Interim Recovery Plans 4–16
for Western Australian Critically Endangered Plants and Animals

Edited by Jill Pryde, Andrew Brown and Andrew Burbidge

1997

Wildlife Management
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WESTERN AUSTRALIAN WILDLIFE MANAGEMENT PROGRAM NO. 29

INTERIM RECOVERY PLANS 4–16 FOR WESTERN AUSTRALIAN CRITICALLY ENDANGERED PLANTS AND ANIMALS

Edited by Jill Pryde, Andrew Brown and Andrew Burbidge

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INTERIM RECOVERY PLAN NO. 4

NIGHT PARROT (*PEZOPORUS OCCIDENTALIS*) INTERIM RECOVERY PLAN FOR WESTERN AUSTRALIA

1996 to 1998

by John Blyth

March 1996

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit:
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FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50.

Where urgency and/or lack of information mean that a full Recovery Plan can not be prepared, IRPs outline the recovery actions required urgently to address those threatening processes most affecting the ongoing survival and begin the recovery process of threatened taxa or ecological communities.

CALM is committed to ensuring that Critically Endangered taxa are conserved, through the preparation and implementation of Recovery Plans or Interim Recovery Plans and ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 21 March, 1996. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at 14 March, 1996.

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SUMMARY

Pezoporus occidentalis, Night Parrot

Family: Platycercidae

CALM Regions: Kimberley, Pilbara, Goldfields, Midwest, Wheatbelt (possibly).

Recovery Team: The establishment of a recovery team for the Night Parrot will be an early action under this Interim Recovery Plan.

Current status: Listed as Threatened Fauna under W. A. Wildlife Conservation Act; classified as Insufficiently Known by Garnett (1992); ranked as Critically Endangered by W. A. Minister for the Environment in September 1995, following assessment by an expert panel using the latest IUCN criteria.

Habitat requirements: Night Parrots are assumed to be largely birds of the arid zone, and require areas of dense spinifex, samphire or other structurally similar vegetation, and, at least in the absence of succulent vegetation, sources of water.

IRP Objective: To decrease the probability of extinction of the Night Parrot by achieving the following aims:

1. find one or more populations of the Night Parrot that can be studied and monitored, and learn how best to locate the birds in the wild;
2. conduct research on movements, home range, activity patterns, food and feeding behaviour, breeding biology, detailed habitat requirements and major threatening processes;
3. use the information gathered:
   - to plan larger scale searches and more detailed research programs;
   - to plan and conduct any emergency management actions (eg predator-control and fire management) seen to be necessary to maintain the population(s);
   - as the basis for a recovery plan.

Recovery criteria:

1. the location of one or more populations in the wild;
2. the development of methods of finding, studying and monitoring birds in the wild;
3. the gathering of sufficient information to begin management actions for the conservation of the species in the wild;
4. an improvement in the status of one or more populations in the wild, as measured by increases in the number of birds being counted, and/or the expansion of the area being used;
5. the establishment of a Recovery Team and the writing of a Recovery Plan.

The criterion for failure is not finding a population of Night Parrots during the life of this Interim Recovery Plan.

Recovery Actions:

1. Conduct field survey as appropriate in response to reports of sightings of Night Parrots. Cost (first year) $12 500.
2. In the event of one or more populations being found:
   - control feral animals as appropriate;
   - manage fire to protect critical habitat;
   - combine publicity releases, supervision involving neighbours, and if necessary, restricted access, to ensure that finding the species does not result in excessive disturbance,
   - design and conduct a captive breeding program as appropriate.

Cost of all of the above actions will depend upon finding population(s) and their circumstances. Minimum cost per year $10 000.

1 INTRODUCTION

1.1 History, Taxonomy and Status

The first known specimen of the Night Parrot was collected by John Mcdouall Stuart, on an expedition led by Charles Sturt, in October 1845 north of Coopers Creek in far northern South Australia (Cleland 1937). Sturt assumed the specimen to be the Ground Parrot, *Pezoporus formosus* (now *P. wallicus*), and sent it to John Gould, who apparently also mistook it for the already known Ground Parrot. The specimen was sent to England under that name (Forshaw *et al.* 1976).

The Night Parrot was finally described by Gould as *Geopsittacus occidentalis*, with a bird collected near Mount Farmer in Western Australia in 1854 as the type specimen (Wilson 1937). The bird illustrated in Gould's Birds of Australia was not the type specimen but was from South Australia. The correct identity of the first specimen, collected by Stuart, was discovered by Gregory Mathews in 1928 (Forshaw *et al.* 1976).

Although placed in its own monotypic genus, *Geopsittacus*, by Gould, the Night Parrot's close relationship to the Ground Parrot has long been recognised. More recent taxonomic work, both anatomical (Ford 1969; Schodde and Mason 1980) and molecular (Leeton *et al.* 1994) confirms that the two species should be placed within the same genus, *Pezoporus,* which appears to be related to the grass parrots, *Neophema* spp., and the Budgerigar, *Melopsittacus undulatus* (Christidis and Boles 1994). Mathews (1917) maintained that the Western Australian population of the Night Parrot was a recognisable sub-species (*occidentalis*), but this distinction has not been recognised in later works.

Sightings of Night Parrots appeared to be very occasional until the 1870s, when another 20 specimens were collected and numerous sightings recorded between 1870 and 1890. Of the 22 specimens collected last century only two (possibly three) were from Western Australia and none of these remain in Australian museums. The Western Australian Museum does not hold any specimens, although both the type specimen, and the specimen used by Mathews (1917) to illustrate his Birds of Australia, were from this State.

At least sixteen of the 23 specimens of Night Parrots now in collections around the world were collected from South Australia by one man, F. W. Andrews, a naturalist collecting for the South Australian Museum. Andrews clearly had a considerable knowledge of the habitat and behaviour of Night Parrots. He spent much time in the field studying the birds during their years of apparent abundance in the 1870s and 80s, and referred to the birds coming and going "according to the nature of the season. When the early season is wet the porcupine grass flourishes and bears large quantities of seed, on which many birds feed; but if on the contrary, the season is a dry one the grass does not seed, and no birds are to be seen". This observation has led some authors (eg. Wilson 1937) to postulate that the period of abundance and many sightings in the 1870s and 80s was abnormal, resulting from a string of unusually wet years throughout much of inland Australia, and that the Night Parrot may usually be sparsely scattered throughout its range.

We could also postulate that the very presence in the 1870s and early 1880s of an experienced field ornithologist who made himself expert in the behaviour and movements of the Night Parrot meant that an unusually large number of these very secretive birds was able to be found and confirmed by collection. The decline in numbers being observed and collected may have had as much to do with Andrews' death in 1884 (by accident while in the field) as with actual changes in abundance of the species. The fact that the species is nocturnal and secretive and occurs in isolated areas little frequented by humans could create an impression of excessive rarity which may not necessarily be a true reflection of its status.

In any case, from the middle of the 1880s onwards confirmed sightings became rarer and by the turn of the century stopped almost completely. The literature contains a number of reports from people who had been familiar with Night Parrots in the period from 1875 to 1885, noting that it appeared to have disappeared entirely from their area since then (eg

Campbell 1915; Whitlock 1924). There are also several references to deliberate searches, in previously known habitats, which were unsuccessful. Mathews (1917) was convinced of its extinction, noting that the separation into eastern and western subspecies "seems quite valid, but cannot arouse much interest owing to the extinction of the species."

Nevertheless, Night Parrots were apparently being seen during the forty or more years from 1890 to the 1930s, although most of these sightings did not become generally known for many years (eg Wilson 1937). Among these was the collection of a specimen by Martin Bourgoin in the upper Gascoyne area of Western Australia, in 1912. This specimen, although confirmed, was poorly preserved and later lost (Wilson 1937).

Apart from a flurry of reported sightings in the 1960s and early 1970s (at least 15 in WA alone), and almost no reports for the ten or so years around each of the two world wars, most decades this century have seen several reported sightings in the literature or in the files of State conservation agencies and museums. The twenty years since 1975 have yielded fewer reliable reports, with a total of about six in Western Australia. Perhaps more ominously, many expert ornithologists, both amateur and professional, have spent much time over this period in parts of the arid zone of this State and have not made any sightings of Night Parrots.

For most of this century ornithological opinion about the status of the Night Parrot has ranged from presumed extinct, to indeterminate and perhaps not threatened at all. More recently two events have proved that the Night Parrot is still extant. In 1979 the late Shane Parker, Curator of Birds at the South Australian Museum, saw a bird he identified as a Night Parrot in "samphire-like Bassia (*Sclerolaena intricata*)" in the far north-west of South Australia, and another member of his party saw three in the same locality (Parker 1980). More conclusively still, in 1990, Walter Boles, ornithologist at the Australian Museum, found a dead specimen in south-western Queensland (Boles *et al.* 1991, 1994). This find was followed by a paper by Garnett *et al.* (1993) reporting seven separate sightings in 1992 and 1993 near Cloncurry on the Mount Isa Uplands. An attempt in 1994 by the Queensland Department of Environment and Heritage to confirm the Cloncurry sightings, and to gather information needed to produce a recovery plan, was not successful (Maher 1995, Jordan 1996).

Australia-wide the Night Parrot is listed as Endangered by ANZECC (1991) although in the Action Plan for Australian Birds, Garnett (1992) listed it as Insufficiently Known. In Western Australia it is gazetted under the Wildlife Conservation Act as threatened or "rare or likely to become extinct". The application of a ranking system, based on international standards and adapted within CALM for Australian conditions, results in the Night Parrot being ranked as Critically Endangered.

1.2 Distribution and Habitat

Night Parrots are essentially birds of the arid zone and apparently require dense, low vegetation, under or in which they hide during the day. Most commonly they have been found in hummock grasslands of porcupine grass or 'spinifex' (*Triodia and Plectrachne* species) or 'samphire assemblages'. Breeding records (unconfirmed; no acknowledged eggs of the Night Parrot exist in any known collection) exist for both habitats (Andrews 1883, Wilson 1937, Parker 1980). They have also been reported in low chenopod shrublands with saltbush and bluebush (eg Kershaw 1943, Powell 1970). Parker (1980) suggested seasonal movement from samphire flats to hummock grasslands when the *Triodia* species are seeding. Reports from hummock grasslands have almost universally referred to the presence of nearby water and many records have come from waterholes. Garnett (1993) suggested that the birds may not need free water when feeding on the succulent foods available in samphire areas.

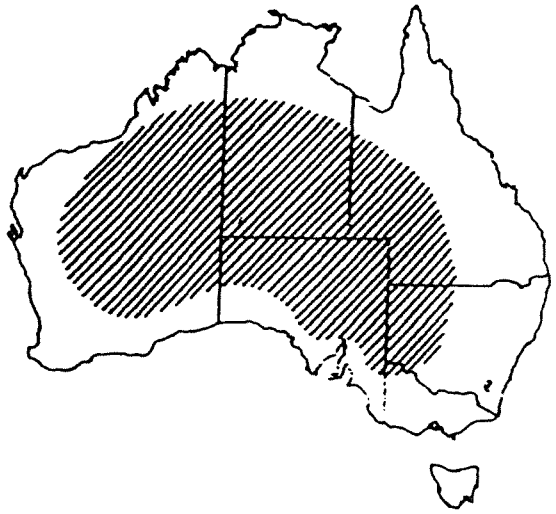
Reports in the literature of Night Parrots come from every mainland state of Australia: from the western Kimberley, through the north-western Northern Territory to the Mount Isa Uplands in the North; to the Victorian Mallee and through the Gawler Range in South Australia to near Cue and Perenjori in Western Australia in the south. Habitat which

superficially appears suitable is found across most of the inland, constituting as much as half of the area of the continent (see map 1).

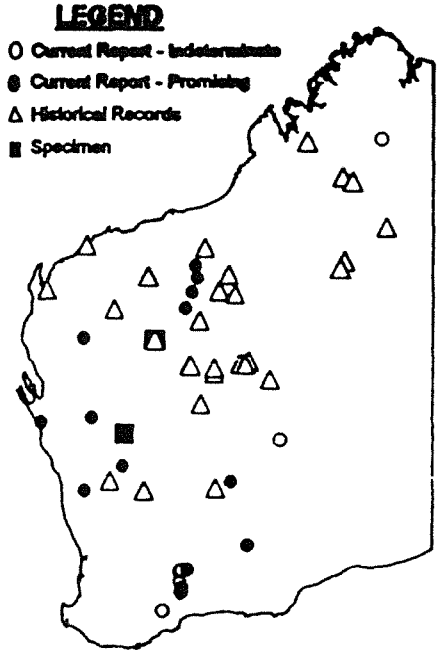
Joseph (1988) and Garnett (1993) referred respectively to four and five main centres of distribution for the Night Parrot. These were: the Gawler Ranges-Lake Torrens-Flinders Ranges region; the Coopers Creek Floodplain and nearby Simpson Desert region; the salt lakes of inland Western Australia and associated Triodia breakaways and saltbush flats; northwestern Victoria (all from Joseph 1988); and the Mount Isa-Cloncurry-Boulia region in Queensland (Garnett 1993).

However, if unconfirmed but reasonably convincing sightings from the southern Northern Territory, and many from the Gascoyne, Pilbara, and southern Kimberley are included, the picture of centres of distribution is considerably blurred (eg Storr 1960, 1977, 1980; Serventy and Whittell 1976; Wilson 1937). Given what is known about the biology and ecology of the species there would be little reason to be surprised at it being found anywhere within arid (or even semi-arid) Australia where well grown or mature spinifex, samphire or saltbush occurs along with fresh water during summer.

The current publicity campaign (see 1.6.1 'Deciding where to start') to elicit reports of sightings of Night Parrots from the general public has resulted in 25 reports, from the 1930s to 1995. Most of these are from areas consistent with the historical view that the Night Parrot is a bird of samphire and spinifex of the arid zone (Map 2).



Map 1 Potential habitat for Night Parrots across Australia



Map 2 Reported sightings of Night Parrots in WA. △, □ 'historical' reports from literature or CALM files; O, O from current CALM public survey

Amongst these reports however, is an unexpected cluster of seven sightings from near salt lake systems in the southern Wheatbelt. These include six reports from the Lake King/Varley area, within a radius of about 50 km, and spread from the 1930s through the 1940s, 1950s and 1980s, with the most recent in August 1995. Not all of these reports are particularly convincing in themselves, and the area is not one anyone would have predicted, being several hundred kilometres south of the nearest previous reports in WA. Nevertheless, at least three of the reports from the area cannot be dismissed lightly, and that six false reports, all quite unrelated, should come from such a small area by coincidence seems unlikely.

In addition, there is a historical report from Ghost Rocks south of Lake Ballard (Storr 1986), and a current rather convincing one from the northern end of Lake Cowan. Considering the vast amount of unpopulated salt lake and 'saltbush' country around Lakes Johnston, Hope and Tay, we could postulate that the potential distribution of Night Parrots extends from more

inland salt lake systems north of Kalgoorlie to the salt lake country of the southern Goldfields and southeastern Wheatbelt. The nineteenth century stronghold of the species in the Gawler Ranges in South Australia is at roughly the same latitude as these Wheatbelt sites, and an accepted 1950s record from northwestern Victoria (Menkhorst and Isles 1981) is slightly further south, with similar average annual rainfall.

1.3 Biology and Ecology

The species is secretive and usually assumed to be genuinely nocturnal. The degree to which it is nocturnal rather than crepuscular is occasionally queried, based largely upon the apparent absence of specific adaptations for nocturnal behaviour (eg Garnett 1993, Maher 1995). Maher (1995) notes that if the species does feed at night it would be the only seed eating bird in the world to do so, and it does not appear to possess any mechanism to find small seeds at night. However, the extent to which Night Parrots eat small seeds taken from the ground as opposed to green herbage, or fruit and seeds taken directly from plants is unknown (see last paragraph this section).

Almost all confirmed sightings of Night Parrots apparently feeding or drinking have come after dark, Aboriginal people familiar with the bird have usually referred to its nocturnal behaviour, and a number of sightings have been of birds flushed by the movement of domestic stock at night (eg Andrews 1883, Whitlock 1924, McGilp 1931, Bourgoin in Wilson 1937). In addition, Murie (1868) referred to a captive bird being active throughout the night. By contrast, daytime sightings have almost always been of birds flushed, by herds of domestic animals, dogs or fire, from nests or hiding places.

Little is known of the detailed biological and ecological characteristics of Night Parrots. The natural history information supplied by early observers, especially Andrews (1883), McDonald (in McGilp 1931) and Bourgoin (in Wilson 1937) does, however, provide a useful general description of the day-to-day routine of the species.

The Night Parrot's dependence upon healthy, dense spinifex or samphire, into or under clumps of which it tunnels or burrows, both for nesting and for daytime refuge, was stressed by all early observers. Only very close disturbance, actually affecting the clump of vegetation in which a bird is hiding, seemed to flush them during the day (Wilson 1937).

The Night Parrot and its congener the Ground Parrot, are unique among Australian parrots in not only constructing a nest, albeit a rudimentary one, but in nesting on or very near the ground and not in hollows of some kind (Campbell 1900). The nest of Night Parrots is constructed with a layer of small sticks, or bitten-off lengths of grass stems, being laid together in an expanded cavity at the end of a tunnel under a clump of porcupine grass or a samphire bush (Wilson 1937). Clutch size is reported by Andrews (1883), McDonald (in McGilp 1931) and Aboriginal informants of Keartland (in North 1898) to be four, while Bourgoin (in Wilson 1937) never saw a nest, but reported watching two adult parrots with a brood of six young birds.

The three early observers all reported the birds flying to water once dark had well fallen, uttering a low but carrying two-toned whistle while doing so. Andrews (1883) referred to this as their first activity for the night, after which they flew to their feeding area, to feed on the seeds of porcupine grass. He also noted that several return trips may be made to water during the night.

Significant additions to the information provided by the three observers referred to above have been made recently with the rediscovery by the late Shane Parker of a population of Night Parrots in extensive stands of Bassia on Coopers Creek (Parker 1980), not far from the site of collection of the first specimen by Stuart in 1845, and the paper by Garnett *et al.* (1993), describing several presumed sighting of Nights Parrots while spotlighting at night in the Cloncurry area. These sightings, often of birds apparently feeding, were usually in open grasslands with species of 'soft' grasses and herbs present. This, the presence of green herbage in the crop of a specimen shot by Bourgoin (in Wilson 1937) and the observation by

Murie (1868) that a captive bird showed a preference for green food, suggest that green plants, or unshed fruit or seeds may be a significant part of the Night Parrot's diet.

1.4 Threatening Processes

Wilson (1937) and Garnett (1992) have considered some of the possible reasons for the assumed decline of the Night Parrot. Garnett (1992) lists:

- predation by foxes and feral cats (several early observers referred to cats as a major problem for Night Parrots, and this view was supported by Keast (1952), although Wilson (1937) did not believe that feral cats were likely to have been a primary factor causing their decline;
- altered fire regimes;
- grazing by stock or rabbits;
- reduced availability of water as a result of over-use by feral camels (to this latter reason one could suggest the decline of waterholes because of reduced maintenance by Aboriginal people).

Garnett (1992) was unconvinced that sufficient information is available to confirm that the species was threatened, and therefore referred to all of his suggested threatening processes as "speculative". Similarly, Wilson (1937) considered that the numbers of Night Parrots fluctuated mainly in response to climatic variation and that the period 1870 to 1885 was probably one of exceptionally good seasons which allowed the species to expand its numbers and range.

Two other threatening processes related to the impacts of introduced grazing animals, especially domestic stock and rabbits, may well be as important for the Night Parrot as those discussed above (P. Mawson, CALM, 1995; pers. comm.).

- The first of these, partly covered by Garnett's (1992) 'grazing by stock or rabbits', is competition by introduced herbivores for, and degrading effects upon, critical areas of above-average nutrients and moisture in the arid zone, especially during times of drought (Morton 1990).

- The second possible impact is the degrading effect by hard-hoofed animals around watering points (eg. Stafford-Smith and Pickup 1990), perhaps resulting in the more or less permanent loss of palatable herbage within a reasonable flying distance for the Night Parrot.

All of these possible threatening processes remain speculative in relation to the Night Parrot, until its status is confirmed and more information is available about its biology and ecology.

Nevertheless, in the CALM ranking system, the susceptibility of any species to particular threatening processes is considered on general ecological and biological grounds and such processes do not need to have been observed directly in relation to the particular species being ranked. There are some similarities in behaviour of the Night Parrot to that of many of the extinct and endangered medium-sized mammals of the arid zone, and foxes (and more recently cats) have been shown to be capable of eliminating populations of such species. Introduced predators and herbivores, particularly together, are likely to constitute a real threat to the Night Parrot over much of its range.

Although no direct evidence exists of the operation on the Night Parrot of particular threatening processes, the list given above is realistic. It provides reasonable hypotheses, that the processes listed do constitute threats, singly and especially together, to the survival of a species with the distribution and behavioural characteristics of the Night Parrot. Such hypotheses provide a good starting point for research and experimental management.

1.5 Number, Size and Trend of Populations

There is firm evidence of only one current population, that around the Mount Isa uplands in Queensland, from which the specimen obtained by Boles *et al.* (1991,1994) near Boulia in

1990 presumably originated. However, it is not known whether there are one or more populations in the general area of north-western Queensland, let alone what size such populations may be or whether they are stable, increasing or declining (Garnett 1993). It can be said, though, that detailed searching by two experienced field ornithologists, conducted for the Queensland Department of Environment, failed to find any Night Parrots around Cloncurry in 1994 (Maher 1995, Jordan 1996).

Whether or not the numbers of Night Parrots were unusually high in the 1870s and 80s as suggested by Wilson (1937) (or may have appeared to be high because of Andrews' skill at finding and collecting them), their decline since that time has been noted by several residents of the arid zone (eg Campbell 1915, McDonald in McGilp 1931). Further, given the searches that have been made for no result (eg. Howe and Tregellas 1914, Mathews 1917, Davies *et al.* 1988, Maher 1995, Jordan 1996), it seems clear that the species is not at all common, even if it should turn out be widely distributed.

Most of the threatening processes discussed in the section above are probably still operating across most of the Night Parrot's assumed range. Further, anecdotal sightings since the early 1970s (prior to CALM's publicity campaign) seem to have decreased; some people responding to the publicity campaign referred to Night Parrots declining in their area; and the searches for the 'Cloncurry population' in 1994, and a large number of searches by ornithologists in Western Australia over the last twenty years, have failed to find the species. An assumption of continuing decline is not unreasonable.

1.6 Strategy for Recovery

1.6.1 Deciding where to start

The fundamental requirement is to find one or more populations of the species, to study and to monitor, and if appropriate, to conduct protective management such as control of feral animals. There are two different starting points. First, from the literature and other reported sightings, we can select several points from which records have come in the past and launch expeditionary surveys to those places. Preliminary analysis might seek to establish which of these historical sites is likely to be least modified since the original sightings. In this case it would be best to choose years in which dry conditions prevail across much of the putative range of the Night Parrot, but in which there are good conditions, or at least permanent water, at the selected sites.

The second approach is the one currently being taken by CALM; that is, conducting a publicity campaign, with distribution of leaflets seeking reports from members of the public, of recent and ongoing sightings. Coloured leaflets (Appendix 1) have been, and are being, distributed to roadhouses along inland highways, major trucking lines working inland routes, pastoralists (by mail), and landcare groups, kangaroo shooters, Agriculture Protection Board 'doggers', and mining companies with interests in the appropriate areas. Reported sightings are followed by interview with and careful questioning of informants according to a prepared series of questions (Appendix 2).

Responses to reports of Night Parrot sightings involve the following steps.

(i) Receive input from the public; contact Officers are John Blyth, Woodvale; Andy Chapman, Goldfields Region; Peter Kendrick, Pilbara Region; Gordon Graham, Kimberley Region, and Mal Graham, Wheatbelt Region. If one of these people is to be out of reach for more than one or two days, that person will ensure that someone else in the office is able to take the information, question the informant according to the assessment form, and record the responses on the form.

