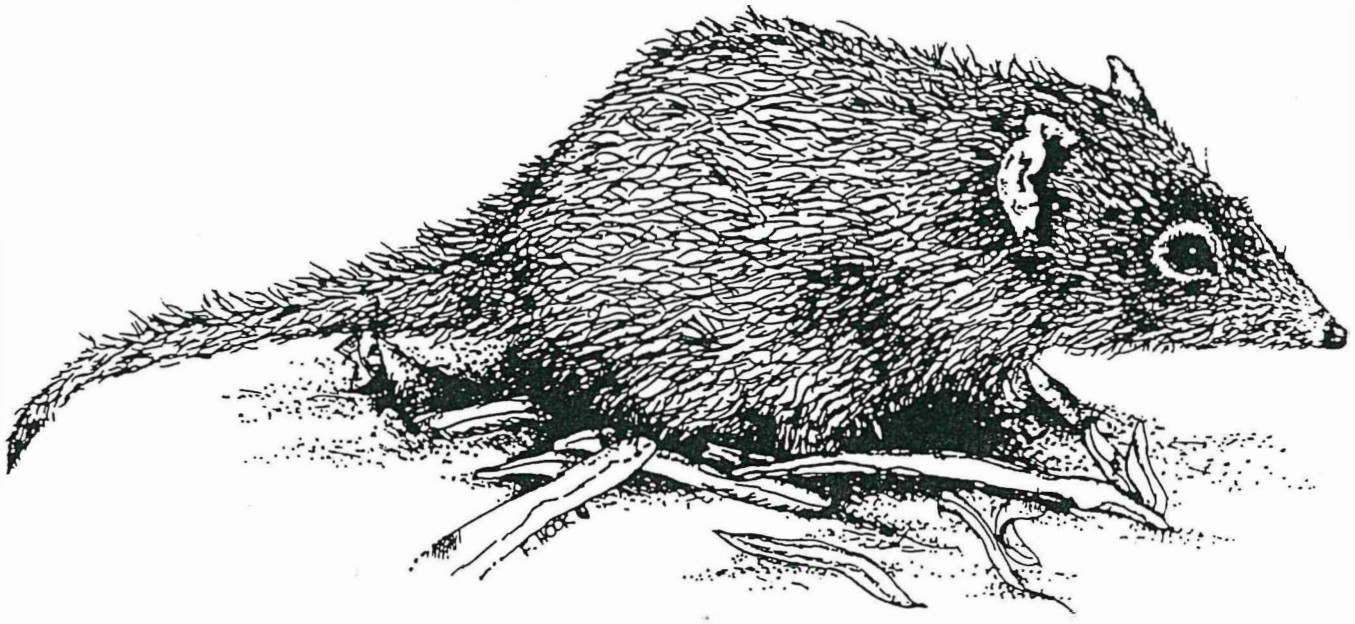
Status and ecology of the Dibbler (*Parantechinus apicalis*) in Western Australia

Final Report

January 1997



By

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draft for Annual report

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1.0. SUMMARY

Since the commencement of the project in January 1995 twenty seven field surveys have been conducted, covering past dibbler captures sites, revisiting those identified by this project and investigating new possible locations. During these surveys dibblers were trapped in the Fitzgerald River National Park after 22,357 trap nights. There still remains many other areas (particularly along the south coast) with predicted suitable habitat for dibblers that have not been surveyed.

Since November 1995, 31 individual dibblers have been tagged on the mainland in the FRNP. Several have been recaptured through the year, indicating that the population is more stable than once thought. Trapping results suggest that the dibbler distribution may be wide spread within the FRNP, although their densities may be low. This is reflected in the broad floristic range in which the animals have been trapped. Further investigations of dibbler distribution within the park will require considerable time and effort within the current access contraints.

This study has confirmed that the dibbler is a difficult subject for behavioural and ecological study due to its apparent low density, and high mobility which makes radiotracking ineffective.

Critical habitat requirements remain unclear but several significant trends can be extrapolated. Most known sites have experienced drastic changes in the last 20 years, mostly a result of plant pathogens and a severe wildfire. This study has revealed that dibblers can utilise vegetation greater than seven years post fire. This clarifies earlier studies which were restricted to vegetation greater than 25 years old. rs, mostly a result of plant pathogendid not occur in the FRNP population in 1996.

The two island populations were visited four times in 1995 and twice in 1996, with unexpected results. The males on both islands at the end of the breeding season did not experience the complete and synchronous die-off which had been recorded in past years by Dr. C.R. Dickman. A short paper detailing these findings is awaiting publication. Trapping results also indicate that the overall population numbers on Boullanger are much lower than the estimates determined in the late 1980s by Dr. Dickman.It appears that male die-off on the islands is linked to high dibbler population densities.

Habitat management has been identified as a main consideration for future research activites on the islands, where the interaction between the dibbler and the island environment, including the burrowing seabird populations is unclear.

A research grant from the BankWest *Landscope* Conservation Visa Card enabled a review of the genetic status of dibblers. This work has been inconclusive as dibbler skin tissue has been difficult to amplify but there is a possiblity of nuclear DNA differences between all three populations (the two islands and that in the FRNP).

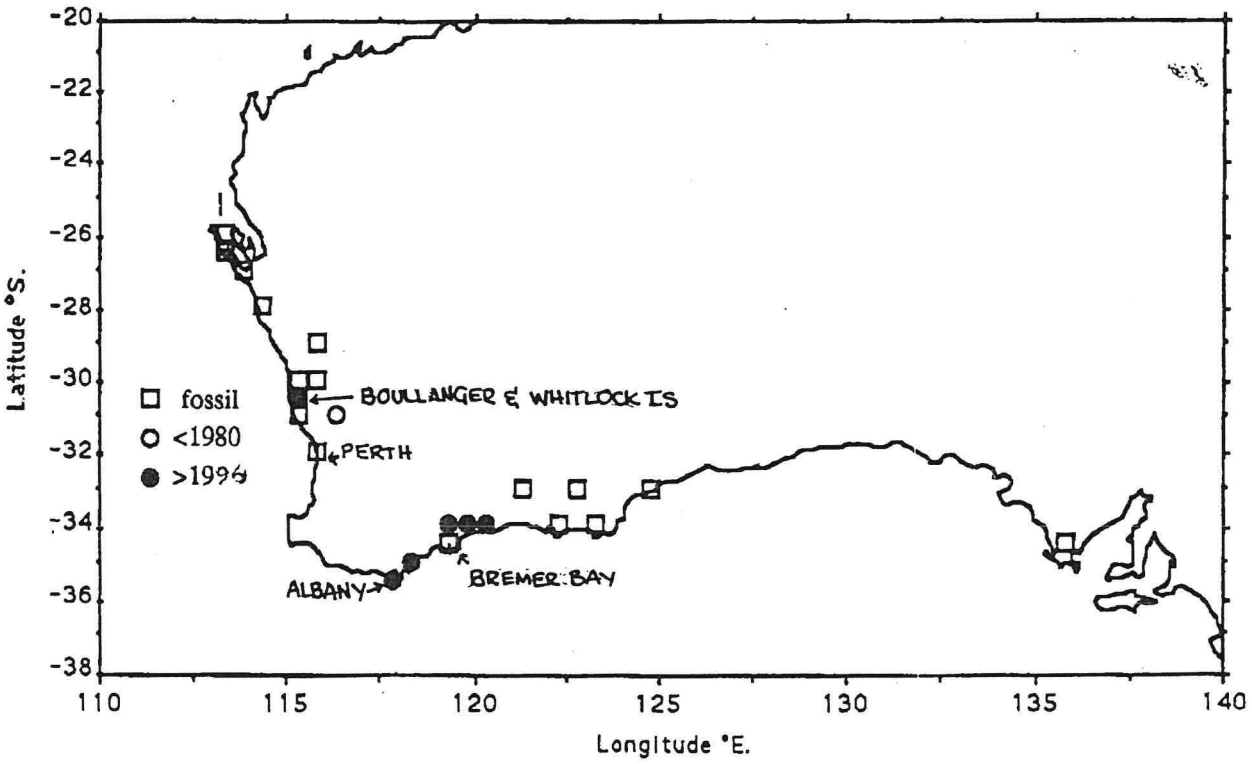
A variety of media opportunities have been taken. The main aims were to promote the project to scientific groups and the general public as well as raise issues of conservation of the species and the need for public involvement in active research.

2.0. INTRODUCTION

2.1. STATUS AND DISTRIBUTION

Parantechinus apicalis has gained a reputation as a somewhat enigmatic species. Based on sub-fossil evidence in cave deposits (Figure 1.), the species once ranged throughout the South-West Botanical Province of Western Australia from Shark Bay in the north to Israelite Bay in the east and to Coffin Bay on the Eyre Peninsular in South Australia. *P. apicalis* was first recorded by John Gilbert in the Moore River area and near King George Sound (Whittell 1954). A number of specimens were collected up until 1884, with two previously unknown collections in the Dublin Museum, rediscovered by a joint investigation with Dr. C. Fisher (Liverpool Museum) in the last year. During the time of these collections *P. apicalis* was considered as rare (Gould 1863), unlike so many other species which have become threatened or extinct in historical times.

Figure 1. Distribution of *P. apicalis*



Courtesy A. Baynes, WA Museum (unpublished data)

It was 83 years before the dibbler was rediscovered at Hassell (Cheyne) Beach by Morcombe (1967), rekindling great interest among biologists to ascertain the species' status and distribution.

Although some individuals were captured during surveys or brought in by cats from various fragmented localities along the south coast eg, Hassell Beach, Jerdacuttup, Torndirrup National Park and Fitzgerald River National Park(FRNP) (Muir 1985; Smith 1990), dibblers remained elusive despite considerable trapping effort at different times by different investigators (Butler unpublished report; Fuller[1] pers. comm.; Woolley 1977,1980; Dickman[2] & Alford[3] pers. comm.). The use of indirect detection techniques such as predator scat analysis failed to located the presence of dibblers (Woolley & Valente 1982). The only exception to these efforts was the Biological Survey conducted in the FRNP by Newbey and Chapman 1985 -1987. This survey located 17 individuals in eight separate locations (Chapman & Newbey 1995). Little biological information was recorded ; however, a detailed and valuable vegetation assessment was made. This vegetation survey along with data collected during this project form the basis for the current assessment of dibbler habitat.

In 1985 two small island populations were discovered on Boullanger and Whitlock Islands in Jurien Bay, 175 km north of Perth (Fuller & Burbidge 1987). This again caused much interest and speculation on the species' conservation status. The first field studies on dibbler ecology were then initiated, with a detailed study of dibbler life history and reproduction (Lynam 1987; Dickman & Braithwaite 1992; Dickman[2] pers. comm.; Woolley 1991).

Until recently (November 1995) the only populations of dibblers currently known to be in existence were on Boullanger and Whitlock Islands. Although dibblers had been caught at several other locations along the south coast in past years, it was not known if these populations still survived. It took an exhaustive effort to relocate dibblers on the mainland by retrapping old capture sites and any "likely" adjoining areas.

2.2. ECOLOGY AND REPRODUCTION

Following the rediscovery of the dibbler in 1967, Morcombe (1967) made observations on the ecology and behaviour of *P. apicalis*. He suggested that it was semi-arboreal with some dependence on large flowers for nectar and insects, and preferred dense stands of Banksia dominated heath with a thick litter layer through which the animals moved and made their nests. These records, and that of Muir (1985), all from long-unburnt stands of vegetation, led to the assumption that dibblers were restricted to older vegetation and that frequent or extensive fire was a serious threat to their longterm conservation. This has been further supported by the findings of Chapman and Newbey (1995).This study found a population in relatively young post fire age vegetation (approximately 10 years). However the importance of fire and dibbler occurrence remains unclear. What remains to be investigated is the importance of adjoining populations post fire. The location of this source population may be an influencing factor determining the current dibbler distribution, and the apparent colonisation of relatively young post fire age vegetation in the FRNP.

[1]P.J Fuller - CALM Woodvale, [2]Dr C.R Dickman - Director of Insitute of Wildlife Research, Sydney University, [3]J Alford - CALM Wanneroo,

The Boullanger and Whitlock Islands habitat, however, is very different from that on the south coast (Keighery[4] pers. comm.). The factors determining habitat preference and species abundance and distribution on the mainland are yet to be clarified.

Lynam (1987) examined aspects of inbreeding and juvenile dispersal of the island populations, and suggested that reduced genetic variation and developmental instability (indicated by a significant morphological asymmetry) were important factors limiting these populations. He ascribed their persistence on the islands to an absence of environmental perturbations like habitat destruction and fire. However the habitat is certainly harsh and is not without considerable ongoing disturbance by humans and to a greater extent by burrowing seabirds. There is also a large population of *Mus musculus* on both islands.

Although details concerning the morphometrics of dibblers can be replicated and demonstrated in all known dibbler populations, mainland and island, the genetic findings of Lynam may be questionable (Adams[5] pers. comm.). An ongoing investigation into the genetics of dibblers from the islands and the mainland is yet to determine any significant difference between populations due to technical problems associated with replicating material from skin tissue. However preliminary results suggest that there are possible nuclear DNA differences between the island and mainland populations (Cooper & Birrell 1996).

Dickman[6] (pers. comm) carried out a three year study of the Boullanger and Whitlock Island population, examining aspects such as population dynamics and the effects of *Mus* removal, reproduction, genetic structure, histology and parasite and bacteria loads. Unfortunately, these data are as yet unpublished. No comparable information was obtained for mainland populations during this project.

Woolley (1971) obtained three of Morcombe's specimens for laboratory studies of reproduction, and determined that *P. apicalis* was unlike other *Antechinus* amongst which it was grouped. Although having only one breeding season per year, this was confined to autumn (instead of late winter to spring as in other *Antechinus* spp.), and there was some evidence from trapping data from the mainland that both males and females may breed in successive years, suggesting there was no male die-off. In his field studies, Dickman found that the Boullanger and Whitlock Island populations experienced a complete and synchronous male die-off, and suggested that the phenomenon may occur in some populations (island) but not in others (Dickman & Braithwaite 1992). By contrast Fuller & Burbidge (1987) and this research program found at least two distinct age classes in both males and females on both islands. Woolley (1991) and our recent work in FRNP sites has shown that males captured on the south coast can survive beyond their first breeding season. These data raise speculation that the life history strategy of *P. apicalis* may be quite variable, both between populations and between years within any one population. Currently in draft is a joint paper with Dickman discussing his data and that from the past two years. Apart from documenting the different age classes found in different years, there is also a discussion concerning the causal factors involved in male die-off.

[4]Dr G Keighery - CALM Woodvale.[5]Dr M Adams - Evolutionary Biology Unit, South Australian Museum, [6]Dr C R Dickman

3.0. RESEARCH AIMS

This research project set out to clarify details of *P. apicalis* distribution and ecology and identify factors which may impinge on its long term conservation. Below are the agreed scope items following a review in 1996.

a) ascertain the distribution and conservation status of *P. apicalis* in Western Australia
b) examine the species' population dynamics and habitat relationships through regular monitoring using traps and radiotracking
c) document the species' ecology in relation to potential threats, particularly fire and plant pathogens
d) prepare a draft Recovery Plan for *P. apicalis* and publications detailing the conservation status and ecology of the species

4.0 PROGRESS ON RESEARCH SCOPE ITEMS

4.1 THE DISTRIBUTION AND CONSERVATION STATUS OF *P. APICALIS* IN WESTERN AUSTRALIA.

This aim was achieved by first collating past information concerning sub-fossil distribution and then gathering all known dibbler capture/sighting records since their rediscovery in 1967 (Figure 1). The locations of these records were then used to create a priority list for the resurvey of sites (Appendix 2). Conclusions on the conservation status of *P. apicalis* were made after investigating these sites, using both previously documented ecology as well as some preliminary investigations carried out during this project.

4.1.2. Sub-fossil distribution

The sub-fossil distribution of *P. apicalis* (Figure 1.) has been determined using deposits in caves and derived from owl pellet accumulations. Dr. A. Baynes of the Western Australian Museum has been the chief investigator and a number of locations have been found over a period of years. A joint paper, currently in draft, detailing the recent dibbler research findings will include much of this previously unpublished work.

From this map it can be seen that *P. apicalis* had an extensive and generally coastal range, the only exception being a record from Peak Charles, 200 km North West of Esperance. This range covers many different habitat types from Shark Bay south to Dibbler Cave near Wanneroo. *P. apicalis,* however, is conspicuously absent from the south west corner of WA, despite the good fossil record of other species from this area (Archer & Baynes 1972). Sub-fossils are then again found from Two Peoples Bay east across the Nullabor to Coffin Bay on the Eyre Peninsula in South Australia (Baynes 1987).

This distribution suggests that *P. apicalis* preferred the drier, coastal areas and did not venture into the forest systems, which produces a distribution pattern remarkably similar to *Pseudomys shortridgei.* Within the fossil deposits, the abundance of *P. apicalis* is often lower than other dasyurid species, which also suggests that this species was rarer than many other widespread dasyurids (Baynes[7] pers. comm.). All current trapping data support these observations.

4.1.3. Resurvey of *P. apicalis* captures/sightings locations since 1967

Past locations for dibbler captures have been collated. A priority list (Appendix 2) for resurvey was created, based upon the nature of these captures and the logistics of reinvestigating these areas. The following is an account of the resurvey conducted.

