this project would be those obtained for studying micro-habitat requirements it would only be done if project 3.5.1 was feasible.

Costs include miscellaneous consumables, as well as assistance to and supervision of a consultant biologist.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	1000	1000	1000	1000	2000					
Other	1000	1000	1000	1000	2000					
Total Cost	2000	2000	2000	2000	4000					

3.5.3 Breeding success

Determination of the breeding success of each subpopulation of western ground parrot will provide information on the health of each subpopulation, the suitability of the habitat and some factors that may be affecting the growth of each subpopulation.

Nests found in each subpopulation will be monitored to determine the clutch size, hatching success rate and causes of failure, and the fledging success rate. Human interference of nests may increase the chances of predation (Major 1990), so monitoring will be kept to minimal levels to prevent this problem. This sort of information has been successfully collected by Meredith and Isles (1980) and McFarland (1991a), but the population densities of ground parrots in their study areas were much higher than that found in Western Australia and it is not known whether sufficient nests can be found to determine reliable estimates of breeding success. Because of this the feasibility of this project should be assessed after the first year.

Costs are covered in the micro-habitat assessment above (3.5.1) as this work can be done concurrently with capture and radio-tracking.

3.5.4 Age structure

The proposed study on the breeding success of western ground parrots will provide information on the number of juveniles produced in each subpopulation, but it will not answer the question of how many juveniles are recruited into the subpopulations. This question is very difficult to answer in a species where birds are rarely seen and recapture rates of banded birds are completely unknown, but expected to be low. Determining the age structure of the subpopulations can provide some indirect information on recruitment rates.

McFarland (1991d) found that a combination of plumage characters and iris colour could be used to place birds into four age classes: chicks, juveniles (1-4 months),

3 Mr D. Watkins, 13 Marian Street, Leederville, WA 6007.

sub-adults (4-12 months) and adults (2+ years) (no data were available on 12-24 month old birds). He found that only those in the adult age class bred. Burbidge *et al.* (1989) observed differences in iris colour between juveniles and adults caught, but had insufficient birds to evaluate whether the patterns observed by McFarland also occurred in *P. w. flaviventris*.

An assessment of whether the patterns found by McFarland (1991d) occur in *P. w. flaviventris* will be made from birds caught for the determination of micro-habitat requirements (3.5.1), and if age classes can be observed the age structure of the subpopulations will be determined. Costs of this project are encompassed by the micro-habitat project because birds are being captured for that project.

3.6 Translocation

Given the restricted distribution of the western ground parrot and the fragmented nature of areas that may be suitable habitat for this subspecies, translocation must be considered an important management tool for enabling the expansion of western ground parrot populations. However, the current level of knowledge about the population size is insufficient to assess the impact that removing individuals from these subpopulations will have on their persistence. This must be known before the use of translocation as a management tool can be investigated.

After the initial survey of all known subpopulations of the western ground parrot (3.1) has been made, an informed assessment of the impact of removing individuals for a pilot translocation program will be possible. At this time a program for implementing a translocation will be prepared as part of the interim Recovery Plan. This program will address when a translocation would be attempted, where the new population would be established and the methods that would be employed to carry out the translocation.

Costs of translocation are expected to include the cost of employing four people for three months ($40 000), two vehicles for this period ($3 000), accommodation and other field expenses at capture and translocation sites (say $5 000) and miscellaneous consumables ($2 000). Research related to the translocation will include costs of monitoring the parent population (covered in section 3.3.1 above), selection of a suitable translocation site (including vegetation analysis) (botanist and zoologist for two months plus vehicle, etc, $20 000), radio-tracking and monitoring of the translocated population (two people for four months plus vehicle, etc, $30 000). This comes to a total of $100 000. More accurate costs will be produced in the interim Recovery Plan.

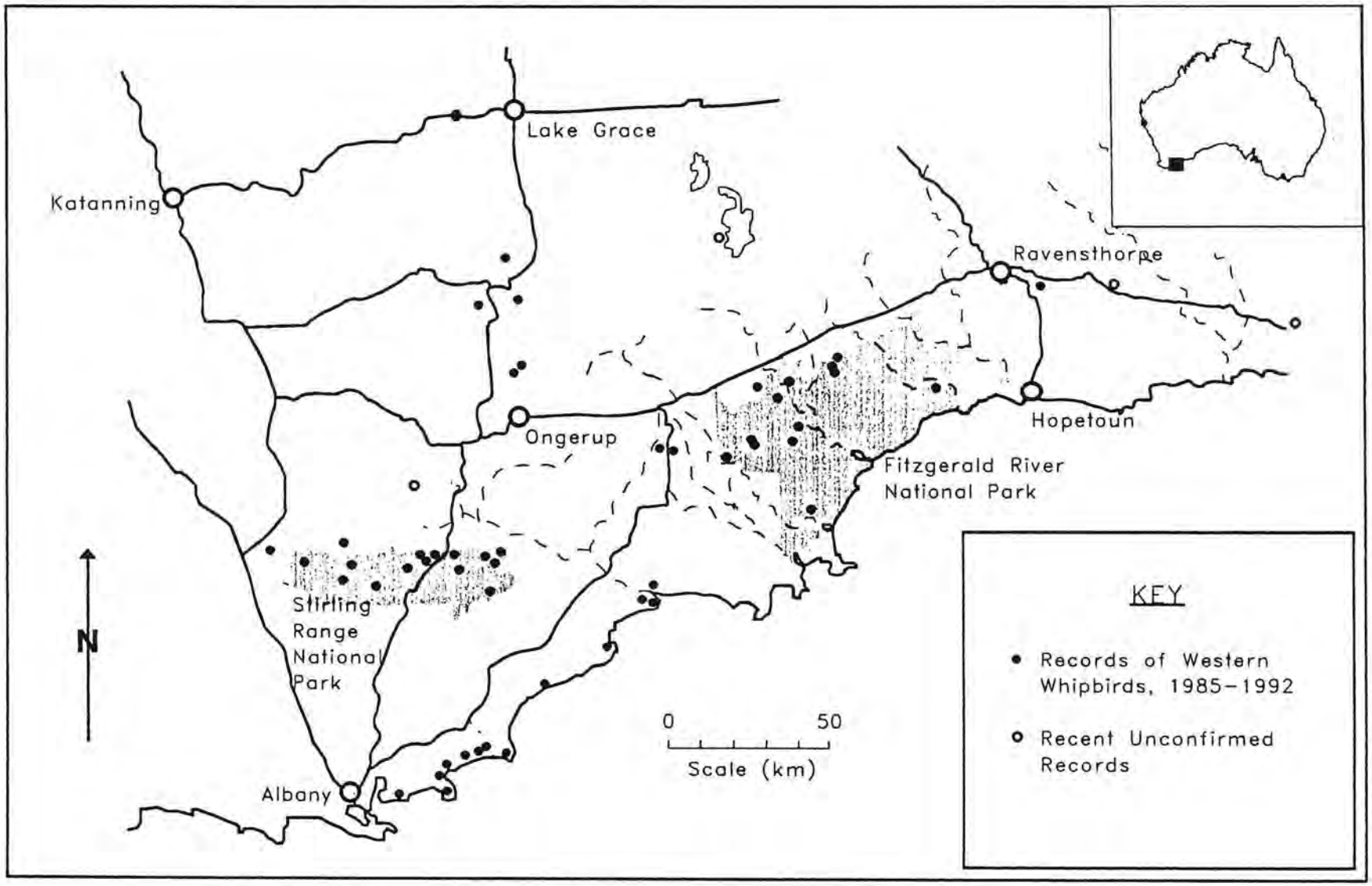

Figure 2: Current distribution of the western whipbird in Western Australia.

Western Whipbird
Psophodes nigrogularis Gould

1 Introduction

1.1 Taxonomy and Status

The western whipbird is a member of the Australian endemic genus *Psophodes* that contains four species *P. nigrogularis*, *P. olivaceus*, *P. cristatus*, and *P. occidentalis* (Blakers *et al.* 1984). It was first heard by Gilbert in September 1842 near Wongan Hills (Milligan 1904) and described by Gould in 1844 from a single specimen collected by Gilbert in the south-west of Western Australia (North 1904). Howe and Ross (1933) described the discovery of the species in Victoria and identified it as *P. n. leucogaster*. Condon (1966) described *P. n. pondalowiensis*, named after the area in which it was found on Yorke Peninsula in South Australia.

A recent taxonomic review based on morphometric and plumage characteristics of the western whipbird by Schodde and Mason (1991), identified four subspecies: *P. n. nigrogularis* Gould, and *P. n. oberon* Schodde and Mason, in Western Australia; *P. n. lashmari* Schodde and Mason, on Kangaroo Island, South Australia and *P. n. leucogaster* Howe and Ross, on mainland South Australia and Victoria (includes *P. n. pondalowiensis* Condon). Schodde and Mason (1991) considered the subspecies formed two groups of populations. One group, comprising *P. n. nigrogularis*, consists of small plain olive-grey birds with dull banded tails which tend to be sexually dimorphic on the belly. The other, represented by the other three subspecies, includes birds that are larger, greyer and whiter-bellied with brighter bands on their tail. They refer to this second group as the *leucogaster* group. Most of the specimens measured by Schodde and Mason (1991) were also measured by Condon (1966) and in several cases the results differ. There is a need for further clarification of sub-specific taxonomy of Western Australian populations.

King (1979) lists the western whipbird as out of danger, considering *P. n. leucogaster* (then believed to be restricted to areas of the Murray Mallee), as rare and the other two subspecies (*P. n. nigrogularis* and *P. n. pondalowiensis*) as moderately common.

Garnett (1992a,b) based his assessment on the taxonomy proposed by Schodde and Mason (1991) and considered *P. n. nigrogularis* as endangered, *P. n. leucogaster* as vulnerable and the other two subspecies (*P. n. lashmari* and *P. n. oberon*) as rare. On Garnett's (1992b) priority list for threatened birds of Australia and its territories *P. n. nigrogularis* is listed at number 9 and *P. n. leucogaster* at number 17. Garnett (1992a,b) classified *P. n. oberon* as rare, but given that only two populations are believed to contain more than 125 individuals, it should be classified as endangered.

1.2 Distribution and Abundance

Historical

The western whipbird was known only from Western Australia until 1933 when Howe and Ross (1933) discovered it at Manya in Victoria. Since then its eastern distribution has been found to include a number of fragmented populations on mainland South Australia, Kangaroo Island and far western Victoria (Condon 1966, 1968; Schodde & Mason 1991).