(ii). Ensure that the information is seen and discussed by at least two experienced ornithologists or birdwatchers with good knowledge of Western Australian birds, especially those of the arid zone. If no such person is likely to be present in the receiving office for several days, the information should be sent to Woodvale for the attention of John Blyth, Allan Burbidge, Andrew Burbidge, or Phil Fuller.

(iii) If the consensus between all of the assessors is that the birds reported are probably not Night Parrots, no field work will be conducted. If the information provided is not good enough to make a decision one way or the other, then field work will be conducted only in the event that it fits in with other commitments.

(iv) If all of the assessors agree that the information strongly suggests Night Parrots, a short trip of three or so days should be conducted by two or more experienced people as soon as possible, to find the birds which have been reported and to confirm or refute that they are Night Parrots. More detailed field work could then be based upon the results of this trip.

Where confirmatory field work is going to be expensive and time consuming, it may be necessary to conduct a further and more detailed interview between the informant and the assessors before making a decision to proceed .

(v) Once the presence of Night Parrots is either confirmed by a short preliminary trip, or judged by all assessors, after interview with the informant(s), to be sufficiently reliable to justify a substantial field survey, an expedition involving as many experienced people, vehicles and varieties of equipment as possible will be organised.

Survey trips should be carried out as quickly as possible after the sightings are reported, and for larger expeditions to more remote places would probably involve staff of CALM and the Western Australian Museum, as well as volunteers, especially from the RAOU.

1.6.2 Finding Populations of Night Parrots

Whether investigating historical sites or reports of modern sightings, many of the field methods likely to be useful would be the same. Much of this section is based upon the assumption that Night Parrots are genuinely nocturnal birds, which remain inactive and hidden during daylight, and probably until darkness is well advanced (Andrews 1883, McDonald (in McGilp 1931) and Bourgoin (in Wilson 1937). Much of the searching effort will need to be at night, especially for the first couple of hours after sunset and the same before sunrise.

Methods would be selected to suit the particular circumstances and would include some or all of the following.

Surveillance at selected waterholes by birdwatchers with good hearing and long experience of arid zone birds. Bourgoin (in Wilson 1937) and McDonald (in McGilp 1931) both refer to birds calling while coming to water after dark and two or three times during the night, and provide descriptions of the calls (see Appendix 3). Further, experienced birdwatchers should be able to recognise as different a call that they had never heard before. In an area where there might be several discrete waterholes, or wide distribution of promising habitat over a distance of several to many kilometres, it would be desirable to have several small camps rather than one large one, and each camp could maintain listening surveillance in its area.

Equipping listeners referred to above with a field microphone and tape recorder to record unknown calls. Once such recordings are available and reasonably assumed to be those of Night Parrots, they could be played back in areas where the calls have been heard in an attempt to entice the birds nearer to observers, or perhaps into mist nets. Recording the call of the Night Parrot would probably be a major breakthrough towards finding more populations and further research.

Mist nets could be set opportunistically at or near waterholes and monitored throughout the night.

Spotlighting at night, which could be used in two ways. The first of these would be to concentrate upon waterholes (especially those around which promising calls had been heard) and in response to sounds or perceived movement, spotlight around the perimeter. This approach will be enhanced by the possession of a 'night scope' or similar device for aiding night vision. Such a device would allow movement around the waterhole to be detected and so could make the spotlighting more selective. Waterhole surveillance will be most useful in a situation where there are few waterholes, little other available water and hot conditions.

The second approach to spotlighting is to search for Night Parrots while they are feeding. On the basis of the slight information available we would concentrate upon areas around the edges of particularly healthy, seed-bearing 'spinifex' (*Triodia and Plectrachne* spp.), upon barer soils with new green growth and especially with low seed-bearing herbage, and perhaps around the edges of dense, flowering or fruiting samphire.

Spotlighting could, perhaps, also be used in conjunction with night application of the flush-searching described below as a daylight method. In that case, the dragging or beating would be done across potential feeding areas rather than the denser refuge areas.

Arrangements should be made to join station workers for any intended movement of stock through potential Night Parrot habitat, whether at night or during the day.

Flush searching during the day (likely to be most effective at first and last light) could include the use of dogs, beating across an area of dense spinifex or samphire with a large number of people or, in combination with the line of people or with two or more vehicles, dragging a rope across such an area of cover. Points from which birds first flushed would be marked and a thorough search conducted around that point for hide or nest.

There are one or two references in the literature to Night Parrots hiding in caves during the day, so any breakaways nearby with caves and crevices would be examined.

There is also reference in the literature to Night Parrots being flushed during daylight by burning spinifex clumps. Given the status of the species, CALM does not believe that this is an acceptable method, either for general searching in an area that seems suitable for Night Parrots, or to flush a particular bird whose hiding place is known or suspected. However, it does suggest that Aboriginal communities or pastoralists, who regularly burn spinifex as a part of their land management, may be most likely to have observed Night Parrots during the day. Further campaigns to gather public input towards the finding of Night Parrots should be concentrated upon these two groups of people;

A second group of 'daylight' methods would include: searching around waterholes and in the nests of other birds for the presence of Night Parrot feathers, which are very distinctive; and searching for nesting or roosting 'burrows' and tunnels around and into dense clumps of spinifex or other dense vegetation, and associated tracks.

1.6.3 Catching and studying the birds

Given the legendary elusiveness of Night Parrots, gathering further information once populations are found will depend heavily upon capturing, examining and radio-tracking birds, probably over several seasons. The aim would be to discover much more about the basic biology and ecology of Night Parrots, especially daily and seasonal movements, detailed habitat requirements, breeding biology and social structure. This information could then be used to find other populations, to assess any trends in the known one(s), to determine any obvious threats, and to design more detailed research and recovery plans.

The identification of possible Night Parrot tunnels or tracks could be followed by the placement of noose-mats as used at Lake Gore for Hooded Plovers (Weston 1995). Carefully placed Elliott-style traps, with associated drift fences, could also be used where the presence of Night Parrots is suspected, with or without baiting with grass-seeds and with or without grass-seed trails leading to the traps. The possibility of using an adaptation of hair tubes will be investigated; the sparse literature on moulting in Australian birds suggests that summer would be the best time to try such a method, which would depend upon capturing feathers being moulted by birds passing through the tubes. Any of these methods could be used in conjunction with drift lines or with identified tunnels through dense vegetation.

If tracks and other signs suggest the presence of Night Parrots hidden in dense vegetation then a combination of beating and mist nets could be used in trying to capture birds. Alternatively, if tracks indicate the use of a waterhole by Night Parrots, mist nets could be erected across possible flight paths. (The literature suggests that the species flies directly to the water's edge to drink, rather than walking in from some distance like bronzewing pigeons, or landing initially in fringing trees like most other parrots).

During the three year life of this interim recovery plan, specimens of the Night Parrot will not be taken from the wild without Ministerial approval (see 3.3 Management Actions). If birds are captured, proof of identity will normally be by photographs and the collection of feathers. Any remains or birds found dead will be retained for study and reference.

2 RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

To decrease the probability of extinction of the Night Parrot by achieving the following aims:

1. find one or more populations of the Night Parrot that can be studied and monitored, and learn how best to locate the birds in the wild;

2. conduct research on movements, home range, activity patterns, food and feeding behaviour, breeding biology, detailed habitat requirements and major threatening processes;

3. use the information gathered:
   - to plan larger scale searches and more detailed research programs;
   - to plan and conduct any emergency management actions (eg predator-control) seen to be necessary to maintain the population(s);
   - as the basis for a recovery plan.

2.2 Criteria

On the assumption that the Night Parrot does still exist in Western Australia, the criteria for successfully achieving the objective are:

1. the location of one or more populations in the wild;

2. the development of methods of finding, studying and monitoring birds in the wild;

3. the gathering of sufficient information to begin management actions for the conservation of the species in the wild;

4. an improvement in the status of one or more populations in the wild, as measured by increases in the number of birds being counted, and/or the expansion of the area being used;

5. the establishment of a Recovery Team and the writing of a Recovery Plan.

Initially, the sole criterion for failure in achieving the objective will be the failure to find a population of Night Parrots. Actions taken, methods being used, and information gathered will be reviewed at the end of each year, and changes made to this plan if appropriate.

3. RECOVERY ACTIONS

This interim recovery plan will remain in force until the above criteria for success have been met, or for three years when it will be reviewed if the aims have not been achieved by that time. If the aims have been completely or largely achieved, this interim plan will be replaced by a recovery plan for the Night Parrot across its whole range, to be prepared by a national recovery team.

Costing this interim plan is difficult because all subsequent actions are dependent upon finding one or more populations. The plan therefore makes the assumption that populations will be found early enough in the life of this plan that the objective can be achieved within three years, and that all actions named in the plan will be funded within that time.

3.1 Field Survey

Since the release in mid 1995 of the leaflet seeking reports of sightings of Night Parrots from members of the public, about 25 reports have been received. On the basis of these there are several areas where field work may be justified. These are: a pastoral property to the north of Lake Cowan near Norseman; the nature reserve system based on the chain of salt lakes along the Hyden to Lake King Road; the Newman /Nullagine/ Rudall River area of the eastern Pilbara, and the GlenAyle/Carnegie/Cosmo Newbery area in the Goldfields. The first two, although outside the area traditionally considered as the stronghold of the Night Parrot, are based on salt lake systems which are more or less continuous with such systems much further north, extending well into the species' known range (see Map 2).

3.1.1 Binarangie Station, Lake Cowan.

Although this is a single report from one person (the station leasee, Mr Mick Cotter) it refers to one sighting, of many birds by spotlight, and several subsequent records based on calls, at the same dam over a period of some years up to the present. Mr Cotter's imitation of the calls seems consistent with the historical description of those of Night Parrots. The nature of Mr Cotter's report, the identification of a specific site at which the birds have been recorded repeatedly, implying residential status, and the relative nearness to Kalgoorlie and Perth give this high priority for further investigation.

Initial survey will be in response to notification from Mr Cotter that he has heard the birds again very recently, and would require only two or three experienced people for a few days to find and positively identify the birds.

Responsibility: CALM Goldfields Region
Cost: travel and field expenses $550
Priority: very high

If it is confirmed that the birds are Night Parrots, follow-up field work would be arranged immediately, perhaps taking three vehicles (two from Perth, one from Kalgoorlie), with two or three people in each, and as much equipment such as spotlights, night scopes, field microphones, mist nets, radio collars and leg bands as the particular personnel will be able to use. Assuming the presence of at least one person experienced with the use and fitting of radio collars, banding, and mist nets, the following items should be taken.

At least three spotlights, preferably six or more;
three night scopes;
three field microphones;

'several' mist nets;
four 'Ground Parrot radio collars';
one or two radio tracking device(s);
measuring equipment, such as rulers and calipers;
recording sheets to note measurements and descriptions for each bird;
cameras, a range of lenses and film, & cage or terrarium for setting up photographs;
plastic bags for feathers, and appropriate containers for blood samples;
freezer for fresh feathers and blood samples;
leg bands, and associated equipment, appropriate to Ground Parrots;
any equipment for live sexing (fresh feathers or blood for genetic analysis may allow this);
at least three maps of property, showing all relevant tracks and features;
stakes/markers to delimit areas where birds observed;

Five days and nights on site should be adequate for this first trip, with an arrangement that one vehicle and its occupants are able to stay behind for a total of two weeks and monitor movements if any birds have been caught and radio-collared. Much of the equipment could be borrowed for this first trip, although once research and monitoring start the project will have to have all of the above items of equipment on a regular basis. Radio collars, and the recording equipment, would need to be purchased for the first trip.

Field efforts should be concentrated at night, especially the first couple of hours after sundown and the last two before sunrise. Ideally, listening and watching posts should be established at two or three likely watering points during this time, and spotlighting conducted around the edges of likely nesting/roosting areas and in potential feeding areas. With three cars and nine people and spotlights a significant area of potential habitat could be covered in four nights. Each participant will need their own binoculars and note book.

Some daylight hours should be spent finding and examining the nests of other birds which might contain Night Parrot feathers (Keartland in North 1898 and Davies *et al.* 1987) and looking for nesting/roosting burrows in areas near where birds have been flushed or which look suitable.

Responsibility: WATSCU

Cost: travel and field expenses	$5 200
equipment (field microphone, 4 radio collars)	$2 600
consumables (markers, maps, leg bands, film etc)	$ 500
Total	$8 300

Priority. very high

3.1.2 The Lake King/Varley/Holt Rock area.

As discussed in section 1.2 above this apparently unlikely place for Night Parrots has been the source of six reports within a circle of about a 50 km radius, with a seventh from north of Needilup, less than 100 km further south.

Given the inconclusive nature of reported recent sightings from this area, a serious field search like that recommended above for Binarangie Station, does not seem warranted immediately. More preliminary investigation, especially interviewing local landholders and examining the sort and abundance of suitable habitat, needs to be conducted first.

A joint CALM/RAOU field outing will be arranged for Easter 1996, to conduct qualitative surveys of potential Night Parrot habitat, and day and night searches for birds, in and around the Lake King/Lake Camm Nature Reserve and around other salt lakes where apparently suitable habitat for Night Parrots exists.

Responsibility: WATSCU, Katanning District
Cost: (Katanning District: travel, consumables) $ 350
Priority: very high

CALM's Katanning District intends to conduct a review in early 1996 of priorities for threatened fauna survey on nature reserves in their district. Preliminary investigation in relation to Night Parrots, especially in the Lake King and Lake Camm Nature Reserves, should be done during that review.

Responsibility: Katanning District
Cost: nil to this interim recovery plan
Priority: very high

3.1.3 The eastern Pilbara, and northern Goldfields

While there are many sightings reported from these two much larger areas over the last thirty years, and based on previous knowledge they seem more likely to harbour Night Parrots, there are no sufficiently recent reports available to CALM to give a clear guide as to where to start looking. Further, given the isolation and harshness of this country, any field trips to these areas will be more expensive and logistically demanding than to either of the two referred to above.

A privately organised expedition to the northern goldfields and adjacent desert country, involving a number of well-known people including Harry Butler, Vincent Serventy and Dick Smith, is currently being planned by Mr Bill Crocker of Perth for October 1996. Mr Crocker claims to have informants who are familiar with the Night Parrot and are suggesting specific sites for investigation. He intends planning and conducting the expedition in consultation and cooperation with CALM. If this trip eventuates, it would be valuable for CALM to provide at least one vehicle and three people.

Responsibility: vehicle from Kalgoorlie Region, at least one person from each of the Region and WATSCU
Cost: (vehicle, travel and field allowances) $3 000
Priority high

The planning of expeditions led by CALM to these areas should await the outcome of investigations in the more accessible areas, and, perhaps, the outcome of Mr Crocker's expedition. This remote area would require a minimum of two vehicles and a minimum of 4 people.

Responsibility: WATSCU
Cost per trip: approximately $6 000
Priority high if confirmed sightings are made.

3.1.4 Historical Sites

In the meantime, and especially if the species is relocated, it would be useful to visit all of the historical sites, to determine what if any changes have occurred since the original sightings, and compare them with any new sites of occurrence. Thus, the following Western Australian locations should be located accurately on a map and the status or ownership of the land determined:

- those of Bourgoin's five sightings (Nichol Spring on a southern tributary of the Ashburton; Bolgers Soak, between Three Rivers Station - now owned by a mining company - and Lake Nabberu; Pinyerinya Pool, on a small creek to Lake Nabberu; Winditch Spring; and Neds Creek, ten km south-east of Bolgers Soak);

- the Mount Farmer type-location;

- that of the Keartland 1896-97 record;
- the three (or four) sites in the Kimberley referred to by Storr, (1980);
- and the two current and two recent/historic records shown in the Atlas of Australian Birds (Blakers *et al.* 1984).

Responsibility: WATSCU
Cost: purchase of maps $ 300
Priority moderate.

Thus the total cost of exploratory fieldwork in the first year would be $12 500 if CALM does not itself conduct an expedition into remote areas within that year, approximately $15 500 if involvement in a private 'remote expedition' is replaced by a CALM expedition, or $18 500 for involvement in both the CALM and private 'remote expeditions'.

3.2 Research and monitoring

The key questions to be addressed relate to establishing numbers in the population(s), whether those numbers are stable, increasing or decreasing, what the most critical factors are in limiting numbers, and determining what steps are required for their recovery or conservation. Designing and costing such research is impossible until one or more populations have been found, because of the much greater costs involved in field work if more than one population is found, if any population(s) being studied are in remote areas, and so on.

Nevertheless, it is clear that such a project will require the employment of a full-time research officer or consultant and that wherever the population(s), field work will require much travel and is likely to rely heavily upon radio-tracking and finding methods of observing nocturnal behaviour. Therefore, at least $60 000 per year will be required, with an extra $10 000 for equipment in the first year of study.

CALM may require external funding to help cover these costs, and a significant task following the finding of one or more populations will be the writing of detailed proposals to submit to various funding agencies and/or to use in seeking sponsorships from Australian companies.

Responsibility: WATSCU
Priority: very high once populations are found

3.3 Management actions

Until one or more populations are found and some information gathered about it/them, it is difficult to identify specific management issues, and impossible to cost them. However, there are four points which can be made on the basis of existing knowledge.

3.3.1 Control of Feral Animals

It seems likely that if a population is found, immediate control of any feral herbivores present in large numbers and foxes (and feral cats once appropriate techniques are available) would be likely to benefit the survival and expansion of the population. This would be particularly so if, as seems likely for any population found on Binarangie Station, the birds appear to reside in, or regularly use, the site. Such work would be done as experimental management, with a hypothesis as to the outcome and a carefully designed control and monitoring strategy.

Responsibility: WATSCU and relevant CALM region
Cost: from less than $1 000 to several thousand dollars per year depending on circumstances

Priority high, if population is found.

3.3.2 Managing Fire Regimes

Given the importance of dense mature vegetation such as spinifex and samphire for shelter and breeding sites, attention should be given to preventing fire at the location of any population, until its status and ecological needs are understood. The principles of experimental management would also be applied to these activities.

Responsibility: relevant CALM region
Cost: from negligible to several thousand dollars per year depending on circumstances
Priority very high if population is found.

3.3.3 Preventing Excessive Disturbance

Because of the 'mystique' and high public profile of the Night Parrot, it is inevitable that if and when a population is found, many people, throughout the world, will be very keen to visit the site and try to find the birds. It is not hard to imagine attempts to make the bird a tourist draw-card, with wide promotion and publicity. Unless carefully controlled, the resulting visitor pressure could have an adverse effect on the species. This is especially so because, given the shy and secretive nature of the species, searching for it is likely to be of an intensive and intrusive nature. The Night Parrot is not a species for which you can move unobtrusively across the landscape, with a reasonable chance of sighting the birds as they go about their normal activities.

Thus, a contingency plan is required in the event of finding one or a very few small populations of Night Parrots, especially if one or more of those populations are in areas relatively easy of access. The following steps or approaches would be applied as appropriate.

- If any population was found on land managed by other than CALM, the owner or manager would immediately be informed. The location of a population of Night Parrots would otherwise be kept confidential until a strategy for publicity and management, appropriate to the particular case, had been developed.

- Initial publicly released information would refer to the area of occurrence in general terms only; eg. southern Goldfields, eastern Pilbara etc.

- The cooperation of owners and managers on whose land populations of Night Parrots are found will be sought, both in terms of gaining support for any necessary management actions, and for helping to supervise access to the population.

- Ministerial agreement will be sought that sites containing populations of Night Parrots on land managed by CALM will be gazetted as restricted access areas under provisions of the CALM Act if, and for as long as, that is appropriate.

- The immediate neighbours of lands managed by CALM, or of vacant Crown land, which contain populations of Night Parrots will be informed and their cooperation sought in limiting and supervising access to any areas which have been gazetted as of limited access.

3.3.4 Taking Birds for Captive Breeding

Captive breeding is likely to play a significant role for such a rare and cryptic species. It is all too likely that a population could be found, perhaps studied for a short time and then the species 'disappear' again. A captive breeding program would provide a safeguard against such a disappearance leading, albeit perhaps gradually, to the final extinction of the species.

CALM and the Perth Zoo will cooperate in designing a captive breeding program, early in the life of this interim recovery plan. Input into the design of a captive breeding program may be sought from private or other avicultural experts. In the event of a population of Night Parrots being discovered, a concerted search for nests with either eggs (preferred) or young birds will be made early in the first breeding season. If a population is found and believed able to sustain the taking of specimens to establish a captive population, CALM will establish and maintain such a population, in collaboration with Perth Zoo and/or selected avicultural experts, starting with at least two birds of each sex. The three other management actions referred to above would be applied as appropriate to the source population, to ensure its retention in the wild.

Such a captive breeding program would be designed to be consistent with CALM Policy Statements No 29, "Translocation of threatened flora and fauna"; No. 33, "Conservation of threatened and specially protected fauna in the wild"; No. 44, "Wildlife Management Programs"; and No 50, "Setting priorities for the conservation of Western Australia's threatened flora and fauna". All established protocols as to recording all captive specimens in a stud book, and maintaining genetic diversity to the greatest extent possible, will be followed.

There is likely to be pressure from aviculturists to obtain Night Parrots as soon as any population is found. A captive breeding program would provide the possibility of releasing birds to approved aviculturists. Conditions would be imposed to ensure the availability of birds and their progeny for eventual relocation in the wild, if that was required under an approved recovery plan.

During the three year life of this interim recovery plan, specimens of the Night Parrot will only be taken from the wild, with Ministerial approval, to establish the captive breeding program referred to above.

Responsibility: CALM (WATSCU) and the Perth Zoo
Cost: to be assessed by staff of the two responsible agencies, and will depend upon particular circumstances
Priority: high if population is found and believed able to sustain the taking of the birds necessary to establish a captive population.

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INTERIM RECOVERY PLAN NO 5

ANTINA (*ZYZOMYS PEDUNCULATUS*) INTERIM RECOVERY PLAN

1996 to 1998

by Andrew Burbidge

April 1996

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FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50.

Where urgency and/or lack of information mean that a full Recovery Plan can not be prepared, IRPs outline the recovery actions required urgently to address those threatening processes most affecting the ongoing survival and begin the recovery process of threatened taxa or ecological communities.

CALM is committed to ensuring that Critically Endangered taxa are conserved, through the preparation and implementation of Recovery Plans or Interim Recovery Plans and ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank, by the Minister.

This IRP was approved by the Director of Nature Conservation on 1 May 1996. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Approved IRPs are subject to modification as dictated by new findings, changes in species' status and completion of Recovery Actions.

Information in this IRP was accurate at April 1996.

CONTENTS

SUMMARY

Zyzomys pedunculatus, Antina (Central Rock-rat).

Family: Muridae.
CALM Region: Not known. May have occurred in Pilbara and Goldfields Regions.
CALM District: Exmouth (for survey).
Shire: Shire of Exmouth.
Recovery Team: None; Team to be appointed only if species rediscovered.
Current status of taxon: Critically Endangered
Habitat requirements: Granite boulder fields, quartzite screes, eroded sandstone cliffs and similar habitat.
IRP Objective: To locate the species in the wild in Western Australia and to commence recovery actions.
Recovery criteria:
The criteria for success are:
1. the location of one or more populations in the wild;
2. the development of methods of finding, studying and monitoring Antina in the wild;
3. the gathering of sufficient information to begin management actions for the conservation of the species in the wild;
4. an improvement in the status of one or more populations in the wild, as measured by increases in the number of Antina being trapped, and/or the expansion of the area being used;
5. the establishment of a Recovery Team and the writing of a Recovery Plan.