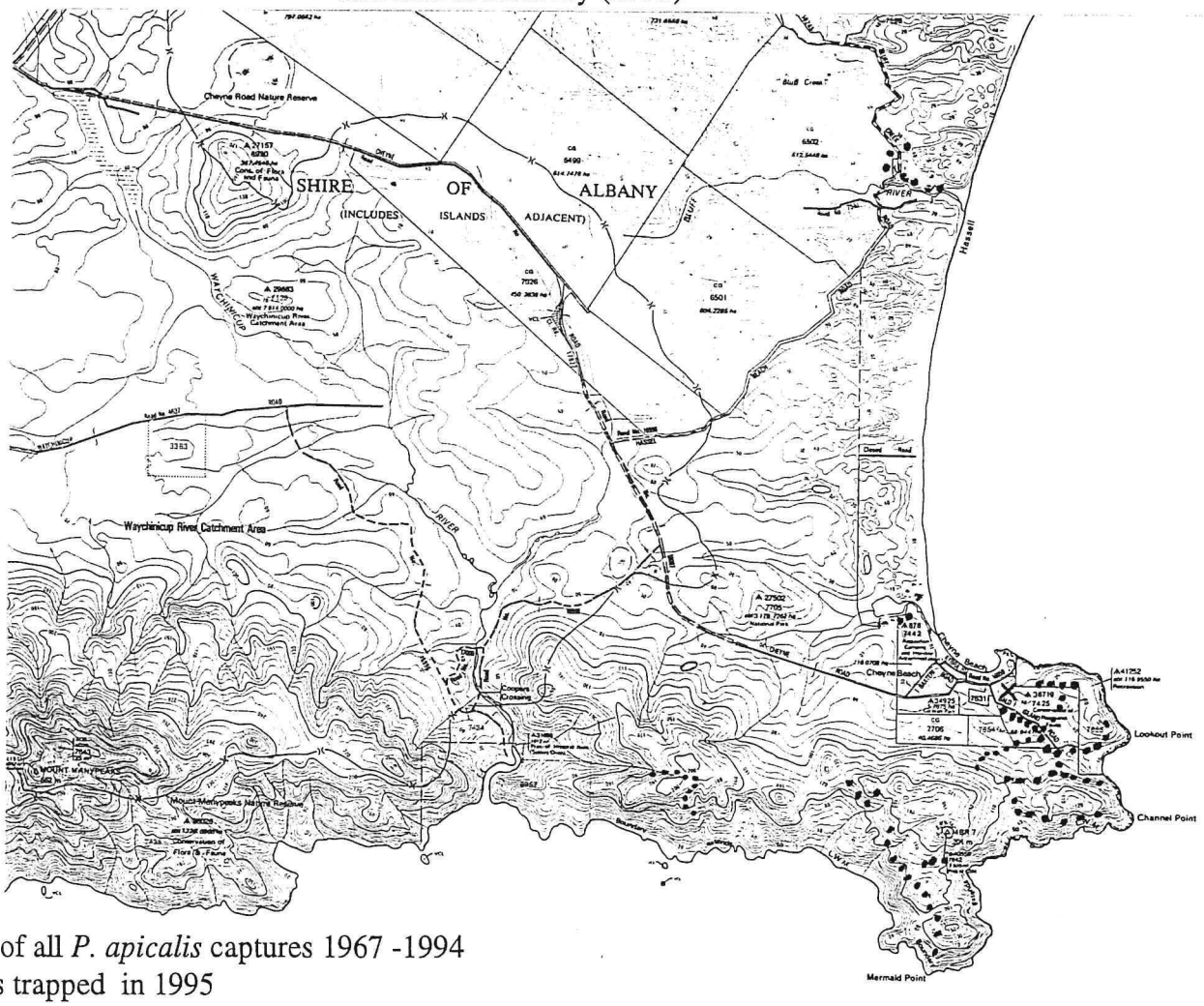
[7]Dr A Baynes - Western Australian Museum

For simplicity, the resurvey of past dibbler sites is treated separately from surveys in predicted areas.

Arpenteur Nature Reserve

The original capture (Morcombe 1967) and follow up captures (Woolley 1977) were all made in the same general area within the reserve (Figure 2.). In January 1967 Morcombe captured one male and one female dibbler. Ride later that year in April captured another female (Ride 1970). In August 1967 Baynes and Kirsch (Baynes[8] pers. comm.) trapped a female in the same area. Several further attempts in 1970 (Fuller pers comm.; Butler unpublished report) were unsuccessful. In November 1975 Woolley revisited the area and captured one male and two females. A single male was then captured by P. Udinga in this same area January 1994. This area was resurveyed in March and September 1995 (Figure 2) but no dibblers were captured (Table 1). An absence of *Tarsipes rostratus* reflects the low number of pit trap nights used as well as the lack of flowering species in this area today.

Figure 2. Arpenteur Nature Reserve dibbler capture location and area of resurvey (1995)



* = area of all *P. apicalis* captures 1967 -1994

σ = areas trapped in 1995

[8]Dr A Baynes - Western Australian Museum

Table 1. Trapping results from resurvey of Arpenteur Nature Reserve

Date	No. Animals Caught								No. Trap Nights
	Rf		Af		Mm		Ep	Ek	
	N	RT	N	RT	N	RT	N	N	
March 1995	36	59	7	6	7	3	38	1	1,350
Sept 1995	31	26	0	0	0	0	6	0	800
Total	**54**	**85**	**7**	**6**	**7**	**3**	**44**	**1**	**2,150**

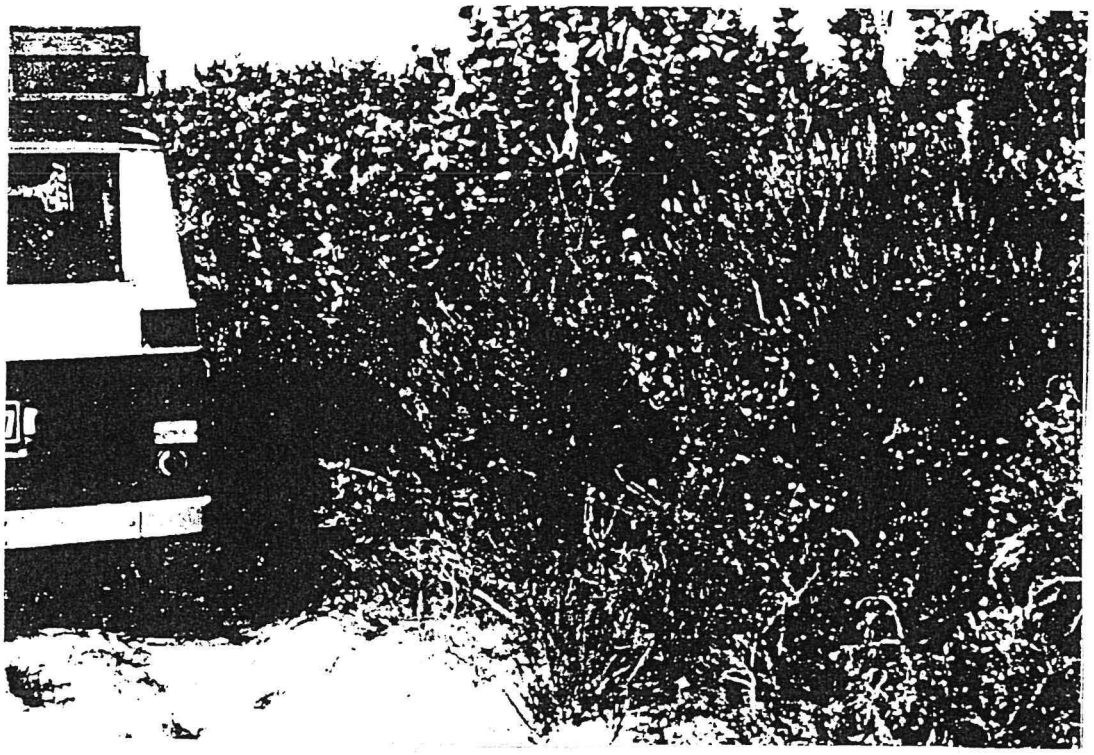
Rf = *Rattus fuscipes*, Af = *Antechinus flavipes*, Mm = *Mus musculus*, Ep = *Egernia pulchra*, Ek = *Egernia kingi*

The failure to locate dibblers in this area may be attributed to the drastic changes which this area has under gone in the last 10 years. Aerial cankers (*Diplodina* spp), *Phytophthora cinnamomi* infection and road development have had a major influence on the habitat of this area. What was once an extensive stand of *Banksia coccinea* and *Banksia baxteri* thickets is now mainly sedges with only a few isolated pockets of *B. baxteri* remaining (Figure 3 & 4.).

Figure 3. Arpenteur Nature Reserve 1995

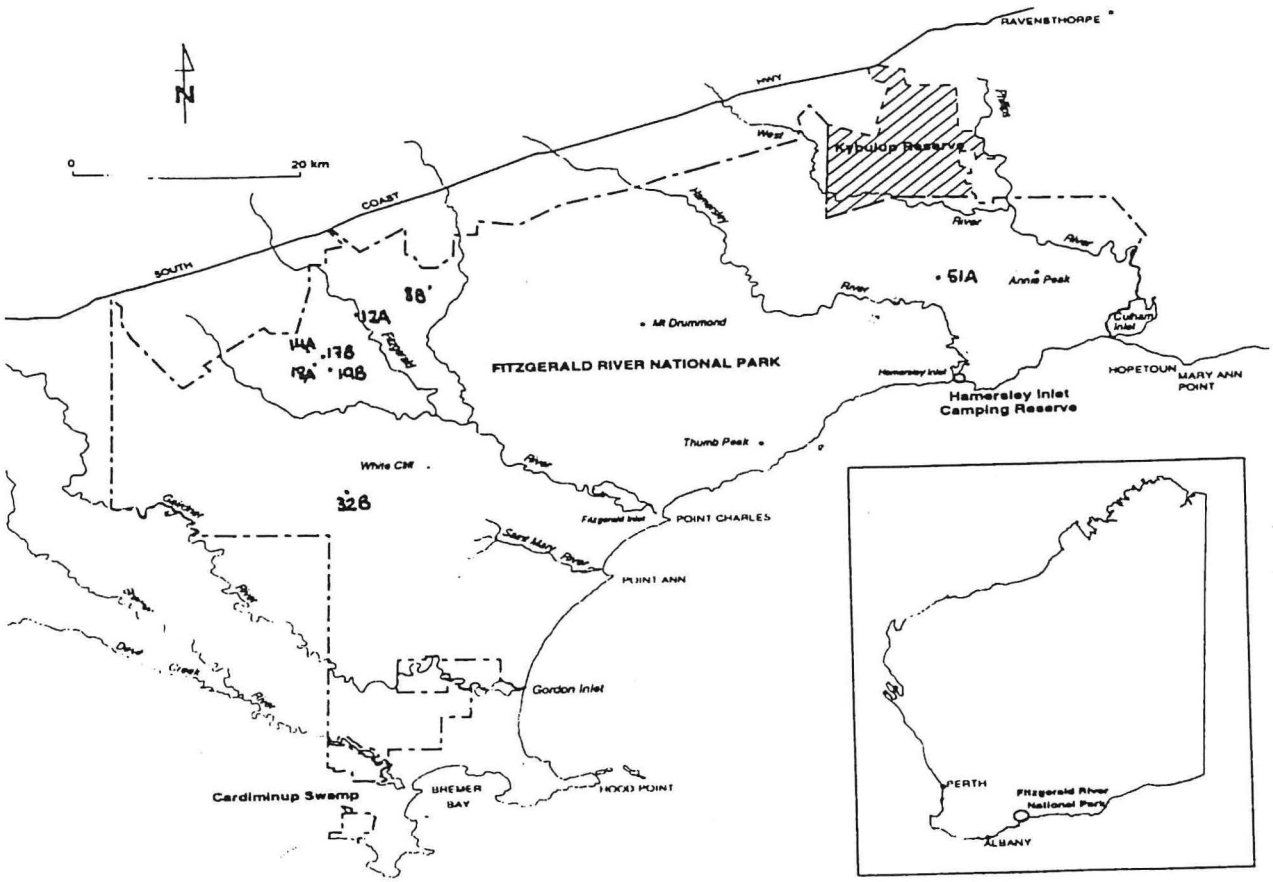
* the grey areas represent dead stands of *B. baxteri* (Photo by N. Baczocha)

Figure 4. Arpenteur Nature Reserve (from Woolley 1977)



Fitzgerald River National Park

Figure 5. Dibbler Capture Locations from the Biological Survey of the FRNP (1986-87)



Dibblers were first found in the park by G. Duxbury in 1984 (Muir 1985), when a dead individual was found on Hamersley Drive. A post mortem concluded that the animal was most likely dropped by either a cat or fox. This discovery is quoted as being a major factor in initiating a biological survey of the Fitzgerald area which took place in 1986 and 1987 (Chapman & Newbey 1995). During this survey 8 male and 7 female dibblers were captured (Appendix 4.). No data were collected other than body weights. Some photographs were taken by Babs and Bert Wells. One specimen is lodged with the WA Museum.

In 1990 a male dibbler was caught in an Elliot trap at location 18A of Chapman's sites (see Figure 5.). (L. Whisson[9] pers. comm.).

[9]L Whisson - CALM Albany

October 1994 saw four out of eight known dibbler capture sites (14A, 17B, 18A & 19B) in the FRNP burnt in a wildfire, which swept through 5000 ha of Wilderness Area. This area was resurveyed in May 1995 without success (Table 2.). However Kinnear[10] in November 1994 (pers. comm.) and Sanders in November 1996 (Sanders and Baczocha in press) have caught animals on the eastern edge of this burnt area (12A). B. Newbey[11] (pers. comm.) whilst conducting a Western Bristlebird survey observed a dibbler within this burnt area during December 1996. It is possible that on occassions dibblers may be attracted to bird calls or imitations of potential prey (ie, rustling leaves like a small lizard moving along), as reported in other dasyurid species (eg *Dasyurus hallucatus* by A. Burbidge[12] (pers. comm.) and *Phascogale tapoatafa* by N. Baczocha).

Between the efforts of this research program and that of Sanders (CALM Fitzgerald Biosphere Ecologist), most of Chapman's dibbler sites have been retrapped in 1995-96.

Table 2. below represents the combined (Kinnear, Sanders and Baczocha) trapping results of the resurvey of Chapman's dibbler sites. These sites were trapped with varying intensity, and used both Chapman's pit lines as well as additional trap lines (Elliots and pits).

Table 2. Trapping results from resurvey of some of Chapman's dibbler sites in FRNP

Date	Location	No. *P. apicalis* Caught	No. trap- nights
Nov 1994*	12A	1	unknown
May 1995	18A	0	4,222
	19B	0	
	17B	0	
Nov 1995	7A	5	350
Dec 1995	7A	0	200
Feb 1996	7A	1	150
May 1996	7A	0	200
Oct 1996	7A	0	150
Nov 1996#	12A	2	unknown
	51A	1	
	31	0	

* J. Kinnear pers comm, # A. Sanders pers comm

Regular sightings since 1985 have also been made at the ranger residence at Jacup in the north western corner of the park. Animals have been observed during the day and caught in Elliots. It seems that the animals are very conspicuous when present and were regularly seen fossicking around pot plants and in the yard at all hours. The most common time for observations was thought to be around September in the year following a wet winter(M. Lloyd, C. Hart & N. McQuoid [13]pers. comm.). However it is difficult to determine the accuracy of this statement due to the lack of detailed sighting records.

[10]Dr J Kinnear - CALM Woodvale, [11]B Newbey - Consultant Scientist, [12]A Burbidge - Director, WATSCU, [13]M Lloyd, C Hart and N McQuoid - Rangers CALM Albany.

A dead individual was found on a fire break to the south of the residence in 1989. This animal was also thought to have been dropped by a fox or cat.

Dibblers have not been sighted around the residence since summer 1991 (McQuoid[14] pers. comm).

The area around Jacup was resurveyed during 1995 and 1996 with~~out~~ ~~un~~successful ~~results~~ (Table 3). In anticipation of dibblers recolonising this area, a set of permanent pit lines have been installed for monitoring purposes.

Table 3. Trapping results from Jacup Area resurvey

Date	No. Animals Caught						No. trap-nights
May 1995 - Oct 1996	Rf	Po	Tr	Ha	Mm	L	
	2	1	7	4	4	6	305

Rf = *Rattus fuscipes*, Po = *Pseudomys occidentalis*, Tr = *Tarsipes rostratus*, Ha = *Heleioporus albopunctatus*, Mm = *Mus musculus*, L = small lizards

Torndirrup National Park

During the period December 1987 to December 1988 Smith caught two male and one female dibblers (Smith 1990). This area had been trapped previously for more than 5000 trap nights and has been regularly trapped since. No other dibblers have been captured in this location or surrounding bushland. Smith noted that all individuals were caught in dense Banksia thickets at the time of heavy flowering. All animals were caught in 60 x 150 mm deep pits, with the female being recaptured in an Elliot 200 m from the point of original capture. Several other observations were also noted and will be discussed later.