In Western Australia the historical records of this species indicate that on the coast it occurred as far north as Perth, where Gilbert recorded it in coastal sand dunes (Gould 1865, Whittell 1951), but it has not been recorded in the area since (McNee 1986). No records of this species appear to have been made between Perth and Bunbury,

although two eggs collected by J. Harris in 1898 were from "near Bunbury" (North 1901-1914). The species was first recorded in the extreme south-west by Gilbert in the 1840s in the Vasse and Augusta areas (Whittell 1951). Milligan (1902) collected the species nearby in the Cape Mentelle-Margaret River area and it was seen and heard by Carter (1904) at Ellensbrook in 1902, but was no longer in the area in 1921 (Ashby 1921; Carter 1921). Only one record of the species has been made between Augusta and Albany, that by S.W. Jackson who saw and heard the bird near the Bow River (approximately 40 km west of Denmark) in 1912 (Whittell 1952).

George Masters collected eight specimens from King George Sound in 1868, the exact locations of which are not known (Whittell 1939). He was known to have worked an extensive area around King George Sound inland as far as the Pallinup River (Whittell 1939). No further records for this area were made for almost 100 years, until 1962 when Mr. H. Webster recorded the species at Two Peoples Bay (McNee 1986) and Chisholm (1963) recorded a bird tending its young on a sandhill east of Albany. The known distribution of the species along the coast east of Albany was slowly extended to Hopetoun where it was first recorded in 1974 (Robinson 1975; McNee 1986).

The only historical record of the western whipbird in northern inland areas is that by Gilbert at Wongan Hills in 1842 (Milligan 1904). The species had apparently disappeared from this area by 1903 (Milligan 1904; Orton 1918). The western whipbird was unknown in southern inland areas until 1929, when Mr. H. Collins collected feathers and eggs from a nest at Ongerup, which were identified by the National Museum of Victoria as belonging to this species (Howe & Ross 1933). In 1938 Mr. E.G. Watts made several records of the bird breeding at Gnowangerup to the west and a specimen was collected a year later by Whittell (1939). Lindgren (1958) recorded the species further east (64 km W of Ravensthorpe on the Ongerup to Ravensthorpe road) in 1957. The known distribution in southern inland areas was slowly increased through the 1960s and 1970s to extend north-east to Beenong 25 km NE of Lake Grace, north-west to Nyabing, south-west to the Stirling Range (Sedgwick 1964) and Kamballup and south-east to the coast (McNee 1986). No historical records of the species were made in the inland regions between the northern extent of this southern area and the record at Wongan Hills, except a record by Mr. C. Towers 25 km NW of Corrigin in 1977. He had lived in the area since 1966 and had not seen a similar bird before or after this sighting (McNee 1986).

The historical records of the western whipbird in Western Australia are fragmented both spatially and temporally, making assessment of historical distribution difficult to determine. For example, the species was considered to be probably extinct in the 1926 Checklist of Birds of Australia (Wolstenholme 1926), as only a handful of scattered records were known at that time. In fact, no records of the species were made in the Albany region for almost one hundred years after it was collected there by George Masters and the species was not recorded in southern inland areas until 1929, despite several eminent ornithologists who were familiar with the bird having investigated or lived in areas where western whipbirds were later found (Stirling Range, Milligan 1903; Whitlock 1911; Broomehill, Carter 1921; and Lake Grace, Carnaby 1933). This suggests that the historical records for this species are unreliable for determining the extent of the species' distribution during the period of early European settlement.

Current

Information on the current distribution of *P. n. leucogaster* shows that it has disappeared from several areas, but is still distributed widely in scattered populations in southern South Australia and north-western Victoria (Woinarski *et al.* 1988; Garnett 1992a). Little is known about the current size of the remaining populations, except those in the Murray Mallee region where they are considered rare even within their restricted distribution (Woinarski *et al.* 1988).

The Kangaroo Island subspecies *P. n. lashmari* is still found in several localities along the northern coast and at four locations (Flinders Chase National Park, Vivonne Bay, Cape Gantheaume Conservation Park and Dudley Peninsula) on the south coast. No estimates of the population sizes in these areas have been reported (Garnett 1992a).

The current distribution of the western whipbird in Western Australia (Fig. 2) is based on an extensive survey by McNee (1986) and several records reported since that survey. The survey by McNee encompassed an area from Albany to Cape Arid National Park and inland as far as Lake Grace. The species has not been recorded outside this region since 1912 (McNee 1986). McNee's (1986) survey and other more recent records (M. Graham[4] *personal communication*) show that the species is still present throughout the survey area, but has been lost from some historical localities mainly due to these areas being cleared for agriculture. Cody (1991) recorded the species east of Munglinup which, if confirmed, is an extension of the species' range to the east by approximately 100 km. The western whipbird has recently been recorded by R. Vervest at Sukey Hill just east of Cranbrook and this record is the current western limit of the species' distribution (Anon. 1992).

Population sizes were not determined by McNee (1986), but based on the number of sites where birds were found and the number of birds heard in an area she estimated that they were most abundant at Two Peoples Bay, Beaufort Inlet, Fitzgerald River National Park and the southern Ravensthorpe Range. McNee (1986) spent insufficient time at Cape Riche and the Stirling Range National Park to determine the relative density of western whipbirds in these areas. Recent work in the Stirling Range National Park showed that western whipbirds are widely distributed throughout the park with approximately 50 singing birds recorded prior to a fire that in 1991 burnt out several areas where this species had been recorded (A. Rose[5] *personal communication*). Studies by Smith (1991) at Two Peoples Bay found that the population of western whipbirds on this reserve increased from approximately 70 pairs in 1970 to approximately 100 pairs in 1982 (based on the number of singing birds), due to an increase in the area of available habitat.

The limits of distribution of the two subspecies *P. n. nigrogularis* and *P. n. oberon* have not been confirmed, but Schodde and Mason (1991) proposed that *P. n. nigrogularis* occurred along the coast from Perth to Two Peoples Bay, while *P. n. oberon* occurred in inland areas and south coastal areas east of Two Peoples Bay. Smith (1991) considered the Mt. Manypeaks population as being *P. n. nigrogularis*. Based on these assessments the area of potential contact between these two subspecies appears to be from Mt. Manypeaks north to the Stirling Range and east to Cape Riche. This area has not been surveyed extensively, but western whipbirds were recorded at Warriup Hill (near the coast between Mt. Manypeaks and Cape Riche) in 1978 (T.E. Bush RAOU Bird Atlas Record) and in the same general area in 1992 (A. Rose[5] *personal communication*).

1.3 Breeding Biology

Western Whipbirds were found by Smith (1991) to have pair bonds that generally lasted longer than one year, but he had insufficient data to determine the usual length of bonding. The longest recorded pair bond was four years by a single pair. Both members of this pair bonded with other birds in the fifth year. These pairs spent most of their time together, rarely separating by more than 50 m (Smith 1991).

The breeding season may vary between Western Australian populations and those in South Australia and Victoria. Based on 15 nests from Two Peoples Bay, Smith (1991) concluded that eggs were laid between mid-July and early September with most being laid in early August. This was a similar period to that recorded by Whittell (1939) in the Gnowangerup area of Western Australia, but earlier than that recorded in South Australia and Victoria where eggs were only found in September (Howe & Ross 1933; Bryant 1938; Howe & Burgess 1942). However, the clutch found by J. Harris near Bunbury in 1898 was collected in December (North 1901-1914).

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4 Mr M. Graham, Dept CALM, 56 Clive Street, Katanning, 6317.

5 Mr A. Rose, Dept CALM, Stirling Range National Park, c/- 44 Serpentine Road, Albany, 6330.

Smith (1991) found clutch size to be exclusively two at Two Peoples Bay, which is consistent with the findings from other areas (Howe & Ross 1933; Whittell 1939). Incubation takes a minimum of 21 days, during which both the male and female incubate the eggs (Smith 1991). Brooding increases from 68% of the time during the first half of incubation to 84% during the second half, with the female brooding for longer than the male and apparently brooding exclusively during the night. Chicks are brooded for 77% of the time during the first two days after hatching and for correspondingly less time from then until fledging at 10-12 days old, when no brooding occurs at all. Newly fledged chicks are capable of running, but not flying. The recently fledged chicks are not very mobile and are left by the adults in dense vegetation while they forage close by, but as they grow they accompany the adults when foraging. Juveniles are fed by the adults for at least the first two months and do not appear to disperse until the next year. The latest time juveniles were seen with their parents was January (Smith 1991).

Smith (1991) found that of 30 eggs only 6 failed to hatch (two complete clutches and two eggs from two other clutches). Of the 24 nestlings 11 failed to fledge for unknown reasons, but possibly due to predation by *Varanus rosenbergii* following the observer's trail to the nests. The productivity of these nests was 0.85 fledglings/nest, but Smith (1991) believed it could have been as high as 1.45 fledglings/nest without his intrusions. No productivity estimates have been determined elsewhere, but of six nests recorded by Howe and Ross (1933) three were found with broken eggs.

1.4 Dispersal

Almost nothing is known about the dispersal abilities of the western whipbird. At Two Peoples Bay, juvenile dispersal appears to occur just prior to the beginning of the next breeding season and one of several fledglings banded in 1976 was found again approximately 1 km away (G. Smith[6] *personal communication*). McNee (1986) records that western whipbirds were found to have established themselves in a reserve near Ongerup, where they had not been recorded previously. The nearest known source of western whipbirds was 4.5 km away. She does not report the degree of connectivity between these two sites.

1.5 Habitat

Smith (1991) found that western whipbird pairs live in home ranges varying in size from 10 to 19 ha with a core area, defined as the area where >60% of observations were made, ranging from 1.5 to 2.4 ha. These core areas were in thicket vegetation below outcrops or in the gullies and were held by the same pair from one year to the next. Home ranges were found to overlap considerably, with adjacent pairs generally being able to use these overlap areas without agonistic encounters. Agonistic encounters did occur, however, increasing in frequency from May to a peak in August and September. The intensity of agonistic encounters varied from both pairs calling from within 20 m of each other to the males chasing each other while calling frequently (Smith 1991).

The vegetation used by western whipbirds has been well described in most areas of its range (Condon 1966; Hunt & Kenyon 1970; McNee 1986; Woinarski *et al.* 1988; Smith 1991). In South Australia and Victoria they are found in a variety of vegetation communities with no apparent floristic component in common, but which could be described broadly as open mallee 3-5 m high, with a dense shrubby understorey 1.5-2 m high (Woinarski *et al.* 1988). McNee (1986) found *P. n. oberon* populations in similar vegetation of open mallee (10-30% cover) that was sometimes in dense thickets, with a dense shrub understorey either in the 1-1.5 m height range (16 of 22 sites) or the 0.5-1 m height range (6 of 22 sites).