The criterion for failure is: failure to locate Antina after conducting adequate surveys in Cape Range.
Recovery Actions: Recovery actions 2 to 5 will depend on the discovery of the species in Western Australia following completion of Action 1.
1. Conduct field survey
2. Research and monitoring.
3. Captive breeding.
4. Management actions.
5. Appoint Recovery Team

1. INTRODUCTION

1.1 History, Taxonomy and Status

Zyzomys pedunculatus, the Antina (the Australian name recommended for this species, Braithwaite *et al.* 1995) or Central Rock-rat, was described in 1896 from a specimen collected near Alice Springs during the Horn Scientific Expedition (Waite 1896). Since then 33 specimens have been collected, but very few of these are from the twentieth century.

Kitchener (1989) redescribed *Z. pedunculatus* and included *Z. pedunculatus*. [var. *brachyotis*] Waite, 1896 within it, considering the specimen on which it was based to be a juvenile. The only species of *Zyzomys* that is likely to occur in the same areas as *Z. pedunculatus* is the Djoorri or Common Rock-rat (*Z. argurus*). Adult Antina are larger than Djoorri (ca 60 g (range unknown) versus 36 g (26-55 g; but note that Kitchener reports an *argurus* weighing 70 g). They are also larger in body measurements, eg, pes 26.5 mm (25.5 - 27.8) versus 21.0 (18.2 - 23.9); thenar pad 3.8 mm (3.3 - 4.1) versus 2.9 mm (2.2 - 3.5). The thenar pad is shorter relative to pes length (see Figure 5 in Kitchener 1989). Field identification should be based on a combination of body weight, pes length and the ratio of pes to thenar pad length. Confirmation of field identification would be dependent on a specimen being collected so that skull and dental characters can be examined.

All nineteenth century specimens came from central Australia. The most recent specimen was collected by a stockman in the western MacDonnell Ranges, about 300 km west of Alice Springs, in 1960. The only other twentieth century specimens came from near The Granites in the Tanami Desert in 1952 (Wurst 1995, Watts and Aslin 1981). Finlayson (1961) reported the species from Hugh Creek (1935), Napperby Hills (1950) and Davenport Range (1953).

Antina have never been collected alive in Western Australia. However, their remains are fairly common in sub-fossil deposits in the Cape Range, where the species has been recorded from 12 caves. These deposits are consistent with accumulations deposited by owls (Baynes and Jones 1993) and are considered to be of recent origin. Because of this the species is considered part of the modern Western Australian mammal fauna.

Extensive surveys for Antina in the Northern Territory in 1990, and shorter surveys in the 1970s and early 1980s, failed to locate the species (Wurst 1990).

No specific searches for Antina have been conducted in Western Australia. General vertebrate survey work has been conducted in parts of the Pilbara, some ranges in the Great Sandy Desert (South Esk Tablelands, McLarty Hills, Edgar Range) and in the Carnarvon Basin, including parts of the Kennedy Range and Pell Range. No mammal survey has ever been conducted in the Cape Range, which, with extensive areas of rugged limestone, is different from any area where general vertebrate surveys have failed to locate Antina.

1.2 Distribution and Habitat

The occurrence of the Antina in the central ranges, the Tanami Desert and on North West Cape suggests that it may once have had a distribution that encompassed the desert ranges of Western Australia, including the Pilbara. The species has been recorded from granite boulder fields, quartzite screes and eroded sandstone cliffs (Wurst 1995); these and similar habitat types are fairly widespread in the arid zone.

1.3 Biology and Ecology

Almost nothing is known about the biology or ecology of the Antina. Its biology probably resembles that of other species of *Zyzomys*. Quandongs (*Santalum acuminatum*) may have played an important role as a food item, since old, chewed quandong nuts can be found in rock crevices and on ledges in the central ranges (Wurst 1995). This food is also exploited by congenerics such as the Djoorri (*Z. argurus*).

1.4 Threatening Processes

With an estimated mean adult body weight of about 60 g (Burbidge and McKenzie 1989), the Antina lies within the Critical Weight Range (CWR). Burbidge and McKenzie (*op. cit.*) have demonstrated that such taxa are particularly susceptible to extinction, particularly in arid areas. They suggested that the reasons for the decline and extinction of many CWR mammal species are associated with factors that emulate an increase in aridity by reducing environmental productivity - the diversion of environmental resources to introduced species, a reduction in vegetative cover by exotic herbivores and changed fire regimes, exacerbated by predation by introduced foxes, cats and rats. Morton (1990) extended Burbidge and McKenzie's general hypothesis, viewing arid Australia as a resource-poor landscape through which were scattered resource-rich, productive patches upon which many arid zone mammals were dependent in times of drought. Such patches have been depleted by human activities and by grazing by introduced herbivores, particularly rabbits.

Burbidge and McKenzie's (*op. cit*) analyses showed that species inhabiting rock piles have not declined as much as those restricted to the ground's surface. Thus, the probability that Antina survive is increased compared to many other possibly extinct arid zone mammal taxa.

1.5 Conservation status

The Antina is listed as 'fauna which is likely to become extinct or is rare' under the Western Australian Wildlife Conservation Act. The Commonwealth Endangered Species Protection Act lists the species as 'Endangered'. The Rodent Action Plan (Lee 1995) also lists it as 'Endangered' but states that under the criteria of Mace and Lande (1991) it is "Critical, possibly extinct" (p. 31). In 1995, the Scientific Ranking Panel for Western Australia's threatened flora and fauna allocated the species to the new IUCN category 'Critically Endangered' (IUCN 1994) using methods prescribed in CALM Policy Statement No. 50.

Policy Statement No. 50 requires CALM to ensure that all taxa identified as Critically Endangered are conserved, through the preparation and implementation of Recovery Plans or Interim Recovery Plans and to ensure that conservation action for taxa identified as Critically Endangered commences as soon as possible and always within one year of endorsement of that rank by the Minister. The Minister endorsed the Antina as Critically Endangered in July 1995.

1.6 Strategy for Recovery

Planning for recovery is not possible unless one or more populations of Antina are located. Thus the main strategy of this Interim Recovery Plan is to conduct field surveys in an attempt to locate the species in the wild.

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan for the Antina is to locate the species in the wild in Western Australia and to commence recovery actions.

2.2 Criteria

On the assumption that the Antina still exists in Western Australia, the criteria for successfully achieving the objective are:

1. the location of one or more populations in the wild;
2. the development of methods of finding, studying and monitoring Antina in the wild;
3. the gathering of sufficient information to begin management actions for the conservation of the species in the wild;
4. an improvement in the status of one or more populations in the wild, as measured by increases in the number of Antina being trapped, and/or the expansion of the area being used;
5. the establishment of a Recovery Team and the writing of a Recovery Plan.

If the Antina can not be located in the wild, the criterion for successfully achieving the objective is:

1. Conducting two field surveys, each of at least 2 000 trap-nights, for Antina in Cape Range National Park, encompassing all the major habitat types within rocky country, one in late winter or spring and one in autumn. Each survey will use pitfall and drift fence traps and Elliott traps.

The criterion for failure to achieve the Objective is:

1. Failure to locate Antina after conducting adequate surveys in Cape Range.

3. RECOVERY ACTIONS

This Interim Recovery Plan will remain in force until the criteria for success have been met, or for three years when it will be reviewed if the objective has not been achieved by that time. Costing this interim plan is difficult because all subsequent actions are dependent upon finding one or more populations. The Plan therefore makes the assumption that populations will be found early enough in the life of this plan that the objective can be achieved within three years, and that all actions named in the plan will be funded within that time.

3.1 Conduct field Survey

Field surveys will be conducted in Cape Range National Park. Baynes and Jones (1993) state that Antina "are more abundant in the cave deposits in Cape Range than anywhere else in its original distribution, suggesting that the Range may have provided particularly favourable habitat. It is possible that it still survives there. A survey of the vertebrates of Cape Range should be a high priority." (p. 207).

There has never been a survey of the mammals of Cape Range National Park (CALM 1987). A survey for Antina would locate many other taxa of mammals. In addition, other animals such as reptiles and a variety of invertebrates would be sampled in traps. Thus, a survey for Antina would provide much information about the distribution of other animals within the Park, improving the knowledge of the area and enabling specific management actions to be implemented if necessary.

Experience with field surveys for vertebrates in Australia shows that surveys in several seasons reveal a greater proportion of the biota than a single survey. In the case of rodents this is partly due to greater trap success when young become independent and disperse. The breeding season of Antina is unknown. In the wet-dry tropics, Djoorri (Common Rock-rat, *Z. argurus*), Djookooropa (Kimberley Rock-rat, *Z. woodwardi*) and Kodjperr (Arnhem Land Rock-rat, *Z. maini*) breed the year round, but few females are found to be pregnant late in the dry season. These data are, however, from an environment that has predictable, relatively high rainfall. Data on arid zone native rodents suggests that breeding is greatly depressed during drought and that it increases after significant rainfall. Climate in the Cape Range area is arid with hot summers and warm winters. Rain may fall at any time of the year, but substantial falls are most likely in between February and July, while little rain usually falls between September and December (Appendices 1 & 2). Taking this information into account, breeding in Antina seems most likely in late summer, with juveniles dispersing in late winter or spring.

Trap success rates for rodents in the arid zone can vary greatly - after a series of good seasons, trap success rates for small mammals can approach 100%; however, during a drought, trap success rates at the same place can be zero. Thus, in order to maximise the possibility of success, it would be ideal to conduct the survey for Antina in the Cape Range after a series of average to good seasons. The annual average rainfall at Exmouth is 264 mm (80 years) while that at Learmonth is 230 mm (20 years). The rainfall in 1992 and 1995 was above average, while that in 1993 and 1994 was near average (Appendix 1). These data suggest that 1996 would be a satisfactory time to conduct the survey. However, the works programs of CALM staff will not allow work in 1996, so the project will be programmed for 1997.

In 1995, Drs Ken Aplin and Alex Baynes of the Western Australian Museum sought funding via CALM from the Commonwealth Endangered Species Program to carry out a search for Antina in Cape Range. The amount requested was $33 620. This application was unsuccessful. The budget was based on using contract staff to carry out the field work. Utilising existing CALM and Museum staff with absorption of salary costs by the agencies would significantly reduce the cost of a survey.

The survey for Antina in Cape Range National Park is based on the following assumptions:

1. Three week field trips will be carried out in two seasons, the first in Spring 1997 and the second in autumn 1998. Survey methods will be pit-fall and drift fence trapping (using the modified McKenzie design), Elliott trapping and searching for sign of animals' presence (eg, chewed *Santalum* nuts). Existing stocks of Elliott traps in CALM and WAM will be used. Cape Range lies within the Carnarvon Basin. Trapping methods will, as far as possible, follow the design used in the Carnarvon Basin Survey so the results can be compared with other sample sites further south in the Basin.
2. Staff will be provided by CALM (WATSCU, SID Woodvale and Pilbara Region/Exmouth District) and by the WA Museum. Staff salary costs will be absorbed by the two agencies.
3. A reconnaissance and set up trip will be conducted in winter 1997 to select survey sites and install pit-fall traps. Pit-fall traps will need to be blasted into rocky areas. This will involve the use of a rock drill (held by SID Woodvale) and a person licensed to use explosives (Phil Fuller (SID Woodvale). Two vehicles are needed ex Perth because explosives and detonators can not be carried in the same vehicle. Two survey sites will be chosen. Each will have six sample sites. Each sample site will be trapped with two pit-fence lines, each with six pit traps, and 80 Elliott traps. Traps will be opened for six nights during each sampling session.
4. Costs of running the field trips, including consumables, vehicle running and travelling allowances will be met from a budget allocated by CALM for the implementation of this Interim Recovery Plan.

5. Writing up the surveys will be carried out by CALM and WAM staff at no extra cost. Budget calculations are provided at Appendix 3.

   Responsibility: CALM WATSCU, SID, Pilbara Region and WA Museum
   Cost: $20 175 (reconnaissance and set up trip $7 035; (two x 18 day surveys $13 140)
   Priority: very high.

3.2 Research and monitoring

Should Antina be located within Cape Range National Park, a research project should be initiated without delay. This will entail either the reallocation of existing CALM Science & Information Division (SID) staff or the employment of a contract scientist supervised by CALM SID staff. Assuming the latter, a budget of about $50,000 per annum for three years would be required. This money will be sought from external sources, including the Commonwealth Government's Endangered Species program and sponsorships from the private sector.

Responsibility: WATSCU and SID
Cost: $50,000 per year for three years (from external sources)
Priority: very high if populations are found

3.3 Captive breeding

Most species of Australian rodents are relatively easy to breed in captivity. If a population of Antina is located, a captive breeding colony will be set up. This will provide additional security for the species and may provide animals for future translocations. The site of the captive breeding colony will be decided at the time. A notional budget is necessary to cover costs of cages, food and husbandry. This money will be sought from external sources, including the Commonwealth Government's Endangered Species program and sponsorships from the private sector.

Responsibility: CALM WATSCU and SID
Cost: $5 000 initially, plus $1 000 per year
Priority: very high if populations are found.

3.4 Management actions

Until one or more populations are found and some information gathered about them, it is difficult to identify specific management issues, and impossible to cost them. However, there is one point that can be made on the basis of existing knowledge.

It seems likely that if a population is found, immediate baiting for Red Foxes and Feral Cats would be likely to benefit the survival and expansion of the population. Baiting for foxes is already conducted within a small part (1 250 ha) of Cape Range National Park at an annual cost of $1 600, allocated from the Environmental Protection Branch budget and is proposed to be extended under CALM's project "Western Shield". If Antina are located, CALM will ensure that baiting includes areas of Antina habitat. Assuming an area of 10 000 ha is baited four times per year from the air, the cost will be approximately $6 200 per annum. However, this expenditure would not be necessary if appropriate areas of Cape Range National Park is baited for foxes under "Western Shield".

Responsibility: CALM Environmental Protection Branch and Exmouth District
Cost: $6200 per year
Priority: very high if populations are found.

Techniques for broad-scale Feral Cat control are not currently available. Research aimed at developing broad-scale techniques is underway in CALM and in some other conservation agencies. Should a population of Antina is located, advice will be sought on the best available Feral Cat control methods, which will then be implemented.

Responsibility: WATSCU, CALM Environmental Protection Branch and Exmouth District
Cost: unknown
Priority: high if populations are found.

3.5 Appoint Recovery Team

Should a population of Antina be located, a Recovery Team will be set up to revise this Interim Recovery Plan, and coordinate research and management actions. Members will be appointed to represent relevant land managers, scientists and funding agencies. Appointment of persons from the local conservation community will be considered. The Recovery Team will report annually to CALM's Corporate Executive and funding agencies.

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Appendix 1. Rainfall data for Exmouth Gulf (provided by Bureau of Meteorology)

1915	0.0	88.7	0.0	94.8	0.0	79.0	8.7	0.0	0.0	0.0	0.0	0.0	271.2
1916	74.9	48.7	56.7	0.0	30.5	67.9	1.0	0.0	0.0	12.7	0.0	0.0	292.4
1917	39.1	0.0	41.9	0.0	14.0	20.8	0.0	4.3	0.0	2.8	0.0	0.0	122.9
1918	2.5	584.9	0.0	0.0	85.6	61.7	10.4	2.3	0.0	0.0	0.0	0.0	747.4
1919	0.0	0.0	13.5	0.0	0.0	5.3	0.0	22.8	0.0	0.0	0.0	0.0	41.6
1920	0.0	0.0	39.4	76.0	27.4	40.4	18.8	9.2	20.6	0.0	0.0	0.0	231.8
1921	0.0	210.3	131.8	0.0	44.4	5.8	9.7	37.1	0.0	0.0	0.0	0.0	439.1
1922	0.0	0.0	58.9	3.8	79.8	26.4	2.0	0.0	0.0	0.0	0.0	0.0	170.9
1923	188.9	0.0	304.1	233.4	47.5	23.0	14.2	0.0	0.0	0.0	0.0	2.5	813.6
1924	0.0	1.0	0.0	6.8	10.9	85.3	0.0	0.0	0.0	0.0	0.0	0.0	104.0
1925	5.1	45.0	10.4	0.0	76.0	20.9	0.0	3.0	3.3	0.0	0.0	0.0	163.7
1926	0.0	13.2	56.6	0.0	48.7	5.1	0.0	0.0	0.0	0.0	0.0	17.8	141.4
1927	0.0	0.0	209.7	0.0	33.3	173.8	34.4	0.0	0.0	0.0	0.0	0.0	451.2
1928	0.0	0.0	0.0	13.0	32.5	84.8	4.3	0.0	0.0	0.0	0.0	15.4	150.0
1929	0.0	32.8	242.3	0.0	149.2	12.4	0.0	20.0	0.0	0.0	0.0	0.0	456.7
1930	0.0	0.0	45.4	0.0	0.0	151.4	0.0	6.9	1.3	0.0	0.0	0.0	205.0
1931	11.7	0.0	2.3	8.9	169.9	91.0	66.0	13.2	0.0	11.5	0.0	0.0	374.5
1932	0.0	0.0	11.7	19.8	80.2	29.0	0.0	19.3	0.0	0.0	0.0	5.1	165.1
1933	0.0	0.0	511.3	8.2	28.4	7.6	25.4	63.1	3.0	0.0	0.0	1.3	648.3
1934	27.8	57.7	275.1	23.9	40.9	25.4	0.0	0.0	0.0	0.0	0.0	0.0	450.8
1935	45.0	8.6	30.5	0.0	0.0	0.0	4.3	15.7	0.0	0.0	0.0	0.0	104.1
1936	0.0	0.0	0.0	55.2	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	58.8
1937	8.9	150.8	0.0	38.1	58.2	18.9	0.0	11.5	8.9	0.0	0.0	0.0	295.3
1938	0.0	0.0	0.0	5.3	66.7	3.3	7.9	7.9	0.0	0.0	0.0	0.0	91.1
1939	6.1	21.0	23.9	0.0	44.5	32.5	5.0	3.0	0.0	0.0	19.1	7.4	162.5
1940	38.0	0.8	0.0	0.0	3.0	39.3	16.5	0.0	0.0	0.0	0.0	0.0	97.6
1941	0.0	0.0	13.9	18.5	45.0	40.1	48.1	241.8	0.0	0.0	0.0	15.0	422.4
1942	8.6	0.0	6.6	3.8	117.9	47.2	23.2	0.0	0.0	0.0	27.2	0.0	234.5
1943	1.3	181.9	17.8	0.0	20.8	52.8	17.8	4.6	0.0	0.0	2.0	0.0	299.0
1944	0.0	2.3	64.3	3.3	5.3	0.0	2.5	9.7	0.0	0.0	0.0	0.0	87.4
1945	0.0	165.1	7.1	0.0	5.6	36.5	0.0	1.3	10.2	0.0	0.0	0.0	225.8
1946	82.6	49.8	31.5	57.6	9.4	21.1	9.4	0.0	0.0	0.0	1.0	0.0	262.4
1947	0.0	84.5	7.4	0.0	58.2	29.5	46.5	6.6	0.8	9.2	0.0	0.0	242.7
1948	0.0	41.7	2.5	54.2	0.0	178.1	61.7	0.0	6.1	0.0	0.0	6.9	351.2
1949	0.0	82.1	26.2	24.3	190.0	71.2	1.5	11.5	14.7	0.0	40.6	1.0	463.1
1950	0.0	2.1	0.0	0.0	77.4	25.4	16.0	0.3	0.0	0.0	2.5	0.0	123.7
1951	0.0	15.7	27.9	5.9	7.1	186.6	9.2	0.3	0.0	0.0	0.0	0.0	252.7
1952	2.5	154.4	0.0	2.3	66.3	0.0	89.4	0.0	0.0	0.0	0.0	0.0	314.9
1953	2.3	0.0	184.2	12.2	138.4	55.7	26.2	0.0	0.0	0.0	0.0	0.0	419.0
1954	0.0	2.6	0.0	0.0	15.1	64.3	10.2	0.0	0.0	8.1	0.0	0.0	100.3
1955	23.6	3.8	0.0	0.0	113.3	0.8	3.8	44.9	4.1	0.0	0.0	0.0	194.3
1956	4.8	2.0	166.2	9.7	16.5	51.0	18.1	42.1	0.0	0.0	0.0	0.0	310.4
1957	2.3	71.4	14.0	0.0	80.2	94.5	1.8	0.0	0.0	0.0	0.0	0.0	264.2
1958	12.7	0.0	104.9	0.0	48.3	16.8	4.8	0.0	2.8	0.0	1.8	3.6	195.7
1959	0.0	0.0	0.0	0.0	19.6	3.8	34.4	0.0	0.0	0.0	0.0	0.0	57.8
1960	33.5	15.7	66.8	0.5	3.0	65.7	48.0	1.5	0.0	0.0	0.0	0.0	234.7
1961	37.9	206.2	86.6	140.5	10.4	33.3	3.0	8.9	0.0	0.0	0.0	0.0	526.8
1962	34.6	8.7	0.0	13.4	37.7	4.0	7.1	0.0	0.0	0.5	0.0	0.0	106.0

1963	99.3	112.0	14.7	14.0	118.2	12.7	43.9	0.0	0.0	0.0	0.0	0.0	414.8
1964	0.0	0.0	257.1	1.8	6.6	90.5	10.9	5.8	3.6	26.4	0.0	0.0	402.7
1965	0.0	1.5	78.3	0.0	10.7	79.9	10.2	66.6	0.0	0.0	0.0	0.0	247.2
1966	0.0	19.5	0.0	32.0	0.0	5.1	1.6	2.3	0.0	34.0	0.0	1.0	95.5
1967	278.3	6.1	11.6	0.0	28.0	15.7	0.0	12.9	0.0	0.0	0.0	0.0	352.6
1968	3.3	54.8	0.0	3.0	17.0	221.0	0.0	10.2	3.6	0.0	0.0	3.3	316.2
1969	0.0	23.9	0.0	0.0	104.9	46.5	0.0	0.0	0.0	1.5	0.0	0.0	176.8
1970	0.0	158.7	0.0	98.5	220.7	11.6	3.6	1.0	11.4	0.0	0.0	0.0	505.5
1971	231.1	8.6	101.9	0.0	34.8	29.8	54.7	1.0	0.0	0.0	0.5	0.0	462.4
1972	0.3	4.0	0.0	0.0	27.9	34.1	46.5	10.9	0.0	0.0	0.0	15.5	139.2
1973	0.8	0.8	34.6	11.4	30.9	77.5	56.2	48.8	1.0	0.0	0.0	39.2	301.2
1974	84.5	7.6	34.5	4.3	44.4	10.9	86.3	29.9	0.0	63.5	0.0	0.0	365.9
1975	0.0	73.2	129.5	32.0	13.2	6.6	34.7	0.3	0.0	19.1	61.7	11.9	382.2
1976	18.0	58.0	7.0	0.0	6.0	1.0	23.0	26.0	3.0	0.0	0.0	0.0	142.0
1977	5.1	0.0	89.4	29.0	24.3	8.1	0.0	1.3	0.0	0.0	5.0	0.0	162.2
1978	10.9	25.3	8.4	24.0	19.4	3.8	39.0	36.1	0.8	0.0	0.0	0.0	167.7
1979	0.0	10.7	81.1	2.1	9.4	3.0	0.0	40.7	0.0	0.0	0.0	0.0	147.0
1980	61.2	56.4	7.8	79.8	74.0	144.3	65.2	1.5	0.0	1.8	0.0	1.0	493.0
1981	25.0	35.0	28.0	0.0	17.0	59.0	5.0	16.0	0.0	0.0	0.0	2.0	187.0
1982	75.0	5.0	12.0	0.0	96.0	33.0	1.0	11.0	4.0	0.0	0.0	0.0	237.0
1983	3.5	0.0	23.8	0.0	2.0	50.0	1.0	9.0	7.0	0.0	2.0	0.0	98.3
1984	0.9	15.1	9.7	19.2	216.0	0.7	66.2	14.6	2.8	8.2	0.0	0.0	353.4
1985	0.0	31.8	0.0	45.5	49.5	85.0	34.0	0.0	0.0	0.0	0.0	0.0	245.8
1986	0.0	132.4	22.0	4.0	0.0	27.8	14.0	0.2	7.8	0.0	0.0	0.0	208.2
1987	0.0	14.0	0.0	9.0	0.0	73.4	26.9	5.0	0.0	0.0	0.0	0.0	128.3
1988	0.0	0.0	9.3	21.0	31.0	5.0	7.5	45.2	0.0	2.4	10.8	0.3	132.5
1989	0.0	2.2	11.3	0.0	64.0	44.6	0.0	0.0	0.0	0.0	0.0	0.0	122.1
1990	142.6	5.1	27.1	0.0	0.0	9.2	32.8	44.2	0.0	0.0	0.0	0.0	261.0
1991	0.0	37.5	0.0	0.0	34.5	59.2	25.4	0.6	2.0	0.0	0.4	0.0	159.6
1992	0.8	0.0	4.2	34.2	117.6	160.2	0.0	1.0	2.4	0.0	0.0	0.0	320.4
1993	14.0	108.4	0.0	9.4	51.2	39.8	9.2	8.0	2.8	0.0	1.6	0.0	244.4
1994	0.0	169.6	0.2	0.0	0.4	28.8	19.0	9.8	0.0	0.0	0.0	8.0	235.8
1995	0.0	134.6	0.0	43.6	20.4	16.8	32.4	1.2	1.6	0.0	0.4	123.2	374.2
1996	0.0	43.0											
avge	21.6	45.3	48.1	17.9	46.3	45.5	18.0	13.3	1.6	2.5	2.2	3.5	265.7
count	81	81	81	81	81	81	81	81	81	81	81	81	81
mini	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.6
maxi	278.3	584.9	511.3	233.4	220.7	221.0	89.4	241.8	20.6	63.5	61.7	123.2	813.6