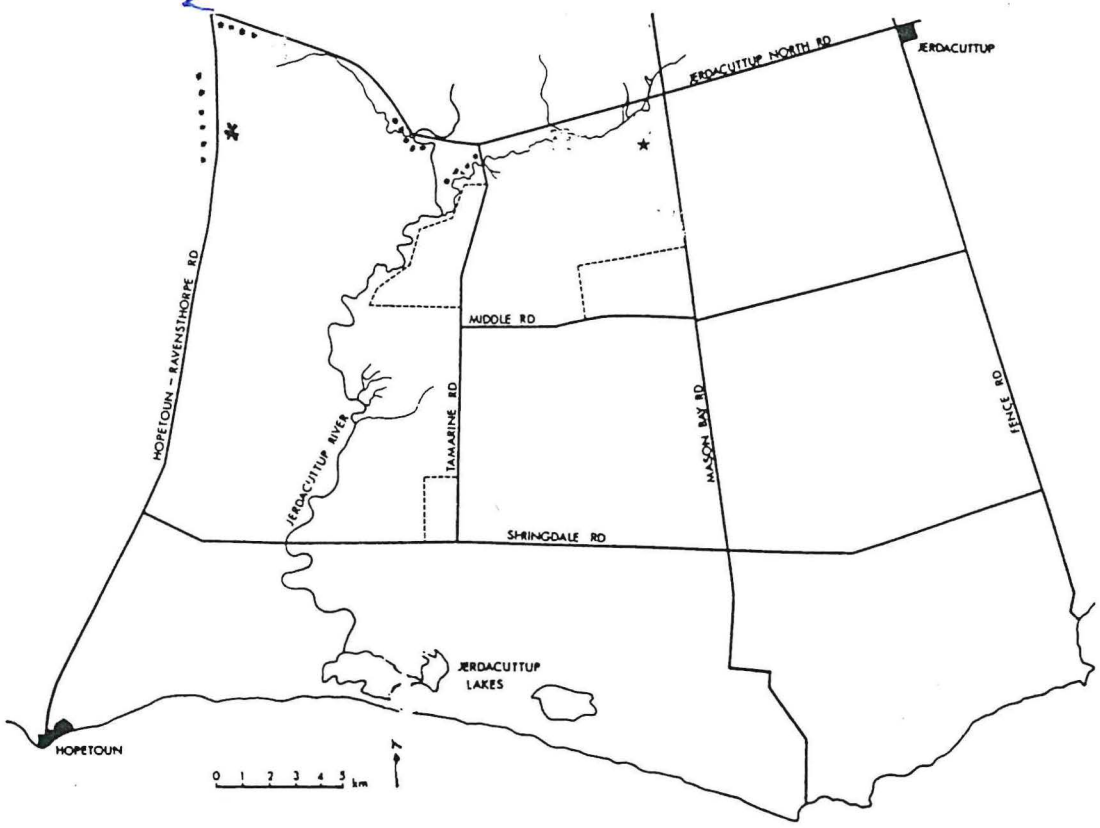
Due to this ongoing study by Smith, the dibbler locations in Torndirrup National Park were not resurveyed. However adjoining bushland was investigated as part of the survey of predicted sites.

Jerdacuttup River area

Two dibblers have been recovered from this area (Figure 7). One was caught south of Kundip Nature Reserve in a cow barn in Dec 1976. Another was brought in by a cat in January 1976, from the Jerdacuttup River area. Both these locations have been extensively surveyed by Woolley (1980) & Woolley & Valente (1982).

[14]N McQuoid - Ranger CALM Albany

Figure 7. *P. apicalis* Capture Locations in the Jerdacuttup Area



* = past dibbler capture locations, ••• = resurvey locations

Adapted from Woolley 1977

The failure to locate dibblers in this area in the past has been puzzling, however there are large expanses of bushland nearby to these properties, which eventually join the FRNP. Given the high potential mobility of this species, individuals could have travelled from a source population in the park in search of more territory and ended up in this farmland. Predicted habitats in Vacant Crown Land on the eastern boundary of the park were trapped without success (Table 4). There was a notable lack of capture of any vertebrate species during this work.

Table 4. Trapping results of resurvey in the Jerdacuttup River area ~ August 1995

Site	No. Animals Caught			No. Trap- Nights
	Rf	Mm	Tr	
Laurina Rd.	3	0	1	520
Jerdacuttup River Reserve	5	0	0	220
Bandalup Hill	18	12	3	600
Total	**26**	**12**	**4**	**1,340**

Rf = *Rattus fuscipes*, Mm = *Mus musculus*, Tr = *Tiliqua rugosa*

Boullanger & Whitlock Islands

The islands were resurveyed in Nov 1994. This produced lower trap success of dibblers than expected (Table 5.) Past work had indicated that the animals were easily trapped with minimal trap nights (Dickman[15] pers. comm). It became apparent that the population on Boullanger had declined from 2 - 10/ha (Dickman & Braithwaite 1992) to approximately 1 - 5/ha.

Table 5. Trapping results from resurvey of Boullanger Island ~ December 1994

No. Animals Caught							No. Trap Nights
Pa		Mm	Ek	Ep	Em	Ct	
Male	Female						
7	6	264	14	20	6	13	496

Pa = *Parantechinus apicalis*, Mm = *Mus musculus* ,Ek = *Egernia kingi*, Ep = *Egernia pulchra*, Em = *Egernia multiscutata*, Cf = *Ctenotus fallens*

A monitoring grid was established and several logistical problems assessed. As future monitoring was going to cause a large amount of damage by the physical crushing of the vegetation as traps were laid out and then checked (this often occurred twice a day to combat problems with extreme temperatures) it was determined that four, one week trips be conducted per year. This balanced the amount of limited damage against the vital information collected.

This degree of visitation produced satisfactory amounts of data on several issues such as population numbers, breeding times, juvenile survival percentages and related issues such as male die-off which amply fulfilled the requirements of the monitoring program set out in the project aims.

The causes of the decline are unknown but are not likely to be genetically linked (Cooper[16] pers. comm.). Other possible factors contributing to the lower density of dibblers on Boullanger could be competition with other species (such as house mice) for food or shelter or the decline in nesting seabirds on Boullanger.

At present there are only a handful of active seabird burrows on Boullanger Island. At the time of Dickman's work the whole island had been utilised by burrowing birds. Dickman identified the burrows as potential shelter sites for dibblers, but no evidence has been gathered on where nesting females deposit their young. Seabird chicks were also identified as potential food items. Circumstancial evidence suggests that there may be a link between the loss of this inhabitant and a population decrease of dibblers. The presence of house mice seems to have little impact on dibbler numbers or survival in the short term (Dickman[17] pers.comm.).

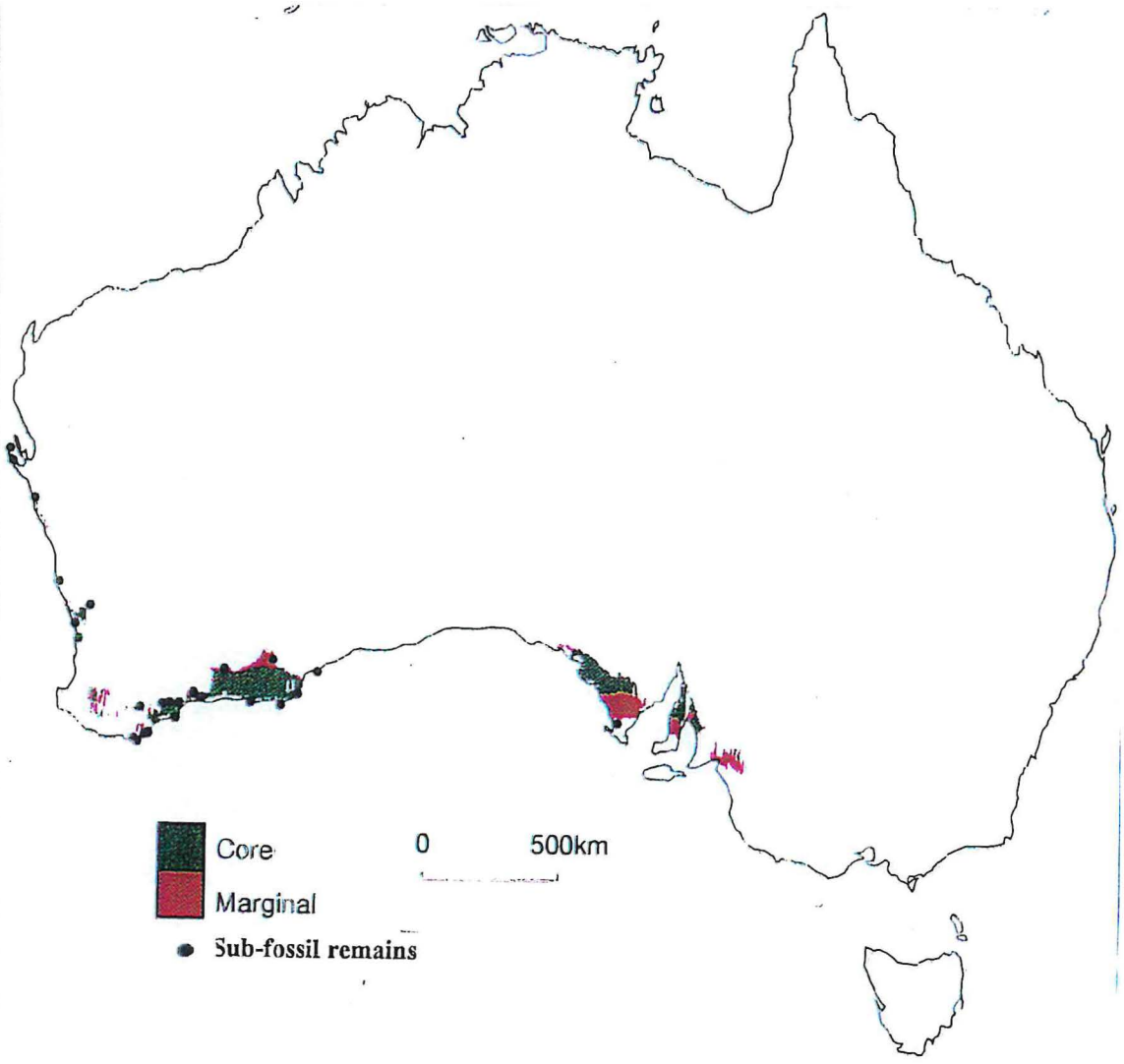
[15]Dr C R Dickman, [16]Dr S Cooper - Evolutionary Biology Unit, South Australian Museum, [17]Dr C R Dickman.

At present although the numbers on the island are lower than previously recorded, data from the last field trip (Appendix 5.) suggests that numbers may be on the increase again.

4.1.4. Survey of Predicted Sites in order of Priority

BIOCLIM prediction was generated based upon all available data by Dr. C.R. Dickman (Figure 7). The map shows clearly that the predicted sites fall within all known capture sites since 1967. Due to the decision to shorten this phase of the project the survey has not been extended beyond the Jerdacuttup River in the east and Torndirrup National Park in the west, which covers the highest priority locations (Table 6).

Figure 7. BIOCLIM ~~Predicted~~ Dibbler ~~Locations~~



Courtesy C. Dickman

The priority list generated (Appendix 2) combined areas adjoining old capture sites as well as additional predicted areas (eg Cape Riche). Logistical details such as difficulties of access, proximity to fox baited areas, fire and *Phytophthora* infection history were also taken into account.

In most areas managed by CALMs South Coast Region (and this includes most previous dibbler capture sites) access is strictly managed to reduce the introduction and spread of the plant killing pathogen, *Phytophthora cinnamomi*. Timing of the surveys and any work in these areas is restricted to dry soil conditions only. This potentially places a considerable constraint on any field work planned for the wetter months.

Table 6. Summary of the survey effort in predicted sites on the south coast

Location	Date	No. Trap Nights (Elliot & Pit traps)	No. Animals Caught			
			Pa	Ro	Ma	Re
Waychinicup NP	March 95	1,050	0	60	34	52
TPB NR	May/June 95	1,105	0	40	8	3
TNP ~ Stony Hill	May/June 95	1,274	0	82	5	0
Waychinicup NP	September 95	1,560	0	134	16	18
Bluff Creek	September 95	200	0	23	2	2
Gull Rock NP	October 95	260	0	28	0	5
TNP ~ Sharp Pt	October 95	1,045	0	41	6	6
TNP ~ Austin Rd	January 96	825	0	19	4	2
FRNP ~ Thumb Peak	January 96	636	2	49	1	0
FRNP ~ Quaalup	February 96	440	0	33	0	0
FRNP ~ Bell Trk	February 96	540	0	3	0	0
Quaranup	March 96	250	0	25	0	0
Cape Riche	March 96	800	0	32	0	0
SRNP ~ NE cnr	May 96	300	0	3	1	3
Total		**10,285**	**2**	**572**	**77**	**91**

NP = national park, TPB = Two Peoples Bay, TNP = Torndirrup National Park, FRNP = Fitzgerald River National Park, SRNP = Stirling Range National Park, Pa = *Parantechinus apicalis*, Ro = rodents, Ma = other mammals, Re = reptiles
** Number of animals does not include recaptures

Waychinicup National Park

It would seem that Cheynes Beach has suffered a serious decline in habitat quality over the past 10 years. However the likelihood of other surrounding areas, particularly in Waychinicup National Park, still providing habitat for dibblers is very high. Since the tolerance of dibblers to different habitats has been shown to be high (by other captures on the south coast), it is possible that dibblers may from time to time be found at Cheynes beach but perhaps only in low numbers.

A wide selection of microhabitats were trapped in this area (Figure. 2). Although cankers and die-back have changed some of the landscape, considerable areas of unaffected vegetation remain. It is considered that this area and west towards Two Peoples Bay Nature Reserve provides the best opportunity for dibbler captures in the future other than those in the FRNP.

Bluff Creek

This area was trapped only briefly around the mouth of the creek and along the dune system which escaped the last wildfire in 1994 (Figure 2).

This area was selected because of its proximity to the Cheynes Beach captures. It supports intact stands of *Banksia* similar to that which was found in Cheynes several years ago, but has not had a fox baiting program like Waychinicup NP. Although there is little evidence to suggest that foxes are a significant predator on dibblers, it is likely that foxes may be competing for similar resources. Common fox prey items such as invertebrates (large beetles, spiders etc), small mammals, lizards and small birds, are also known dibbler food items.

Bluff Creek is typical of much of the unexplored (in the scientific sense) coastal bushland between Cheynes Beach and FRNP. There appear to be many areas which fall within the predicted dibbler habitat criteria between Cheynes Beach and the FRNP. Most of this land is VCL with little active management. As a result many of the Banksia stands have been targets for wildflower pickers and have also been exposed to die-back as a result of vehicle traffic during wet soil conditions. Wildfires are also common along this coastline. Therefore, although this land represents possible dibbler habitat it is generally more degraded and fragmented than land found in managed reserves. Survey efforts were therefore concentrated on other areas with a higher level of management, and consequently often represented better and larger tracts of predicted dibbler habitat.

Further work in this area could prove to be successful for dibblers. However it would be logistically difficult because of access problems and the total area of land which would need to be surveyed.

Torndirrup National Park

a) Stony Hill

The oldest habitat remaining in the park is on Stony Hill, this was assessed to be the most likely area within the park which still supported a dibbler population (Figure 8). This area was trapped resulting in enormous numbers of *Rattus fuscipes*. After 1,274 trap nights 82 individual rats were tagged. There was also a high level of trap interference by foxes and also cats.

If this type of habitat is to be retrapped, it would only be fruitful if the large rat numbers could be offset by large numbers of traps and trap nights. It is possible that dibblers are no longer extant in Torndirrup, however there is still much undisturbed habitat remaining which was not surveyed.

b) Sharp Point

This area (Figure 8) was trapped since it had shown potential by there not being many *R. fuscipes*. This later turned out to be a direct result of illegal activities in this vicinity. This area still holds promise for dibblers as there are extensive tracts of undisturbed coastal vegetation, extending beyond the park westwards towards West Cape Howe NP. Beyond this, all sub-fossil evidence suggests that the increase in rainfall indicates the limit of dibbler distribution.

c) Austin Road

This area (Figure 8) contains many patches of various flowering *Banksia* sp. Several of these patches were trapped as well as extensive lines along the internal fire breaks in this area.

Geographically this location is on the north eastern side of the hill system on which Smith caught three dibblers in 1988-89. This particular area has not been surveyed by any followup attempts to find dibblers after these captures (Alford[18] pers. comm). There is a strongly likelihood that this area is good dibbler habitat but that the species has declined beyond detection.

This area has recently (January 1997) been burnt during a deliberately lit wildfire. Given the intensity of the fire, this area now probably represents unfavorable dibbler habitat and should not be considered as a priorty area for further survey work. Smith will continue to monitor this area as part of his ongoing studies.