At Two Peoples Bay, Smith (1991) found *P. n. nigrogularis* in vegetation communities ranging from heath to low eucalypt forest. However, 87% of records were in either thicket associations or in the ecotone between low eucalypt forest and heath, which is structurally similar to thicket. These associations are two layered formations with a canopy 2-3 m high (up to 5 m in wetter areas) dominated by a variety of *Hakea*

spp., *Eucalyptus* spp. and other species, with a dense to mid-dense understorey composed primarily of *Anarthria* spp., *Restio* spp. and small shrubs (Smith 1991).

A comparison of the vegetation used by the western whipbird throughout its range suggests that structure is the most important factor determining the suitability of the vegetation. They require a dense to mid-dense understorey of shrubs, sedges or tussock grasses, with a low open to mid-dense canopy.

Nest sites

In the Murray Mallee of south-eastern Australia, nests have been found in clumps of *Triodia irritans*, *Melaleuca uncinata*, *Xanthorrhoea* sp. or a species of "sword grass" 10-50 cm above the ground (Howe and Ross 1933; Woinarski *et al.* 1988).

In the southern wheatbelt region of Western Australia *P. n. oberon* nests have been found predominantly in *Banksia caleyi*, with a few in *Daviesia* sp. and *Hakea* sp. (Whittell 1939; McNee 1986). These nest sites were similar in that these shrubs are dense with prickly leaves and all nests were no more than a metre from the ground (Whittell 1939; McNee 1986). At Two Peoples Bay *P. n. nigrogularis* nests have been found in heath 4-50 m from thicket associations. All nests were in well hidden sites below the canopy (<50 cm above the ground) of dense shrubs such as *Daviesia brevifolia*, *Hakea ceratophylla* and *Melaleuca thymoides* (Smith 1991). Smith (1991) believed that the use of heath associations for nesting instead of their preferred thicket associations, was due to the lack of dense shrubs within thickets.

Nests are a bowl shaped structure 72-120 mm deep and 102-145 mm in diameter (external measurement), with an internal depth of 40-55 mm (Smith 1991). They are strongly constructed of sedges and the foliage and sometimes bark of shrubs with a lining of finer material (Howe & Ross 1933; Smith 1991).

1.6 Diet

Little information is available on the foraging behaviour and diet of the western whipbird. It appears to forage in similar ways throughout its distribution, predominantly on the ground or in low vegetation (Condon 1966; Smith 1991; Rose 1991). It has also been recorded foraging by probing into or stripping the bark from small eucalypts and shrubs and probing into flowers, especially those of *Dryandra formosa* that have many small beetles (Smith 1991).

The western whipbird is largely insectivorous (Condon 1966; Smith 1991) and, based on items fed to chicks at Two Peoples Bay, utilises a range of food items especially larvae and orthopterans and less frequently spiders, beetles, cockroaches, flies and skinks (Smith 1991). The use of larvae was also noted by Condon (1966) who records them feeding on large larvae associated with Coastal Wattles (*Acacia sophorae*). The gut contents of one specimen, collected in 1965 by J. Ford in the Fitzgerald River National Park, was recorded as consisting of ants (Western Australian Museum specimen A13667). Milligan (quoted by Mathews 1922) recorded land snails as forming part of the diet in the Cape Mentelle area.

1.7 Potential Causes of Decline

Destruction of habitat and changes in the fire frequency are the two main factors suggested as having contributed to the decline of the western whipbird throughout its distribution (Ashby 1921; Condon 1966; Smith 1977; 1985; McNee 1986; Woinarski *et al.* 1988). Other factors that have been considered deleterious or potential threats to the species are egg collecting (Woinarski *et al.* 1988), predation by introduced animals (McNee 1986) and the harvesting of broombush in South Australia (Woinarski *et al.* 1988).

Habitat destruction

Two forms of habitat destruction have been identified as problems for the western whipbird: clearing for agriculture (Smith 1977; McNee 1986) and grazing of native vegetation by domestic stock (Condon 1966). Clearing of the native vegetation for agriculture obviously reduces the available habitat for the species, but it also

fragments the remaining vegetation. This has a series of detrimental effects on the quality of the vegetation and on the dispersal of birds between the fragmented populations (Saunders *et al.* 1991).

Grazing by sheep has been shown to change the composition and sometimes reduce the biomass of the shrub and herb layers (Wilson 1990; McIvor & Gardener 1990) and to cause significant declines in litter and soil invertebrates (King & Hutchinson 1983). Due to such changes, grazing has been suggested as having contributed to the decline of other ground foraging species of birds (Frith 1962; Saunders & Curry 1990).

Little is known about the effects of these processes on the western whipbird but McNee (1986) reports the loss of the species from small remnants of native vegetation in the southern wheatbelt (*P. n. oberon*) and Woinarski *et al.* (1988) comment on the instability of many populations that have been recorded in the fragmented vegetation of the Murray Mallee in south-eastern Australia. Habitat clearance and grazing by domestic stock are no longer a problem for *P. n. nigrogularis* as all of its populations are in protected areas.

Response to fire

The increased use of fire to improve the grazing value of bushland was implicated in the decline of the western whipbird as early as 1921, when Ashby (1921) blamed it for the loss of this species at Ellensbrook in the south-west of Western Australia. Since then it has been at the fore front of reasons for the species' decline (Smith 1977, 1985; McNee 1986; Woinarski *et al.* 1988).

In South Australia and Victoria it was considered that the western whipbird preferred early stages of regrowth after fire (Meredith 1982; Hunt & Kenyon 1970), but Woinarski *et al.* (1988) found populations in areas varying from less than two years post-fire to at least 40 years post-fire. They did, however, find that intermediate post-fire ages (10-25 years) seemed most characteristic of western whipbird habitat (Woinarski *et al.* 1988). This period of post-fire ages in broombush vegetation (a common whipbird habitat) was found by Woinarski (1989) to correspond to the peak in the density of litter invertebrates. Woinarski *et al.* (1988) also proposed a successional shift in habitat use from the quick growing broombush habitats recently after fire to the more productive, slower growing heaths with longer post-fire age.

In Western Australia McNee (1986) found western whipbirds in vegetation varying in post-fire age from 7 years to at least 40 years. She also reported on an unpublished survey by A. Chapman in the Fitzgerald River National Park that showed western whipbirds in this area were only found in vegetation older than 15 years post-fire (McNee 1986).

Smith (1977) found that at Two Peoples Bay birds established themselves in areas burnt after the 1962 and 1964 fires on the headland, 7-10 years later, while areas burnt on the isthmus were recolonised 4-6 years after fire. He argued that the time taken to recolonise burnt areas was a function of the vegetation type and the availability of recolonisers (Smith 1991). This argument is supported by the possible differences in post-fire age required for recolonisation between Two Peoples Bay and the Fitzgerald River National Park which differ considerably in vegetation.

Smith (1991) found western whipbirds in areas that had not been burnt for up to 50 years. He argued that fire was probably not required as a management tool to maintain areas of vegetation for this species at Two Peoples Bay, but that a generalised fire prescription was not possible because of the difference in the response to fire of the vegetation in different areas.

Predation by introduced predators

McNee (1986) suggested that predation was a potential threat to the western whipbird because it nested close to the ground. No data are available to assess the threat of predation, but 11 of 24 chicks studied by Smith (1991) disappeared due to unknown causes, and three of six nests found by Howe and Ross (1933) had broken eggs. G.

Smith[6] (*personal communication*) believes the vegetation at Two Peoples Bay is too thick for feral cats and foxes to be a serious threat to western whipbirds. The increase in numbers of whipbirds since fires have been excluded from the reserve despite introduced predators being present, support this argument. (Foxes have been controlled at Two Peoples Bay in recent years, but numbers of whipbirds were increasing before fox control was introduced). However, introduced foxes and cats may pose more of a threat to whipbirds in other areas of their distribution where the vegetation is more open.

Because the western whipbird nests close to the ground, is a ground forager and occurs in fragmented vegetation in some areas, predation by foxes and feral cats must be considered as a potential threat to their persistence, particularly on the local scale.

Influence of Dieback Disease (Phytophthora spp.)

Dieback disease caused by introduced *Phytophthora* spp. may be a potential threat to western whipbird populations. Work by Wills (in press) on the effects of *Phytophthora cinnamomi* on heath communities in the Stirling Ranges National Park, indicates that the disease causes changes in plant community structure and composition. In heaths in the Stirling Ranges, *Phytophthora* infections are associated with a general decline in total projective foliage cover, due mainly to the loss of many woody perennials. An increase in the cover of sedges (Cyperaceae and Restionaceae) may also occur. Changes in floristic composition were also observed, primarily through a decline in woody perennials of the Proteaceae. Such changes could have adverse effects on western whipbird habitat.

Two Peoples Bay Nature Reserve has been extensively infected with dieback since the 1940s (Hart in press), but the increasing population trend for the western whipbird in this reserve suggests that in this area dieback has no long term detrimental effects on the species. It is not known, however, if the expression of dieback in areas that differ in vegetation will affect western whipbirds differently.

1.8 Existing Conservation Measures

All known populations of *P. n. nigrogularis* are on reserved land managed by CALM (Gull Rock National Park (unvested), Two Peoples Bay Nature Reserve, and Mt. Manypeaks to Mermaid Point), except the population at Betty's Beach. This latter area is managed by the Albany Shire Council, which has expressed interest in creating a management plan for the area that will include the issue of the conservation of the rare flora and fauna (K. Gillen[7] *personal communication*). The largest known population of *P. n. oberon* (Fitzgerald River National Park) and other populations (Stirling Range National Park, and some reserves in the southern wheatbelt) are on land managed by CALM. There is a proposal (CALM 1992) for areas of unvested crown land near Cape Riche and Beaufort Inlet to be vested in the National Parks and Nature Conservation Authority (NPNCA) under the management of CALM. These areas may contain populations of whipbirds.

Two Peoples Bay Nature Reserve has been managed primarily for the noisy scrub-bird since 1971, with particular emphasis on the exclusion of fire from the reserve (Danks *et al.* 1992). This management has had direct benefits for the *P. n. nigrogularis* population on the reserve, and current management policies consider the requirements of this species (A. Danks[8] *personal communication*). The Management Plan for the Fitzgerald River National Park (Moore *et al.* 1991) contains several general management prescriptions (hygiene for prevention of the spread of dieback, fire prescriptions) that could benefit western whipbirds in the park, but since the exact distribution of the species in the park is not known, some management prescriptions may have unforeseen effects on western whipbird populations.

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6 Dr G.T. Smith, CSIRO Division of Wildlife and Ecology, LMB No 4, Midland, WA 6056.