Appendix 2. Rainfall data for Learmonth (provided by Bureau of Meteorology)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1976	22.6	38.4	5.0	0.0	7.3	4.2	20.0	37.6	3.2	1.4	0.0	0.0	139.7
1977	1.6	0.6	98.0	10.0	59.0	12.4	0.0	6.8	0.0	0.4	1.4	0.0	190.2
1978	4.4	10.2	5.2	33.0	4.8	22.8	36.0	47.0	0.0	0.0	0.0	0.0	163.4
1979	0.0	0.0	91.4	4.2	10.4	3.4	0.0	45.4	0.0	0.0	0.0	0.6	155.4
1980	13.8	41.2	1.0	90.2	60.2	124.8	63.2	0.4	0.0	2.2	0.0	0.4	397.4
1981	18.0	19.4	38.2	0.0	33.0	46.4	0.4	4.2	14.4	0.0	0.6	0.6	175.2
1982	85.0	27.8	13.6	2.6	71.6	27.0	0.2	4.4	10.0	0.0	0.2	0.0	242.4
1983	0.0	0.0	8.6	7.2	15.0	45.8	8.6	13.0	10.4	0.0	3.8	0.0	112.4
1984	0.0	54.0	23.8	5.0	230.8	12.0	89.0	14.6	1.4	10.0	0.0	0.6	441.2
1985	0.0	32.0	0.0	36.4	51.4	58.8	68.0	1.2	0.0	2.0	0.0	0.0	249.8
1986	2.2	97.6	29.2	0.0	8.6	39.0	9.8	3.4	7.8	2.4	0.0	0.0	200.0
1987	0.0	33.6	0.8	2.0	11.6	74.0	26.4	1.4	0.0	0.4	0.0	0.0	150.2
1988	0.0	0.0	11.0	11.8	40.0	14.2	28.2	54.8	0.2	2.4	11.4	0.8	174.8
1989	0.2	2.6	13.8	0.8	55.8	66.2	1.0	0.0	0.0	0.0	0.2	0.0	140.6
1990	143.0	1.0	47.0	0.0	0.4	8.0	29.0	38.8	0.0	0.0	0.0	0.0	267.2
1991	0.0	32.2	22.6	0.4	47.6	86.0	18.4	2.6	0.0	0.0	0.4	0.0	210.2
1992	0.4	0.0	11.8	48.6	137.2	152.6	0.0	2.4	3.2	0.2	0.0	0.0	356.4
1993	11.6	118.0	0.0	11.8	33.8	40.6	8.8	9.0	1.4	0.0	4.0	0.0	239.0
1994	0.0	158.2	0.0	0.0	4.0	28.4	11.0	17.2	0.0	0.0	0.0	0.0	218.8
1995	0.0	138.4	0.0	15.6	7.4	37.0	20.6	0.6	2.8	0.0	0.0	153.0	375.4
1996	0.0	51.6											
avge	35.6	46.2	33.7	16.1	45.2	43.5	22.1	13.9	2.2	2.3	1.5	6.6	230.0
count	20	20	20	20	20	20	20	20	20	20	20	20	20
mini	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	112.4
maxi	361.1	238.7	257.5	129.5	230.8	223.5	89.0	64.0	14.4	45.7	31.6	153.0	441.2

Appendix 3. Budget calculations

1. Reconnaissance and installation trip

4 staff ex Perth (CALM & WAM), two 4WD vehicles

2 Pilbara Region/Exmouth District staff, one 4WD vehicle (vehicle costs met by Pilbara Region)

ex Perth TA 4 x 2 day @ $58/day	465
ex Perth TA 4 x 12 days @ $33/day	1585
ex Karratha/Exmouth TA 2 x 10 days @ $33/day	660
14 days commuted overtime (@ $42/day)	600
Toyota running 4 000 km @ 30 c + $150	1350
Pajero running 3 000 km @ 20 c + $100	700
explosives ($2.50 / hole, 144 holes)	360
rock drill costs	300
24 lines of pit traps and lids (@ $23.50 / line of 6)	565
12 sets drift fences and McKenzie funnels (@ $24 per line)	450
TOTAL	**7035**

2. Each 18 day field trip

3 staff ex Perth (CALM & WAM), 2 ex Pilbara/Exmouth, one 4WD ex Perth, one from Exmouth. Pilbara Region/Exmouth District vehicle costs met by Region

ex Perth TA for 3 people, 10 days @ $58 / day	1740
ex Perth TA for 3 people, 8 days @ $33 / day	790
ex Perth vehicle running 4000 km @ $0.30 + $150	1350
ex Region TA for 2 people, 10 days @ $58 / day	1160
ex Region TA for 2 people, 8 days @ $33 / day	530
consumables (bait, preservative, batteries, etc)	1000
TOTAL PER TRIP	**6570**

INTERIM RECOVERY PLAN NO. 6

WESTERN GROUND PARROT

INTERIM RECOVERY PLAN

1996 to 1999

by

Allan H. Burbidge[1], John Blyth[2], Alan Danks[3], Kelly Gillen[3] and Brenda Newbey[4]
for the South Coast Threatened Birds Recovery Team

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June 1997

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FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50.

Where urgency and/or lack of information mean that a full Recovery Plan can not be prepared, IRPs outline the recovery actions required urgently to address those threatening processes most affecting the ongoing survival and begin the recovery process of threatened taxa or ecological communities.

CALM is committed to ensuring that Critically Endangered taxa are conserved, through the preparation and implementation of Recovery Plans or Interim Recovery Plans and ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Approved IRPs are subject to modification as dictated by new findings, changes in species' status and completion of Recovery Actions.

Information in this IRP was accurate at December 31, 1996.

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FIGURES

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SUMMARY

Species: *Pezoporus wallicus flaviventris* Western Ground Parrot

Order: Psittaciformes **Family:** Psittacidae

CALM Region: South Coast (and possibly also Southern Forest)

CALM Districts: Albany, Esperance (and possibly also Walpole and Pemberton Districts, Southern Forest Region)

Recovery Team: South Coast Threatened Birds Recovery Team: Kelly Gillen (Chair), John Blyth, Allan Burbidge, Andrew Burbidge, Peter Cale, Alan Danks, Shapelle McNee, Bruce Male, Brenda Newbey and Graeme Smith.

Current Status: Critically Endangered (CALM Scientific Ranking Panel, 1995)

Habitat Requirements and Limiting Factors: low coastal and near coastal heathlands, unburnt for at least 15 years in some areas (depending on source population); requirements poorly understood in other areas

IRP Objectives: The long-term objective is to increase the probability of survival of the Western Ground Parrot. Over the time frame of this three year plan, specific objectives are to (a) improve the protection of known populations and any new ones that become known during the term of this plan, (b) obtain more accurate estimates of population size, distribution and trends, so that the effectiveness of management actions can be assessed, (c) improve understanding of habitat requirements, particularly with respect to fire regime, and (d) produce a formal recovery plan.

Recovery Criteria:

The criteria for success are (in priority order):

(a) establishment of a monitoring program, (b) a measured increase in population size or increasing area occupied by those populations being monitored, (c) discovery of previously unknown populations, (d) production and application of fire management guidelines for each known population, (e) the application of an on-going predator control (fox baiting) program in monitored populations in Fitzgerald River National Park and Waychinicup National Park and (f) the production of an approved Recovery Plan.

The program will be considered to have failed if:

(a) there is a measured decrease in overall population size or decrease in area occupied by those populations being monitored, or (b) adequate data cannot be/have not been collected to allow a confident assessment of population trend or area occupied.

Recovery Actions:

1. Fire management
2. Predator control
3. Dieback hygiene
4. Vesting in the NPNCA of land in Manypeaks area
5. Documentation of known populations and monitoring of trends in population size/boundaries
6. Survey of areas possibly suitable for Western Ground Parrots
7. Taking birds for captive breeding or translocation
8. Production of an approved Recovery Plan

Estimated Cost of Actions: Cost of the above actions depends to a large degree on the amount of volunteer resources that can be accessed and how many new populations are found. The minimum cost over three years will be $108 855 (including salaries and overheads) but this includes significant extra volunteer input.

BACKGROUND

Description, Taxonomy and Status

The Ground Parrot (*Pezoporus wallicus* Kerr) is a cryptic, ground-dwelling parrot, endemic to Australia and having a fragmented distribution in coastal south-eastern and south-western parts of the continent. It is a medium sized, slim parrot with a long, strongly gradated tail comprising narrow, pointed feathers (Forshaw 1973, 1981). The wings are short and rounded. The tarsi are long and the claws extremely long and only slightly curved. Sexual dimorphism is absent. Adults are generally rich green, strongly mottled with black and yellow. Feathers on the upper surface show black shaft streaking. Adults have a red frontal band. Three adult birds caught in Fitzgerald River National Park weighed 105-110 g with wing length 135-145 mm (Burbidge *et al.* 1989).

North (1911) was the first to distinguish the Western Australian populations of *P. wallicus* as different from those in eastern Australia, describing the western birds as *P. flaviventris*. He based this view on differences in plumage, with the western birds having broken barring on the under surface and a yellow (rather than greenish yellow) lower breast and abdomen. Mathews (1912) reduced *flaviventris* to subspecific level, describing it as "... not too well differentiated when South Australian specimens are considered." This situation has persisted, despite the view of some authors that the subspecies are poorly differentiated (Ford 1969; Forshaw 1981). No genetic investigations have been made on subspecific variation in this species and the morphometric investigations are based on few specimens and show little difference between the populations (Ford 1969; Forshaw 1981). On the other hand, there are some habitat differences, and possibly behavioural differences between eastern and western birds (Burbidge *et al.* 1989).

The Ground Parrot has often been considered the sole member of the genus *Pezoporus* and part of a relict group including two other monotypic genera: *Geopsittacus* (Night Parrot) from Australia and *Strigops* (Kakapo) from New Zealand (e.g. Mathews 1917; Condon 1975; Forshaw 1981). It has also been thought to be related to *Melopsittacus* (Budgerigar) (Forshaw 1973). However, Serventy (1953) considered *Pezoporus wallicus* and *Geopsittacus occidentalis* as members of the same genus as did Ford (1969), who considered the major differences between the two species to be simply a result of adaptations to their different environments. Recent DNA work (Leeton *et al.* 1994) is consistent with this latter view, suggesting that the Ground Parrot and Night Parrot are closely related, congeneric, and more closely related to *Neophema* than *Strigops*.

King (1979) considered *P. wallicus wallicus* as vulnerable to extinction and *P. w. flaviventris* as endangered. Since then, work on eastern Australian populations has shown that numbers of *P. w. wallicus* in Tasmania are high (Bryant 1991), and Garnett (1992a, 1992b) no longer considers this subspecies as threatened, but classified *P. w. flaviventris* as endangered. On Garnett's (1992b) list of priorities of threatened birds of Australia and its territories, *P. w. flaviventris* was listed at number 13.

However, recent reappraisals of the available data (Cale and Burbidge 1993; CALM Scientific Ranking Panel, 1995) found that the status of *P. w. flaviventris* is critically endangered. According to the most recent IUCN criteria (IUCN Species Survival Commission 1994) the taxon is Critically Endangered on the basis of Criterion C, ie the total population is less than 2500 individuals with a severely fragmented distribution (no population in excess of 250 individuals), and declining due to losses brought about through wildfire. In addition, the known area of occupancy is only about 10 km^2, and so the taxon may also meet Criterion B.

Distribution

Historical

At the time of European colonisation, the Western Ground Parrot was distributed in coastal areas from Cape Arid, west along the south coast and north possibly to the Dongara-Watheroo area of Western Australia (Watkins 1985).

It was first collected by John Gilbert near Perth in the 1840s (Ford 1969). The only other records from the west coast are nestlings in the Gould collection at the British Museum, recorded as taken from Wanyun Hills (Wongan Hills) and an adult from the Swan River collected by Dr. R.B. Sharpe (Salvadori 1891). Leake (1962) commented briefly about this species being a visitor to the eastern wheatbelt, where it fed in the vicinity of granite hills, but was not seen there after 1892. Several second hand reports from sandplain country between Dongara and Watheroo up to the 1890s when the area was burnt out, were recorded by Ashby (1921). Ford (1969) noted second hand reports of this species being found in stunted heath in laterite hills between Jurien Bay and Badgingarra during the 1890s and 1900s. In addition, Gilbert recorded a name for this species from Aborigines resident to the north of Perth, as well as one from Aborigines resident in the Perth area (Gould 1865, Whittell 1951).

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

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

Current

Knowledge of the presence of Ground Parrots in an area is determined mainly by listening for their calls and by flushing parrots (Watkins 1985; McFarland 1989; Bryant 1991); difficulties in obtaining positive data are discussed by Cale and Burbidge (1993). Practicalities make it difficult to determine if Ground Parrots are *absent* from an area; the following account is based on known definite records (Figure 1).

Watkins (1985) conducted an extensive survey along the western and southern coasts of Western Australia from Cervantes to Cape Arid National Park and found Western Ground Parrots in only two areas, the Fitzgerald River National Park and the Cape Arid National Park. Further studies (Burbidge *et al.* 1989, 1990) suggested that Western Ground Parrots were restricted to five subpopulations in the northern part of Fitzgerald River National Park and one population in Cape Arid National Park (Watkins & Burbidge 1992) (Fig. 1).

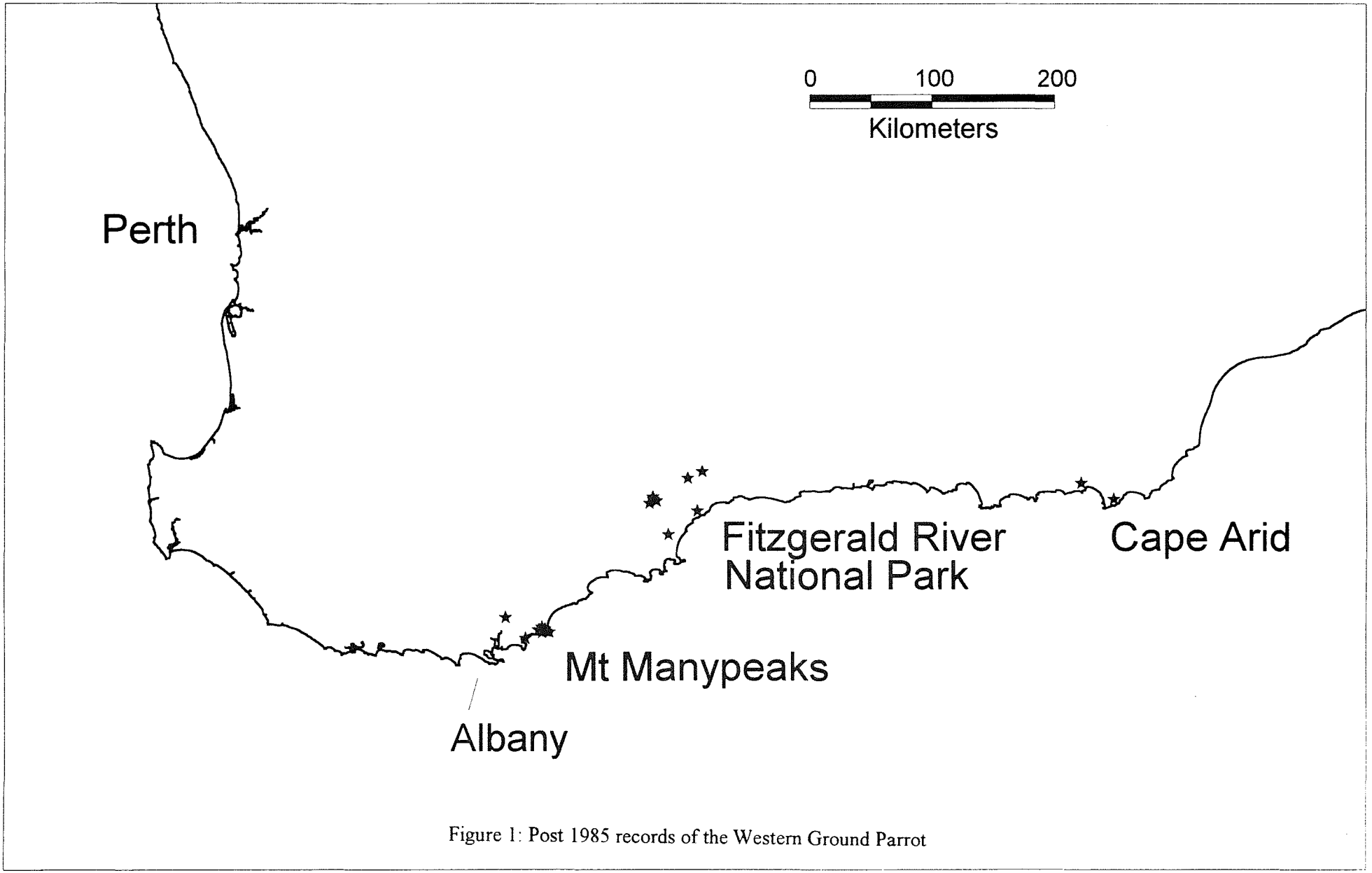

Figure 1: Post 1985 records of the Western Ground Parrot

A number of recent records have also come from the Mt Manypeaks area (Anon. 1993a, 1993b, 1994, A. Danks unpubl., D. Wilson pers. comm., L. Whisson pers. comm.). These have all been from low heathlands on the lower slopes of the Manypeaks complex in an area visited only briefly by Watkins (1985). Taken together, these records suggest that there is also a significant population inhabiting this area.

Following post-natal dispersal, Ground Parrots can occur away from known populations, sometimes in sub-optimal habitat, particularly in autumn (Meredith *et al.* 1984). Recent reports from Woolbernup Hill and near West Mt Barren, Fitzgerald River National Park (S. McNee pers. comm. 1994; N. Brown *et al.* pers. comm. 1996) and at Upper Kalgan (P. Collins pers. comm.) are probably in this category. Reports from the western side of Cape Arid National Park (M. Paxman pers. comm. 1994) may also represent dispersing birds, although the vegetation and geomorphic setting in this area is similar to that occupied in the northern parts of Fitzgerald River National Park. In any case, these sites should be re-surveyed to determine whether any of them actually represent permanent or semi-permanent populations, as opposed to being sites occupied only by itinerant birds.

Number, Size and Trend of Populations

Cale and Burbidge (1993) discussed the considerable difficulties in obtaining useful census data for Ground Parrots and summarised that available for *P. w. wallicus* at the time of writing. There are two basic methods, one based on calls and the other on flushing birds.

The listening method requires a number of observers to listen for calls during the two calling periods (before sunrise and after sunset). Numbers and locations can then be estimated by knowing the exact location of each observer, the time at which each call was heard, and the use of a triangulation procedure. Cale and Burbidge (1993) discuss the considerable difficulties with this technique. Provided listening conditions are good and the survey is carried out at an appropriate time of year, it is believed that the method is fairly reliable for determining the area occupied. Numbers can be estimated with much less confidence. Some workers (Bryant 1991; Baker and Whelan 1996) have used this technique with one observer, without triangulation, but with an estimate of area censused, corrected for listening conditions (wind, rain). However, the correction factors used to date are coarse and qualitative. In any case, conditions in Western Australian sites are different from those in the east (less rain but probably more wind) and correction factors should be determined for local conditions and stated explicitly.

Alternatively, birds can be flushed using a line of observers walking through the heath. Western Australian populations of Ground Parrots appear to be at a density which is an order of magnitude lower than those in eastern Australia (Watkins and Burbidge 1992) and this means that very few birds are flushed this way in western populations. It is therefore not a very efficient technique under Western Australian conditions. Nevertheless, if observers are available, it can be used to supplement data obtained by listening for calls.

Due to the low lumbers of birds and the exploratory nature of investigations to date, existing data for Western Australian populations are probably inadequate for monitoring purposes except at a coarse level. In the first year of this IRP, therefore, emphasis should be given to determining the level of survey needed to provide base line data adequate for meaningful monitoring. This will also provide better population estimates.

Watkins and Burbidge (1992) estimated the total population of Western Ground Parrots to be 378 birds. This estimate was determined using an estimate of the density at one site ("Short Road", Fitzgerald River National Park) and extrapolating to all known subpopulations, on the basis of the extent of suitable habitat associated with each. The estimate of population density for the Short Road sub-

population was 1-2 birds/40 ha, which is an order of magnitude lower than the densities found in eastern Australian populations (Watkins & Burbidge 1992). Only three of the six known subpopulations were estimated to have greater than 50 birds (Watkins & Burbidge 1992). These population estimates are preliminary, because the true boundaries of the five subpopulations were not known and the estimates based on data from the post-breeding period, when densities would be expected to be higher than prior to breeding.

Table 1: Estimate of Western Ground Parrot population size in 1990 (from Watkins and Burbidge 1992).

Site	Area of vegetation (ha)	Proportion suitable	Population estimate	
Fitzgerald River NP				
Hamersley Drive	2 900	.75	145	
Short Road	1 000	1.00	67	
Fitzgerald Track	2 400	.25	40	
Drummond Track	5 300	.10	35	
Moir Track	50	1.00	3	
Other	2 000	?.10	?13	
Sub-total				303
Cape Arid NP				
Poison Creek Road	1 100	1.00	75	
Sub-total				75
Total population estimate				**378**

Since this estimate was made, there have been two significant developments. First, most of the Fitzgerald Track area was burnt in October 1994. The effect on the Western Ground Parrot population is unknown, but the total estimate could be reduced by 40 birds. Second, the Mt Manypeaks area has been recognised as supporting an extant population. The area of suitable habitat here is unknown but could be in excess of 1500 ha and might therefore support about 100 birds.

In summary, Western Ground Parrots are known to exist in three areas (Fitzgerald River National Park, Cape Arid National Park and the Mt Manypeaks area), with the total number of birds probably being less than 500. Population trends are unknown for any of these areas.

The extremely low total population size and fragmented distribution indicate that the taxon is Critically Endangered (IUCN Species Survival Commission 1994).