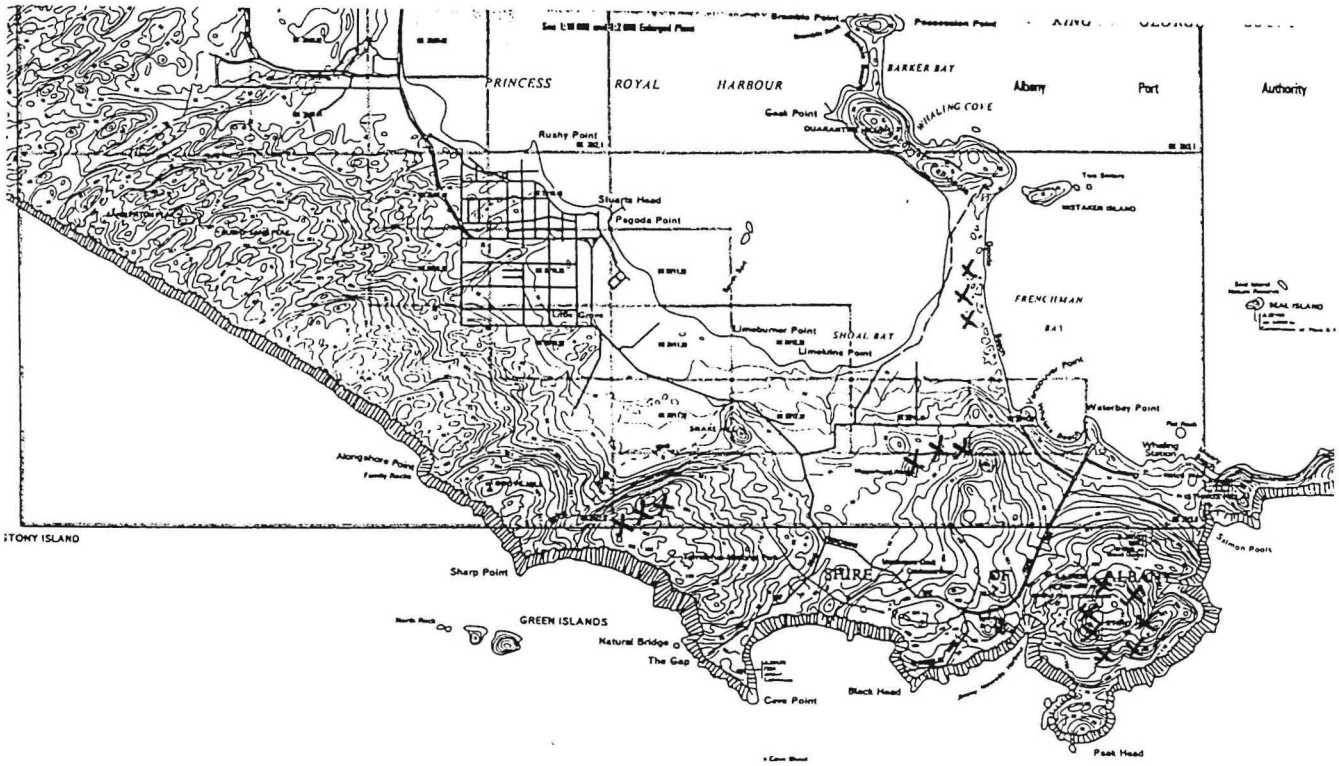
[18] J Alford - CALM Wanneroo,

Fitzgerald National Park

a) Quaalup

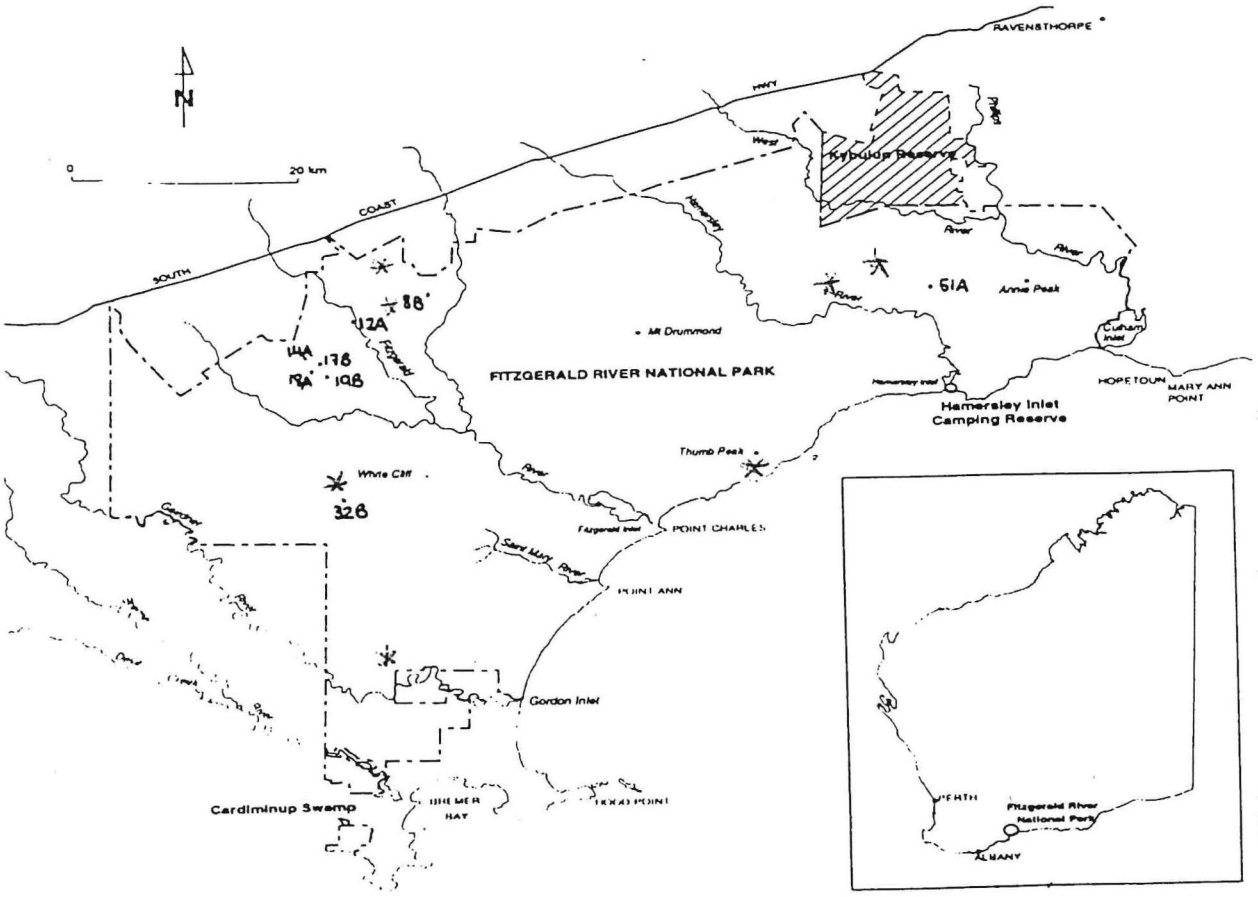
Following a reported sighting by L. Brown[19] in October 1994, the *Banksia baxteri* stands along the Quaalup road were trapped (Figure 9). Although many years of research on *Tarsipes rostratus* by Ron Wooller and Ken Richardson from Murdoch University has failed to locate a dibbler, the type of pit-traps used in this work are shallow enough to allow even a juvenile dibbler to escape.

Figure. 8 Torndirrup National Park survey locations



[19]L Brown - Ranger, Fitzgerald River National Park

Figure. 9 Fitzgerald River National Park survey locations



* = survey locations

Survey of this area has indicated that the vegetation is suitable for dibblers. Only a small area of this probable habitat was surveyed, and further work could produce positive results.

b) Thumb Peak

Following the capture of a male dibbler by S. Barrett in November 1995, a survey of this location (Figure 9) was completed in January 1996. Two more male dibblers were captured after 636 trap nights. It was later determined that although there is a population in this area, no further detailed work should be carried out. Thumb Peak and the track system leading into this area is difficult to negotiate and has restricted access. To carry out further investigative work, regular access is needed which contradicts protocol for this region of the park, as stated in the park Management Plan.

Again the presence of dibblers in this location extends our knowledge of habitat types frequented by the species to include shallow laterite soils with limited flowering potential.

Given the variety of vegetation found in dibbler capture sites, it is possible that dibblers are found through out this part of the park. The logistics of sampling areas between the northern fire line sites and Thumb Peak are prohibitive, but vegetation characteristics and fire age comparisons, indicate that much of the wilderness area is likely to be occupied by dibblers.

c) Moir Track

The prospects of capturing dibblers in this location (Figure 9) were considered high due to the close proximity to Chapman's capture site and because of the large amount of unburnt *Banksia* and mallee over heath vegetation present. However after trapping in August 1995 and that by Sanders[20] in November 1996 (pers. comm.) it seems that this area is not only depauperate in dibblers but other vertebrate animals as well. This is a puzzling result as the quality of the vegetation would suggest that this should have had a more prolific vertebrate population.

d) Bell Track

Bell Track represents a site within the FRNP which based upon its vegetation type, should have a dibbler presence. However the vegetation shows a severe expression of *P. cinnamomi* infection. Extensive trap lines were placed through the area of infection which has progressed down slope towards the Dempster River. *R. fuscipes* was the only animal caught and there were no visible signs of other rodent activity. Adjacent sites have populations of *P. occidentalis* and *P. albocinereus*, *Smithopsis griseoventer*, *Mus musculus* as well as dibblers (Newbey & Chapman 1995).

These results suggest that the die-back infection has had a substantial impact on these species. Exactly what factors are limiting the ranges of these species is as yet unknown. Mostly likely the loss of flora species has resulted in lowering the flowering potential of the area thus decreasing food sources and shelter. However the impact of die-back on dibblers is at this time speculative.

[20] A Sanders - CALM South Coast Region

Two Peoples Bay Nature Reserve

Subfossil data from Two People Bay Nature Reserve shows evidence of dibblers in the area between Rocky Point and the Lakes (Hopkins & Smith in prep.). This area was trapped on two different occasions (Figure 10). A pit line was also established in this area. *Phytophthora (*dieback) management is a high priority in the area around Mt Gardner which is a limited access Special Conservation Zone. It is unlikely that dibblers will be found in these wetter areas of the nature reserve. The lakes area and heathland towards Rocky Point seem to have more suitable vegetation.

A short venture to Coffin Island was also attempted. After an initial survey with hair tubes it was decided that it was unlikely to harbour any mammal species. Scales from *Egernia kingii* and sea bird feathers were the only material found in the hair tubes.

Gull Rock National Park

A survey of the *B. coccinea* stands within this park was conducted with no dibblers being captured (Figure 11). This type of vegetation is similar to that found at Cheynes Beach. However the abundance of *R. fuscipes* made the detection of any other species difficult. This type of vegetation is also very similar to that which can be found in the Water Corporation Catchment Area, adjacent to Two Peoples Bay Nature Reserve.

There are many other areas within this park particularly closer to the coast than this survey that hold promise of dibblers. Further work in this area is recommended.

Quaranup

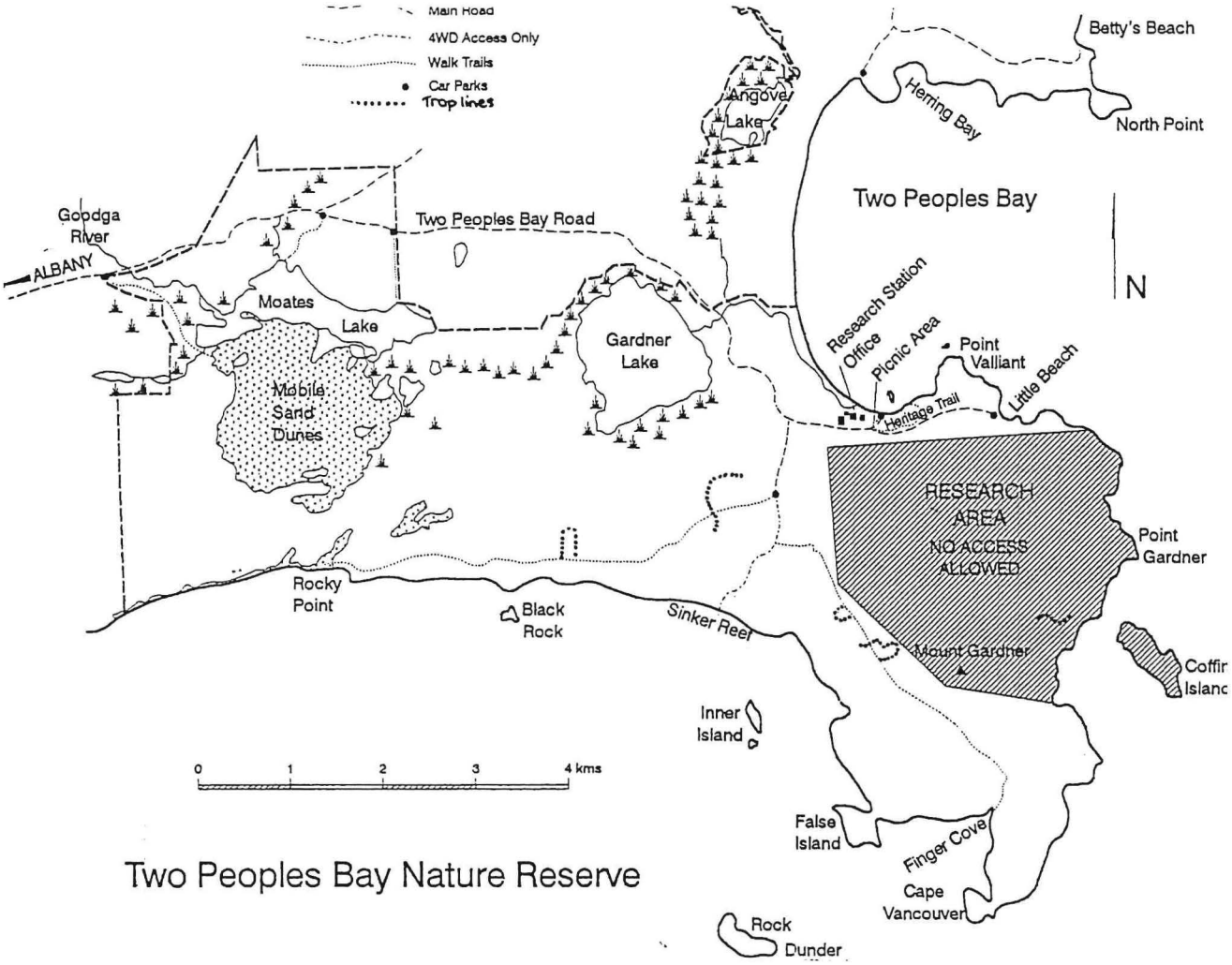
The stretch of heath and low Banksia woodland bordering Torndirrup National Park was identified as potential dibbler habitat (Figure 8). Since dibblers had been found in Torndirrup in the recent past, it was assumed that if animals were still living in the area, they might still be in other areas of long undisturbed habitat.

Quaranup provides good quality habitat with protection from fires as well as benefiting from fox baiting programs in the park. The location of this peninsula provides an unique chance for species to persist within close proximity to urban districts.

Time constraints did not enable the survey to reach the end of the peninsula, however it would be a prime location for dibblers and should be a target for any future research into dibbler distribution.

Figure. 10 Two Peoples Bay Nature Reserve survey locations

•••• = survey location



Cape Riche & Mettler Lake Nature Reserve

Like Bluff Creek, Cape Riche (Figure 12) represents a large expanse of possible dibbler habitat but the quality of this habitat is slowly eroding over time. Past surveys by local groups have shown little in the way of native species. The fire history of the Cape Riche area is one of frequent and often hot burns.

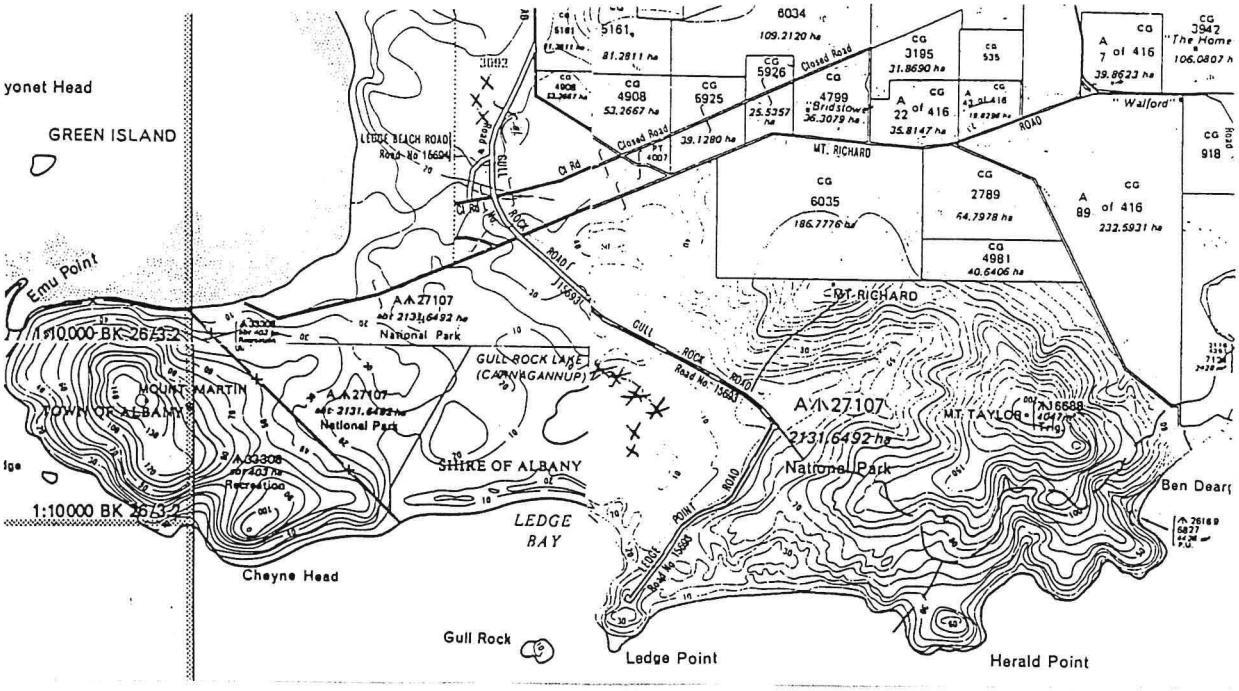
Basil Road Nature Reserve and VCL on the coast opposite Haul Off Rock and that around Cheyne Bay, were possible locations but were discounted from the priority list because of the frequent fire history. Some long unburnt patches still exist in the VCL near Mt Melville and were the subject of the survey in this area. There are however, other large pockets of old vegetation remaining throughout this area which are worthy of further study.