7 Mr K. Gillen, Dept CALM, 44 Serpentine Road, Albany, 6330.

8 Mr A. Danks, Dept CALM, Two Peoples Bay Nature Reserve, c/- 44 Serpentine Road, Albany, 6330.

Research on *P. n. nigrogularis* was carried out by CSIRO in the 1970s at Two Peoples Bay Nature Reserve, and has provided most of the current information on the species' biology, habitat requirements and management needs (Smith 1985, 1991). Research funded by ANPWS was done by the RAOU and identified most of the known populations of the western whipbird (McNee 1986). A biological survey of the Fitzgerald River National Park funded by the Australian Heritage Commission under the National Estate Program, investigated the distribution of *P. n. oberon* in the park and noted some aspects of the habitat preferences of the species (Chapman & Newbey 1987).

1.9 Research/Management

The research proposed in this Plan is based on the premise that the two subspecies of western whipbird in Western Australia proposed by Schodde and Mason (1991) are distinct. The evaluation of the taxonomic status of this species and the determination of the distribution and status of these subspecies if they exist, is the highest priority research for this species in Western Australia. This work could be completed in three years after which time, if the populations of western whipbirds in Western Australia are found to consist of two subspecies, a Recovery Plan for *P. n. nigrogularis* should be produced, so that translocation of this subspecies can be implemented (see 3.5).

Fire has been identified as the greatest threat to *P. n. nigrogularis* and research by Smith (1991) has already provided sufficient information for management prescriptions for this subspecies to be developed. This has already been done at Two Peoples Bay Nature Reserve where a total fire exclusion policy based on the protection of the noisy scrub-bird is in operation (A. Danks[8] *personal communication*). The question of whether there is an upper limit to the post-fire age of vegetation, after which it becomes less suitable for this species, has not yet been assessed. This will be assessed for post-fire ages up to 50 years by the research proposed in action 3.3.1, that will repeat G. T. Smith's estimates of the species' density at Two Peoples Bay. Little is known about the response to fire of *P. n. oberon* and this is an area of high priority for this subspecies. This research is long term and has been designed to run concurrently with management preventing fires in areas where this subspecies occurs.

The effects of land clearance and the resultant fragmentation of remnant vegetation is still a conservation issue for *P. n. oberon* in the southern wheatbelt. However, the distribution and status of this subspecies in the southern wheatbelt is poorly known and an assessment of research/management proposals for this area cannot be made until it has been determined.

2 Research Objectives and Criteria

2.1 Objectives

There are two objectives of this research plan. The first is to determine if the Western Australian populations of the western whipbird belong to two subspecies and if so to determine the current distribution and status of these subspecies. The second is to provide sufficient information on these subspecies to prevent the decline of existing subpopulations and increase the potential for their expansion.

2.2 Criteria

The criteria for successfully achieving the objectives of this research plan are:

1. The identification, mapping of the boundaries and determination of the relative density of all subpopulations of the western whipbird in Western Australia.

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8 Mr A. Danks, Dept CALM, Two Peoples Bay Nature Reserve, c/- 44 Serpentine Road, Albany, 6330.

2. The assessment of the taxonomic status of Western Australian populations of the western whipbird.

3. To have repeated the census work on *P. n. nigrogularis* conducted by G. Smith in the 1970s at Two Peoples Bay Nature Reserve.

4. The implementation of a monitoring program to assess changes in the relative density of *P. n. oberon* subpopulations with changes in post-fire age of their habitat, in the Fitzgerald River National Park and in other areas.

5. The characterisation of the micro-habitats used by *P. n. oberon* in at least some of the known subpopulations.

6. The determination of the effect of an introduced predator control program on the relative density of *P. n. oberon* subpopulations.

7. The assessment of the feasibility of using translocation as a management tool for *P. n. nigrogularis* (Dependent on the outcome of the taxonomic assessment of this species).

3 Research Actions

3.1 Population Survey

3.1.1 Determine subpopulation boundaries

The general distribution of the western whipbird in Western Australia is fairly well known (see 1.2). However, three areas need further investigation: the southern wheatbelt that was covered only sparsely by McNee (1986); the southern coastal region to the east of Ravensthorpe, where Cody (1991) has reported seeing this species at two locations; and the area between Mermaid Point and Cape Riche that is the potential contact zone between the two subspecies. Information on the distribution of the species in these areas and the boundaries of the subpopulations of this species throughout its Western Australian distribution is essential for determining the status of the species and for making informed decisions concerning research and management.

The boundaries of subpopulations will be determined by mapping the outer limits of calling birds in each area. In the southern wheatbelt where this species often occurs in small remnants, the presence of calling birds will be noted for each remnant and the boundaries of the remnant will be considered as subpopulation boundaries. Because of the extensive area under investigation this project will require a minimum of two years to complete.

Costs are outlined in the next section, as the two projects are closely inter-related.

3.1.2 Determine index of relative density for subpopulations

The relative density of subpopulations can be reliably obtained by censusing calling birds (Smith 1991). This information is essential for the assessment of the status of the species and the relative importance of different subpopulations. It will also provide the baseline data for monitoring changes in the abundance of subpopulations that are being managed.

Censusing of subpopulations will be run concurrently with the establishment of subpopulation boundaries and so will require two years. After this the regular monitoring of selected subpopulations will be done as part of other studies proposed in this research plan.

Costs include salaries for a consultant zoologist for four months per year for two years plus on-costs, vehicle usage, miscellaneous consumables, travelling/camping expenses, administration and supervision.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	2000	2000								
Other	19000	19000								
Total Cost	21000	21000								

3.2 Assessment of Taxonomic Status

Schodde and Mason (1991) have proposed that populations of western whipbirds in Western Australia should be considered as two subspecies. Birds at Two Peoples Bay, Mt. Taylor and at Mt. Manypeaks are considered to be *P. n. nigrogularis*, although Schodde and Mason pointed out that (because of the lack of specimens from these populations) this hypothesis needs testing. Given that *P. n. nigrogularis* has been classified as endangered while *P. n. oberon* is considered rare (Garnett 1992a,b) the resolution of the subspecific status of these populations is of the highest priority and will greatly influence further priorities for the management of this species in Western Australia.

The importance to conservation of different subspecies is that they may represent different gene pools. It is therefore essential to investigate this question at the genetic level before management is commenced, as the result will determine what kind of management is appropriate. Molecular genetic analyses appear to be the most suitable because they can be done on relatively small quantities of genetic material that can be obtained with nondestructive sampling techniques.

Blood samples are required from major subpopulations such as at Two Peoples Bay and Mt. Manypeaks (presumed *nigrogularis*), Stirling Range and Fitzgerald River National Parks (presumed *oberon*) and from populations found in the population survey (3.1) in the suspected contact zone between the two subspecies. Sampling will be done concurrently with the population survey, in winter-spring. From 10-15 birds will be sampled from each area. This is the minimum sample size and depending on the results from the analysis of these samples, it may be necessary to resample some areas to clarify to which subspecies the birds belong.

Genetic techniques available to resolve such problems include use of isozyme or DNA analyses. Birds generally show insufficient isozyme variation to be useful in this context (Zink 1991) but analysis of mitochondrial DNA or of hypervariable loci of nuclear DNA is likely to reveal high levels of variation. The most appropriate technique to resolve this particular problem is restriction enzyme analysis on mitochondrial DNA. This work can be done by L. Christidis (National Museum of Victoria) and M. Westerman (La Trobe University).

Sampling (in the first two years) will require two consultant zoologists for 2.5 months, together with on-costs, vehicle usage, miscellaneous consumables, travelling/camping expenses, administration and supervision. DNA analysis (in the third year) will require one technician and one Honours student for one year, plus consumables and time to interpret and write up the data.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	2000	2000	5000							
Other	22000	22000	50000							
Total Cost	24000	24000	55000							

3.3 Response to Fire

3.3.1 Response to fire of *P. n. nigrogularis*

The recolonisation of vegetation after fire has been well documented for *P. n. nigrogularis* at Two Peoples Bay Nature Reserve (Smith 1991), but it is uncertain whether long unburnt vegetation eventually becomes less suitable for this subspecies. Collection of relevant data will provide information that can be used to determine whether fire is required in this area to maintain suitable habitat for this subspecies.

Smith (1991) determined the density of western whipbirds in several areas during the mid 1970s and none of these areas have been burnt since this time. This provides a unique opportunity to compare the density of this subspecies in the same areas at two greatly different fire ages and to provide information on changes in the density of western whipbirds with increasing post-fire age up to 50 years old.

Vegetation data was also collected by Smith during the 1970s and repeating this sampling will provide data that will help to interpret any changes in whipbird population density that may be found.

Costs include employment of a consultant zoologist for two months to estimate numbers of whipbirds in the way used by Smith (1987) and a consultant botanist for two months to monitor vegetation, together with on-costs, vehicle usage, travelling costs, miscellaneous consumables, administration and supervision. This work will also include the gathering of similar data on the western bristlebird. All the costs for the combined project are included here.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	1500	--	--	--	--	--	--	--	--	1500
Other	20000	--	--	--	--	--	--	--	--	20000
Total Cost	21500	--	--	--	--	--	--	--	--	21500

3.3.2 Response to fire of *P. n. oberon*

The vegetation used by *P. n. oberon* differs considerably from that used by *P. n. nigrogularis* (see 1.5) and Smith (1985) has argued that it is not appropriate to transfer fire prescriptions determined for Two Peoples Bay to other areas. It is essential that the response of *P. n. oberon* to fire be determined for the effective management of this subspecies.

Researching changes in the suitability of the vegetation with changing post-fire age has been done for the ground parrot by determining the correlation between post-fire age and the density of the species in a range of areas (Meredith & Isles 1980; McFarland 1989). The problem with this approach is that differences between the areas not related to fire age cannot be separated from the influence of the post-fire age of the vegetation (see ground parrot 1.7). Monitoring changes in the relative density of a species through time in several areas provides a direct measure of the effects of post-fire age on the suitability of the vegetation for that species. This research is long term and requires that no fires occur in at least some monitored areas for long periods of time. Because of this it is only appropriate for this type of research to be run concurrently with management actions designed to exclude fire from the area. Since Smith (1985) has found that fire exclusion is beneficial for *P. n. nigrogularis* at Two Peoples Bay this long term approach to fire management/research for *P. n. oberon* appears to be the most appropriate.

Regular monitoring of the boundaries and relative density of *P. n. oberon* in selected subpopulations in Stirling Range National Park and Fitzgerald River National Park will be carried out with vegetation sampling designed to measure changes in structure and floristics. Additional areas where *P. n. oberon* is known to have disappeared after fire will also be monitored in the same way to determine at what post-

fire age the subspecies returns to these areas. Several subpopulations will be needed for this study to provide replication and to allow for the incidence of accidental fires. Areas that are accidently burnt will continue to be monitored as they will provide further information on recolonisation of burnt areas.