Habitat

The vegetation types used by Ground Parrots can be broadly characterised as sedgelands, temperate shrub heaths, temperate graminoid heaths or sub-tropical graminoid heaths (Meredith 1984). All have medium to high species richness except sedgelands that are frequently dominated by a single species, and all are similar structurally being low with dense vegetation cover (Table 2). However, all Western Ground Parrot sites show much higher plant species richness than any of the eastern Australian sites where *P. w. wallicus* has been studied (Burbidge *et al.* 1989). Sites currently used by the Western Ground Parrot receive considerably lower rainfall than any of the eastern Australian sites (Table 2), but areas west of Albany known to have been used by Western Ground Parrots in the past have a rainfall (900-ca. 1300 mm) comparable to many sites used by *P. w. wallicus* in eastern Australia.

Table 2: Comparison of the climate (including mean annual rainfall) and vegetation communities used by Ground Parrots in different States of Australia (from Cale and Burbidge 1993).

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

Biology and Ecology

Little is known about the breeding biology of the Ground Parrot, and most work that has been done concerns the eastern *P. w. wallicus*. The major study has been that by McFarland (1988; 1989; 1991a,b,c,d) in Queensland, with other studies having been made in New South Wales (Jordan 1984, 1987, 1989; Barren Grounds Bird Observatory, unpublished), Victoria (Meredith & Isles 1980; Meredith *et al.* 1984) and Tasmania (Bryant 1991, 1992).

The breeding season of *P. w. wallicus* varies geographically, beginning earlier in northern latitudes (eggs: Queensland, July-November; NSW-Victoria, September-November; Tasmania, October-January) (McFarland 1988). However, the breeding season of the Western Ground Parrot is not known clearly. Whitlock (1914) found a nest with three eggs in late November 1913 and one with two young chicks (a few days old) in late October 1912, both east of Irwin Inlet, near Denmark. In contrast, Burbidge *et al.* (1989) found that, in 1988, juvenile birds were common by late October in Fitzgerald River National Park. Based on the estimated age of these juveniles, they suggested that the breeding season commenced at their study site in mid-late winter (June-August). These differences suggest that either (1) the breeding season in Western Australia varies from year to year, or (2) the records by Whitlock represent replacement or second clutches (Burbidge *et al.* 1989), or (3) the breeding season in Western Australia varies geographically (perhaps in response to patterns of rainfall). The second possibility is consistent with the fact that Whitlock only searched for nests during spring and so could not have found nests earlier (Whitlock 1914). McFarland (1991b) found no evidence of double clutching in Queensland, but he did observe two cases of females re-nesting after abandoning earlier nests.

The clutch size of the Eastern Ground Parrot varies from two to six eggs with the majority having three or four (McFarland 1988). Clutch size is consistent throughout eastern populations, except for Tasmanian birds having a higher mean clutch size. The data for Western Australia are limited to the two nests found by Whitlock (1914), which were a brood of two and a clutch of three.

In eastern Australia Ground Parrot eggs have an incubation period of 21-24 days and are incubated only by the female, which is fed by the male during this period. Chicks are continuously brooded by the female for the first four days after hatching and during the night for a further two days, and are capable of running by 18 days, though they usually remain in the nest for 24 days (range 18-28 days). After fledging juveniles remain near the nest for at least three weeks, but once they are capable of flying they follow the adults (McFarland 1991b). No data on the chronology of breeding are available for *P. w. flaviventris*.

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

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

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

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

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

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

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

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

Threatening Processes

Two major factors have been implicated in the decline of Western Ground Parrots: clearing for agriculture and the imposition of unsuitable fire regimes (Watkins & Burbidge 1992; Garnett 1992a, 1992b). Two other factors - predation by introduced predators and the changes in the vegetation brought about through dieback disease caused by root-rot pathogens (*Phytophthora* spp.) - have been considered as potential threats to the survival of the Western Ground Parrot (Watkins & Burbidge 1992; Garnett 1992a, 1992b). Clearing for agriculture is no longer a serious threatening process for the Western Ground Parrot because all known populations occur on Crown land, and most populations are in conservation reserves.

Response to fire

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

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

The use of the correlation between post-fire age of the vegetation and the density of Ground Parrots in that vegetation has two major problems associated with it. Firstly, correlations do not indicate a cause and effect relationship between the two variables, and for Ground Parrot densities other factors not

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

In Western Australia insufficient work has been done to assess accurately the relationship between post-fire age of vegetation and its use by Ground Parrots. Two observations, however, suggest that the relationship may differ from that suggested for the eastern subspecies. Firstly, birds in the Short Road population at Fitzgerald River National Park, are still present in vegetation that has not been burnt for at least 35 years (Burbidge *et al.* 1989; A.H. Burbidge *et al.* unpublished). Secondly, in the Cape Arid National Park population, birds appear to be restricted to long unburnt areas and only occasionally utilise an adjacent area of habitat that was six years post-fire (Burbidge *et al.* 1989). Burbidge *et al.* (1989) suggested that the possible preference by *P. w. flaviventris* for older vegetation than that used by *P. w. wallicus*, may be due to the slower growth rates of the vegetation in areas used by the parrots in Western Australia, due to a lower rainfall.

Care must be taken in interpreting the current information from Western Australia because it is not known how the current densities of Western Ground Parrots compare with the carrying capacity of Western Australian heaths. The absence of Ground Parrots from some areas may be due to insufficient birds to colonise them, as has been found for the Western Bristlebird at Two Peoples Bay (Smith 1987), rather than some deficiency in the habitat. In the Fitzgerald River National Park, Western Ground Parrots have recolonised an area by six and a half years after an intense wildfire. This shows that they can survive in vegetation this young in this area. However, colonisation was from an immediately adjacent area. Furthermore, it is not known if they breed in vegetation this age but, as it is much more open than the adjacent unburnt area, it might not yet be suitable.

In fire management for Ground Parrots it would seem prudent to follow the model developed for vegetation occupied by the rare birds at Two Peoples Bay, ie total fire exclusion and wildfire suppression in areas occupied by Noisy Scrub-birds and Western Bristlebirds. This has resulted in expansion of populations of these species (in numbers and area occupied) and has provided new information on habitat usage.

Predation

Mattingley (1918) and Edwards (1924) recorded that the Ground Parrot has a powerful scent that was easily found by dogs, and Mattingley noted that quail shooter's dogs frequently ran down and captured Ground Parrots. This, together with the terrestrial habits of the bird, suggests that the Ground Parrot could be particularly susceptible to predation by foxes and feral cats. They often fly to their night-time roosts (Burbidge *et al.* 1989), thus affording some protection from scent-following predators, but usually walk to the nest (McFarland 1991b), putting them at risk from predators such as foxes which follow scent trails. Although there are records of Ground Parrots being taken by foxes and cats (Mattingley 1918; Fletcher 1927; Jordan 1989), there are no data on the level of predation or its effects on populations. McFarland (1989) did not consider predation to be a major problem for Ground Parrots at densities of predators or parrots normally encountered in Queensland, but stated that they may prevent or slow down the recolonisation of small areas of suitable habitat after fire. No data are available on predation in Western Australia, but due to the very low number of Ground Parrots in this

State, the drier and more open habitats utilised and the known effects of foxes on ground-dwelling mammals (eg Kinnear *et al.* 1988), the fox must be considered a potential threat.

Influence of Dieback Disease (Phytophthora spp.)

Dieback disease caused by introduced *Phytophthora* spp. has been considered a potential threat to Ground Parrot populations (Garnett 1992a, 1992b). Work by Wills (1993) on the effects of *Phytophthora cinnamomi* on heath communities in the Stirling Ranges National Park, indicates that the disease causes changes in plant community structure and composition. In heaths in the Stirling Ranges, *Phytophthora* infections are associated with a general decline in total projective foliage cover, due mainly to the loss of many woody perennials. An increase in the cover of sedges (Cyperaceae and Restionaceae) may also occur. Changes in floristic composition were also observed, primarily through a decline in woody perennials of the Proteaceae. Such changes could have adverse effects on Western Ground Parrot habitat in some areas. On the other hand, such changes may actually improve the habitat in other areas by e.g. removing large shrubs of *Banksia* spp. and increasing the dominance of sedges with a possible increase in food availability.

Nevertheless, the effects of such vegetation changes on Western Ground Parrots are unknown and cannot be assessed without better information on habitat requirements, diet and population densities, as well as better knowledge of the effects of *Phytophthora* in vegetation types used by Ground Parrots.

Existing conservation measures

Most of the known populations of Western Ground Parrot are in CALM-managed land, ie Fitzgerald River National Park, Cape Arid National Park and Waychinicup National Park. Some of the Cheyne Beach - Waychinicup population is in unvested Crown land adjacent to Waychinicup National Park.

The presence of Ground Parrots constituted a major argument for the addition to Fitzgerald River National Park of approximately 100 000 ha of land on the northern boundary in 1988. This area holds the major known, and the most intensively studied, subpopulations of the Western Ground Parrot (Watkins & Burbidge 1992).

Management of Fitzgerald River National Park is carried out under a management plan (Moore *et al.* 1991) which provides considerable protection for the Ground Parrot through fire protection, dieback control and fox baiting. No specific management guidelines have been proposed for the Western Ground Parrot in the management plan, but the general prescriptions were formulated with conservation of the Ground Parrot as a major objective. For example, the major subpopulations of Ground Parrots in the Fitzgerald River National Park occur in several habitat management cells that are protected by wide, open-edged buffers. Within these cells prescribed burning will occur only after assessment of the risk to rare fauna and attempts will be made to keep wildfires confined to a single cell. Dieback disease caused by *Phytophthora* has been identified as the greatest threat to the Fitzgerald River National Park and management/research prescriptions to reduce the threat of this disease have been implemented. A fox baiting program was initiated in part of the Fitzgerald River National Park, to assess the effects of reducing the numbers of this introduced predator on mammal populations. The Fitzgerald Track sub-population of Western Ground Parrots is within the baited area and some monitoring of this sub-population has occurred. While it was hoped that this would assist in an assessment of the effect of fox baiting on Western Ground Parrots, the situation has been complicated by the fact that most of the area occupied by this sub-population has been burnt in a recent wildfire. Furthermore, the baiting program has now been superseded by the Western Shield program, in which the whole park is being baited for foxes four times per year. This program started in Fitzgerald River National Park in spring 1996.

No management plan exists for Cape Arid National Park, but Interim Guidelines for Management have been produced that identify the area where Western Ground Parrots occur and classifies it as a no planned burn area. These guidelines were written prior to the finding of Ground Parrots in the western part of the park, but it is not yet known whether these western records constitute a permanent population. Under the Western Shield program, baiting for predator control began in Cape Arid National Park in spring 1996.

Interim Guidelines for Management are also in operation for the Waychinicup National Park, but they were written prior to recent findings of Ground Parrots in the area. Waychinicup National Park is managed primarily for the benefit of other threatened species such as the Noisy Scrub-bird, Western Bristlebird and Dibbler, but such management would in most cases be advantageous for Ground Parrots. Fire management is a high priority. Regular ground-based fox baiting has been carried out along boundaries for some time, and in spring 1996, aerial baiting was commenced (including some areas not part of the CALM-managed estate), with the planned frequency of baiting being four times per year. The interim guidelines are currently being reviewed.

Two research programs on the Western Ground Parrot have been completed (Watkins 1985; Burbidge *et al.* 1989). The first, funded by CALM and carried out by the RAOU, identified two of the three currently known populations of the Western Ground Parrot (Watkins 1985). (The third population, in the Manypeaks area, was not identified until much more recently.) The second project - a joint program between CALM and World Wildlife Fund Australia - provided preliminary information on the habitat preferences and daily movement patterns of Western Ground Parrots (Burbidge *et al.* 1989). In addition to this information the second project found that capturing and radio-tracking Western Ground Parrots was feasible (Burbidge *et al.* 1989). Based on information from both projects Watkins and Burbidge (1992) produced an estimate of the total population numbers for the Western Ground Parrot (see above for details).

A research plan has been prepared (Cale and Burbidge 1993) but to date this has not been funded.

Captive breeding

Captive breeding has been suggested as an option but is not proposed within the life of this interim plan. A few birds have been legally held in captivity, mostly in eastern Australia, but to date, attempts to maintain or breed Ground Parrots in captivity have been *ad hoc* and sporadic. If the known populations are considered sufficiently viable to allow removal of enough birds for a sustainable breeding program or for translocation, the priority should be for translocation.

If it is found that captive breeding is desirable, CALM will seek to co-operate with appropriate agencies and individuals in designing a captive breeding program. If proceeded with, a captive population will be established and maintained in liaison with suitably qualified private aviculturists.

Such a captive breeding program would be designed to be consistent with CALM Policy Statements No 29, "Translocation of threatened flora and fauna"; No. 33, "Conservation of threatened and specially protected fauna in the wild"; No. 44, "Wildlife Management Programs"; and No 50, "Setting priorities for the conservation of Western Australia's threatened flora and fauna". All established protocols as to recording all captive specimens in a stud book, and maintaining genetic diversity to the greatest extent possible, would be followed.

A breeding colony set up by CALM would provide the possibility of releasing birds to approved aviculturists to spread the load of providing enough birds for eventual relocation in the wild, if that was in accordance with an approved translocation proposal or was required under an approved recovery plan.

STRATEGY FOR RECOVERY

The immediate need is to review management needs in terms of protection, particularly from wildfire and predation. This needs to be done for each population on a case by case basis, as well as from an overall perspective.

A better knowledge of distribution, population sizes and boundaries will enable improvements in management actions and allow assessment of the effectiveness of management actions. Current knowledge of distribution is reasonable in general terms, but it would be useful to have better knowledge of population sizes and boundaries in all areas, particularly in the Manypeaks area. There is also a need for on-going survey in areas with potential to support Ground Parrots, and to investigate possible sightings of Ground Parrots reported by CALM staff or the general public.

There is a need to improve our understanding of response to fire. The Cape Arid population appears to be restricted to long unburnt vegetation (15+ years). In the Fitzgerald River National Park, one population has expanded into an area burnt 6.5 years previously, but it is unknown if they breed in this younger vegetation. It is likely that under some circumstances Ground Parrots are able to utilise vegetation burnt more recently than this. It is also likely that response to fire will vary geographically, depending largely on rainfall. A priority in this area is to monitor the Ground Parrot population and the permanent vegetation quadrats in burnt and non-burnt areas at the Short Road site. A further priority is to obtain more accurate data on post-fire ages of vegetation where Ground Parrots are known to occur.

It is assumed that Western Ground Parrots are susceptible to predation by foxes (and possibly feral cats; see above) and therefore that predator control through baiting for foxes will benefit the birds. Predator control is therefore seen as a priority for management. Available evidence (J.A. Friend pers. comm., P. de Tores pers. comm.) suggests that cats may be a less significant problem in the south-west than in more arid parts of the state, but the evidence is not conclusive. Nevertheless, the emphasis at this stage is on fox control because of the known negative effects on prey populations and the availability of an effective control measure. It was hoped that monitoring of some sites in Fitzgerald River National Park (Fitzgerald Track area, Hamersley Drive area) would aid in understanding of the effectiveness of baiting for predator control, but due to unforeseen circumstances (see above) this is now not possible.

Better knowledge of population sizes and boundaries will enable an assessment of the need for translocation. Such an assessment should be done within the life of this IRP. If translocation is contemplated, work will need to be put into locating suitable translocation sites. This information will also enable an informed assessment of whether a captive breeding program might be appropriate, and such an assessment should also be done within the life of this IRP.

OBJECTIVES

The long-term objective is to increase the probability of survival of the Western Ground Parrot. Over the time frame of this three year plan, specific objectives are to

- improve the protection of known populations and any new ones that become known during the term of this plan,
- obtain more accurate estimates of population size, distribution and trends, so that the effectiveness of management actions can be assessed,
- improve understanding of habitat requirements, particularly with respect to fire regimes, and
- produce a recovery plan.

CRITERIA

Success

The criteria for success are (in priority order):

- production and application of fire management guidelines for each known population,
- the application of an on-going predator control (fox baiting) program in populations in Fitzgerald River National Park, Waychinicup National Park and Cape Arid National Park,
- establishment of a monitoring program,
- a measured increase in population size or increasing area occupied by those populations being monitored,
- discovery of previously unknown populations,
- production of an approved Recovery Plan.

Failure

The program will be considered to have failed if:

- there is a measured decrease in overall population size or decrease in area occupied by those populations being monitored, or
- adequate data cannot be/have not been collected to allow a confident assessment of population trend or area occupied.

RECOVERY ACTIONS

The WA South Coast Threatened Birds Recovery Team will co-ordinate the implementation of this IRP and will report annually to CALM's Corporate Executive. The following actions are listed in priority order, with the first (fire management) being essential. In the long term, management will be dependent on adequate information concerning population sizes, distribution at the local level, response to fire, predators and possibly other factors, micro-habitat preferences and population dynamics. Actions in this IRP, however, only address the most basic and pressing issues.

1. Fire management

In Cape Arid National Park, the Western Ground Parrot is only known to be resident in vegetation which is unburnt for at least 15 years. Until recently, this was also thought to be the case in Fitzgerald River National Park. Recent surveys have shown that they are resident in vegetation unburnt for 6.5 years in one part of Fitzgerald River National Park, although this is adjacent to a very long unburnt area, and it is thought unlikely that they breed in the six year old vegetation. In the Waychinicup area, they appear resident in vegetation unburnt for eight years. Nevertheless, it would appear prudent at this stage to maintain a regime of no planned burns and maximum possible protection against wildfire for all known populations. This is likely to be particularly important in Cape Arid National Park and Fitzgerald River National Park, where the rainfall is lower than in the Waychinicup area (and hence the heath regenerates more slowly and is perhaps more prone to wildfires). Where possible, fire exclusion will also be extended to potential Ground Parrot areas, to promote older vegetation ages and better conditions for supporting Ground Parrots in future translocations or self-introductions.

Interim Management Guidelines for Waychinicup National Park are currently being reviewed, and locations of Ground Parrots and information on perceived fire management needs will be incorporated in this process. Not all of the area occupied by Ground Parrots in the Waychinicup area is vested in the National Parks and Nature Conservation Authority (NPNCA) but this issue is addressed in Action 4.

Fire exclusion/no planned burn areas need to be defined for each population. There is also a need to ensure that the requirements of Ground Parrots with respect to management of fire can be met without detriment to other threatened species.

Responsibility: CALM South Coast Region, Recovery Team

Costs:

	FRNP	CANP	WNP
1) planning for each population (1996)	675	675	950
2) on-ground application (per year)	1000	500	1000

Note: salaries (here and below) include 35% salary overheads.

Sources of funds: WATSCU 1996; ESP 1997-1999

Completion date: initial planning to be complete by mid 1997; on ground application on-going for the life of the IRP.

2. Predator control

The effect of fox predation is unknown, but, as discussed above, is likely to be important. Monitoring of Western Ground Parrot populations in Fitzgerald River National Park and perhaps in Waychinicup National Park may provide some evidence as to whether there is an increase in numbers of birds following baiting, but is unlikely to provide a conclusive result within the life of this plan. In the interim, the baiting should continue at as many Ground Parrot locations as practicable, particularly in Fitzgerald River and Waychinicup National Parks. An appropriate baiting regime should be defined for each population. In some cases, it may be appropriate to increase the intensity of baiting above the current level, as particular Ground Parrot populations may require better protection than the general level provided under the Western Shield program.

Interim Management Guidelines for Waychinicup National Park are currently being reviewed, and locations of Ground Parrots and information on perceived needs for predator control will be incorporated in this process.

Responsibility: CALM South Coast Region, Recovery Team

Predator control costs in 1996 were met under CALM's Western Shield program. For the Ground Parrot areas, these are approximately as follows (assuming ground and aerial baiting at a cost of 10c/ha four times per year):

Cost:

	FRNP	CANP	WNP
per year			
application	2000	1200	400
salaries	800	800	800
Total over three years:	8400	6000	3600

Sources of funds: CALM 1996; CALM and Environment Australia's Endangered Species Program (ESP) 1997-99

Completion date: on-going for the life of this IRP

3. Dieback Hygiene

Effects on Ground Parrots of dieback due to *Phytophthora* species are unknown, but detrimental effects could occur through reduction of cover or availability of food source species. The conservative course for management is to continue to carry out dieback hygiene precautions, and improve measures where necessary. Management and/or research actions should be avoided at times of high risk.

Responsibility: CALM South Coast Region, Recovery Team

Cost per year:

	FRNP	CANP	WNP
Annual mapping updates, permit system	700	700	700
Totals over three years	2100	2100	2100

Sources of funds: CALM South Coast Region

Completion date: on-going for the life of this IRP

4. Vesting of land in Manypeaks area

Land to the north of Mt Manypeaks where Ground Parrots are known to occur is currently unvested. Under the Regional Management Plan for CALM's South Coast Region (CALM 1992) it was proposed that this area be added to Waychinicup National Park. CALM has been involved in negotiations concerning the future vesting of this land but some issues remain to be resolved. Vesting of this area in the National Parks and Nature Conservation Authority (NPNCA) would enable CALM to manage the area more effectively for conservation of the Ground Parrot and other rare birds in the area.

Discovery of Ground Parrots in this area in recent years has added to its already high conservation values and increased the need to complete these negotiations.

Responsibility: CALM South Coast Region

Administrative costs: ca. $800 (mostly salaries) over the life of the IRP

Sources of funds: CALM South Coast Region

Completion date: mid 1999 (subject to outcome of negotiations)

5. Documentation of known populations and monitoring of trends in population size/boundaries

Effective management relies on knowledge of the number of parrots and/or the area occupied. Assessment of either parameter for a given population can be determined by listening for calls or using an area search method. Both methods require a number of observers at the same time.

Knowledge of trends in area occupied and/or numbers of birds will be used to assess the effectiveness of management actions such as baiting for predators or vegetation management (fire exclusion/control). Some base line data already exist for three areas in Fitzgerald River National Park, but these populations should be re-examined to detect change, and comparable data should be gathered for all other populations. Some of these populations should be selected for further monitoring.

To reduce errors from inclusion of dispersing juveniles, the proposed monitoring would best be carried out in late winter - early spring. However, access to some areas may pose logistic problems at this time of year due to the need to avoid the possible spread of *Phytophthora*. It is therefore recommended that this action be carried out in autumn. In dry winters, it may be possible to gain some supplementary information at that time, but interpretation of trends in numbers and boundaries will need to be done from data gathered at the same season each year.

In the first year, monitoring will be carried out at the Short Road population in Fitzgerald River National Park. This will concentrate on estimating numbers at sample sites within the population, not population boundaries, and will provide information on the amount of survey required to gather such information from other sites. At the same time, tests will be done to quantify better the distance at which different observers can hear Ground Parrot calls under varying conditions. Measurements of wind strength will be made as this is the major factor influencing listening conditions. A minimum of four observers will be needed, so they can be positioned on a square grid pattern which will provide data to concurrently estimate density of calling birds and distances. The feasibility of using tape-recorders to extend the area covered at a given time, or to assist when observers are unavailable, will also be investigated.

After the first year, techniques and correction factors determined can be used, as appropriate, at other sites.

The most efficient way to carry out this action effectively would be through a combination of CALM staff, consultants with particular expertise and RAOU volunteers. In the first year, a minimum of four persons is required for a minimum of 12 nights. It is difficult to estimate what will be required in subsequent years, but it may need at least four persons for a month or more, depending on how many sites are monitored. Determination of population boundaries would require considerably more effort.

Responsibility: Recovery Team

Cost: $7500 in the first year (salaries, consultancy fees, vehicle usage, field costs) and $10200 per year thereafter, assuming a very high rate of volunteer input.

Sources of funds:
1996: WATSCU and Science and Information Division.
1997-99: CALM (Science and Information Division, South Coast Region, Southern Forest Region) and ESP.