The northern end of Mettler Lake NR has large stands of long unburnt *Banksia baxteri.* Trap success in this area was dissappointing and futher survey is probably of limited value.

Other sites not surveyed -

Other areas that may harbour dibblers other than those discussed above are listed in Appendix 2.

Figure. 11 Gull Rock National Park survey locations



* = survey location

Figure. 12 Cape Riche and Mettler Lake survey locations

4.2. OBSERVATIONS AND ECOLOGY OF *P. APICALIS*

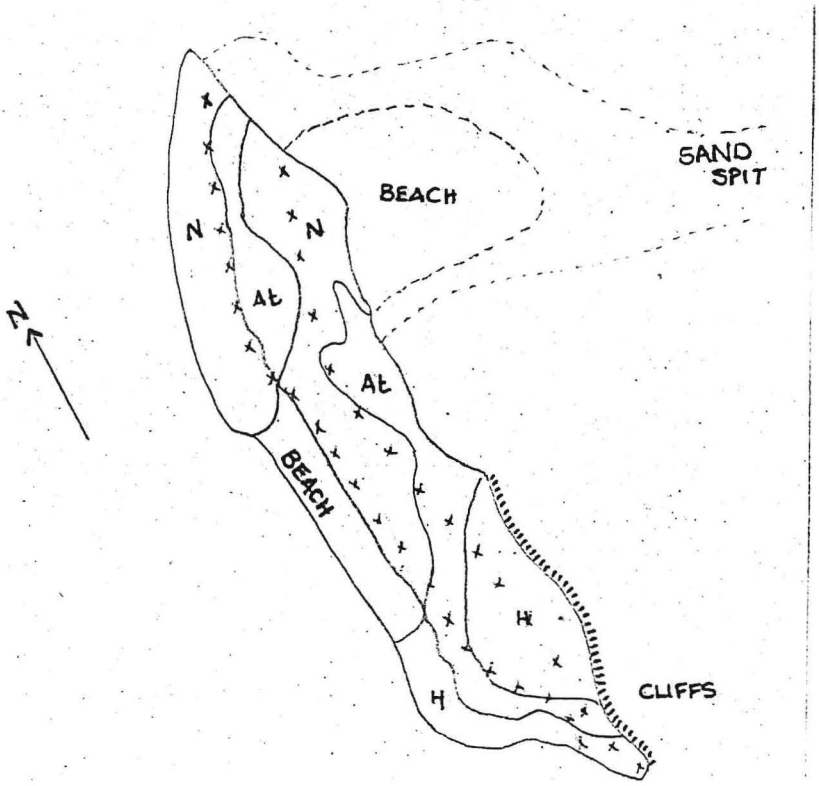
Due to limited time this aspect of the investigation is incomplete and inconclusive. However, many observations and details have been gathered. Brief details from the unpublished work of Dickman will be presented and compared with results from the island monitoring and mainland survey and consequent study. It must be remembered that Dickman's work represents a concentrated effort over a longer period of time. This project was primarily a general survey and preliminary investigation into other dibbler populations.

4.2.1. ISLAND MONITORING

P. apicalis occurrence in relation to vegetation

Most of Whitlock Island consists of a low limestone plateau covered with a low heathland association. The central area has a small "dune" system dominated by *Nitraria billardieri* (Alford & Keighery[21] unpub. data). It is this section of the island that provides the densest and also the tallest vegetation. Trap success suggests a preference for this type of habitat in comparison to the low heathland with shallow soils. Figure. 13 shows the capture locations in relation to vegetation type. (Map adapted from Alford & Keighery unpublished report).

Figure 13. Whitlock Island vegetation map & dibbler capture locations



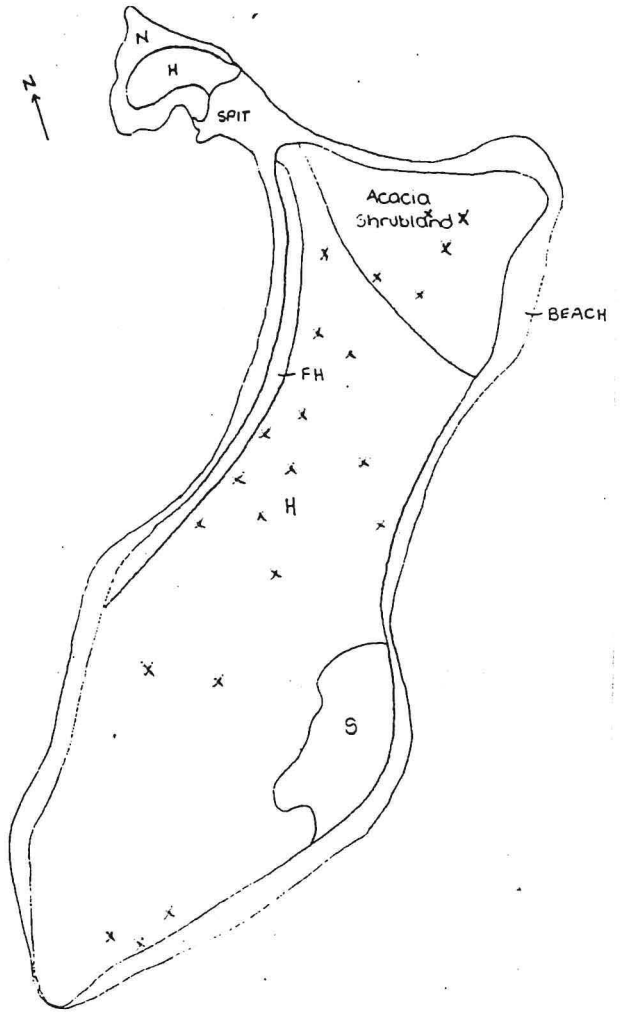
N = *Nitraria* shrubland, At = *Atriplex* heath, H = succulent heath, * = *P. apicalis* capture locations

[21] J Alford and G Keighery

In contrast Boullanger Island is composed entirely of sand apart from a limestone plateau headland. This headland is often separated from Boullanger after winter storms. No dibblers were captured on this headland during the resurvey in December 1994 and as a consequence not retrapped during monitoring events in 1995-96.

Boullanger Island is covered by a low heath with 50-100 % cover. Since the decreased activity of burrowing seabirds, the vegetation seems to have become more closed since the original survey of Alford and Keighery in 1985. They reported a canopy cover of 40-90 %. The southern end of the island seems to have also changed from a low open heath of *Olearia axillaris, Myoporum insulare* and *Scaevola crassifolia* to that of a shrubland dominated by *Acacia cyclops* over heath. Figure. 14 indicates the location of dibbler and dunnart captures in relation to the vegetation cover (map adapted from Alford and Keighery unpub data).

Figure.14. Boullanger Island vegetation map & dibbler capture locations



N = *Nitraria* shrubland, **H** = succulent heath, **FH** = fore dune heath, **S** = succulent shrubland, * = *P. apicalis* capture locations

There is no record of introduced plant pathogens on the islands and neither have burnt in recorded history. A fire strategy has been written by K. Hockey (Appendix 8.) in which is it stated that the islands represent a low fire risk area. The risk of infection by plant pathogens such as cankers and *Phytophthora* is also considered low (G. Keighery pers comm).

Island Population Density 1995-96

Appendices 5 & 6 detail results of trapping between December 1994 and March 1996. Although not many trips were made, there are enough data to show some trends in the population.

In comparison to Dickman's findings during 1986-88 the number of animals on Boullanger Island have decreased. There are insufficient data to predict a population size at the present time, however it can be said that the incidence of capture for a similar trap effort during Dickman's work is markedly low (Dickman[22] pers. comm.).

There are no obvious changes on the island which could be responsible for this drop in number. An investigation of this was beyond the scope of this project however a future study could compare the current island parameters against data collected by Dickman. For example, invertebrate and *M. musculus* numbers could be studied to see if any changes in abundance have occurred. Recent trapping results did not indicate that the mouse numbers had increased, however no work was attempted on invertebrate numbers. Another factor that could be important is the seeming lack of seabird activity on the island which may have some link to the increased vegetation cover over the past 10 years. Much more detailed studies would be needed to investigate this area further.

Male Die-off

The other major finding of this work was that unlike in years documented by Dickman, 1995 did not see a complete or synchronous male post mating die-off. Due to a cancellation of a field trip in 1996 it is unknown if there was a male die-off this breeding season as well. At this stage it seems that the die-off in males is related to dibbler population density, which in turn stimulates a hormonal change in individuals. Male die-off is a well known strategy of small dasyurid species (Dickman & Braithwaite 1992, Lee & Cockburn 1985). A paper co-authored with Dickman, documenting this aspect of the life history strategy of dibblers is currently in draft.

[22]Dr C R Dickman

Other investigations conducted

During the initial monitoring trips to both islands, several bait trials were conducted. Universal bait (rolled oats & peanut butter) was the standard base for bait. To this each one of the ingredients listed below was added one at a time. Although not all the different baits were offered at the same time, no preference was detected amongst mice or dibblers.

vanilla essence
liver digest
colour (red vs green food dye added to the universal bait)
pilchards in aspic
honey
live cockroaches (from the island)
no bait

Three male dibblers were radiocollared during December 1994. Limited information was received from these due to lack of time. A return trip to the islands a couple weeks later was postponed due to heavy seas and a mishap with transport.

When radiotracked upon release the animals immediately sought shelter in the nearest sea bird burrow. The next day they were located in the area of original capture. All animals were found to be hiding in the middle of very dense shrubs. It was assumed that the animals were located underground, but no evidence of a tunnel entrance was found in the immediate area. It is possible that the entrances were well concealed or further away from our search area (approximately 2 meter diameter circle around the point of best reception). None were excavated due to the damage this would cause to the habitat.

A research grant provided by the BankWest Landscope Visa Card enabled a genetic review of the dibbler. This work was conducted by the Evolutionary Biology Unit in the South Australian Museum. The results were inconclusive but there is some suggestion that a difference between the island and mainland populations could be detected if more refined techniques using skin tissue can be developed. This findings of this work are detailed in Appendix 3.

General Conclusions

As discussed earlier there are threats of increased environmental stress associated with continued monitoring or associated investigations, which could be causing the dibbler and dunnart populations further stress. It is therefore highly recommended that visits be kept to a minimum and further investigations be of a low impact design.

4.2.2. FRNP - A CASE STUDY FOR *P. APICALIS* ON THE MAINLAND

Reported *P. apicalis* sightings

Within FRNP dibbler captures and sightings have been reported for over 10 years from many areas of the park by many people. Unfortunately it is difficult to verify sightings, but one detail of these sightings may prove useful.

In most cases people who report dibblers sightings indicate the animal they saw either at night or during the day stood and watched them or darted across a track in front of them. One detail is also often reported, that is the upright carriage of the tail. Observations from field work have indicated that this posturing may signal agitation or a warning. To date no other small mammal has been reported with this characteristic and it is thought that this detail may help verify or even identify dibbler sightings versus other animals.

***P. apicalis* data collected 1985-1996**

Appendix 4 tabulates all known captures within FRNP. This includes data from several different sources and I gratefully acknowledge permission granted by these individuals to report their data. This record will prove a valuable tool for future reference and study into the dibbler in mainland Western Australia.

Habitat Preferences

The locations in which dibblers have been captured indicates a tolerance to a variety of vegetation types. This association is still not fully understood, data indicate a complex relationship is determining the dibblers range. However some broad statements can be made about information gathered so far.

Dibblers seem to prefer vegetation to 1 metre in height which has been unburnt for 10 years and has a high percentage of cover. Floristics in the different capture sites on the south coast vary considerably. Newbey has given detailed accounts of most of the dibbler locations (Chapman & Newbey 1995), new locations have been described in less detail in Appendix 7.

In FRNP dibblers seem also to be associated with areas with significant abundance of other vertebrate species (Sanders & Baczocha in prep). This is to date only an observation, but if investigated further may provide some interesting insights into the dibblers life history.

Threats to Dibbler populations in the FRNP

Despite the incidence of wildfire's in the FRNP, dibbler populations seem to be persisting in the historical capture areas of the park. The impacts of disturbances such as wildfires and die-back are however likely to have a long term impact on the presence of dibblers locally due to changes in habitat. All of the known sites have at least a high dieback hazard rating though the risk of introduction is considered reasonably low due to restricted access.

Trapping results from the FRNP suggest that there is some factor influencing both juvenile survival and the percentage of females becoming pregnant. This is the only site which has a lower capture rate of females regardless of season (Table 7). All other populations both on the islands (Fuller & Burbidge 1987) and the mainland (Woolley 1977; Smith 1990; Chapman & Newbey 1995) shows that the capture rate of males and females has been equal, and the recapture rate is similar again.

Table 7. Percentages of each Sex in *P. apicalis* Capture Locations (not including recaptures)

Location	% of Captures Male (n)	% of Captures Female (n)
Boullanger Island 1994-96	57.1 (49)	42.8 (49)
Whitlock Island 1994-96	54.6 (75)	45.3 (75)
FRNP 1986-87	50.0 (18)	50.0 (18)
FRNP 1995-96	**66.7 (29)**	**33.3 (29)**

This observation is at present speculative since there is inadequate data to indicate a significant difference. Only a long term intensive study would provide a basis for further discussion on this matter. This may prove an important issue for consideration in the management and conservation of the species, since if the mortality rate of females increases, the recruitment potential and basic turnover rates are greatly diminished and the population within the FRNP although wide spread may become less abundant in a short space of time. Investigative work, particularly on female and male fertility, litter sex and survivorship, mortality rates and causes should become a high priority research aim for future work.

Behavioural Observations

An attempt was made to radio-track four individuals (one female, three males). The results from this are not encouraging, as the animals seem to be moving distances at night which are beyond the tracking capabilities of the equipment available (the range of the transmitters in this terrain is < 70 metres). Results indicate that animals start moving away when approached, even when 70 - 100 metres from the observer during the day but generally remain in the same area if persued quietly. No nesting or shelter sites were identified because of this behaviour.

Radiotracking on the ground is more successful if conducted in a confined area. Dickman successfully conducted several studies using radio collared dibblers on Boullanger Island. To gather information on dibblers in FRNP a different method was adopted. Fluorescent paint pigment (Leman & Freeman 1985) was dusted onto animals prior to releasing them. The dust is traceable up to two days under certain conditions (Halfpenney 1992). Past study has also shown that this type of tracking produces less stress and change to an animals behaviour than radiotracking (Mikesic & Drikamer 1992) and can reliably show more detailed information regarding the animals movements (Goodyear 1989, McShea & Gilles 1992).

Unfortunately, due to the combination of a shortfall in time and bad weather, very little information was gathered using this method. However the potential for this technique was evident. Dibbler nesting sites were not located but confirmation of habitat use was gained. Typically dibblers seem to seek thick cover when startled and then slowly dart between thick vegetation clumps away from disturbance. They use their powerful neck and shoulders to "swim" through thick vegetation and strong claws to provide a good grip on branches. These long claws suggest a heavy reliance on an arboreal habit. Further dusting may indicate the amount of time spent in branches versus on the ground.

Spooling tracking was also trialed with little success, as the animals seem very dexterous and extremely strong. Most spools were dumped within five metres of the release point regardless of position of the spool, size or amount of adhesive used. This method was considered to be unsuccessful and could cause injury if a more substantial technique of attachment was used. Pigment dusting was considered to be the most successful and acceptable method for investigating microhabitat relationships and general behaviour of dibblers in the FRNP.

Dibblers are particularly sensitive to any noises and movement even with their eyes covered during handling. If radiotracking was adopted in the future for investigative studies of any kind, careful consideration should be made to reduce the amount of audible disturbance caused which may influence the dibblers behaviour being recorded.

Population Stability and Activity Observations

Intensive studies on dibblers in the Wilderness Area have shown that not only are the populations fairly stable over time (there have been recaptures in the same location for the duration of the last year), but individuals can move great distances in very short periods of time as well as being active at any hour. Past observations (Woolley[23] pers. comm; Dickman[24] pers comm) have noted that activity peaks at dawn and dusk.