The choice of sites to be sampled in Fitzgerald River National Park will be made so that the data can also be used to assess the effect of the introduced predator control program (see 3.4). The vegetation sampling associated with this project will be run jointly with similar projects proposed for the western ground parrot and the western bristlebird (see ground parrot 3.4 and western bristlebird 3.2), and will provide information on the fire response of mallee communities in this region that will be of great value to other species in the Park.

Sampling will be done each year, but in alternate years in Stirling Range National Park and Fitzgerald River National Park.

Sampling will require one zoologist for two months and one botanist for 1.5 months, together with on-costs, vehicle usage, miscellaneous consumables, travelling/camping expenses, administration and supervision. Extra botanical effort will be needed in the Stirling Range because of the high plant species richness. There is no coupling with bristlebird work in the Stirling Range, because bristlebirds do not occur there.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	1000	1000	1000	1000	1000	1000	1000	1000	1000	4000
Other	18000	20000	18000	20000	18000	20000	18000	20000	18000	20000
Total Cost	19000	21000	19000	21000	19000	21000	19000	21000	19000	25000

3.3.3 Micro-habitat requirements

The micro-habitat requirements of *P. n. nigrogularis* are well documented for the Two Peoples Bay subpopulation (Smith 1991) but only general habitat information is available for *P. n. oberon* (McNee 1986) and information on which components of this habitat are used by this subspecies is not known. This information will be valuable in predicting response to management actions such as fire exclusion and in identifying areas suitable for the expansion of the subspecies if the appropriate management actions are implemented. It may also provide information relevant to an assessment of the potential impact of dieback disease on this subspecies.

The use of radio-tracking to determine temporal (daily and seasonal) changes in the use of different components of the habitat and the size of an individual's home range has been used successfully with the ground parrot (McFarland 1989; Burbidge *et al.* 1989), and it is proposed to use these techniques for *P. n. oberon*. This work will be carried out in at least two different areas within *P. n. oberon's* range, preferably with different vegetation.

Extra costs include salaries for two consultant zoologists for three months for radio-tracking and a consultant botanist for vegetation sampling for one month, plus vehicle usage, miscellaneous consumables (including radio-transmitters), travelling/ camping expenses, administration and supervision. Extra botanical effort will be needed in the Stirling Range (1995) because of the high plant species richness. There is no coupling with bristlebird work in the Stirling Range, as bristlebirds do not occur there.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	2000	2000	4000							
Other	30000	30000	34000							
Total Cost	32000	32000	38000							

3.4 Predation by Introduced Animals

Information from Two Peoples Bay Nature Reserve suggests that predation by foxes and feral cats has not been a major limiting factor on the persistence of *P. n. nigrogularis* in this area, because the size of the population has grown considerably since fire exclusion despite the presence of both predators. However, the effect of these two introduced predators on *P. n. oberon* in areas such as the Fitzgerald River National Park and Stirling Range National Park, where the vegetation is different in structure, is not known.

A 1080 baiting program to control foxes has been implemented in part of the Fitzgerald River National Park, while other areas of the Park remain uncontrolled. This program provides an opportunity to begin an assessment of the impact of reducing the numbers of this predator on *P. n. oberon* populations. It is proposed that several subpopulations of this subspecies that are inside and outside the baited area within the reserve, be monitored regularly to determine if changes occur in either the extent or relative density of these subpopulations. One potential problem of such programs is that feral cats may not be controlled and may increase in numbers (J. Short[9] *personal communication*). Since feral cat numbers are not being monitored at present, this cannot be assessed in Fitzgerald River National Park.

The costs of monitoring *P. n. oberon* are outlined in section 3.3.2 and the fox baiting is currently being done under other funding (see section on predation of ground parrots).

3.5 Translocation of *P. n. nigrogularis*

If Schodde and Mason's (1991) subspecific classification of the western whipbird is correct, then it is likely that *P. n. nigrogularis* will be restricted to Mt. Taylor (Gull Rock National Park), Two Peoples Bay Nature Reserve and the area between Mt. Manypeaks and Mermaid Point. These areas provide little room for the natural expansion of this subspecies and translocation to other potential areas could be a valuable management tool.

Before a translocation project can proceed potential translocation sites need to be found and assessed. This can be done with the current level of knowledge about the habitat requirements of *P. n. nigrogularis*.

The techniques for translocating birds have already been developed for the noisy scrub-bird and G. T. Smith[10] (*personal communication*) has developed reliable techniques for capturing western whipbirds, so once suitable sites have been identified a translocation program could commence. This program should include research into the outcome of these translocations. This will involve the monitoring of parent and translocated populations and, if translocations fail, research into factors that may have caused their failure. Translocation will be done under a Recovery Plan (see 1.9).

It is proposed in the first year to assess sites for possible translocation, followed by a two year translocation. Costs will include costs of one biologist for three months to assess sites in the first year, followed by four zoologists for three months to carry out a pilot translocation during the second and third years. Monitoring to assess the success of the program will be required in at least this and the subsequent year. Further use of translocation will be assessed in the Recovery Plan.

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9 Dr J. Short, CSIRO Division of Wildlife and Ecology, LMB No 4, Midland, WA 6056.

10 Dr G.T. Smith, CSIRO Division of Wildlife and Ecology, LMB No 4, Midland, WA 6056.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	2000	4000	4000							
Other	12000	50000	50000							
Total Cost	14000	54000	54000							

Western Bristlebird
Dasyornis longirostris Gould

1 Introduction

1.1 Taxonomy and Status

The western bristlebird is one of three species (*D. brachypterus*, *D. longirostris* and *D. broadbenti*) of the Australian endemic genus *Dasyornis*, all of which are now considered threatened (Garnett 1992a,b). The western bristlebird was first collected by Gilbert near Perth in 1839 and was named by Gould in 1840 (Whittell 1941).

King (1979) lists the western bristlebird as a subspecies of *D. brachypterus* and considered it Rare and very local. Garnett (1992b) considered it as endangered and on his priority list for threatened birds of Australia and its Territories it is listed at number 9.

Application of the Mace and Lande (1991) criteria suggest that the status of the species is close to critical because the subpopulation at Two Peoples Bay is the only one likely to exceed 125 individuals. If the probability of this subpopulation being burnt out in the next 5-10 years is considered to be greater than 50%, then the status of the species would have to be considered critical.

1.2 Distribution and Abundance

Historical

Gilbert collected the western bristlebird near Perth in 1839 and considered it widespread (Whittell 1941), but it has not been recorded there since (McNee 1986). No contemporary records of the species exist between Perth and Wilson Inlet on the south coast (McNee 1986), but Baird (1991) found fossil evidence of the species at Skull Cave approximately 10 km west north-west of Augusta.

On the south coast the species was probably collected in the vicinity of King George Sound by Gilbert during his visits to the area (Whittell 1941), and was collected by George Masters in 1866 and again in 1868-69 (Serventy & Whittell 1976). W. Webb collected the western bristlebird in the King George Sound area in the 1880s (Serventy & Whittell 1976), but it has not been recorded from the area since (McNee 1986). F. Lawson Whitlock recorded the species at Wilsons Inlet in 1907, where they had apparently moved due to a fire to the east (Whittell 1936). They were observed there until at least 1912, but vanished after another fire burnt out the area (Whittell 1936). Thomas Carter was in this area in 1919 and again in 1922, but failed to find any sign of bristlebirds (Whitley 1971).

After the record by Whitlock no further records of this species were made until 1944 when Buller (1945) collected it at Two Peoples Bay (Ford 1965). It was recorded on the Waychinicup River in 1961 and on the north side of Mt. Manypeaks in 1962 (Ford 1965). Its distribution was further extended eastward along the coast in 1976, when D. James and P. de Rebeira recorded it at Beaufort Inlet (McNee 1986), and Smith and Moore (1977) recorded it in the Fitzgerald River National Park along the old telegraph line.

Current

McNee (1986) conducted a comprehensive survey of the area from Albany east to Cape Arid National Park in 1985 and recorded the western bristlebird at Two Peoples Bay, Betty's Beach, Mt. Manypeaks to Mermaid Point, and at three sites in the Fitzgerald River National Park (Fig. 3).

Smith (1987) found the population of western bristlebirds at Two Peoples Bay to contain about 86 pairs in 1976 (based on singing birds only) and estimated the population to have increased to approximately 100 pairs in 1983. A. Danks[11] (*personal communication*) estimated the population to have increased to approximately 245 pairs in 1991 due mainly to an expansion of the area utilised by the species.

Estimates of the density of western bristlebirds are based on singing birds, and since this species has overlapping home ranges, extensive mapping of calls is required for an accurate density estimate (G. Smith[12] *personal communication*). However, an index of relative density obtained by censusing calling birds and using accumulated censuses over time to determine the number of pairs, has produced comparable estimates (A. Danks[11] *personal communication*).

1.3 Breeding Biology

Very little is known about the breeding biology of this secretive bird (Smith 1987). Masters collected eggs of this species in September (Smith 1987). Whitlock recorded finding a nest in September at Wilsons Inlet (Whittell 1936). This nest contained an infertile egg that had dried out and Whitlock believed a chick had been raised in the nest (Whittell 1936). Incomplete or new nests have been found at Two Peoples Bay in July, August and September and L. Harrison found a nest with two chicks on 11 October (Smith 1987). The limited available data suggest that the breeding season commences around July and extends into November, with the main egg laying period in August to September (Smith 1987).

Nothing is known about incubation or the feeding of chicks mainly due to a lack of nests and the apparent sensitivity of the species to disturbance around the nest. Three nests found by L. Harrison at Two Peoples Bay, that were under construction or newly finished, were found several months later to have been abandoned (Smith 1987). Sensitivity to disturbance at the nest has also been observed for the congeneric eastern bristlebird (J. Baker[13] *personal communication*).

1.4 Dispersal

Almost nothing is known about the dispersal behaviour of this species. Sightings of juveniles and the behaviour of disturbed adults suggest that juveniles remain with their parents until around January (Smith 1987). Records of birds colonising the isthmus of Two Peoples Bay showed one pair's home range to be more than 2.5 km from the nearest source of colonising birds, suggesting that these individuals had dispersed at least this distance (G. Smith[12] *personal communication*). The notes of Whitlock at Wilsons Inlet also indicate that western bristlebirds will move into new areas when a fire burns out their previous habitat, but he gave no indication how far these birds had moved (Whittell 1936).

1.5 Habitat

Based on an area of 80 ha at Two Peoples Bay, Smith (1987) determined that western bristlebird pairs had overlapping home ranges that varied in size from 6 to 8 ha, with a core area (where >60% of observations were made) of 1-3 ha. Members of a pair apparently spend most of their time close to each other and song appears to play a part in the birds maintaining this contact (Smith 1987). Only three instances of presumed boundary disputes were recorded by Smith (1987); these consisted of all four birds being within 20 m of each other with two birds singing (Song A) continuously for 2-5 minutes.