Completion date: mid 1999

6. Survey of areas possibly suitable for Western Ground Parrots

Cape Arid National Park and Fitzgerald River National Park have been surveyed reasonably well for the presence of Western Ground Parrots, although some areas in Fitzgerald River National Park have not been surveyed well (eg near Hamersley Drive). The Manypeaks/Waychinicup area is poorly surveyed, and there is a need for intensive, systematic surveys in this area, including the areas north of Manypeaks, the western part of Waychinicup and in the Boulder Hill reserve. Some historical sites (eg Bow River area, Torbay) have been inadequately surveyed (only one brief visit by a reputable ornithologist since the survey of Watkins (1985)) and, given the existence of several promising recent reports from near Denmark and near Broke Inlet, the area west of Albany should be given emphasis. In the Denmark area, this is already being done by local CALM staff and volunteers, with assistance from members of the Recovery Team. Some areas, such as Alexander Bay (west of Cape Arid National Park), have not been surveyed for at least a decade.

There also is a need to go back to areas where previously no Ground Parrots were seen, but where fire management may have changed or age of vegetation increased significantly since they were last visited.

Survey of all historical and likely sites would assist in an assessment of potentially suitable translocation sites. Ideally, this would include sites thought previously to be only occupied by dispersing birds (eg near West Mount Barren).

Population boundaries should be mapped and numbers estimated where possible.

CALM staff and volunteers are a source of assistance in this action. For example, recent records from Mt Manypeaks and Cape Arid National Park have come from both sources. This action could be accomplished in one year if funding was available for a consultant (about $20 000) who would utilise volunteers and assist in the training of CALM field staff, or could be addressed over a number of years at lower cost but with less useful assessment of sites. In either case, local CALM staff could assist with logistics and possibly personnel.

Responsibility: Recovery Team, CALM districts in South Coast Region and Southern Forests Region

Cost: $4320 spent in 1996; $9250 per year required in 1997-99, plus high volunteer input over this period.

Sources of funds:
1996: WATSCU and Science and Information Division.
1997-99: CALM (Science and Information Division, South Coast Region, Southern Forest Region) and ESP.

Completion date: mid 1999

7. Taking birds for captive breeding or translocation

Captive breeding or translocation are not currently proposed within the life of this interim plan, but will be treated in detail when the formal Recovery Plan is prepared, or beforehand if sufficient data are available. If the known populations are considered sufficiently viable to allow removal of enough birds for a sustainable breeding program or for translocation, the priority should be for translocation. Under exceptional circumstances (the finding of large numbers in a population as well as the finding of an ideal site for translocation) translocation could be considered but such action would need to be

consistent with CALM Policy Statement No 29, "Translocation of threatened flora and fauna". Within the term of this IRP, the need for and appropriateness of both translocation and establishing a captive breeding program will be assessed.

Responsibility: CALM (Recovery Team)

Cost: Within the life of this interim plan, no costs separate from those identified above.

Priority: Low at the present time; to be re-assessed at the time of preparation of a full Recovery Plan, or beforehand if available information indicates a need to examine the option of captive breeding or translocation.

Completion date: to be re-assessed at the time of preparation of a full Recovery Plan.

8. Recovery Plan

A formal Recovery Plan should be written within the life of this IRP.

Responsibility: Recovery Team

Costs: ca. $ 1500 (salaries, travel for Recovery Team members to attend meetings).

Sources of funds: CALM, ESP.

Completion date: full recovery plan to be written by mid 1999.

Table 3: Summary of recovery actions, priority, responsibility and completion date.

Recovery Action	Priority	Responsibility	Completion date
1. Fire management	1	CALM Sth Coast Region, Recovery Team	Planning: mid 1997 On ground: on-going
2. Predator control	2	CALM Sth Coast Region, Recovery Team	On-going
3. Dieback Hygiene	3	CALM Sth Coast Region, Recovery Team	On-going
4. Vesting of land in Manypeaks area	4	CALM Sth Coast Region	Mid-1999 (if possible)
5. Documentation of known populations and monitoring of trends in population size/boundaries	5	CALM Sth Coast Region, Recovery Team	On-going
6. Survey of areas possibly suitable for Western Ground Parrots	6	CALM Sth Coast Region, CALM Southern Forest Region, Recovery Team	mid 1999
7. Taking birds for captive breeding or translocation	7	CALM (Recovery Team)	Re-assess by mid-1999
8. Writing of a formal Recovery Plan	8	Recovery Team	mid 1999

Table 4: Summary of costs, identifying sources of funds. The costs assume a high rate of volunteer input for Actions 5 and 6.

Action	1996	1997		1998		1999		Sub-total for each action(1997-99)
	CALM*	CALM	ESP	CALM	ESP	CALM	ESP	
1. Fire management	4800	-	2500	-	2500	-	2500	7500
2. Predator control	-	800	3600	800	3600	800	3600	13 200
3. Dieback hygiene	700	700	-	700	-	700	-	2100
4. Vesting (Manypeaks area)	270	270	-	270	-	270	-	810
5. Population documentation and monitoring	7500	4900	5300	4900	5300	4900	5300	30 600
6. Survey	4320	6750	2500	6750	2500	6750	2500	27 750
7. Taking birds for captive breeding or translocation	-	-	-	-	-	-	-	-
8. Writing a formal Recovery Plan	-	-	-	-	-	7750	1000	8750
Sub-Totals	17 590	13 420	13 900	13 420	13 900	21 170	14 900	90 710
Corporate overheads (CALM)	3520	5465		5465		7215		18 145
Totals	21 110	1997: $32 785		1998: $32 785		1999: $ 43 285		108 855

(Salaries of permanent officers are calculated as salary plus 35% salary overheads; corporate overheads calculated at 20% and included as part of CALM contribution)

(CALM = WA Dept Conservation and Land Management; ESP = Environment Australia's Endangered Species Program)

* Much of the funding in 1996 was from AMRAD funds obtained via WATSCU

Summary to 1999:

1996	$s
CALM	21 110
1997-1999	
CALM	66 155
ESP	42 700
Total (1997-99)	**108 855**

ACKNOWLEDGMENTS

This IRP draws heavily on the Research Plan for the Western Ground Parrot, Western Whipbird and Western Bristlebird (Cale and Burbidge 1993); thanks are due to Peter Cale for his contribution to discussions concerning Ground Parrot recovery.

Ron Johnstone gave assistance with museum specimens and location records and Andrew Burbidge, Shapelle McNee and Graeme Smith contributed to a number of discussions concerning research and management of Ground Parrots. Drs Stephen Garnett and Peter Mawson provided helpful comments on an earlier version of this document.

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INTERIM RECOVERY PLAN NO. 7

SMALL FLOWERED CONOSTYLIS (*CONOSTYLIS MICRANTHA*) INTERIM RECOVERY PLAN

1996-1999

by

Emma Holland, Kim Kershaw and Andrew Brown

June 1997

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March, 1997.

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SUMMARY

Small Flowered Conostylis, *Conostylis micrantha* Family: HAEMODORACEAE

Flowering period: July-August

CALM Region: Midwest **CALM District:** Geraldton **Shire:** Irwin

Current status: Declared as Rare Flora in September 1987, ranked as Critically Endangered in September 1995

Recovery team: Geraldton District Threatened Flora Recovery Team

Illustrations and/or further information: S.J. Patrick & A.P. Brown *Declared Rare and Poorly Known Flora in the Moora District* (draft 1997); S.D. Hopper Haemodoraceae, *Flora of Australia* (1987); S.D. Hopper *et al. Western Australia's Endangered Flora* (1991).

Conostylis micrantha is a small tufted perennial herb to 30 cm in diameter with yellow-cream flowers that turn to a brick red colour with age. It occurs over a range of c. 15 km to the north-east of Dongara growing in low heath on white-grey sandy soils.

The first known collection of *C. micrantha*, housed at the Western Australian Herbarium, was made in 1961 by R. D. Royce. *C. micrantha* was known from 122 plants in six populations, but during surveys in 1995 plants were not found at two of these sites and a total of just 65 plants were recorded.

The main cause of the threatened status of *C. micrantha* is thought to be the loss of suitable habitat due to wide scale clearing for agriculture. The ongoing threat to the survival of the species in the wild is the continued decline in the condition of the remaining habitat, caused by weed invasion and soil disturbance from rabbits and road works. The aim of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations of *Conostylis micrantha* in order to preserve the wild genetic stock of the species. To achieve this aim the following essential and desirable recovery actions are prescribed:

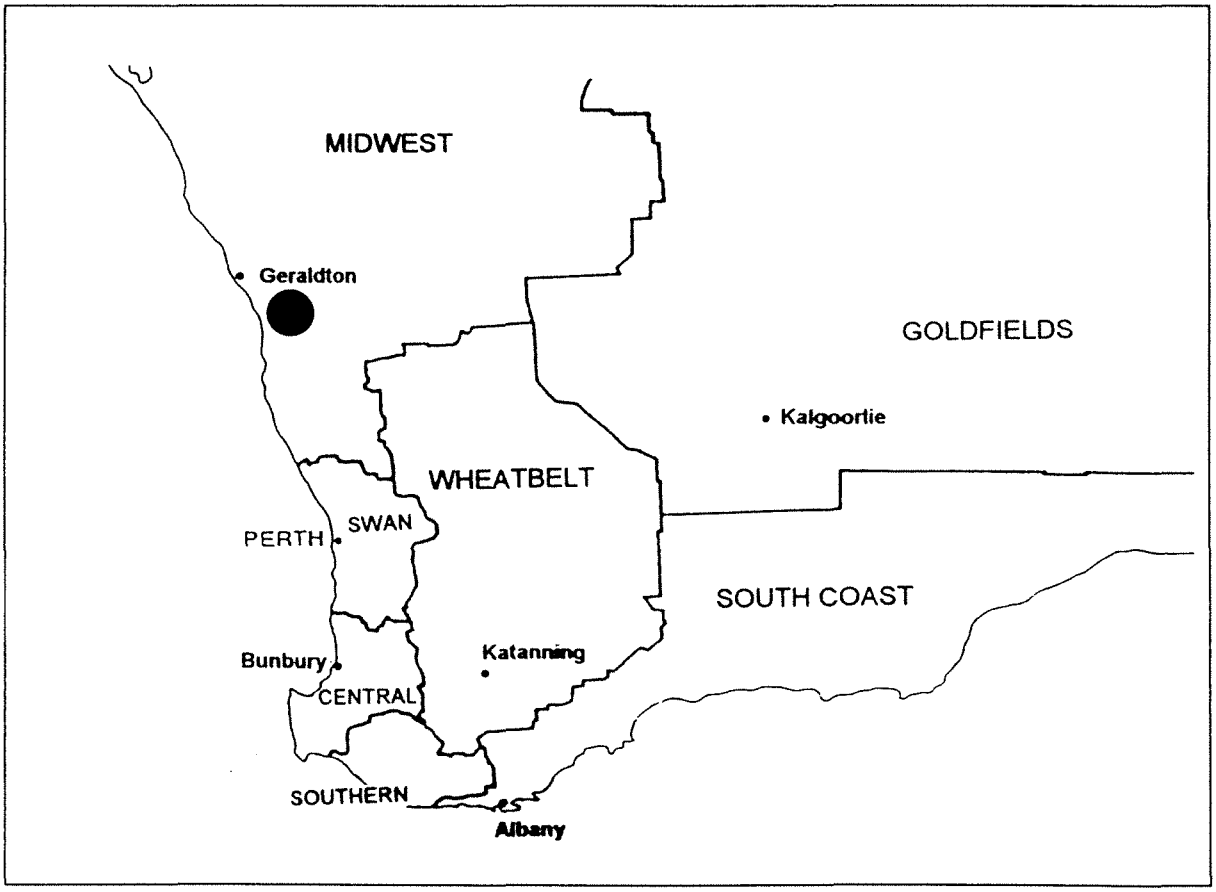
Recovery actions:

Essential	Desirable
1. Install Declared Rare Flora markers	1. Preserve genetic diversity of the species
2. Implement weed control	2. Fence populations 2 and 6
3. Develop a fire management plan	3. Conduct further surveys
4. Monitor populations	4. Information dissemination
	5. Conduct research
	6. Survey for translocation sites if deemed necessary

Conostylis micrantha

Susan J. Patrick

Distribution of *Conostylis micrantha*



1. BACKGROUND

1.1 History, taxonomy and status

Conostylis micrantha is a small, tufted perennial herb to 30 cm in diameter with yellow-cream flowers that turn a brick red colour with age. The leaves are terete, with a few simple, spreading, white hairs on the lower margins. The species is related to *C. teretifolia*, which is common in the northern heaths from Moore River north to Arrowsmith River. *C. micrantha* differs from *C. teretifolia* in having longer leaf hairs that are confined to the base, an earlier flowering time and smaller flowers (the smallest in the genus) which are arranged in a bifurcate, flattened, many flowered head (not in a few-flowered simple head).

A full taxonomic description is provided by Hopper *et. al.* (1987) in Appendix 1.

The genus *Conostylis* contains 45 species, all of which are endemic to the south-west of Western Australia. A number of species are grown as ornamentals and *C. micrantha* has the potential to be of horticultural significance.

The first known collection of *C. micrantha*, housed at the Western Australian Herbarium, was made in 1961 by R. D. Royce. Since that time six populations have been discovered, with the most recent discovery (Population 6) made by S. Patrick and A. Brown in 1992. All six populations were surveyed in 1995 by E. Holland, and 65 plants were recorded in total, with no plants recorded from populations 4 and 5. Prior to 1995, 122 plants were recorded.

Due to small population sizes, restricted habitat (narrow road and rail reserves) and continuing decline in habitat quality, *C. micrantha* was declared as Rare Flora on 25 September 1987 and ranked as Critically Endangered in September 1995.

1.2 Distribution and habitat

All populations occur on narrow road or railway reserves in fragmented, remnant heath vegetation. *C. micrantha* is found over a range of c. 15 km to the area north-east of Dongara, where it grows in white or grey sand in low heath. Associated species include *Allocasuarina humilis, Hakea trifurcata, Hibbertia hypericoides, Dryandra fraseri* and *Hakea erinacea*. A full list of associated species is included in Appendix 2.

Table 1: Summary of population information

Pop no & location	Land status	No of plants	Condition	Threats
1. East of Dongara	Shire Road Reserve	1988, 40+ 1995, 48	Moderate	Weeds, road works, inappropriate fire
2. East of Dongara	Shire Road Reserve	1988, 50+ 1995, 7	Poor	Weeds, rabbits, inappropriate fire
3. East of Dongara	Shire Road Reserve	1988, 40+ 1995, 4	Poor	Weeds, rabbits, inappropriate fire
4. East of Dongara	Shire Road Reserve and Railway Reserve	1988, 15+ 1995, 0	Poor	Weeds, inappropriate fire
5. East of Dongara	Shire Road Reserve	1988, 2 1995, 0	Moderate	Weeds, inappropriate fire
6. East of Dongara	Shire Road Reserve	1992, 9 1995, 6	Moderate	Weeds, rabbits, inappropriate fire

1.3 Biology and ecology

The response of *C. micrantha* to fire is unknown, however, it is predicted that, like other species of *Conostylis*, it will regenerate from subterranean regenerative buds emerging from horizontal rhizomes (Gill 1981) and soil stored seed will germinate following summer fire.

The genus *Conostylis* is comprised of a mixture of insect and bird pollinated species, however, little is known about the pollination of *C. micrantha*.

1.4 Threatening processes

1.4.1 Causes of the Critically Endangered status of this species

Clearing for agriculture around the Irwin River area began approximately 140 years ago when the town of Dongara was first established. Subsequent wide scale clearing has resulted in a loss of most areas of suitable habitat for *C. micrantha*.

All six known populations are restricted to narrow road and rail reserves, with high perimeter to area ratios. This results in virtually the whole corridor being subjected to edge effects from management of the adjacent land (Lynch 1987; Saunders *et al.* 1987; Taylor 1987). Effects include increased wind speed, increased fertiliser runoff, modified hydrology and altered disturbance regimes, including fire. The fragmentation of the corridors, combined with edge effects, subjects the vegetation to high levels of stress and periodic acute disturbances. The condition of the habitat of *C. micrantha* has declined since the species was first discovered and will continue to decline unless recovery actions are applied.

1.4.2 Threats to the ongoing survival of this species in the wild

- **Weed invasion** is evident in all populations, almost certainly as a result of edge effects such as increased nutrient levels (fertiliser runoff, rabbit droppings) and soil disturbance (rabbits, earthworks). Introduced weedy species respond more favourably to a combination of nutrient addition and soil disturbance (Hobbs and Atkins 1988). *C. micrantha* is both directly and indirectly affected by weeds due to:
    - direct competition, inhibiting the growth of *Conostylis micrantha* and displacing the species where it once grew.
    - a decrease in the diversity of the habitat of *Conostylis micrantha*.
    - an alteration in nutrient cycling.
    - a change in soil acidity.
    - an increased fire hazard due to easy ignition, high fuel loads produced annually, and the formation of a continuous fuel bed permitting a fire to spread quickly (Hussey and Wallace 1993).

- **Rabbits** (*Oryctolagus cuniculus*) have caused major disturbance in populations 2 and 3 and some disturbance at Population 6. Warren construction, increased nutrient levels from their droppings, introduction of weeds and grazing are all having an impact on the habitat.

- **Inappropriate fire regimes** during the reproductive phase of *C. micrantha.* (ie. flowering, pollination, seed growth and seed dispersal) may result in low/nil seedling recruitment. High fire frequency may also lead to the degradation of the habitat of *C. micrantha* due to a depletion of soil seed banks and a temporary increase in the availability of nutrients for weed establishment (Panetta and Hopkins 1991). Appropriate irregular summer fire may be an important part of the life cycle of this species and be necessary for regeneration.

1.5 Conservation status

Most populations of *C. micrantha* occur on narrow Shire road reserves, with one found on equally narrow Westrail rail reserve. No populations are known to occur on a conservation reserve.

1.6 Strategy for recovery

The following essential strategies will be implemented:

1. Control the most threatening factors currently affecting *C. micrantha* as outlined at 3.2.
2. Protect *C. micrantha* from possible future threats (eg further clearing), by appropriate management practices (see 3.2.1, 3.2.3).

The following desirable strategies will be implemented if resources permit:

1. Preserve genetic material of *C. micrantha* by including it in cryostorage and/or *ex situ* cultivation (see 3.3.1).
2. Enhance plant numbers (eg by removal of a limiting factor or direct interference with propagation and translocation techniques (see 3.3.2, 3.3.6 and CALM Policy Statement No 29 *Translocation of Threatened Flora and Fauna*).
3. Ensure that relevant land managers and CALM personnel are aware of the presence of *C. micrantha*, and the need to protect it (eg by notification and roadside markers) and ensure that all are familiar with the threatening processes identified in these guidelines (see 3.3.3).
4. Research the biology, ecology and management of *C. micrantha* (see 3.3.5).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term preservation of the species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if threats identified have not abated within the three year period of this IRP or there has been a substantial decrease in the number of mature plants.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

Cuttings were collected from *C. micrantha* in 1993, 1994 and 1995 by staff from Kings Park and Botanic Garden (KPBG). In August 1995 KPBG had 16 plants growing in their nursery, 10 of which were still in the propagation house. Several of these plants have since been planted out into the Rare and Endangered Garden at KPBG, while the remainder are still in pots. The rooting success rates of the cuttings taken from two populations in 1993 were 18% and 10%.

The Shire of Irwin and Westrail have been informed of the presence of *C. micrantha* on their lands. Declared Rare Flora (DRF) markers were installed at populations 1-3 and 6 in July 1993. Westrail markers are present at population 4.

The Geraldton District Threatened Flora Recovery Team (GDTFRT) is overseeing the implementation of this IRP and will include it in its annual report to CALM's Corporate Executive.

3.2 Essential recovery actions

3.2.1 Install Declared Rare Flora markers

Declared Rare Flora (DRF) markers are not currently in place for population 5. It is essential that markers are installed at this site as soon as possible to help ensure accidental destruction does not occur.

Action:	Install two DRF markers on Population 5
Responsibility:	CALM (Geraldton District, Western Australian Threatened Species and Communities Unit (WATSCU))
Cost:	$150

3.2.2 Implement weed control

All populations are affected by the invasion of wild oats, **Avena fatua* (cape weed), **Arctotheca calendula*, and other introduced annual grass species. Weed control with the use of herbicides and hand pulling is recommended for these areas. The tolerance of native plant species to herbicides at *C. micrantha* sites is unknown and it is recommended that weed control programs are undertaken in conjunction with research (see 3.3.4). The aim of weed control is to maintain the pre-invasion condition of the habitat (prevention), control or arrest ongoing weed invasion (intervention) and reverse the degraded condition of the habitat where applicable (rehabilitation) (Panetta and Hopkins 1991. A weed control program is required and will involve:

1. Accurately mapping the boundaries of the populations.
2. Selection of an appropriate herbicide or other method of weed control after determining which weeds are present.
3. Controlling invasive weeds internal to the boundary by hand removal and spot spraying around individual *C. micrantha* plants when weeds first emerge.
4. Scheduling to include weed spraying of other Declared Rare Flora populations requiring weed control within the Geraldton District.

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* asterisk designates an introduced (non-native) species

All roadside populations are vested in the Shire of Irwin. A weed control program will be developed in consultation with the Shire Council.

Action:	Implement weed control
Responsibility:	CALM (Geraldton District, CALM Science and Information Division (SID), WATSCU), Shire of Irwin
Cost:	$2500 pa. for 1997, 1998

3.2.3 Develop a fire management plan

Little is known about the effects of fire on this species (see 1.3). It is likely that the species requires occasional hot summer fire (December- April) for recruitment from soil stored seed (see 1.3) but frequent fires during the flowering and seeding phase (July-October) may be detrimental to the long term survival of the species (see 1.4.2).

Fires also promote the introduction of introduced weed species. Until weed control has been achieved, the vigour of the native vegetation has improved and the fire response of *C. micrantha* has been determined, fire should be prevented from occurring in the populations (see 1.4.2). It is recommended that a fire management plan for the areas of each population be developed in consultation with relevant authorities and land managers.

Action:	Develop a fire management plan
Responsibility:	CALM (Geraldton District, WATSCU), relevant authorities and land managers
Cost:	$450

3.2.4 Monitor populations

Monitoring of factors such as weed encroachment, habitat degradation, population stability (expanding or declining), pollination activity, seed production, recruitment and longevity is prescribed.

Populations should be inspected annually as a requirement under CALM's Policy Statements, No. 9 *Conservation of Threatened Flora in the Wild* and No 28 *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also 3.3.5 *Development of a Quadrat/Transect Based Monitoring System For Threatened Plant Species.*

Action:	Monitor populations
Responsibility:	CALM (Geraldton District, WATSCU)
Cost:	$450 pa.

3.3 Desirable recovery actions

3.3.1 Preserve genetic diversity of the species

Germplasm collections should be given a high priority if the extinction of populations of *C. micrantha* is considered a high probability through disease, its limited distribution or low number of plants. If this is deemed to be the case, recovery of the species is likely to need *ex situ* conservation techniques.

Genetic diversity conservation of the species should be incorporated into the research component (see 3.3.5) and should include collection of seed from all populations, ensuring an adequate representation of genetic diversity.

If it is not possible to collect adequate quantities of viable seed, other more costly germplasm storage methodologies may need to be investigated. These can involve living collections from cutting or other source material, or storage of tissue culture material. If resources are limited these techniques will need to be carefully prioritised in relation to *in situ* conservation. This will be coordinated by the GDTFRT.

It is also important that the size and viability of the soil seed bank is determined and research undertaken to develop techniques for stimulating germination of soil stored seed. Care, however, should be taken as these processes inherently carry a significant risk of depletion of seed bank reserves.