Breeding Cycles

Signs of breeding activity (pouch staining and nipple size and activity) was seen from February through to April 1996, similar to that seen on the islands. A female with eight pouch young (crown-rump measured 11 mm) was caught in late May. Adult males have been caught at all times throughout the year.

Morphometric Observations

The instance of differing number of footpads on the hind feet of animals was studied. At present a joint paper with the W.A. Museum is documenting this in some detail. This occurrence seems to be particular to dibblers.

Dickman also used the number of different pads on hindfeet to show significant asymmetry in island animals, which could be considered an expression of genetic instability (Dickman[25] pers comm).

[23] Dr. P. Woolley, La Trobe University, [24] Dr C.R. Dickman , [25]Dr C.R. Dickman

4.3 POTENTIAL THREATS TO *P. APICALIS* POPULATIONS

Mainland populations

The impact of plant disease on dibbler communites on the mainland remains largely unknwon. However based upon past work (Wilson et al 1994) where it is suspected that plant diseases such as *P. cinnamomi* will effect both the size and thus the genetic structure and diversity of remnant dibbler populations. Demonstrated impacts have been recognised for many other mammal species both arboreal and terrestrial. Since it is suspected that dibblers utilise most layers of their habitat, it is predicted that the removal of floristic structure and plant diversity by plant diseases will have a major impact upon dibbler survival. This will occur through alterations to the understorey and litter layer, decline in plant species richness and decreased plant cover. The exact effects of these changes need to be investigated and should be considered as a high priorty aim for future studies.

Historically, dibblers are known to be a prey item of owls, particularly the barn owl. This is represented by the sub-fossil records of Baynes which are mostly taken from owl pellets within rock shelters. However the degree of predation by exotic predators (foxes and cats) is unknown and rarely recorded.

Fox and cat densities in the FRNP are thought to be fairly high, however with the advent of Western Shield (widespread aerial and ground baiting program), it is thought that these numbers will be effectively decreased. The issue of these predators being effective hunters of dibblers in the habitat in which dibblers occur within the FRNP is also questionable. Drs. Algar and Kinnear (CALM, Woodvale) are of the opinion that foxes would not find dibblers easy prey in dense undergrowth like that found at the FRNP sites, nor would cats be able to effectively use their eye sight during forays through this type of country. Therefore while it is possible that foxes and cats could be preying on dibblers, it is most likely that this pressure is not critical. However if plant diseases open up the habitat by decreasing the canopy cover and plant species in the understorey, dibblers will become more susceptible to predation.

Dibblers in FRNP have been found utilising areas of a relatively young age (as little as seven years old). This is contrary to past findings in which dibblers have only been found in long unburnt vegetation (older than 25 years, Chapman & Newbey 1995). The current management plan for FRNP indicates a need to restrict fires to relatively small blocks and maintain a mosaic rather than omit all fire to try and create an area of great age. In the past, large wildfires in this park have been exacerbated by continuous even aged vegetation of considerable post fire age (> 25 years).

Ongoing monitoring of dibbler populations pre and post fire are important issues which should be included in future research studies on the south coast. Without this information it will not be possible to refine further managment recommendations.

Island populations

A causal link may be found between dibbler and mouse diets and the nature of the limited resources on Boullanger and seasonal changes in both. Although dibblers are known predators of House mice, it may be that mice do not represent a balanced diet for a dibbler and that other prey items are necessary to maintain optimum fertility and health. Competition with House mice for items such as invertebrates may be a crucial factor impeding the rate of dibbler survival or powers of recruitment. This aspect of the islands' ecology should become a priority for future investigations.

The impact of fire on the island populations has been assessed in an unpublished report to the Interim Dibbler Recovery Team (Appendix 8.). This report outlines the action which would be taken in case of a fire, however, a verbal report has indicated that the chance of this occuring is low. Apart from deliberate arson, the incidence of wildfire from lightening strike on either Whitlock or Boullanger Island is predicited to be very low. The structure and salt covered nature of the vegetation would in the advent of fire inhibit burning at any great rate (Hockey[26] pers. comm.).

4.4. RECLASSIFICATION OF *P. APICALIS*

It is recommended that the classification of *P. apicalis* should be regularly reviewed in the light of current research. There are several points identified by the ranking schemes which to date are not possible to apply to the dibbler, due to the lack of information on the range of different populations, factors limiting range and population densities.

It should be noted that past and current researchers have indicated a concern over the current classification of dibblers. There is an amount of confusion and misunderstanding about the general biology of this species brought about by a lack of research and published data. Future research on the dibblers should aim to rectify this situation by investigating key issues relating to dibbler ecology and responses to management practises such as fire.

5.0 MEDIA COVERAGE

Public awareness of the project has been limited to local interest groups around the known capture sites and other interested naturalist groups. Due to of the animals elusive nature, small size and similar appearance to other common species, seeking public information on dibbler sightings has proven to be unproductive. Articles in local papers and the involvement of local volunteers have been the approach used to generate general public interest. Copies of these articles are held with in the Albany CALM office and by CALM Records Dept.

Several papers are also in preparation. These will cover the main issues investigated by this project and its major outcomes. One is co-authored with Dr. C.R. Dickman and Dr. G. Friend discussing the issue of male die-off. A second paper documenting the occurrence of dibblers within the FRNP will be co-authored with A. Sanders. A final paper will present the major findings and capture locations on the south coast.

6.0 INTERIM RECOVERY PLAN

At the begining of 1996 an Interim Recovery Plan was prepared and a recovery team selected. The details of this team and a copy of the Interim Recovery Plan is included in Appendix 9. This team was useful in resolving long standing problems encountered during the research as well as rationalising decisions for directions within the program. The current program will continue utilising this plan.

[26] K. Hockey - Senior Ranger Nambung National Park

7.0 CONCLUSIONS

This report addresses the actions specified by the dibbler research plan which commenced in January 1995. All scope items have been addressed, however a clearer understanding of issues such as habitat relationships and population dynamics can only be gained by many years of observations combined with field and laboratory manipulations.

The following conclusions can be made based on the work conducted in 1995/96.

MAINLAND STUDIES

- Dibblers are trappable in Elliots, cages and pit traps. The degree of trapability may be related to animal densities rather than time of year. Dibblers were not re-located at several places on the mainland where they had been previously recorded. The lack of captures may reflect local population demise or the mobility of the population.

- Dibblers were captured at six sites within the FRNP representing a broad floristic range. There are no significant vegetation features which are common to all locations, however there may be a link to areas of high vertebrate diversity. The capture of 31 animals has confirmed a widespread though probably low density occurrence in the park, which pending further survey to the east appears to be the stronghold of the species on the mainland.

- Recapture of animals over the period of one year suggests stability in the population monitored in the Fitzgerald River National Park.

- It is apparant that a male die off did not occur in Fitzgerald River National Park population during 1995/96. This may indicate a variable life history strategy.

- Evidence from this study indicates that dibblers require vegetation greater than seven years post fire. The FRNP Management Plan addresses this habitat requirement, however monitoring of dibbler population(s) in relation to age of vegetation after fire should continue.

- Radio tracking, trapping and observation suggest that animals can be highly mobile at all hours.

- Standard radio tracking procedures are not suitable for the monitoring of dibbler behaviour on the mainland due to their capacity to move quickly and a considerable distance in a short time and their intolerance of disturbance. More sophisticated equipment (ie. smaller and stronger transmitters) are required if this technique is to be pursued. Cotton spooling is also ineffective as the animals are capable of quickly removing the spools. Dusting with fluorescent pigments is at present the most appropriate technique to obtain data.

- Observations suggest that animal sightings in potential dibbler areas which feature a small mammal with tail held erect should be investigated.

ISLANDS

- No male die off occurred on the islands in 1995. The situation in 1996 is unknown.

- Dibbler numbers on Boullanger Island are lower than expected and recorded by Dickman ten years ago. Dibbler numbers on Whitlock Island seem comparable to those recorded by Dickman.

- Habitat management on the islands is critical. Future studies on these islands must endevour to protect and ensure that the habitat remains as intact and undisturbed as possible. Past research experience has shown that foot traffic must be kept to a minimum and be carefully controlled.

- Genetic studies so far have been inconclusive. However the continuation of this work may see the advancement of current technology in the use of skin tissue rather than deep tissue samples. This will allow accurate sampling of species without the need to take specimens. Once this has been acheived it will also be possible to collate a data bank which will have much importance in the foundation of a breeding colony and future translocations.

8.0 RECOMMENDATIONS

1. On a priority basis, response to fire and the impact of dieback should be studied further to determine behavioural and biological patterns. Other issues which need to be considered include mortality rates of juveniles and adults, mobility in different vegetation structures, critical habitat requirements and the relationship proposed between male die-off and population densities.

2. Continue the survey on the mainland to determine the current distribution of dibblers, and identify possible sites for future translocation of captive bred animals. A prority list of possible future survey locations is provided in Appendix 2.

3. That further public awareness campaigns on the species and its history in Western Australia be conducted.

4. Given that the numbers of dibblers on the islands has declined in the last ten years, further work should endeavour to identify factors which may have lead to this decline including the influence of *Mus* populations. This work should build upon that done by Dickman in 1988-89. Regular monitoring of the populations should also continue to identify any population trends.

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Appendix 1.

APPENDIX B - RANKING SCHEME MODIFIED AFTER MILLSAP *ET AL.* AND SCORES FOR TAXA INCLUDED IN THIS ACTION PLAN.

Modified from Millsap *et al.* 1990 and Cogger *et al.* 1993

BIOLOGICAL VARIABLES - calculate Biological Score out of 40 for questions 1-4

1 Population size - the estimated number of adults throughout the range of the taxon

a	0-500 individuals	10
b	501-1000 individuals, or the population size is unknown but suspected to be small	8
c	1001-3000 individuals	6
d	unknown population size	5
e	3001-10 000 individuals	4
f	10 001-50 000 individuals, or the population size is unknown but suspected to be large	2
g	>50 000 individuals	0

2 Population trend in Australia - overall trend in number of individuals throughout taxon's range over the last 50 years. If population trend is unknown, consider trends in the availability and condition of the taxon's habitat as indicative of population trend.

a	Population size known to be decreasing	10
b	Trend unknown but population size suspected to be decreasing.	8
c	Population formerly experienced serious declines but is presently stable or increasing	6
d	Population trend unknown	5
e	Population size stable or suspected to be stable or increasing	2
f	Population size known to be increasing	0

3 Range size in Australia - the size of area over which the taxon is distributed during the season when distribution is most restricted (eg for a species that nests over 1000 km^2 on the coast, use the breeding range).

a	<100 km^2	10
b	101-1000 km^2	9
c	1001-80 000 km^2 (up to 1% of Australia, approximately the area of Tasmania)	7
d	80 001-1 000 000 km^2 (up to 12% of Australia, or about the size of South Australia)	4
e	1 000 001-4 000 000 km^2 (about 50% of the area of Australia)	1
f	>4 000 000 km^2	0

4 Distribution trend - percentage change (since European settlement) in area occupied by the taxon. (This is an estimate of change in the portion of the total range that is occupied or utilised; it may not equal the change in total range.)

a	Area occupied has declined by 90-100%	10
b	Area occupied has declined by 75-89%	8
c	Area occupied has declined by 25-74%	5
d	Area occupied has declined by 1-24%	2
e	Area occupied is stable or has increased	0

5 Geographic population concentration - degree to which individuals within populations congregate or aggregate seasonally (eg at hibernacula, breeding sites, migration focal points) or daily (eg communal roosts) at specific locations. Implies a regular temporal compression of the distribution independent of factors considered in variables 3 and 4.

a	Majority concentrates at a single location	10
b	Concentrates at 1-25 locations	6
c	Concentrates at >25 locations	2
d	Does not concentrate	0

6 Reproductive potential for recovery - ability of the taxon to recover from serious declines in population size.

A Average number young produced per adult female per year.

a	<1 offspring per female per year	5
b	1-9 offspring per female per year	3
c	10-100 offspring per female per year	1
d	>100 offspring per female per year	0

B Minimum age at which females typically first reproduce.

a	>8 years	5
b	4-8 years	3
c	2-3 years	1
d	<2 years	0

ACTION VARIABLES - calculate Action Score out of 40

1 Knowledge of distribution in Australia (survey score).

a	Distribution is extrapolated from a few locations or knowledge limited to general maps or known only from single records, type series etc	10
b	Broad range limits or habitat associations are known, but local occurrence cannot be predicted accurately	5
c	Distribution is well known and occurrence can be accurately predicted throughout the range	0

2 Knowledge of population trend in Australia (monitoring score).

a	Not currently monitored	10
b	Monitored locally	6
c	Widespread monitoring, but not with statistical sensitivity	4
d	Widespread monitoring with statistical sensitivity, or nearly complete census	0

3 Knowledge of Australian population limitations (research score).

a	Factors affecting population size and distribution are unknown or unsubstantiated	10
b	Some factors affecting population size and distribution are known, but one or more major factors are unknown	5
c	All major factors affecting population size and distribution are known	0

4 Ongoing management activities in Australia (management score).

a	None directed primarily at the taxon	10
b	Management mostly related to enforcement of conservation laws	5
c	Some direct management/interventionist (ie manipulation of natural populations) activities in addition to enforcement of conservation laws	0

SUPPLEMENTAL VARIABLES - no scores allocated

1 Systematic significance of the taxon (select ALL categories that apply)

a Monotypic family
b Monotypic genus
c Monotypic species (no described subspecies)
d Disjunct subspecies
e Intergrading subspecies or taxonomic distinctiveness uncertain

2 Percentage of taxon's total range that occurs in Australia (select category that best applies).

a Endemic to Australian island(s)
b Endemic to Australia
c 75-99% of total range in Australia
d 50-74% of total range in Australia
e 25-49% of total range in Australia
f <25% of total range in Australia

3 Trend in taxon's Australian population (select category that best applies)

a Known to be decreasing
b Trend unknown or suspected to be declining
c Stable or increasing overall but declining in some areas
d Formerly experienced serious declines but is presently stable or increasing
e Stable or suspected to be stable or increasing
f Known to be increasing

4 Period of occurrence in Australia (select category that best applies)

a Permanent resident
b Resident during breeding season
c Resident during winter or non-breeding season
d Transient

5 **Harvest of the taxon in Australia (select category that best applies)**

a Harvested, with no legal protection

b No substantial harvest other than accidental take or harvest of nuisance animals; no legal protection

c Harvested, but harvest regulated (includes taxa utilised by Aboriginal and Torres Strait Islander communities)

d Harvest prohibited by regulation

Appendix 2.

Priority List of likely *P. apicalis* habitat in Western Australia ~ not surveyed as of Dec 1996

Location	Comments
Jurien	2 sightings have been reported (one by M.Moore) in VCL north of Jurien townsite and crossing the road east of Jurien townsite. All sightings have been made in daylight. Upright carriage of tail reported in both instances.
Leuseur NP & surrounding uncleared land	Although several surveys have been conducted in Cockleshell Gully, there is still much land remaining unsurveyed and typical of dibbler habitat.
Cape Arid NP	Sub-fossil material collected at Mt. Arid. There are several areas remaining along the coast of a long unburnt, undisturbed nature.
Israelite Bay and east	Again many areas remain long unburnt and consistent with reported dibbler habitat. No extensive surveying has ever occurred in these areas.
Waychinicup NP & Mt. Manypeaks	This area has a very diverse habitat range. Because of the long history of past captures at Cheynes Beach, it is likely that remnant populations still occur in the drier heath areas.
VCL adjoing Torndirrup NP ~ "Sandpatch"	Given past captures in the park, this area represents a similar expanse of coastal heath including some very old stands of *Banksia* sp.
Quaranup Peninsular	Again this represent an extension of the habitat in Torndirrup NP in which dibblers have been previously caught.
Cape Le Grand NP/ Stokes NP	and adjoining coastal VCL. There are many areas here which have are of long post fire age and support a diverse environment. These are often structurally similar to the area in Arpenteur NR during the 1960-70s.
FRNP	There are several unsurveyed areas within this park which have potential dibbler habitat. These areas include unburnt sections around Quaalup*, East Mt. Barren, and along Drummond & Telegraph Tracks within the wilderness area.

NP = National Park , **FRNP** = Fitzgerald River National Park , **NR** = Nature Reserve

*Given that dibblers have been found in a diverse array of vegetation types and age, predictions of potential location sites at this stage is difficult. The animals are also potentially capable of moving great distances, which would potentially allow them to access isolated pockets of suitable habitat. Consequently it is unsuitable to mention all reserves and uncleared land that could harbour dibbler populations. The table above represents general areas in which dibbler populations could be found. These areas have been selected based upon unpublished research on fossil habitat and information from surveys conducted since the animals rediscovery in 1967.

* Despite the long history of research in this area on *Tarsipes rostratus* it is likely that dibblers are present in some areas this end of the park. It is predicted that the traps used in this research would be too shallow to keep a healthy dibbler captive for long. However, this has not been tested in positive dibbler locations.

Appendix 3.