Whitlock found the western bristlebird at Wilsons Inlet on gravel ridges covered with dense flowering plants that reached the height of his knees. These ridges were

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11 Mr A. Danks, Dept CALM, Two Peoples Bay Nature Reserve, c/- 44 Serpentine Road, Albany, 6330.

12 Dr G.T. Smith, CSIRO Division of Wildlife and Ecology, LMB No 4, Midland, WA 6056.

13 Mr J. Baker, PO Box 422, Moruya, NSW 2537

surrounded by *Xanthorrhoea* flats that were inundated with water in winter and spring (Whittell 1936).

The main habitat of the western bristlebird at Two Peoples Bay is closed heath 1-1.5 m high. These heaths are floristically diverse (120 species), but within any given area may be dominated by one or two shrub species, with the spaces between shrubs filled with sedges (Smith 1987). Within these heaths there are thickets of low *Eucalyptus marginata* and *E. calophylla* that, though open underneath, provide areas of dense litter (Smith 1987). Along the Waychinicup River and on the northern slopes of Mt. Manypeaks the species is found in open to closed heath, 0.5-1 m high (Smith 1987).

Smith and Moore (1977) found this species in the Fitzgerald River National Park in open heath 0.5-1 m high, with elongated patches of eucalypts (2-4 m tall) that had an understorey of closed heath 1-1.5 m high. Birds whose exact locations could be determined were all in these areas of eucalypts with closed heath.

McNee (1986) found that at all sites where western bristlebirds were found the vegetation was dominated by shrubs up to a height of 1 m. At sites in the Fitzgerald River National Park the vegetation had a taller component, usually of eucalypts or *Banksia* spp., but were still dominated by shrubs <1 m high. The cover of sedges and grasses in all sites varied from 5 to 40%, but was usually 15-30% (McNee 1986).

Nest sites

Whitlock found two nests of the western bristlebird at Wilsons Inlet (Whittell 1936). The first was about 45 cm from the ground in a small "dwarf" *Banksia* concealed by coarse grasses, and was a domed nest constructed from short pieces of dried grass. The second nest was " . . . nearly on the ground, in a matted clump of wiry grass . . ." (Whittell 1936). Based on the two photographs of the second nest published by Whittell (1936), the "wiry grass" appears to be a round-stemmed sedge.

At Two Peoples Bay the nests of western bristlebirds are loosely constructed domes (120 mm high, 100 mm wide, 120 mm long, with a 60 mm diameter nest cavity), with a large side entrance (Smith 1987). The base and sides of the nest are constructed from the leaves of *Anarthria scabra*, *Dasypogon bromeliifolius*, *Cyathochaeta clandestina* and twigs, while the rest is made of finer pieces of sedges and grasses (Smith 1987). It is placed 10-40 cm off the ground in a dense shrub or clump, often of *D. bromeliifolius* (Smith 1987).

1.6 Diet

The diet and foraging behaviour of the western bristlebird is based on the stomach contents of two birds and observations made by Smith (1987). The species appears to forage predominantly on the ground, by gleaning and occasionally probing into the sand in open areas, while in jarrah thickets on deep leaf litter they probe under leaves and move litter aside with their bills (Smith 1987).

The stomach of the bird collected by Buller (1945) contained many small Coleoptera and Hymenoptera, one small tenebrionid and seven small Acridiidae, with four small grass seeds and three other unidentified very small seeds. The stomach contents of a female bristlebird, killed on the road at Two Peoples Bay, consisted of abundant fine, unidentifiable insect material and the seeds of *Daviesia* spp., *Acacia* spp. and *Anarthria scabra* (Smith 1987). The anatomy of the stomach of this specimen also suggested that this species is granivorous (G. Smith[14] *personal communication*). Smith (1987) also observed species feeding on tenebrionid larvae and earthworms. These results are similar to that found for *D. broadbenti* stomachs analysed by Lea and Gray (1935), except that seeds and berries figured more prominently in *D. broadbenti*.

These data show that the western bristlebird is both insectivorous and granivorous, but the relative importance of these two dietary components is not known. Nor is it known if the relative importance of these two dietary components differ with location, because all the available data are from Two Peoples Bay.

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14 Dr G.T. Smith, CSIRO Division of Wildlife and Ecology, LMB No 4, Midland, WA 6056.

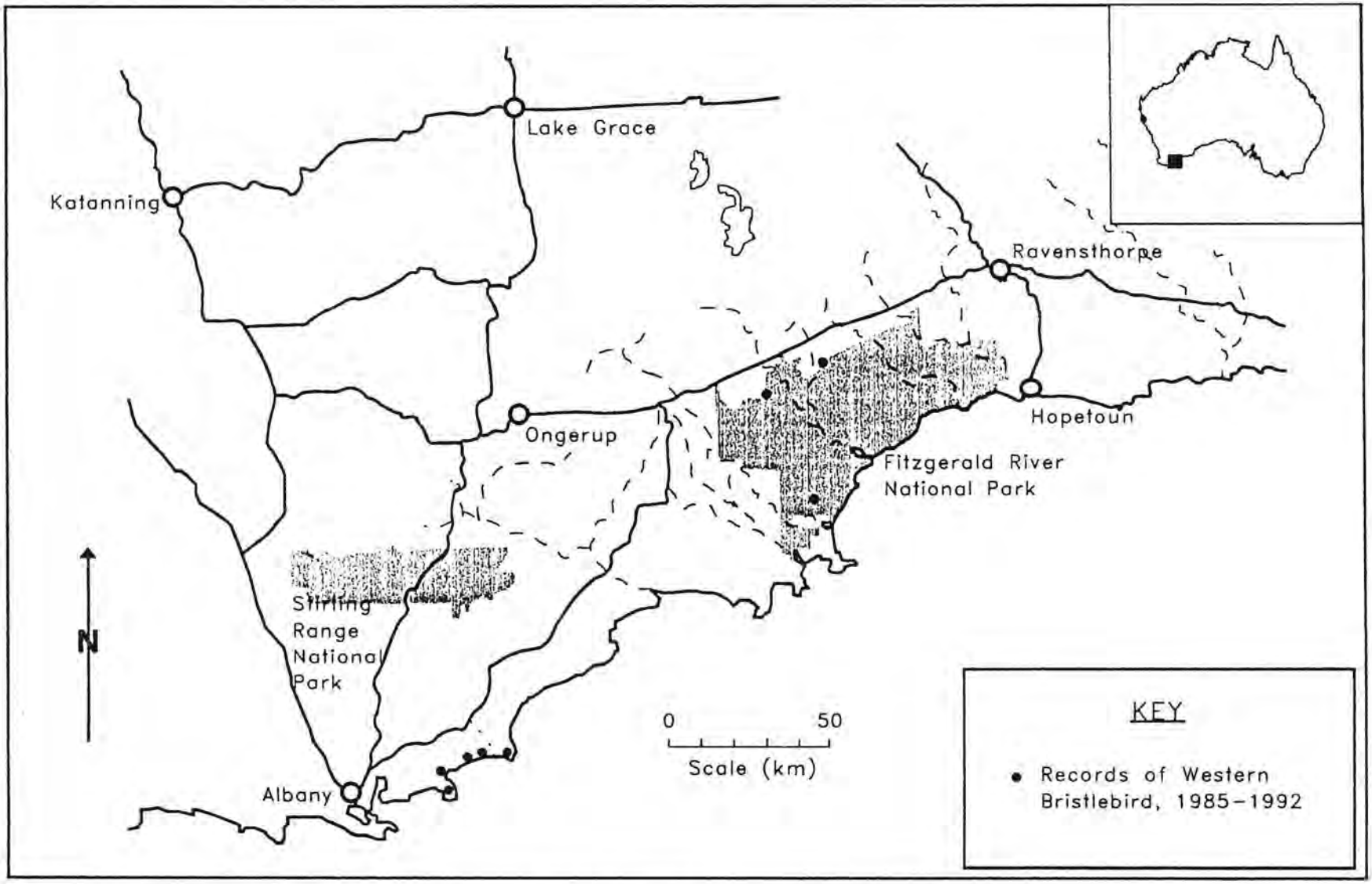

Figure 3: Current distribution of the western bristlebird.

1.7 Potential Causes of Decline

The decline of the western bristlebird has been attributed to habitat changes caused by humans, specifically clearing and changes to the fire frequency (Smith 1977). Due to a lack of general knowledge of this species the potential threat of factors such as predation by introduced predators, or the influence of dieback disease caused by *Phytophthora* cannot be assessed.

Response to fire

Smith (1985) found that the time taken for heaths at Two Peoples Bay to be recolonised by western bristlebirds was dependent on the rate of regrowth of the heath, and the number of bristlebirds available for recolonisation. He also found that heavy grazing of recently burnt heaths by grey kangaroos (*Macropus fuliginosus*) could extend the period required for recolonisation, especially when small areas were burnt.

Because the number of available bristlebirds for recolonisation is a dependent factor in recolonisation and this has differed in different areas it is difficult to assess the time required for the heath to become suitable. The swampy areas at Lake Gardner were recolonised five years after fire. On Mt. Gardner, however, wetter areas took nine years and drier areas 11-14 years post-fire to be recolonised (Smith 1985). Based on visual assessment of the heath, Smith (1985) believed the wetter areas would become suitable for bristlebirds three years after fire, while drier areas would take 6-10 years.

Little information is available on areas outside Two Peoples Bay. In some other areas, McNee (1986) found western bristlebirds in areas 5-28 years post-fire. In the Fitzgerald River National Park which has a lower rainfall than areas to the west, the western bristlebird was found in sites from 14 to 28 years post-fire.

Smith (1987) found that areas of heath at Two Peoples Bay that had not been burnt for at least 45 years had lower densities of western bristlebirds than areas only 20 years post-fire. He suggested that though the heath remains structurally suitable for bristlebirds, its productivity with respect to seeds and insects may decline. In a part of the Fitzgerald River National Park where western bristlebirds were present, vegetation patches that had not been burnt for at least 50 years did not appear to be used by these birds (Chapman & Newbey 1987). A further problem with older vegetation is the encroachment of thicket vegetation into the heaths reducing the area available to bristlebirds (Smith 1987). This suggests that for the western bristlebird long fire rotations may be a valuable management tool, but as with the western whipbird this would need to be assessed on a site by site basis.

Influence of Dieback Disease (Phytophthora spp.)