Action:	Collect seed and/or other genetic material from all populations
Responsibility:	GDTFRT, CALM (Threatened Flora Seed Centre (TFSC), Geraldton District, WATSCU), KPBG
Cost:	$1600

3.3.2 Exclusion Fencing

In consultation with the Shire of Irwin it is recommended that populations 2 and 6 be fenced to protect them from rabbits. For both populations, the road reserve is over 40m wide.

Action:	Fence populations 2 and 6
Responsibility:	CALM (Geraldton District, WATSCU)
Cost:	$2300

3.3.3 Conduct further surveys

C. micrantha has been extensively surveyed for by CALM staff in recent years. However, it is recommended that populations 4 and 5 be resurveyed in 1997 (plants were not found at these sites in 1995 and 1996). Further surveying for the species in areas of suitable habitats, perhaps with the aid of volunteers from the local community, wildflower societies and naturalist clubs, should be undertaken on a systematic basis during its flowering period (July and August). These should be supervised by CALM staff.

Action:	Conduct further surveys
Responsibility:	CALM (Geraldton District)
Cost:	$900

3.3.4 Information dissemination

To promote an awareness of *C. micrantha* among relevant CALM and Shire staff, the production of posters and dashboard stickers is recommended. Dashboard stickers should illustrate a DRF marker and provide a contact telephone number if one is encountered. Posters should illustrate and provide descriptive information on the subspecies.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted to the general public, however, it is recommended that the exact location *C. micrantha* remain confidential. Awareness can be encouraged throughout the community by a publicity campaign using the local print and electronic media and by setting up poster displays in venues of high exposure. Formal links with local naturalist groups and interested individuals should also be encouraged. Such activities may lead to the discovery of new populations of the species.

Action:	Produce posters and dashboard stickers, implement a publicity campaign
Responsibility:	CALM (Corporate Relations Division, Geraldton District, WATSCU)
Cost:	$500 first year, $1500 second year

3.3.5 Conduct research

Research designed to increase understanding of the biology of the species will provide a scientific base for management of *C. micrantha* in the wild. Research should include:

1. The response of *C. micrantha* and its habitat to herbicide treatments.
2. The effect of weeds on recruitment and establishment of *C. micrantha*.
3. Pollinator activity within populations of *C. micrantha*.
4. Investigation of factors determining level of flower and fruit abortion.
5. Quantification of level of invertebrate grazing or removal of seed.
6. The size and viability of the soil seed bank.
7. The seed germination requirements of *C. micrantha*.
8. The role of disturbance in regeneration.
9. Response of *C. micrantha* and its habitat to fire.
10. Longevity of plants, and time taken to reach maturity.
11. The extent of genetic variation within and between populations (essential knowledge if new populations are to be established).
12. The establishment of a monitoring system. Specific protocols for rare flora will be outlined in a future CALM discussion paper *Development of a Quadrat/Transect Based Monitoring System For Threatened Plant Species* (D. Coates, P. Pigott and A. Brown in prep).

Action:	Conduct research
Responsibility:	CALM (SID, Geraldton District, WATSCU)
Cost:	$1000 first year, $2000 second year

3.3.6 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Surveying potential habitat for possible future translocation sites is recommended within the scope of IRPs, with actual translocation addressed in full Recovery Plans where necessary. Translocations should be coordinated by the GDTFRT. All translocation proposals require endorsement by the Director of Nature Conservation.

Action:	Survey potential habitats for translocation
Responsibility:	GDTFRT, CALM (Geraldton District, WATSCU)
Cost:	See Section 3.3.3

Table 2: Summary of recovery actions

Recovery Actions	Population	Priority	Responsibility	Completion date
Essential				
Install DRF markers	5	High	CALM (Geraldton District, WATSCU)	February 1996
Implement weed control	All	High	CALM (Geraldton District, SID, WATSCU), Shire of Irwin	April 1996, ongoing
Fire management plan	All	High	CALM (Geraldton District, WATSCU), relevant authorities and land managers	April 1996, ongoing
Monitor populations	All	High	CALM (Geraldton District, WATSCU)	July 1996, ongoing
Desirable				
Preserve genetic diversity of the species	All	Moderate	GDTFRT, CALM (TFSC, Geraldton District, WATSCU), KPBG	July-August 1996, ongoing
Exclusion fencing	3 &/or 5	Moderate	CALM (Geraldton District, WATSCU)	April 1996
Conduct further surveys		Moderate	CALM (Geraldton District)	July- August 1996, 1997, 1998
Information dissemination		Moderate	CALM (Corporate Relations Division, Geraldton District, WATSCU)	March 1996, ongoing
Conduct research	All	Moderate	CALM (SID, Geraldton District, WATSCU)	July 1996, ongoing
Translocation	-	Low	GDTFRT, CALM (Geraldton District, WATSCU)	ongoing

3.4 Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Install DRF markers	150						
Implement weed control	1000	1500		1000	1500		
Develop a fire management plan	200	250					
Monitor populations	200	250		200	250	200	250
Sub-total	**$1550**	**$2000**		**$1200**	**$1750**	**$200**	**$250**
Desirable							
Preserve genetic diversity of the species		500	1100				
Exclusion fencing	1800	500					
Conduct further surveys	400	500					
Information dissemination	500			1500			
Conduct research	1000			2000			
Translocation							
Sub-total	**$3700**	**$1500**	**$1100**	**$3500**			
Totals	**Year 1: $9850**			**Year 2: $6450**		**Year 3: $450**	

EA Environment Australia (formerly ANCA)

Total of all costs $16 750

ACKNOWLEDGMENTS

The following people have provided valuable assistance and advice in the preparation of this Interim Recovery Plan;

Scott Godley	Reserves Officer, CALM Geraldton District
Susan J. Patrick	Senior Research Scientist, Western Australian Herbarium, CALM
Phil Roberts	District Wildlife Officer, CALM Geraldton District

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Appendix One: Taxonomic description

Hopper, S. D., Purdie, R. W., George, A.S. and Patrick, S. J. (1987). *Haemodoraceae*, Flora of Australia **45**,57 and 92-94.

26. Conostylis micrantha Hopper, Fl. Australia 45: 461 (1987)

T: 3 km SSE of Mt Horner, 8.5 km N along Tabletop Rd, from the Midlands Rd, W.A.., 29o09'S, 115o06'E, 20 Aug. 1982, *S.D. Hopper* 2468; holo: PERTH; iso: AD, CANB, K, MEL, NSW.

Tufts to 30 cm diam. Leaves terete, 13-24 cm long, 0.7-1.2 mm diam., glabrous except lower margins, green; hairs few, 3-9 mm long, spreading, flexuose, white, flattened at base, with minute marginal serrations. Inflorescence a shortly bifurcate many-flowered flattened head; scape 5-13 cm long, with a median scarious hirsute bract 3-8 mm long. Perianth 5-7.5 mm long, finely tomentose, pale yellowish cream ageing to brick-red; lobes 2.5-4.5 mm long, cream inside, golden yellow towards base. Stamens uniseriate; anthers 1-1.7 mm long, somewhat longer than filaments. Style 3-4 mm long. Fig. 40B-D.

Confined to sandplain uplands N of the Irwin R., W.A. Grows in heath. Flowers July-Aug. Map 95.

W.A.: 16.4 km N of Irwin on road to Northern Gully, *S.D. Hopper 460* (PERTH); 7.3 km W of Strawberry, *S.D. Hopper 461* (PERTH); c. 20 km NW of Strawberry on road to Northern Gully and The Casuarinas, *R.J. Hnatiuk 760300* (PERTH); Mingenew district, *R.D. Royce 6446* (PERTH); Burma Rd, *A.C. Burns 6* (PERTH).

Allied to *C. teretifolia*, but leaf hairs longer and confined to the base, flowers earlier, and has smaller flowers (the smallest in the genus) arranged in a shortly bifurcate many-flowered flattened head similar to species of *Phlebocarya*.

Appendix Two: Associated species

ZAMIACEAE

Macrozamia riedlei

POACEAE

**Avena fatua*

**Briza maxima*

**Eragrostis curvula*

CYPERACEAE

Lepidosperma sp.

Mesomelaena pseudostygia

RESTIONACEAE

Ecdeiocolea monostachya

DASYPOGONACEAE

Calectasia cyanea

PHORMIACEAE

Dianella divaricata

HAEMODORACEAE

Anigozanthos humilis

Conostylis androstemma

Conostylis candicans

Conostylis dielsii subsp. *teres*

Conostylis ? robusta

Conostylis teretiuscula

ORCHIDACEAE

Caladenia deformis

CASUARINACEAE

Allocasuarina humilis

Allocasuarina lehmanniana

Allocasuarina sp.

PROTEACEAE

Banksia attenuata

Banksia menziesii

Banksia sphaerocarpa

Conospermum stoechadis

Dryandra carduacea

Dryandra fraseri

Dryandra sessilis

Grevillea sp.

Hakea sp.

Hakea costata

Hakea erinacea

Hakea trifurcata

Petrophile macrostachya

Synaphea sp

LORANTHACEAE

Nuytsia floribunda

DROSERACEAE

Drosera sp.

MIMOSACEAE

Acacia sp.

Acacia stenoptera

Chorizema sp.

PAPLIONACEAE

Gompholobium viscidium

MYRTACEAE

Calytrix strigosa

Eremaea beaufortiodies

?Pericalymma sp.

EUPHORBIACEAE

Stachystemon sp.

DILLENACEAE

Hibbertia hypericoides

GOODENIACEAE

Dampiera sp.

Lechenaultia lineroides

Scaveola sp.

ANTHERICACEAE

?Agrostocrinum scabrum

LAURACEAE

Cassytha sp.

*Introduced species

INTERIM RECOVERY PLAN NO. 8

RED SNAKEBUSH (*HEMIANDRA GARDNERI*) INTERIM RECOVERY PLAN

1996-1999

by

Emma Holland, Kim Kershaw and Andrew Brown

June 1997

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March, 1997.

CONTENTS

SUMMARY

Red Snakebush, *Hemiandra gardneri* **Family:** LAMIACEAE

Flowering period: September - January

CALM Region: Midwest **CALM District:** Moora **Shire:** Moora and Coorow

Current status: Declared as Rare Flora in September 1987, ranked as Critically Endangered in September 1995

Recovery team: Moora District Threatened Flora Recovery Team

Illustrations and/or further information: S.J. Patrick and A.P. Brown *Declared Rare and Poorly Known Flora in the Moora District* (in prep); J. Leigh *et al. Extinct and Endangered Plants of Australia* (1984).

Hemiandra gardneri is a prostrate perennial shrub forming a mat up to 2 m in diameter. The leaves are up to 20 x 5 mm in size, linear lanceolate, green or grey-green with pungent points and three raised veins on the lower surface. Both leaves and calyx are covered with short hairs, giving the plant a grey appearance. The dark red to pink flowers, which appear in late spring and summer, are bell shaped and clustered towards the end of the stems.

H. gardneri was first collected from near Watheroo in 1926 by C. A. Gardner and was described from those specimens by O. Sargent in 1927. It was later collected from Wubin (1959) and near Jurien Bay (1978). By December 1982 the species was known from six sites and a total of 2206 plants.

During surveys near Watheroo in September, October 1995, five populations were found scattered along road and railway reserve and in private property with a total of 667 plants.

All populations are exposed to threats associated with weed invasion, agricultural chemical drift and grazing from rabbits. The aim of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations of *Hemiandra gardneri* in order to preserve the wild genetic stock of the species. To achieve this aim the following recovery actions are recommended.

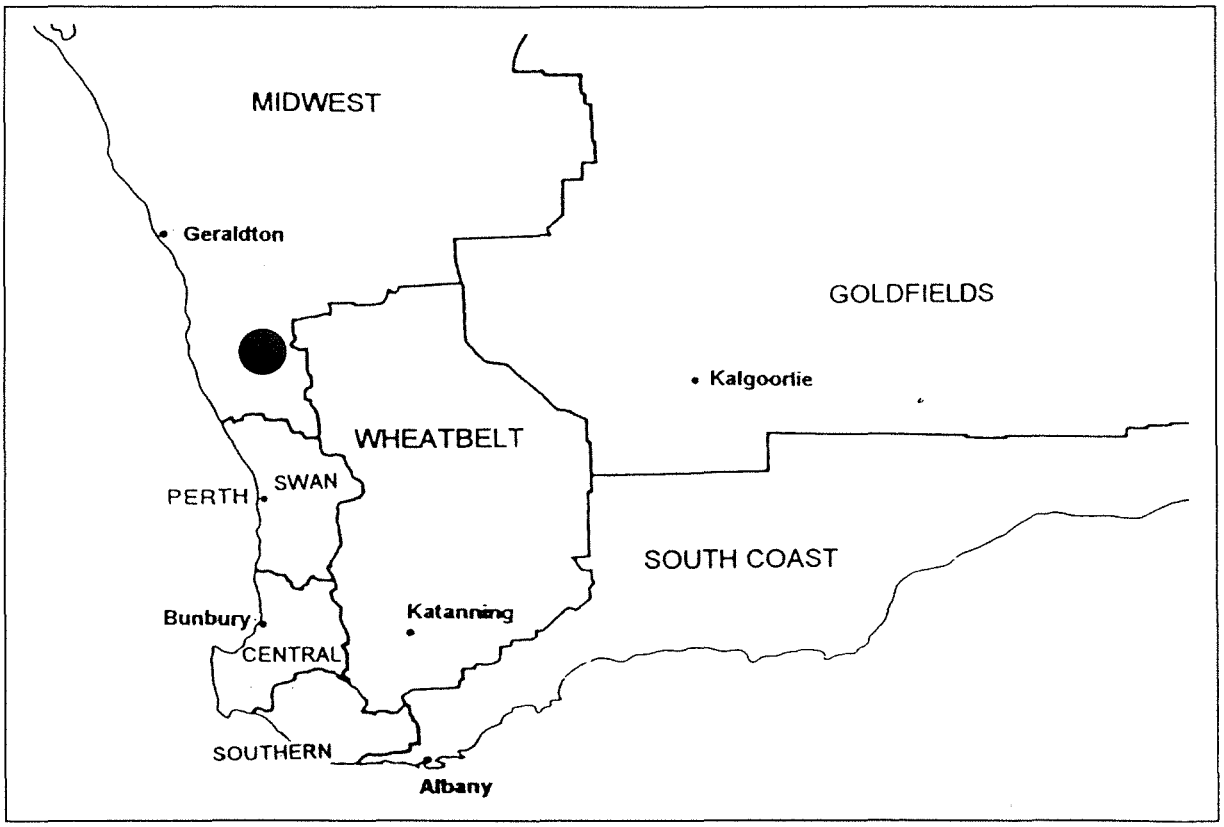
Recovery actions:

Essential	Desirable
1. Implement weed control	1. Preserve genetic diversity of the species
2. Develop a fire management plan	2. Conduct further surveys
3. Monitor populations	3. Information dissemination
	4. Conduct research
	5. Survey for translocation sites if deemed necessary

Hemiandra gardneri

Susan J. Patrick

Distribution of *Hemiandra gardneri*



1. BACKGROUND

1.1 History, taxonomy and status

Hemiandra gardneri Sargent is a prostrate perennial shrub forming a mat up to 2 m in diameter. The green or grey-green leaves are up to 20 x 5 mm in size, linear to linear oblanceolate with a pungent point and three raised veins on the lower surface. Both leaves and calyx are covered with short hairs, giving the plant a grey appearance. The dark red to pink flowers are clustered towards the end of the stems. The calyx is bell shaped, two lipped and 5 mm long. The corolla tube is 14 mm long, with inserted stamens and anthers protruding a short way from the corolla mouth. This species was first thought to be a variety of *Hemiandra pungens* but is distinguished by the velvety indumentum, shortly exerted anthers and characters of the corolla. A full taxonomic description is provided by O.H. Sargent in Latin (1927) and in English (1984), the latter is included in Appendix 1.

H. gardneri was collected from near Watheroo in 1926 by C. A. Gardner and described by O. Sargent in 1927 from those specimens. Historical records show that it was collected from Wubin in 1959 and near Jurien Bay in 1978, however recent surveys have failed to relocate the species in these localities.

Prior to 1982 the species was known from two sites, south of Gunyidi and north of Watheroo. Comprehensive surveys for the species were conducted in November and December 1982 by M. A. Burgman, resulting in four new sites being found and a total of 2206 plants recorded. The species was again surveyed in September and October 1995 by E. Holland and found to consist of five populations (all north of Watheroo) with a total of 667 plants. All plants were recorded in full flower. Population 6 (Jurien Bay) was not surveyed in 1995 as limited information is available and it is only known as a herbarium record.

Due to its restricted distribution and the continuing decline in the quality of its habitat, *H. gardneri* was declared as Rare Flora on 25 September 1987 and ranked as Critically Endangered in September 1995.

1.2 Distribution and habitat

H. gardneri was found in 1995 over a range of approximately 11 km north of Watheroo where it grows in deep yellow to yellow-white sand on sandplains and hills. It is most abundant in open areas under low woodland of *Banksia prionotes, B. attenuata, Xylomelum angustifolium, Actinostrobus pyramidalis, Jacksonia eremodendron, Conospermum stoechadis* and *Verticordia* species, occasionally with low sedges and grasses. A list of associated species is included in Appendix 2.

Table 1: Summary of population information

Pop. No & Location.		Land Status	No. of plants.	Condition	Threats
1.	N of Watheroo	Shire Road Reserve	1982, 8 1995, 16	Poor	Road and rail works, weeds, inappropriate fire
2a.	N of Watheroo	Shire Road Reserve	1991, 10 1995, 4	Poor	Road and rail works, weeds, inappropriate fire
2b.	N of Watheroo	Private.	1989, 400+ 1995, 58	Moderate	Weeds, inappropriate fire
3.	N of Watheroo	Shire Road Reserve	1982, 1196 1995, 543	Poor	Road and rail works, weed, inappropriate fire
4.	N of Watheroo	Railway Reserve	1982, 222 1995, 1	Poor	Road and rail works, weed, rabbits
5.	N of Watheroo	Shire Road Reserve & Private	1982, 7 1995, 45	Moderate	Road and rail works, weed, inappropriate fire
5*.	Cockleshell Gully	?National Park			

* Population 6 is known only from a Herbarium specimen.

1.3 Biology and ecology

Sargent (1927) discussed corolla characteristics and the possibility of the flowers being bird pollinated.

Burgman (1983) noted that seed set was adequate in natural populations with seedlings making up 16.3 % of the total number of plants in the populations studied. *H. gardneri* seedling recruitment is concentrated on open disturbed or cleared areas. However, the mechanisms involved in the response of this species to disturbance are not fully understood. Seedlings appear to compete poorly with native vegetation that is mid-dense or dense (Burgman 1983).

The response of *H. gardneri* to fire is unknown, however, as it is a disturbance opportunist, it is likely that appropriate fire is desirable and perhaps necessary for its long term survival.

Most species of the Mint family are grown easily from cuttings, though they often develop poor root systems. Seed germination would be required to overcome this problem (B. Conn[1] pers comm 1996).

1.4 Threatening processes

1.4.1 Causes of the critically endangered status of the species

The cause of the critically endangered status of *Hemiandra gardneri* may be due to the clearing for agriculture which began in the region at the turn of the century, resulting in the loss of much of its former habitat. The five extant populations are restricted to narrow road and rail reserves and adjacent remnant vegetation, with high perimeter to area ratios. This results in virtually the whole habitat being subjected to edge effects from management of the adjacent land (Lynch 1987; Saunders *et al* 1987; Taylor 1987). Effects include increased wind speed, increased fertiliser runoff, modified hydrology and altered disturbance regimes, including fire. The fragmentation of the corridors, combined with edge effects, subjects the vegetation to high levels of stress and periodic acute disturbances.

The historical distribution of the species suggests that it may have been far more widespread (Burgman 1983). A lack of suitable disturbance (fire/grading), combined with a naturally restricted distribution may also have contributed to the decline of the species. The prerequisites required for stimulating germination and the factors involved in determining seed viability for this disturbance opportunistic species are unknown.

1.4.2 Threats to the ongoing survival of the species in the wild

- **Weed invasion** is evident in all populations, almost certainly as a result of edge effects such as increased nutrient levels (fertiliser runoff, rabbit droppings) and soil disturbance (rabbits, earthworks). Introduced weedy species respond more favourably to a combination of nutrient addition and soil disturbance (Hobbs and Atkins 1988). *H. gardneri* is both directly and indirectly affected by weeds due to:
    - direct competition, inhibiting the growth of *Hemiandra gardneri* and displacing the species where it once grew.
    - a decrease in the diversity of the habitat of *Hemiandra gardneri*.
    - an alteration in nutrient cycling.
    - a change in soil acidity.
    - an increased fire hazard due to easy ignition, high fuel loads produced annually, and the formation of a continuous fuel bed permitting a fire to spread quickly (Hussey and Wallace 1993).
- **Rabbits** (*Oryctolagus cuniculus*) have caused disturbances at population 4. Warren construction, increased nutrient levels from their droppings, introduction of weeds and grazing are all having an impact on the habitat. Mature *Hemiandra* plants appear to be able to tolerate a fairly high level of grazing, possibly an adaptation for seed dispersal. However, seedlings and immature plants have softer leaves and

[1] Dr. Barry Conn, The National Herbarium of NSW

hence are more palatable (B. Conn[2] pers comm 1996). Grazing may have an impact on the establishment of *H. gardneri* seedlings thus limiting the natural recruitment of the species.

- **Inappropriate fire regimes** during the reproduction phase of *H. gardneri* (ie. flowering, pollination, seed growth and seed dispersal) may result in low/nil seedling recruitment. High fire frequency may also lead to the degradation of the habitat of *H. gardneri* due to a depletion of soil seed banks and a temporary increase in the availability of nutrients for weed establishment (Panetta and Hopkins 1991). Appropriate irregular summer fire may be an important part of the life cycle of this species and be necessary for regeneration.

1.5 Conservation status

Hemiandra gardneri occurs on Shire Road Reserve, Westrail Reserve and private property. No populations are known from conservation reserves.

1.6 Strategy for recovery

A Moora District Threatened Flora Recovery Team has been established. The Recovery Team will oversee the implementation of this IRP and report annually to CALM's Corporate Executive.

The following essential strategies will be implemented:

1. Implement weed control in all populations (see 3.2.1).
2. Exclude fire from all populations and implement a fire management plan (see 3.2.2).
3. Monitor all populations annually (see 3.2.3).

The following desirable strategies will be implemented if resources permit:

1. Protect *H. gardneri* from possible future threats (eg. clearing) by appropriate management practices (see 3.3).
2. Conserve the genetic resources of *H. gardneri* by including it in cryostorage and/or *ex situ* cultivation (see 3.3.1).
3. Ensure that relevant land managers and CALM personnel are aware of the presence of *H. gardneri*, and the need to protect it (eg. notification) and ensure that all are familiar with the threatening processes identified in these guidelines (see 3.3.3).
4. Research the biology, ecology and management of *H. gardneri* (see 3.3.4).
5. If deemed necessary, enhance plant numbers (eg. by removal of a limiting factor or direct interference with propagation and translocation techniques, see CALM Policy Statement No 29, *Translocation of Threatened Flora and Fauna* (see 3.3.5).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term preservation of the species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

[2]Dr Barry J. Conn, The National Herbarium of NSW

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if identified threats have not abated within the three year period of this IRP or there has been a substantial decrease in the number of mature plants.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

The owners of the private property containing Population 2b were notified of the presence of the species in September 1988. The population is located in remnant vegetation which is adequately fenced from stock.

Declared Rare Flora markers are in place for all roadside populations. Westrail markers are in position along the railway reserve. These alert road and rail maintenance workers to the presence of each population, and enable them to take appropriate care.

Approximately 300 cuttings were taken by staff from Kings Park and Botanic Garden (KPBG) in 1987, and trialed using a variety of hormone strengths. Only five cuttings produced roots, two of which were planted out and soon died. The remaining three survived in pots. More cutting material was collected in 1994, three of which were grown on and are on display at Kings Park. No seed has been collected.