A population genetics study of *Parantechinus apicalis* using DNA sequence markers

By Steven Cooper & Jan Birrell
Evolutionary Biology Unit, South Australian Museum

Aim

Investigate the species status of mainland forms of *Parantechinus apiclais* using a mitochondrial DNA (mtDNA) sequence marker and test the hypothesis that *P. apicalis* compromises a single species.

Introduction

A previous allozyme survey of *P. apicalis* found no genetic differences between island and mainland forms of *P. apicalis* at 46 loci (Mark Adams, unpublished data). In addition, it was found that there were was no allozyme variation within the Boullanger island population. These results imply that a hypothesis that *P. apicalis* comprises a single species can not be rejected. However, low levels of variation at allozyme loci have been commonly reported for dasyurid marsupials (Baverstock *et al*, 1984), and hence allozyme electrophoresis may not reveal speciation events that have occurred more recently during the evolution of dasyurids. The d-loop region of the mitochondrial genome is known to evolve rapidly in eutherian mammals relative to single copy nuclear DNA and allozymes. It was therefore chosen as a suitable genetic marker to investigate the species status of island and mainland forms of *P. apicalis.*

Prior to the commencement of this project we used the polymerase chain reaction (PCR) procedure to amplify and sequence the d-loop region from four other dasyurid genera, *Smithopsis, Planigale, Antechinomys* and *Dasycercus.* These were used as reference sequences for an analysis of the d-loop region in *P. apicalis.*

Results

Initially, DNA was extracted from 9 ear punch samples, including 3 each from Fitzgerald River National Park, Boullanger Island and Whitlock Island using phenol-chloroform based extraction procedure. Additional ear punch tissue was available from each of these populations and was stored in alcohol.

PCR primers and conditions used to amplify the d-loop region in *Smithopsis* were initially tested with *P. apicalis* DNA but failed to amplify a specific d-loop product. A combination of primers, previously designed from other mammalian mitochondrial DNA sequences, were therefore tested and PCR amplification of an approximately 500 bp DNA fragment was obtained for one set of primers (designated m3 and m7). This fragment was amplified and sequenced from the 9 DNA samples referred to above. Three allelic sequences were detected, each differing by between 1 and 2 nucleotides. Within each population individuals were found to have identical alleles.

Comparison of this sequence, using pairwise DNA alignment program, with d-loop sequences from *Sminthopsis* and *Planigale* showed no significant regions of homology. These comparisons suggest that this *P. apicalis* sequence was not the d-loop region and is most likely to be nuclear in origin. To test this possibility DNA was extracted from frozen *P. apicalis* liver tissue (donated by the SA Museum) using a procedure that preferentially enriches for mitochondrial DNA (mtDNA) over nuclear DNA. The m3/m7 primers were found to amplify 2 fragments from this DNA sample, one of which was the same size as the fragment previously sequenced. A second combination of d-loop primers (m20/m7) were found to amplify a single 650 bp fragment from the enriched mtDNA and this fragment was purified and DNA sequenced. The sequence obtained showed significant regions of homology with d-loop sequence from *Sminthopsis crassicaudata* and *Planigale gilesi* and no regions of homology with the sequence previously derived from *P. apicalis* (Fig 1.).

The same m20/m7 primer combination, however, failed to amplify a specific PCR product from DNA extracted from ear punch tissue. To obtain d-loop sequence data from these samples, two P. apicalis-specific d-loop primers were designed and synthesised. Recent experiments carried out to optimise PCR amplifications using these primers, resulted in sequence being obtained from on either specimen. The 8 other DNA samples obtained from skin tissue failed to show PCR amplification of the predicted d-loop product. To date, d-loop sequence data has been obtained from two *P. apicalis* individuals, both of which were collected from Boullanger Island.

Discussion

Due to a number of major difficulties we have been unable to obtain mtDNA sequence data from mainland WA and Whitlock Island populations of *P. apicalis* and, therefore, can not address the hypothesis that island and mainland forms of *P. apicalis* comprise a single species. A possible reason for these technical problems is that mtDNA is not present in high copy number in the skin cells of ear punch tissue. In contrast, liver tissue provides a rich source of mtDNA and was used successfully to PCR amplify the d-loop region from *P. apicalis*. DNA samples are currently being extracted, using mtDNA enrichment procedure, from frozen liver tissues stored at the SA Museum and will be used to obtain d-loop sequence data from a mainland specimen of *P. apicalis* and *P. bilarni*. Liver tissue from a Whitlock Island specimen of *P. apicalis* is currently unavailable. These data, although limited, will enable us to assess the level of variation in the d-loop region between the island and mainland forms of *P. apicalis* and determine whether further sample would be necessary to complete the study.

Using the primer combination m7/m3 sequence data was also obtained from a DNA fragment that is likely to be nuclear in origin. Three allelic sequence variants were detected each of which were geographically localised. Although preliminary in nature these results suggest possible nuclear DNA differences between each of thee populations. However, further data is required to estimate the frequency of each allele in the 3 populations and test this possibility. Techniques can be developed t identify the variable nucleotide sites in each allele without the use of DNA sequencing and would greatly facilitate the use of DNA marker in future population studies of *P. apicalis.*

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Fig. 1. DNA sequence alignment of a portion of the d-loop from *P. apicalis* (dibblerm7/) with d-loop sequences from *Planagale gilesi* (6/12Pgil-w) and *Sminthopsis crassicaudata* (4/17psmb9).

```
dibblerm7/      CACTTTTATTTCTTCAGAATTCACTAACATATGTATTAATATATATTTAT
6/12Pgil-w      CA-----A-GT------AAATTACATATA-ATGAATTAATAAATATTTAT
4/17psmb9       CA-----ATGT------AAATTACATATC-ATGTTACAATAAATATTTAT
                **     *  *      ** * **  *   ***    **** ********

dibblerm7/      GTATATAGAGCATACATTTATATACCTCTAGCATATATTAATATACATAT
6/12Pgil-w      GTATATAGAGCATACATTTATATACCTCTAGCATATAATAATATACATAT
4/17psmb9       GTATATAGAGCATACATTTATTTACCACTAGCATATAATAATATACATAA
                ********************** **** ********** **********

dibblerm7/      TAACTAAGTATTACTAAATACATTAATATATTATATTGCTATAAATTAAT
6/12Pgil-w      TTATCATACATTACTAAATACATTAATTTAA-GTATTATTAATAATGA-T
4/17psmb9       TAATCATATATTACTAAATACATTAATATAA-GTATTACTAATAATTA-T
                * *  *   ******************** **   ****  **  *** * *

dibblerm7/      ATAAATACATTCATATCATAAATTAATATAATCTCATAATAGTACATAAT
6/12Pgil-w      TTAA-TACATGCATATCTTAACCTAATATA-TATCATA-TAGTACATACT
4/17psmb9       ATAA-GACATGCAGATCATTACCTAATAAA-TCTCATA-TAGTACATAAT
                 ***  **** ** *** * *  ***** * * ***** ********* *

dibblerm7/      ACATAATATGTATATATTACATAAGACATATAATGTTGGCGTACATAGAC
6/12Pgil-w      ACATATTATGTATATATTACATAAGACATTACATGTTGGCGTACATAGAC
4/17psmb9       ACATAATATGTATATATTACATAAGACATTATATGTTGGCGTACATAGAC
                ***** ************************   ******************
```

Appendix 4.

P. apicalis data collected from FRNP 1985 - 1996

SITE	DATE	ID #	N/R/RT	SEX	WT (g)	HL (mm)	COMMENTS
12A	8/16/85		N	M	23		# DIED IN CAPTIVITY, sent to WA Museum
18A	8/20/85		N	F	?		# 8 DISTENDED TEATS
18A	8/22/85		N	M	28.5		# PHOTOGRAPHED AND RELEASED
18A	8/24/85		RT	M	28.5		#
32B	9/29/85		N	M	60		#
32B	12/8/85		RT	M	119		#
18A	2/8/86		N	F	39		# KEPT FOR PHOTO, RELEASED 11/2/86
14A	2/10/86		N	F	49.5		# PIT TRAPPED
18A	2/11/86		N	M	77		# PIT TRAPPED, KEPT FOR PHOTO, RELEASED 13/2/86
17B	2/12/86		N	F	76.5		# PIT TRAPPED, 8 SMALL TEATS
51A	2/15/86		N	M	93		# PIT TRAPPED
51A	2/15/86		RT	M	106		# PIT TRAPPED
8B	2/19/86		N	M	115		# PIT TRAPPED
19B	3/7/86		N	F	67		# PIT TRAPPED
51A	11/28/86		N	F	76.5		# PIT TRAPPED
51A	11/29/86		N	F	48.5		#
51A	12/2/86		N	M	71.5		# PIT TRAPPED, ORANGE MITES AROUND ANUS
18A	12/16/90		N	M	82	43.0	CAUGHT BY L. WHISSON
12A	11/10/94		N	?	?		PIT TRAPPED BY J. KINNEAR
TWIN FIRE BREAK	11/8/95	1	N	M	58	39.1	COLLARED
FR9	11/9/95	3	N	F	40	39.8	COLLARED
TWIN FIRE BREAK	11/10/95	4	N	M	61.5	40.4	COLLARED
FR9	11/10/95	5	N	M	63	39.3	COLLARED
TWIN FIRE BREAK	11/11/95	6	N	M	75	41.1	
TWIN FIRE BREAK	11/11/95	7	N	F	44	39.1	NO POUCH DEV
FR9	11/12/95	10	N	M	77		
TWIN FIRE BREAK	11/12/95	8	N	F	43	37.8	
TWIN FIRE BREAK	11/12/95	0	N	0	0		ESCAPED
FR9	11/12/95	9	N	M	94	39.3	
FR9	11/13/95	3	RT	F	42		COLLAR TIGHTENED
TWIN FIRE BREAK	11/13/95	11	N	M	80	41.6	
TWIN FIRE BREAK	11/14/95	4	RT	M	58		OLD INJURY ON BACK OF SKULL
THUMB PEAK	11/15/95	12	N	M	70	41.5	CAUGHT IN CAGE BY S. BARRETT ON TWIN BAYS TRACK
TWIN FIRE BREAK	11/15/95	1	RT	M	60		
FR9	11/15/95	13	N	F	62	41.7	ELONGATED NIPPLES (8)
FR9	11/15/95	5	RT	M	75		COLLAR REMOVED
TWIN FIRE BREAK	11/17/95	8	RT	F	45		
THUMB PEAK	1/22/96	1	N	M	104	46.1	
THUMB PEAK	1/25/96	2	N	M	105	45.1	CAUGHT NEAR LOCATION OF NO. 11

SITE	DATE	ID #	N/R/RT	SEX	WT (g)	HL (mm)	COMMENTS
FR9	2/5/96	3	R	F	66	42.7	COLLAR RETRIVED. NO POUCH DEV
TWIN FIRE BREAK	2/5/96	16	N	M	118	44.8	
TWIN FIRE BREAK	2/22/96	17	N	F	68	43.2	CLOACA SWOLLEN, NIPPLES RECESSED, FAINT POUCH STAINING
TWIN FIRE BREAK	2/22/96	8	R	F	65	42.0	NIPPLES RECESSED, NO POUCH STAINING, CLOACA SWOLLEN
TWIN FIRE BREAK	2/22/96	16	R	M	125	46.0	
TWIN FIRE BREAK	2/23/96	16	RT	M	120		MOVED 600m IN 20 MIN
TWIN FIRE BREAK	2/23/96	16	RT	M	115		
TWIN FIRE BREAK	2/23/96	18	N	M	91	45.0	RIGHT CANINE WORN
TWIN FIRE BREAK	2/23/96	19	N	M	117	47.2	
TWIN FIRE BREAK	2/23/96	20	N	M	121	47.6	CLOACA SWOLLEN, R FLANK WOUNDED, COVERED IN SMALL TICKS
TWIN FIRE BREAK	4/17/96	19	RT	M	94	44.7	IN EXCELLENT CONDITION
TWIN FIRE BREAK	4/18/96	21	N	F	71	41.1	POUCH DEV NIPPLES RECESSED
TWIN FIRE BREAK	/96	6	R	M	84	42.4	
TWIN FIRE BREAK	5/28/96	16	R	M	105	34.5	ORANGE EAR MITES AT BASE OF EAR
TWIN FIRE BREAK	5/29/96	16	RT	M	108		
TWIN FIRE BREAK	5/30/96	16	RT	M	108		
TWIN FIRE BREAK	5/30/96	16	RT	M	113		MAY HAVE BEEN No. 6
TWIN FIRE BREAK	5/30/96	25	N	F	85	43.3	8 PY CR 11.5 CAUGHT LATE PM (1700HRS)
TWIN FIRE BREAK	9/13/96	8	R	F	62	38.9	LACTATING, 8 ACTIVE NIPPLES
TWIN FIRE BREAK	9/13/96	6	R	M	90	42.4	SPOOLED PM
TWIN FIRE BREAK	9/13/96	22	N	F	32	36.1	JUVENILE, SPOOLED PM
TWIN FIRE BREAK	9/14/96	24	N	F	32	35.6	JUVENILE
TWIN FIRE BREAK	9/14/96	23	N	M	37	34.8	JUVENILE, BROKEN TAIL 1/2 WAY DOWN
TWIN FIRE BREAK	10/23/96	26	N	M	71	43.2	NOT THIS YEAR'S YOUNG
TWIN FIRE BREAK	10/23/96	6	R	M	100	43.3	
TWIN FIRE BREAK	10/24/96	26	RT	M	82		
TWIN FIRE BREAK	10/25/96	27	N	M	70	43.1	
TWIN FIRE BREAK	10/25/96	26	RT	M	70	42.0	

SITE	DATE	ID #	N/R/RT	SEX	WT (g)	HL (mm)	COMMENTS
12A	10/29/96	28	N	M	68.5	40.0	*
12A	10/30/96	29	N	F	48.0	37.0	*ORANGE MITES AROUND ANUS
7km E Quiss Rd	11/1/96	30	N	M	60.0	40.8	*ORANGE MITES AROUND ANUS
3km E 14A	11/1/96		N				*ESCAPED
51A	11/8/96	31	N	M	55.5	39.0	*ORANGE MITES AROUND ANUS

Caught by A. Chapman
* Caught by A. Sanders
~ the date is written month/day/year to show seasonal differences

N = not previously caught, **R** = recapture from a previous trip, **RT** = recapture from same trip
HL = Head length

Appendix 5.

Trapping results from ***P. apicalis*** captures on Boullanger Island ~ December 1994 - March 1996

Date	Id	N/R/Rt	Sex	WT (g)	HL (mm)	Comments
12/7/94	1	N	M	50	36.9	
12/8/94	7	N	M	35	36.0	
12/8/94	8	N	F	32	37.2	NO TEAT/POUCH DEV
12/8/94	50	N	F	34	39.1	NO TEAT/POUCH DEV
12/8/94	6	N	M	49	37.4	COLLARED
12/8/94	5	N	M	44	37.1	COLLARED
12/8/94	4	N	M	45	36.9	COLLARED
12/8/94	3	N	F	47	36.9	3 DEV TEATS (2 RECESSED)
12/8/94	2	N	F	33	35.6	NO POUCH DEV 3+ NIPPLES
12/9/94	51	N	M	42	36.0	
12/9/94	10	N	M	50	39.1	
12/9/94	52	N	F	34	29.5	NO TEAT/POUCH DEV
12/9/94	9	N	F	40	35.4	
2/8/95	11	N	M	37	38.8	
2/8/95		N	F	42	35.9	DEAD IN TRAP ,NO POUCH/TEAT DEV
2/8/95		N	M	80	40	DEAD IN TRAP
2/8/95		N	M	65	39.3	DEAD IN TRAP
2/9/95	13	N	M	68	41.9	
2/9/95	12	N	F	56	38.3	8 TEATS, DEV POUCH
2/9/95	14	N	F	46	37.9	8 TEATS, NO POUCH DEV
3/8/95	2	R	F	57	38.3	DEV POUCH, 8 DEV NIPPLES
3/9/95	17	N	F	43	26.8	NO POUCH DEV, 8 NIPPLES
3/9/95	16	N	F	43	35.0	NO POUCH DEV, 8 NIPPLES
3/10/95	18	N	M	83	39.3	LARGE ADULT MALE
3/10/95	14	R	F	48	37.2	LITTLE POUCH DEV, ID LOOKS LIKE #24
4/4/95	80	N	M	50.5	39.7	
4/5/95	24	R	F	38.5	37.0	NO POUCH DEV
4/6/95	12	R	F	46	38.3	POUCH STAINING & DEV, GROWTHS ON EAR
4/7/95	4	R	M	46.5	38.7	
4/7/95	20	N	M	53	39.8	
4/7/95	24	RT	F			
4/7/95	19	N	M	50.5	37.7	VERY BONY/SWOLLEN ANUS
4/7/95	21	N	F	44	37.7	POUCH STAINING & DEV/OLD BREAK 2/3 FROM BASE OF TAIL
9/5/95	20	R	M	51	36.9	
9/5/95	25	N	F	36	36.5	1 EXTENDED NIPPLE
9/6/95	10	R	F	48	37.7	MAYBE #20? 8 ACTIVE NIPPLES
9/6/95	26	N	M	24	31.0	JUVENILE
9/8/95	20	RT	F	47	36.9	8 LACTATING NIPPLES

Date	Id	N/R/Rt	Sex	WT (g)	HL (mm)	Comments
12/6/95	63	N	M	68	39.0	
12/6/95	66	N	F	35	34.5	SCAR BETWEEN EYES
12/6/95	64	N	M	48	37.0	
12/6/95	62	N	M	60	38.1	
12/6/95	67	N	F	37	36.0	NO POUCH DEV
12/6/95	60	N	M	46	37.7	
12/6/95	59	N	M	54	38.2	
12/6/95	58	N	F	37	35.3	NO POUCH DEV
12/6/95	57	N	F	34	35.2	NO POUCH DEV
12/6/95	56	N	F	34	35.6	NO POUCH DEV
12/6/95	55	N	M	57	38.4	
12/6/95	54	N	M	49	38.2	
12/6/95	53	N	M	55	40.4	
12/6/95			M	52		ESC
12/6/95	65	N	M	58	37.8	
12/7/95	63	RT	M	65		
12/7/95	21	R	F	50	39.2	TAIL BROKEN 2/3 FROM BASE TAIL, NO POUCH ACTIVITY
12/7/95	23	N	F	39	38.1	NO POUCH DEV, UNBRED
12/7/95	22	N	M	55	39.7	
12/7/95	69	N	M	53	39.2	
12/7/95	68	N	F	50	35.3	REGRESSED POUCH, 7 NIPPLES
12/7/95	67	N	M	52	36.0	LUMP ABOVE LEFT EYE/NOSE
12/7/95	70	N	F	40	36.5	
3/26/96	2	R	F	53	38.3	SWOLLEN NIPPLES, POUCH DEV
3/27/96	20	R	M	75	42.1	
3/27/96	2	RT	F	58		
3/28/96	67	R	M	70	40.9	GOOD CONDITION
3/28/96	2	RT	F	55		

* the date is written month/day/year to show seasonal differences
N = not previously caught, **R** = recapture from a previous trip, **RT** = recapture from same trip
HL = Head length

Appendix 6.