Dieback disease caused by introduced *Phytophthora* spp. may be a potential threat to western bristlebird populations. Work by Wills (in press) on the effects of *Phytophthora cinnamomi* on heath communities in the Stirling Ranges National Park, indicates that the disease causes changes in plant community structure and composition. In heaths in the Stirling Ranges, *Phytophthora* infections are associated with a general decline in total projective foliage cover, due mainly to the loss of many woody perennials. An increase in the cover of sedges (Cyperaceae and Restionaceae) may also occur. Changes in floristic composition were also observed, primarily through a decline in woody perennials of the Proteaceae. Such changes could have adverse effects on western bristlebird habitat.

The increasing population trend for the western bristlebird in Two Peoples Bay Nature Reserve, which has been extensively infected with dieback since the 1940s (Hart in press), suggests that in this area dieback has no long term detrimental effects on the species. It is not known, however, if the expression of dieback in areas that differ in vegetation will affect western bristlebirds differently. Knowledge of micro-habitat requirements of bristlebirds will be important in assessing the potential effects of dieback disease in these areas.

1.8 Existing Conservation Measures

All the known subpopulations of the western bristlebird are in reserved areas. Two Peoples Bay Nature Reserve, Fitzgerald River National Park and part of the Mt. Manypeaks to Mermaid Point area are under the management of the Department of Conservation and Land Management. The north side of Mt. Manypeaks is part of Waychinicup River Catchment Reserve and is currently unvested Crown land, proposed to be added to Waychinicup National Park (CALM 1992). Betty's Beach is under the control of the Albany Shire Council. They have expressed interest in creating a management plan for the Betty's Beach area that will include the issue of the conservation of the rare flora and fauna (K. Gillen[15] *personal communication*).

Two Peoples Bay Nature Reserve has been managed primarily for the noisy scrub-bird since 1971, with particular emphasis on the exclusion of fire from the reserve (Danks *et al.* 1992). This management has had direct benefits for the western bristlebird population on the reserve, and current management policies consider the requirements of the western bristlebird (A. Danks[16] *personal communication*). One management action in operation at Two Peoples Bays Nature Reserve is the use of a series of buffer strips on the isthmus to protect the Mt. Gardner headland from fire. These buffer strips are burnt on a rotational basis and are a potential management problem for the western bristlebird because this area contains approximately 20% of the western bristlebird home ranges in the reserve. Careful monitoring of the effects of these burns will be needed to ensure they have no significant effect on the population.

The Management plan for the Fitzgerald River National Park (Moore *et al.* 1992) has a range of general management prescriptions (hygiene prescriptions for dieback, fire protection) that will benefit the western bristlebirds in this area. However, since their exact distribution is not known in this area, some management prescriptions proposed in the plan may have unforeseen impact on some areas where western bristlebirds occur. The current fox-baiting program in Fitzgerald River National Park encompasses all populations of bristlebirds known in the park. A fox baiting program has also been implemented at Two Peoples Bay Nature Reserve (A. Danks[16] *personal communication*).

Research on the western bristlebird was carried out by CSIRO in the 1970s at Two Peoples Bay Nature Reserve, and has provided most of the current information on the species' biology, habitat requirements and management needs (Smith 1985, 1987). Further research funded by ANPWS was done by the RAOU and identified all the currently known populations of the western bristlebird (McNee 1986). A biological survey of the Fitzgerald River National Park, funded by the Australian Heritage Commission under the National Estate Program, investigated the distribution of the species in the park and noted some aspects of the habitat preferences of threatened species including the bristlebird (Chapman & Newbey 1987).

1.9 Research/Management

The largest subpopulation of western bristlebirds (Two Peoples Bay Nature Reserve) is on land already being managed for the conservation of flora and fauna and which already has a draft management plan that includes actions that will protect western bristlebirds. However, in some areas of the species' range its distribution is poorly known and so management prescriptions may not always be as beneficial or as effective as they could be. Determination of the boundaries of all subpopulations and the relative density of bristlebirds in each of these areas is therefore considered the highest priority. The remaining research proposed is designed to run concurrently with management in an effort to determine the impact of management prescriptions on bristlebirds. These projects generally involve the regular monitoring of the boundaries and relative density of subpopulations where management actions have been implemented. In conjunction with this monitoring, the collection of information about changes in the vegetation in

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15 Mr K. Gillen, Dept CALM, 44 Serpentine Road, Albany, 6330.

16 Mr A. Danks, Dept CALM, Two Peoples Bay Nature Reserve, c/- 44 Serpentine Road, Albany, 6330.

these areas will be made to enable better interpretation of the effects of management actions. In some areas (Fitzgerald River National Park and Two Peoples Bay Nature Reserve) this vegetation analysis will be run jointly with similar projects proposed for the western ground parrot and western whipbird. Because of the near critical status of the species, it is proposed to carry out a pilot translocation to increase the number of birds outside Two Peoples Bay Nature Reserve.

When producing a Recovery Plan for a species it is desirable to have information on its population dynamics (breeding success, recruitment rate, *etc.*), but it is unlikely that this information can be obtained reliably for the western bristlebird, because of its secretive nature and apparent sensitivity to disturbance at the nest. The Recovery Plan could be written in the fourth year after implementation of this Research Plan. At this time the project on micro-habitat requirements in Fitzgerald River National Park would be complete and there will be some information available from long-term monitoring with respect to fire. It would be desirable to write the Recovery Plan in conjunction with that proposed for the western whipbird.

2 Research Objective and Criteria

2.1 Objective

To provide sufficient information on the distribution of the western bristlebird and the response of subpopulations of this species to management actions, to enable better implementation of these management actions.

2.2 Criteria

The criteria for successfully achieving the objective of this research plan are:

1. The identification, mapping of the boundaries and determination of the relative density of all subpopulations of the western bristlebird.

2. To have repeated the census work conducted by Smith in the 1970s at Two Peoples Bay Nature Reserve.

3. The implementation of a monitoring program to assess changes in the relative density of western bristlebirds with changes in post-fire age of their habitat in the Fitzgerald River National Park and in other areas including the buffer strip at Two Peoples Bay Nature Reserve.

4.* The determination of the characteristics of the micro-habitats utilised by western bristlebirds in at least some of the known subpopulations.

5. Completion and assessment of a pilot translocation program.

* Meeting criterion 4 is dependent on the feasibility of the proposed project, which will be assessed in the first year of its implementation.

3 Research Actions

3.1 Population Survey

3.1.1 Determination of subpopulation boundaries

McNee (1986) identified two major areas where western bristlebird subpopulations occur: the Two Peoples Bay to Mermaid Point area and Fitzgerald River National Park. However, time and resources did not allow her to identify the distribution of the species in these areas. The determination of the boundaries of these populations

and whether there are discontinuous subpopulations within these areas is essential information for the effective management and research of this species.

The distribution of the western bristlebird at Two Peoples Bay was determined in the 1970s and early 1980s by Smith (1987). A. Danks[16] (*personal communication*) has updated these data to the present and partially mapped the distribution of bristlebirds between Two Peoples Bay and Mermaid Point. Chapman & Newbey (1987) have provided some information on the distribution of bristlebirds in the Fitzgerald River National Park. These data will be used as the basis for mapping the boundaries of bristlebird distribution in the two areas and a few possible sites between Mermaid Point and the Fitzgerald River National Park will be investigated for the presence of bristlebirds.

This project will also provide the baseline data for the assessment of the impact of management actions such as fire exclusion (3.2) and feral predator control (3.3). This will be determined by regular monitoring of the boundaries of subpopulations where these actions have or have not, been implemented.

Costs are included under the next project, as the two are closely inter-related.

3.1.2 Determination of index of relative density for subpopulations

Estimates of the density of western bristlebirds can only be determined reliably by mapping home ranges (G. Smith[17] *personal communication*), which is a time consuming process and is probably not essential information for all subpopulations of this species. An index of the relative density of the species in different areas can be done by censusing calling birds and should provide sufficient information to assess the relative importance of different subpopulations and allow for an assessment of changes in the abundance of birds in subpopulations following specific management actions.

The determination of relative density of each identified subpopulation will be done concurrently with the boundary mapping project. Initial estimates will be obtained in the first year. Like the boundary mapping project this project will provide the baseline data for the assessment of management actions.

One consultant biologist is required for three months, together with vehicle usage, travelling costs, miscellaneous consumables, administration and supervision.

Cost:	1993
CALM	3000
Other	14000
Total Cost	17000

3.2 Response to Fire

3.2.1 Two Peoples Bay Nature Reserve

The minimum time required for vegetation to become suitable for western bristlebirds after fire has been determined at Two Peoples Bay Nature Reserve. It is not certain, however, if vegetation becomes less suitable for bristlebirds when left unburnt for long time periods. In the 1970s Smith (1987) determined the density of western bristlebirds in three areas in Two Peoples Bay Nature Reserve and one area near the Waychinicup Inlet, that had different post-fire ages. A repeat of this research using the same areas and techniques will provide information on changes in the density of western bristlebirds with increasing post-fire age. This is essential information to determine if vegetation becomes less suitable for this species with increasing post-fire age. The data provided by this project will cover post-fire ages up to 50 years.

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17 Dr G.T. Smith, CSIRO Division of Wildlife and Ecology, LMB No 4, Midland, WA 6056.

Vegetation data was also collected by Smith (1987) and repeating this work will provide information on which changes have occurred in the vegetation with increasing post-fire age. This will help in interpreting the reasons for changes in the density of western bristlebirds if they occur. This comparison can be completed in one year and will supply additional information about the accuracy of the estimates of relative density (see 3.1.2).

A management action already implemented at Two Peoples Bay Nature Reserve that may have a detrimental impact on western bristlebirds is the rotational burning of several buffer strips in the isthmus, designed to protect the Mt. Gardner headland from fire. The buffer strips and the proposed burning regime have been designed with the requirements of bristlebirds in mind. However, the area contained by these buffer strips includes approximately 20% of the current western bristlebird population (A. Danks[18] *personal communication*), so it is important that results of this management are monitored closely to ensure that there is no significant detrimental effect on bristlebird populations. An additional problem related to these buffer strips is the grazing of the recently burnt areas by grey kangaroos that Smith (1987) found increased the time required before the vegetation became suitable for western bristlebirds. If it is not possible to control grazing pressure it may be necessary to modify the rotational burning program.

To assess the impact of these buffer strips the population of western bristlebirds in this area will be monitored regularly and vegetation sampling will be done to assess changes in structure and floristic composition. To assess its impact on western bristlebird abundance, monitoring of grazing by grey kangaroo in these areas is being proposed under the management plan for the reserve (A. Danks[18] *personal communication*).