Trapping results from *P. apicalis* on Whitlock Island ~ February 1995 - March 1996

Date	Id #	N/R/Rt	Sex	WT (g)	HL (mm)	Comments
2/7/95	53	N	F	36.5	34.1	
2/7/95	50	N	M	58	36.9	
2/7/95	51	N	F	35.5	32.4	NO POUCH/TEAT DEV
2/7/95	52	N	M	47.5	34.5	
2/8/95	51	RT	F			
2/8/95		N	F	43		ESCAPED
2/8/95	55	N	M	52	37.5	
2/8/95	64	R	M	63	37.4	EARS HAD OLD NOTCHES, NOT OURS !!
2/8/95	54	N	M	65.5	37.5	
2/8/95	58	N	M	47	35.8	
2/8/95	57	N	F	46	34.1	DEV POUCH WITH MITES (left ear tear bw 2 &4)
2/8/95	56	N	M	48	36.5	
2/8/95		N	F	36	35.3	NO TEAT/POUCH DEV, DEAD IN TRAP
2/8/95	59	N	F	40	37.4	NO TEAT/POUCH DEV
2/8/95	60	N	M	36	34.3	SEMI SCROTAL
2/9/95	62	N	M	36	35	SEMI SCROTAL
2/9/95	64	N	M	51	35.6	
2/9/95	65	N	F	44	35.3	DEV POUCH
2/9/95	66	N	F	35	34.2	NO TEAT/POUCH DEV
2/9/95	63	N	F	47	33.3	black specks (ticks ?) in pouch ~ <1mm diam
2/9/95	61	N	M	37	34.1	SEMI SCROTAL
3/8/95						ESCAPED
3/8/95	67	N	F	41	35.8	NO POUCH DEV
3/8/95	66	R	F	39	35.4	NO POUCH DEV
3/8/95	51	R	F	38	34.6	NO POUCH DEV
3/8/95	70	N	M	64	37.3	
3/8/95	68	N	F	45	35.3	VERY SLIGHT POUCH DEV
3/8/95	56	R	M	53	36.7	
3/8/95	69	N	F	43	36.1	DEV POUCH (2ND YEAR ?)
3/8/95		R	F	36.5	34.3	NO POUCH DEV
3/9/95	71	N	M	66	37.8	
3/9/95	72	N	M	56	36.6	
3/10/95	71	RT	M	61		
3/10/95	73	N	M	48	36.4	
3/10/95	59	R	F	34	35.1	NO POUCH DEV
3/10/95	66	RT	F	37		
3/10/95	76	N	M	52	39.2	FLEAS?
3/10/95	75	N	F	45	36.7	SOME POUCH DEV
3/10/95			M			ESCAPED
3/10/95	74	N	M	57	37.5	

Date	Id #	N/R/Rt	Sex	WT (g)	HL (mm)	Comments
4/4/95		ESC				ESCAPED
4/4/95	2	N	F	34	34.2	POUCH DEV
4/4/95	1	N	F	33	34.9	POUCH DEV
4/4/95	4	N	F	52	35.9	POUCH DEV & STAINING
4/4/95	3	N	F	35	36.4	SOME POUCH DEV
4/4/95	6	N	M	44	36.7	pushed trap door down during the day, after 11am
4/4/95	69	R	F	37	36.7	SOME POUCH DEV & STAINING
4/4/95	66	R	F	38	35.1	POUCH DEV & STAINING
4/4/95	75	R	F	37	35.3	SOME POUCH DEV & STAINING
4/4/95	5	N	F	37	36.4	POUCH DEV & STAINING
4/4/95	60	R	F	33	34.5	SOME POUCH DEV
4/5/95	65	R	F			
4/5/95	7	N	F	34	36.2	SOME POUCH DEV
4/5/95	69	R	M	47	38.2	EAR NOTCH UNCLEAR
4/5/95	60	R	M	52	36	LIGHTER COLORING
4/5/95	67	R	F	43	36	pouch dev & staining/lighter sandy coloring
4/5/95	12	N	F	41	37	POUCH DEV & STAINING
4/5/95	60	R	F	38	35.7	" "/EAR NOTCH UNCLEAR
4/5/95	11	N	F	35	33.6	" "
4/5/95	63	R	F	46	33.2	POUCH DEV & STAINING
4/5/95	6	RT	M			
4/5/95	64	R	M	45	37.8	
4/5/95	10	N	M	46	35.7	CALLOSED BREAK ON TAIL TIP
4/5/95	66	RT	F			large scab b/w shoulder blades (bird attack?)
4/5/95	9	N	M	44	36.7	VENTRAL HAIR LOSS ON TAIL
4/5/95	8	N	M	44	36.5	tip of tail broken/ventral hair loss on tail
4/5/95	72	R	M	47	37.3	
4/5/95	70	R	M	42	35.9	
4/5/95	69	RT	F			
4/5/95	74	R	M	47	38.9	
4/6/95	13	N	F	40	37	some pouch dev/old tail break midway along tail
4/6/95	67	RT?	F	39	32	NO POUCH DEV
4/6/95	52	R	M	31	35.6	
4/6/95	76	RT	M			
4/6/95	72	RT	M			PENDULUS TESTES
4/6/95	2	RT	F			
4/6/95	64	RT	M			
4/6/95	71	R	M	46	37.9	
4/6/95	7	RT	F	31		
4/6/95	14	N	M	42	34.8	
4/6/95	76	R	M		35.6	PENDULUS TESTES
4/6/95	66	RT	F			
4/7/95	59	R	F	37	32.7	
4/7/95	78	N	M	43	37	3MM TEAR ON LEFT EAR
4/7/95	66	RT	F	35		
4/7/95	68	R	F	41	35.2	NO POUCH DEV
4/7/95	77	N	M	48	37.4	
4/7/95	8	RT	M			
4/7/95	14	RT	M			NOTCH #4 IS CLOSE TO THE #7 AREA
4/7/95	70	RT	M			

Date	Id #	N/R/Rt	Sex	WT (g)	HL (mm)	Comments
4/7/95	1	RT	F			
4/7/95	11	RT	F			
4/7/95	63	RT	F			
4/7/95	1	N	M	49	36.9	NATURAL EAR MARK
4/7/95	64	RT	M			
4/7/95	15	N	F	35	34.7	POUCH DEV & STAINING
4/7/95	73	R	M	43	36.6	
4/7/95	75	RT	F			
4/7/95	74	RT	M			
4/7/95	60	RT	F			
9/5/95	72	R	M	45	35.5	
9/5/95	79	N	F	38	35	6 ACTIVE NIPPLES
9/5/95	14	R	M	37	35.8	
9/5/95	15	R	F	36	36	2 ACTIVE NIPPLES
9/5/95	4	R	F	43	35.8	6 ACTIVE NIPPLES
9/5/95	72	R	M	46	37.4	
9/6/95	51	R	M	49	37	?51
9/6/95	86	N	M	50	37	
9/6/95	56	R	F	48	35	7 NIPPLES LACTATING
9/6/95	28	R	F	45	35.1	4 NIPPLES LACTATING, ?28 OR ?21
9/6/95	27	R	M	41	35.7	6 NIPPLES LACTATING
9/6/95		N	F			VERY WET IN TRAP, NOT MARKED
9/6/95		N	M	42	37.3	LRG "V" TOP LEFT EAR, LOST TAIL TIP
9/6/95	54	R	F	47	35.3	UNBRED 2ND YR, REGRESSED POUCH SOME STAINING
9/7/95	11	R	F	34	32.8	4 ACTIVE NIPPLES
9/7/95	69	R	M	44	38.4	?69
9/7/95	51	R	M	43	38.7	?51
9/7/95	66	R	F	39	32.9	5 ACTIVE NIPPLES
9/7/95	81	N	M	17	29.8	JUVENILE
9/7/95	82	N	F	15	29.8	JUVENILE
9/7/95	61	R	F	40	32.4	4 ACTIVE NIPPLES, NOT LACTATING ?61
9/8/95	10	RT	F	37	36.2	R. EAR TORN, 8 ACTIVE NIPPLES
9/8/95	24	N	M	25	30.2	NATURAL "V" AT #4
9/8/95	16	N	F	24	31.6	
9/8/95	15	RT	F	34	34.1	
9/8/95	17	N	F	17	28.9	
9/8/95	27	RT	M	42	36.2	
12/6/95	18	N	M	42	34.2	SCROTAL
12/6/95	72	R	M	60	37.3	SCROTAL
12/6/95	19	N	F	34	33.9	UNBRED
12/6/95	20	N	M	48	35.6	
12/6/95	21	N	M	55	38.9	
12/6/95	22	N	M	49	35.6	
12/6/95	23	N	M	41	35.2	
12/6/95	31	R	F	57	34.8	POUCH DEV, BUT NO MAMMARY DEV
12/6/95	25	N	F	38	35.3	UNBRED
12/6/95	26	N	F	46	35.6	DEV POUCH BUT NIPPLES RECESSED
12/6/95	27	N	M	44	35.2	
12/7/95	28	N	M	49	34.8	
12/7/95	29	N	M	41	36.8	

Date	Id #	N/R/Rt	Sex	WT (g)	HL (mm)	Comments
12/7/95	30	N	F	33	31.9	HAIR LOSS ON MUZZLE, NO POUCH DEV
12/7/95	31	N	M	40	34.1	
12/7/95	53	R	F	44	36.5	DEV POUCH, RECESSED NIPPLES
12/7/95	4	R	F	55	36	DEV POUCH, RECESSED NIPPLES
12/7/95	32	N	F	37	34	
12/7/95	83	N	M	40	36.1	
12/7/95	84	N	F	55	33.8	REGRESSED POUCH
12/7/95	71	R	M	60	37.1	
12/7/95	21	RT	M	53		
12/7/95		R	M	56	34.7	LRG "V" TOP LEFT EAR
12/7/95	22	RT	M	51		
12/7/95	85	N	M	46	34.5	SCAR ON TOP NOSE
3/27/96	61	R	F	40	36.1	POUCH DEV
3/27/96	17	R	F	38	35	NO POUCH DEV
3/27/96	23	R	M	42	36.4	
3/27/96	67	R	F	42	37.2	POUCH DEV, NIPPLES SWOLLEN
3/28/96	83	R	M	48	37.8	NOT IN GOOD CONDITION
3/28/96	30	R	F		34.1	MARGINAL POUCH DEV
3/28/96	71	R	M	51	37.5	1/2 EATEN MOUSE IN TRAP
3/28/96	25	R	F		34.1	MARGINAL POUCH DEV
3/28/96	25	R	F	37	35.5	LOWER CANINES WORN, MINOR POUCH DEV
3/28/96	33	N	M	43	37	
3/29/96	83	R	M	40	35.2	
3/29/96	26	R	F	34	34.2	MIN POUCH DEV, LOTS FLEAS (samples taken)
3/29/96	27	R	M	42	35.8	
3/29/96	40	N	M	42	35.3	LARGE "V" IN #40 POSITION
3/29/96	4	R	M	42	34.3	ESC

* the date is written month/day/year to show seasonal differences
N = not previously caught, **R** = recapture from a previous trip, **RT** = recapture from same trip
HL = Head length

Appendix 7.

P. apicalis Capture location habitat data : areas not included in K.R. Newbey's Descriptions (Chapman & Newbey 1995)

ET/B Location : approx 7km E Quiss road on northern firebreak

Stratum 1, 3-4m, 5-10 % canopy cover
E. tetragona, E. leptophylla, E. phaenophylla

Stratum 2, 1-1.5m, 5-10 % canopy cover
Hakea corymbosa, H. Trifurcata, H. lissocarpa, Gastrolobium parviflorum, Melaleuca uncinata, Davesia pachyphylla

Stratum 3, 0-1m, 80-90 % canopy cover
Leucopogon sp., Hibbertia sp., Andersonia sp., Calytrix leschenaultii, Gastrolobium parviflorum, Hakea nitida

Sedges 5-10 % cover

Midslope on top of breakaway on loamy sand with spongolite.

ET/C Location : 3km E 14a2 on the northern firebreak , habitat as per 12A2 K.R. Newbey description

Wilderness Area Location : 33° 75', 119° 25'

Stratum 1. 2-3 m, 5-10 % canopy cover
Eucalyptus tetragona, E. spp., Lambertia , Nuytsia floribunda

Stratum 2. 1-2 m, 10-20 % canopy cover
Banksia baxteri, B. coccinea, Lambertia

Stratum 3 0-1m, 80-90 % canopy cover
Banskia calyei, Davesia pachyphylla, Hakea lissocarpa, Hakea trifurcata

Area last burnt 10-15 years ago , mid slope with deep sandy soils.

A. Sanders unpublished data

Appendix 8.

FIRE OCCURRENCE CONTINGENCY PLAN

BOULANGER and WHITLOCK ISLANDS

JURIEN BAY

1.0 FORWARD

This fire control contingency plan has been prepared to meet a requirement identified by the Interim Recovery Team at their inaugural meeting on 2 April 1996.

Although the effects of a major fire occurrence on the fauna populations and in particular dibblers inhabiting Boulanger and Whitlock Islands is relatively unknown, it is generally accepted that such an incident could have drastic effects on the future viability of the populations.

As a result, a policy of fire exclusion has been decided upon and will remain so until such times as further information comes to light to support the contrary.

The purpose of this plan is to detail the response procedure identified as practical in regards to resources and the obvious geographical restrictions imposed by the very nature of the islands themselves, whilst considering the limited resources of the CALM Moora District.

2.0 PREVENTION

Objective: To exclude fire from Boulanger and Whitlock islands.

Strategies:

- Continue to follow Moora District policy regarding the use of wood fireson CALM estate.
- Discourage use of the islands, particularly for activities that are synonymous with the use of fire. e.g. camping, bbqs, etc.
- Remove any evidence of the use of fire during routine visits. eg fire places, ashes, etc.

3.0 PREPAREDNESS

Objective: To ensure that adequate planning and preparation .is given with regard to combating a fire occurrence on the islands.

Strategies:

- Ensure CALM Moora District staff are aware of this plan and the role they play in it.
- Encourage the local community to report any fire occurrences to CALM as soon as possible.
- Ensure the inflatable boat stationed at Cervantes is maintained in an operational state for rapid deployment.
- Prepare a list of equipment required to be taken to the island for the initial reconnaissance and suppression

4.0 RESPONSE

Objective: Were possible attend fires that occur on the islands and minimise the area burnt.

4.1 On report of fire :

- Notify the District Manager or the "Fire Emergency Availability" Officer (FEA)
- In consultation with the District Manager or the FEA Officer Moora arrange for a reconnaissance of the fire. (Consideration will be required in regards to the time of day or night and weather conditions to ensure safe passage to the island.)
- Dispatch 2 officers in the boat stationed at Cervantes to the island equipped with :

a) 2 x Rake Hoes .
b) 2 X Knapsacks.
c) 1 x hand held CALM VHF radio.

4.2 On arrival at the island:

- Assess the situation and report back to the District Manager or FEA Officer.
- Arrange for any assistance that may be required to suppress the fire.
- If practical begin work with hand tools. ie Knapsacks and rake hoes.

4.3 District Manager/FEA Officer Role

- Provide incident control infrastructure.
- Notify Director of WATSCU and the Supervising Scientist, Dibbler Project of the fire occurrence and status of events.
- Notify Regional Duty Officer of situation.