Costs include employment of a consultant zoologist for two months to estimate numbers of bristlebirds in the way used by Smith (1987) and a consultant botanist for two months to monitor vegetation, together with on-costs, vehicle usage, travelling costs, miscellaneous consumables, administration and supervision. This work will also include the gathering of similar data on the western whipbird. All the costs for the combined project are included under the western whipbird except for monitoring bristlebird numbers in the buffer strip.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	2000	--	2000	--	2000	--	2000	--	2000	--
Other	6000	--	6000	--	6000	--	6000	--	6000	--
Total Cost	8000	--	8000	--	8000	--	8000	--	8000	--

3.2.2 Fitzgerald River National Park

Though similar in many respects, the vegetation utilised by western bristlebirds in the Fitzgerald River National Park and at Two Peoples Bay Nature Reserve differ and Smith (1985) has argued that it is not appropriate to transfer fire prescriptions determined for Two Peoples Bay to other areas. For management of the species in Fitzgerald River National Park to be effective, it is essential that the response of the western bristlebird to fire in that area be determined.

As described for the ground parrot (3.4), monitoring changes in the relative density of bristlebirds through time in several areas provides a direct measure of the effects of post-fire age on the suitability of the vegetation for that species, and is the only reliable way to determine response to fire. This research is long term and requires that no fires occur in at least some monitored areas for long periods of time. Because of this it is only appropriate for this type of research to be run concurrently with management actions designed to exclude fire from the area. Since Smith (1987) has found that fire

18 Mr A. Danks, Dept CALM, Two Peoples Bay Nature Reserve, c/- 44 Serpentine Road, Albany, 6330.

exclusion is beneficial for western bristlebirds at Two Peoples Bay this long term approach to fire management/research for this species in the Fitzgerald River National Park is the most appropriate.

Regular monitoring of the boundaries and relative density of western bristlebirds in selected subpopulations will be carried out with vegetation sampling designed to measure changes in structure and floristics. Additional areas where western bristlebirds are known to have disappeared after fire will also be monitored in the same way to determine at which post-fire age this species returns to these areas. Several subpopulations will be needed for this study to provide replication and to allow for the incidence of accidental fires. Areas that are accidently burnt will continue to be monitored as they will provide information on recolonisation of burnt areas.

The vegetation sampling associated with this project will be run jointly with similar projects proposed for the western ground parrot and the western whipbird (see ground parrot 3.4 and western whipbird 3.3.2). The data on the response of heaths in this region to fire will provide information that will be of great value to other species in the Park.

Costs include employment of one consultant zoologist for two months and one consultant botanist for 1.5 months, together with on-costs, vehicle usage, travelling costs, miscellaneous consumables, administration and supervision. Assessment of bristlebird numbers in the first year will be done under 3.1 above.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	--	--	2000	--	2000	--	2000	--	3000	--
Other	--	--	18000	--	18000	--	18000	--	18000	--
Total Cost	--	--	20000	--	20000	--	20000	--	21000	--

3.2.3 Micro-habitat requirements

The habitat requirements of the western bristlebird are well documented for the Two Peoples Bay subpopulation (Smith 1987) and general habitat information is available in other areas occupied (McNee 1986), but it is not known how micro-habitat requirements differ throughout the bristlebird's range. This information will be valuable in interpreting responses to management actions such as fire exclusion and in identifying areas suitable for the expansion of the species if the appropriate management actions are implemented. It may also provide information relevant to an assessment of the potential effects of dieback disease on bristlebirds.

The use of radio-tracking to determine temporal (daily and seasonal) changes in the use of different components of the habitat and the size of an individual's home range has been used successfully with the ground parrot (McFarland 1989; Burbidge *et al.* 1989), and it is proposed to use these techniques for the western bristlebird at Fitzgerald River National Park.

Cost includes capture and tracking of birds at Fitzgerald River National Park; this requires two consultant zoologists for three months, plus a botanist for one month, together with on-costs, vehicle usage, travelling costs, miscellaneous consumables, administration and supervision.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	2000	2000	4000							
Other	30000	30000	30000							
Total Cost	32000	32000	34000							

3.3 Translocation

Because of the near critical status of the western bristlebird, translocation should be considered as a tool to increase the number of subpopulations. The subpopulation at Two Peoples Bay Nature Reserve is increasing (section 1.2), but the remaining subpopulations appear to be small. The feasibility of translocation is unknown because it is uncertain whether birds can be caught reliably. Careful assessment of potential translocation sites is also needed. This will include assessment of habitat together with management considerations (*eg* proposed fire management and wildfire suppression capability).

It is proposed to assess sites for possible translocation, followed by a pilot translocation during which capture techniques will be evaluated. Costs for a feasibility study will include costs of one biologist for three months to assess sites in the first year, followed by four zoologists for three months to carry out a pilot translocation during the second year. Monitoring to assess the success of the program will be required in at least this and the subsequent year. Translocation in the third year may also be necessary. Further use of translocation will be assessed in the Recovery Plan.

Cost:	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CALM	2000	4000	4000							
Other	12000	50000	50000							
Total Cost	14000	54000	54000							

Research Schedule
Western Ground Parrot

Task	Priority	Feasibility	Funding Party	Cost ($000s/year, 1992 dollars) 1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
1 Population survey to map boundaries and determine index of relative density.	1	100%	CALM	4.0										4.0
			Other	54.0										54.0
2 Preparation of Interim Recovery Plan integrating management and the research proposed below.	1	100%	CALM	--	9.0									9.0
3 Assess changes in suitability of habitat with changing post-fire age.														
3.1 Monitoring changes in index of relative abundance with changing post-fire age.	1	90%	CALM	--	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0	20.0
			Other	--	41.0	17.0	41.0	17.0	41.0	17.0	41.0	17.0	41.0	273.0
3.2 Vegetation sampling	1*	100%	CALM	--	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	6.0	14.0
			Other	--	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	45.0
4 Monitoring effects of introduced predator control on the western ground parrot.	2	75%	CALM	#	#	#	#	#	#	#	#	#	#	#
5 Assess micro-habitat requirements & population dynamics of the ground parrot.														
5.1.1 Assess micro-habitat requirements:	1	85%	CALM	5.0	5.0	5.0	5.0	5.0						25.0
			Other	72.0	72.0	72.0	72.0	72.0						360.0
5.1.2 Vegetation sampling	1*	100%	CALM	2.0	2.0	2.0	2.0	8.0						16.0
			Other	9.0	9.0	9.0	9.0	9.0						45.0
5.2 Determine diet: seasonality, habitat differences.	3	85%	CALM	1.0	1.0	1.0	1.0	2.0						6.0
			Other	1.0	1.0	1.0	1.0	2.0						6.0
5.3 Breeding success	2	75%		Costs covered in 5.1.1										
5.4 Determine age structure of subpopulations.	2	50%		Costs covered in 5.1.1										
6 Assess feasibility of translocation of ground parrots to other areas.	1	100%		Costs covered in 5.1.1 (Management phase translocations would be costed separately)										
Total Costs			CALM	12 #	20 #	11 #	11 #	18 #	3 #	3 #	3 #	3 #	10 #	94 #
			Other	136.0	128.0	104.0	128.0	105.0	46.0	22.0	46.0	22.0	46.0	783.0

Current input to the experimental fox baiting in Fitzgerald River National Park is about $19000 per year, about 70% of which is from external sources. This is additional to the amounts shown above. Current monitoring is concerned with threatened mammal species.

* Research at least part of which can be run jointly with research on one or both of the other species considered in this plan.

Research Schedule
Western Whipbird

Task	Priority	Feasibility	Funding Party	Cost ($000s/year, 1992 dollars) 1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
1 Population survey to map boundaries and determine index of relative density.	1	100%	CALM	2.0	2.0									4.0
			Other	19.0	19.0									38.0
2 Assess taxonomic status of currently recognised subspecies.	1	100%	CALM	2.0	2.0	5.0								9.0
			Other	24.0	24.0	55.0								103.0
3 Assess changes in the suitability of habitat with changing post-fire age.														
3.1 For *P. n. nigrogularis* census areas done by Smith to assess changes with increased post-fire age.	1*	100%	CALM	1.5									1.5	3.0
			Other	20.0									20.0	40.0
3.2 For *P. n. oberon* long term monitoring of subpopulations where fire has been excluded.	1	90%	CALM	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.0	13.0
			Other	18.0	20.0	18.0	20.0	18.0	20.0	18.0	20.0	18.0	20.0	190.0
3.3 Determine micro-habitat requirements for *P. n. oberon*.	2*	100%	CALM	2.0	2.0	4.0								8.0
			Other	30.0	30.0	34.0								94.0
4 Effects of reducing feral predator numbers on subpopulations of *P.n. oberon*	2	90%	Costs covered elsewhere											
5 Assess feasibility of translocation of *P. n. nigrogularis* to other areas.	2	100%	CALM	2.0	2.0	4.0								8.0
			Other	12.0	50.0	50.0								112.0
Total Costs			CALM	10.5	9.0	14.0	1.0	1.0	1.0	1.0	1.0	1.0	5.5	45.0
			Other	123.0	143.0	157.0	20.0	18.0	20.0	18.0	20.0	18.0	40.0	577.0

* Research at least part of which can be run jointly with research on one or both of the other species considered in this plan.

Research Schedule
Western Bristlebird

Task	Priority	Feasibility	Funding Party	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
				Cost ($000s/year, 1992 dollars)										
1 Population survey to map boundaries and determine index of relative density.	1	100%	CALM	3.0										3.0
			Other	14.0										14.0
2 Assess changes in suitability of habitat with changing post-fire age.														
2.1 Census areas studied by Smith to make comparison with increased post-fire age.	1*	100%	CALM	Covered in whipbird plan										
			Other											
2.2 Long term monitoring of use of buffer strips at TPB.	1	100%	CALM	2.0	-	2.0	-	2.0	-	2.0	-	2.0	-	10.0
			Other	6.0	-	6.0	-	6.0	-	6.0	-	6.0	-	30.0
2.3 Long term monitoring of subpopulations in FRNP where fire has been excluded.	1	90%	CALM	--	--	2.0	--	2.0	--	2.0	--	3.0	--	9.0
			Other	--	--	8.0	--	8.0	--	8.0	--	8.0	--	32.0
2.4 Determine micro-habitat requirements.	2*	100%	CALM	2.0	2.0	4.0								8.0
			Other	30.0	30.0	30.0								90.0
2.5 Translocation	1	100%	CALM	2.0	4.0	4.0								10.0
		Other	Other	12.0	50.0	50.0								112.0
Total Costs			CALM	9.0	6.0	12.0	0.0	4.0	0.0	4.0	0.0	5.0	0.0	40.0
			Other	62.0	80.0	94.0	0.0	14.0	0.0	14.0	0.0	14.0	0.0	278.0

* Research at least part of which can be run jointly with research on one or both of the other species considered in this plan.

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