3.2 Essential recovery actions

3.2.1 Implement weed control

All populations are affected by weeds to varying degrees. Effective weed control with the use of herbicides and hand pulling is recommended for these areas. The tolerance of native plant species to herbicides at *H. gardneri* sites is unknown and it is recommended that weed control programs are undertaken in conjunction with research (see 3.3.5). The aim of weed control is to maintain the pre-invasion condition of the habitat (prevention), control or arrest ongoing weed invasion (intervention) and reverse the degraded condition of the habitat where applicable (rehabilitation) (Panetta and Hopkins 1991). A weed control program is required and will involve:

1. Accurately mapping the boundaries of the populations.
2. Selection of an appropriate herbicide or other method of weed control after determining which weeds are present.
3. Controlling invasive weeds internal to the boundary by hand removal and spot spraying around individual *H. gardneri* plants when weeds first emerge.
4. Scheduling to include weed spraying of other Declared Rare Flora (DRF) populations requiring weed control within the Moora District.

All roadside populations are on land vested with the Shires of Moora and Coorow and the rail reserve population is on land vested with Westrail. A weed control program should be developed in consultation with these agencies.

Action:	Implement weed control
Responsibility:	CALM (Moora District, Science and Information Division (SID), Western Australian Threatened Species and Communities Unit (WATSCU))
Cost:	$1050 pa.

3.2.2 Develop a fire management plan

Little is known of the effects of fire on *H. gardneri*. However, as it is a disturbance opportunist it is likely that it requires occasional fire for recruitment. Until research is undertaken (3.3.5) to determine if this is the case, it is recommended that fire be excluded from all populations and a fire management plan be developed in consultation with relevant authorities and land managers. Collation of historical fire data is essential in developing such a plan..

Action:	Develop a fire management plan
Responsibility:	CALM (Moora District, WATSCU), relevant authorities and land managers
Cost:	$250

3.2.3 Monitor populations

Monitoring of factors such as weed encroachment, habitat degradation, population stability (expanding or declining), pollination activity, seed production, recruitment and longevity is prescribed.

Populations should be inspected annually as a requirement under CALM's Policy Statements, No. 9 *Conservation of Threatened Flora in the Wild* and No 28 *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also below 3.3.4, *Development of a quadrat/transect based monitoring system for threatened plant species.*

Action:	Monitor populations
Responsibility:	CALM (Moora District, SID, WATSCU)
Cost:	$450 pa.

3.3 Desirable recovery actions

3.3.1 Preserve genetic diversity of the species

Germplasm collections should be given a high priority if the extinction of populations *H. gardneri* is considered a high probability through disease, its limited distribution or low number of plants. If this is deemed to be the case, recovery of the species is likely to need *ex situ* conservation techniques.

Genetic diversity conservation of the species should be incorporated into the research component (see 3.3.4) and should include collection of seed from all populations, ensuring an adequate representation of genetic diversity.

If it is not possible to collect adequate quantities of viable seed, other more costly germplasm storage methodologies may need to be investigated. These can involve living collections from cutting or other source material, or storage of tissue culture material. If resources are limited these techniques will need to be carefully prioritised in relation to *in situ* conservation. This will be coordinated by the MDTFRT.

It is also important that the size and viability of the soil seed bank is determined and research undertaken to develop techniques for stimulating germination of soil stored seed. Care, however, should be taken as these processes inherently carry a significant risk of depletion of seed bank reserves.

Action:	Collect seed and/or other genetic material from all populations
Responsibility:	MDTFRT, CALM (Moora District, Threatened Flora Seed Centre (TFSC), WATSCU), KPBG
Cost:	$1600

3.3.2 Conduct further surveys

It is recommended that suitable reserves in the Moora and Coorow Shires be surveyed on a systematic basis for the presence of the species, particularly during its flowering period (September-January) and following disturbances such as fire and road works (grading, widening).

Action:	Conduct further surveys
Responsibility:	CALM (Moora District, WATSCU)
Cost:	$900 pa.

3.3.3 Information dissemination

To promote an awareness of *H. gardneri* among relevant CALM staff and the staff of the Shires of Moora and Coorow, the production of vehicle dashboard stickers and posters are recommended. Dashboard stickers should illustrate a rare flora marker and provide a contact telephone number if one is encountered. Posters should illustrate and provide information on the species.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted to the general public, however, it is recommended that the exact location of populations of *H. gardneri* remain confidential. Awareness can be encouraged throughout the community by a publicity campaign using the local print and electronic media and by setting up poster displays in venues of high exposure. Formal links with local naturalist groups and interested individuals should also be encouraged. Such activities may lead to the discovery of new populations of the species.

Action:	Produce posters and dashboard stickers, implement a publicity campaign
Responsibility:	CALM (Corporate Relations Division, Moora District, WATSCU)
Cost:	$2000

3.3.4 Conduct research

Research designed to increase understanding of the biology and ecology of *H. gardneri* will provide a scientific base for management of the species in the wild. Research should include:

1. The response of *H. gardneri* to herbicide treatments.
2. Pollination biology and seed set.
3. Investigation of factors determining level of flower and fruit abortion.
4. Quantification of level of invertebrate grazing or removal of seed.
5. The size and viability of seed bank.
6. Seed germination requirements.
7. The role of disturbance in regeneration.
8. The longevity of plants, and time taken to reach maturity.
9. The response of *H. gardneri* and its habitat to fire.
10. Knowledge of the extent of genetic variation within and between populations. This is essential if new populations are to be established.
11. Effects of weeds on recruitment and establishment.
12. The development of a monitoring system. Specific protocols for rare flora will be outlined in a future CALM discussion paper "*Development of a quadrat/transect based monitoring system for threatened plant species*", A. Brown, P. Pigott and D. Coates (in prep).

Action:	Conduct research
Responsibility:	CALM (SID, Moora District, WATSCU)
Cost:	$3000

3.3.5 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Surveys for potential habitats for possible future translocation sites are recommended within the scope of IRPs, with actual translocation addressed in full Recovery Plans where necessary. This should be coordinated by the MDTFRT. All translocation proposals require endorsement by the Director of Nature Conservation.

Action: Survey potential habitats for translocation
Responsibility: MDTFRT, CALM (Moora District, WATSCU)
Cost: See section 3.3.2

Table 2: Summary of recovery actions

Recovery Actions	Population	Priority	Responsibility	Completion date
Essential				
Implement weed control	All	High	CALM (Moora District, SID, WATSCU)	1996, annually
Develop a fire management plan	All	High	CALM (Moora District, WATSCU), relevant authorities and land managers	1996.
Monitor populations	All	High	CALM (Moora District, SID, WATSCU)	1996, annually
Desirable				
Preserve genetic diversity of the species	All	Moderate	MDTFRT, CALM (TFSC, Moora District, WATSCU), KPBG,	Commenced, ongoing
Conduct further surveys		Moderate	CALM (Moora District, WATSCU)	Commence October 1996
Information dissemination		Moderate	CALM (Corporate Relations Division, Moora District, WATSCU)	1996
Conduct research	All	Moderate	CALM (SID, Moora District, WATSCU)	1996, ongoing
Translocation	-	Low	MDTFRT, CALM (Moora District, WATSCU)	October 1996

3.4. Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Implement weed control	800	250		800	250	800	250
Develop a fire management plan	250			250		250	
Monitor populations	200	250		200	250	200	250
Sub-total	**$1250**	**$500**		**$1250**	**$500**	**$1250**	**$550**
Desirable							
Preserve genetic diversity of the species		500	1100				
Conduct further surveys	400	500		400	500	400	500
Information dissemination		500			1500		
Conduct research	1000			2000			
Sub-total	**$1400**	**$1500**	**$1100**	**$2400**	**$2000**	**$400**	**$500**
Total	**$2650**	**$2000**	**$1100**	**$3650**	**$2500**	**$1650**	**$1050**

EA Environment Australia (formerly ANCA)

Total of all costs $14600

ACKNOWLEDGMENTS

The following people have provided valuable assistance and advice in the preparation of this Interim Recovery Plan:

Susan J. Patrick Senior Research Scientist, Western Australian Herbarium

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Appendix One: Taxonomic description

English Translation of Sargent's (1927) taxonomic description of *Hemiandra gardneri*, in J. Leigh *et al* (1984).

Hemiandra gardneri P.H. Sargent
STATUS 3E
DESCRIPTION Prostrate, hairy or sometimes hairless shrub to 1 m in diameter. *Leaves* are light-green or greyish-green, opposite, oblanceolate, stiff, 2 cm long and 5 mm wide, rather congested and pointed. *Flowers* are usually dark brick-red but ranging from orange to pinkish-mauve, borne singly in the leaf axils and clustered towards the ends of the stems. Individual flowers are bell-shaped, with the lower part of the corolla tubular, about 1.4 cm long, the upper part spreading and divided into 2 lips and 2 large lateral lobes as long as the lips. The upper lip is divided into 2 short lobes and the lower lip is also 2-lobed with each lobe having 3 distinct teeth. The calyx is narrowly bell-shaped and opens into 2 lips, the upper lip being 3-lobed. *Fruit* has not been described. *Flowering* September and October.

Appendix Two: Associated species

CUPRESSACEAE

Actinostrobus pyramidalis

RESTIONACEAE

Ecdeiocolea monostachya

Lyginia barbata

PHORMIACEAE

Dianella revoluta

HAEMODORACEAE

Conostylis neocymosa

Conostylis aculeata

Macropidia fuliginosa

CASUARINACEAE

Allocasuarina campestris

MIMOSACEAE

Acacia pulchella

Acacia pulchella var. *glaberrima*

PROTEACEAE

Banksia attenuata

Banksia menziesii

Banksia prionotes

Conospermum stoechadis

Grevillea amplexans

Grevillea eriostachya

Grevillea integrifolia

Grevillea leucopteris

Grevillea polybotrya

Hakea prostrata

Synaphea spinulosa subsp *spinulosa*

Xylomelum angustifolium

PAPILIONACEAE

Kennedia sp.

Jacksonia eremodendron

Jacksonia sp.

RUBIACEAE

Opercularia vaginata

MYRTACEAE

Beaufortia elegans

Eremaea pauciflora

Eremaea pilosa

Eucalyptus todtiana

Leptospermum erubescens

Lhotskya acutifolia

Scholtzia drummondii

Verticordia brownii

Verticordia densiflora

Verticordia nitens

Verticordia pennigera

CHLOANTHACEAE

Lachnostachys eriobotrya

GOODENIACEAE

Lechenaultia linarioides

Lechenaultia juncea

INTERIM RECOVERY PLAN NO. 9

DWARF ROCK WATTLE (*ACACIA PYGMAEA*) INTERIM RECOVERY PLAN

1996-1999

by

Emma Holland, Kim Kershaw and Andrew Brown

June 1997

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March, 1997.

CONTENTS

SUMMARY

Dwarf Rock Wattle, *Acacia pygmaea* **Family:** MIMOSACEAE

Flowering period: November-March

CALM Region: Wheatbelt **CALM District:** Merredin **Shire:** Wongan-Ballidu

Current status: Declared as Rare Flora in May 1991, ranked as Critically Endangered in September 1995

Recovery team: Merredin District Threatened Flora Recovery Team

Illustrations and/or further information: Hopper *et al*, *Western Australia's Endangered Flora*, (1990); Maslin, Acacia Miscellany 12. *Nuytsia* **10** (1995); B. L. Rye, Wongan Hills Species No. 4, Unpbl. (1980).

Acacia pygmaea is a small shrub to 70 cm high with prominently ribbed branchlets and elliptic to obovate phyllodes 20 to 30 mm long. Its globular flowers are pale in colour with white filaments that turn orange with age. First collected in 1977 and formally described by B. Maslin in 1995, the species is endemic to the Wongan Hills area where it is confined to crevices on lateritic outcrops, in open heath mallee communities. Five populations with a combined total of 129 plants (1995, 1996) have been recorded over a range of approximately eight km.

The extremely localised nature of the populations is a major threat to the survival of the species. Although populations are generally well protected from threats associated with land use such as weed invasion and agricultural chemical drift, all are vulnerable to localised singular environmental events.

The aim of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations of *A. pygmaea* in order to conserve the wild genetic stock of the species. To achieve this aim the following essential and desirable recovery actions are prescribed.

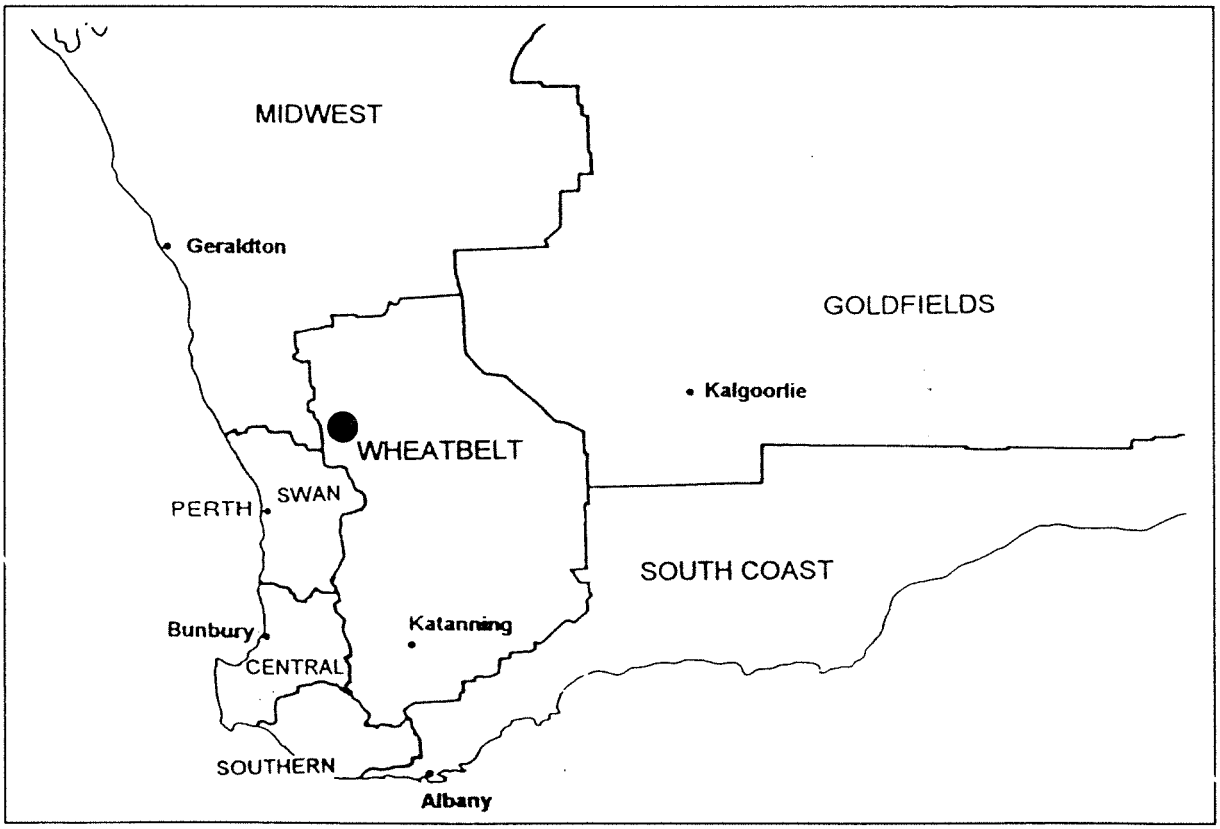
Recovery actions:

Essential		Desirable	
1.	Protect from inappropriate fire	1.	Conduct further surveys
2.	Monitor populations annually	2.	Acquire land
3.	Preserve genetic diversity of the species	3.	Information dissemination
4.	Conduct research	4.	Survey for possible translocation sites

Acacia pygmaea

Illustration not available

Distribution of *Acacia pygmaea*



1. BACKGROUND

1.1 History, taxonomy and status

Acacia pygmaea Maslin is a dwarf shrub to 70 cm tall with prominently ribbed branchlets. The green phyllodes are elliptic to obovate, 20-30 mm long and 9-13 mm wide with yellow marginal nerves (pale red when young). The inflorescences, produced from November to March, are globular with white filaments which turn orange with age. Seed pods are narrowly oblong to 30 mm long. *A. pygmaea* has similar phyllodes to *A. disticha* and is closely allied to that species. *A. disticha* and *A. pygmaea* have affiliations with *A. myrtifolia,* and belong to the "*Acacia myrtifolia*" group. The name of the species is derived from the Latin *pygmaeus*, meaning dwarf, and refers to the diminutive height of the mature plant.

A. pygmaea was first collected in 1977 by K. F. Kenneally from private property at Mount Matilda in the Wongan Hills area. The species was known as *Acacia* sp. (Wongan Hills) until formally described in 1995 by Bruce Maslin. A full taxonomic description is included in Appendix 1.

In 1980 B. L. Rye undertook surveys in the Wongan Hills area for 13 geographically restricted species (including *A. pygmaea*). At this time one population of 25 plants was recorded from private property (Pop. 1). This population was again surveyed in September 1991 by CALM and the Toodyay Naturalists Club and 57 plants were recorded. A second population of approximately 15 plants (Pop. 2) was discovered during these surveys. Further surveys were undertaken by E. Holland and F. Bunny in September 1995 and April 1996, during which two new populations were found (Pops 3 and 4). A fifth population was located by N. Woolfrey in 1996. *A. pygmaea* is known from a combined total of 129 plants.

The Shire of Wongan-Ballidu is situated in an extensively cleared, wheat and sheep farming district, however the Wongan Hills township is surrounded by substantial areas of bushland which support a great diversity of flora with many endemic and threatened species. The following threatened and priority flora occur in Mount Matilda Nature Reserve and in the vicinity of Mount O'Brien:

Threatened flora	**Priority flora**
Acacia denticulosa	*Lepidium pseudotasmanicum* (P.3)
Acacia pharangites	
Acacia pygmaea	
Acacia semicircinalis	
Daviesia spiralis	
Eremophila ternifolia	
Eriostemon wonganensis	
Microcorys eremophiloides	
Rhagodia acicularis	

Due to the low number of populations and plants and threats associated with a highly restricted habitat, *A. pygmaea* was declared as Rare Flora in May 1991. Although a second population was found in 1991, it was relatively small and the species was ranked as Critically Endangered in September 1995.

1.2 Distribution and habitat

A. pygmaea occurs over a range of approximately eight km where it is known from five populations, two of which contain sub populations.

Its habitat consists of open mallee *Eucalyptus ebbanoensis* over an open heath of *Allocasuarina campestris*, *Dryandra comosa*, *D. hewardiana*, *D. pulchella* and *Persoonia divergens*. The species is confined to the ridges of lateritic breakaways, growing in rock crevices with the roots presumably reaching into the underlying clay.

Other associated species are listed in Appendix 2.

Table 1: Summary of population information

Pop. No & Location.	Land Status	No. of plants.	Condition	Threats
1A. Mount Matilda	Private	1980, 25 1991, 57	Good	Inappropriate fire regime
1B. Mount Matilda	Nature Reserve	1996, 71	Good	Inappropriate fire regime
2A. Mount Matilda	Private	1991, 15 1995, 16	Good	Inappropriate fire regime
2B. Mount Matilda	Nature Reserve	1995, 3	Good	Inappropriate fire regime
3. Mount Matilda	Nature Reserve	1995, 6	Good	Inappropriate fire regime
4. Mount O'Brien	Private	1996, 5	Good	Inappropriate fire regime
5. NW of Wongan Hills	Nature Reserve	1996, 28	Good	Inappropriate fire regime

1.3 Biology and ecology

The genus *Acacia* is estimated to contain more than 1,200 species, of which more than 700 are native to Australia. It is pantropical, occurring in Asia, the Americas and Africa (Simmons 1981).

Many species of *Acacia* are highly adapted to surviving fires which are a regular occurrence in many Australian habitats. Germination of seed is often stimulated by fire but depends on factors such as fire intensity and seed depth in the soil. No information is available for the response of *A. pygmaea* to fire, however it is presumed that germination of the soil seed bank will be stimulated by such an event.

Pollination is probably by insects (Rye 1980), although the process is poorly understood. Unlike most *Acacia* species which fruit and shed their seeds a short time after flowering, the pods of *A. pygmaea* take nearly a year to mature with flower buds and unopened pods borne on the plant simultaneously. *A. pygmaea* appears to produce relatively few fruits with each pod containing just 2-3 seeds (Rye, 1980).

1.4 Threatening processes

1.4.1 Causes of the Critically Endangered status

Despite numerous searches for the species since its discovery in 1977 and an abundance of suitable habitats (lateritic breakaways), only five populations with a combined total of 129 plants are known. The critically endangered status of *A. pygmaea* may be partly attributed to its naturally restricted geographical range. The species may also require specific components within the ecosystem for its success in the wild.

1.4.2 Threats to the ongoing survival of this species in the wild

Inappropriate fire regimes may interfere with the reproductive phases of *A. pygmaea* (ie. flowering, pollination, seed production and seed dispersal) resulting in low/nil seedling recruitment. High fire frequency may lead to the degradation of the habitat of *A. pygmaea* due to factors such as depletion of soil

seed banks and a temporary increase in the availability of nutrients for weed establishment (Panetta and Hopkins 1991). Conversely, a lack of fire may cause the disappearance of extant populations due to poor or no recruitment from the soil seed store (soil stored seed may require fire stimulation for germination).

1.5 Conservation status

A. pygmaea is known from three localities in the Wongan Hills, which are separated by cleared farmland. Populations 1b, 2b and 3 are located in Mount Matilda Nature Reserve, Class A, which is vested in the National Parks and Nature Conservation Authority (NPNCA) for the purpose of Conservation of Flora and Fauna. Populations 1a and 2a are located on private property adjoining Mount Matilda Nature Reserve. The border between the nature reserve and private property is unmarked. Population 4 is on private property at Mount O'Brien. Population 5 is located in Rogers Nature Reserve, Class A, which is vested in the NPNCA for the purpose of Conservation of Flora and Fauna.

1.6 Strategy for recovery

The following essential strategies will be implemented:

1. Control the most threatening factors currently affecting *A. pygmaea* as outlined at 3.2.
2. Conserve the genetic diversity of *A. pygmaea* by including it in a seed bank, cryostorage and/or *ex situ* cultivation (see 3.2.3).
3. Research the biology, ecology and management of *A. pygmaea* (3.2.4).

The following desirable strategies will be implemented if resources permit:

1. Protect *A. pygmaea* from possible future threats (eg. clearing of private property) by appropriate management practices (see 3.3).
2. Enhance plant numbers (eg. by removal of a limiting factor or by direct interference by propagation and translocation techniques) (see 3.3.4, and CALM Policy Statement No 29 *Translocation of Threatened Flora and Fauna*).
3. Ensure that relevant land managers and CALM personnel are aware of the presence of *A. pygmaea*, and the need to protect it (eg. fire management) and ensure that all are familiar with the threatening processes identified in these guidelines (see 3.3.3).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term preservation of the species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if identified threats have not abated within the three year period of this IRP or there has been a substantial decrease in population size.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

A single Declared Rare Flora (DRF) marker has been placed at population 2a, approximately three metres east of the walk trail.

The owners of the private property containing populations 1a and 2a were notified in June 1991 and January 1992 respectively.

Staff from Kings Park and Botanic Garden (KPBG) collected seed, cuttings and grafts from population 1 in December 1991 and 1993. Results from cuttings gave a 0.3 % success rate and one plant has been grown on and potted. A total of 148 seeds are in storage at -20°C.

Staff from CALM's Threatened Flora Seed Centre (TFSC) collected 53 seeds from populations 1 and 2 in November 1995 which are currently in storage at -18°C.

The Merredin District Threatened Flora Recovery Team (MDTFRT) will oversee the implementation of this IRP and report annually to CALM's Corporate Executive.

3.2 Essential recovery actions

3.2.1 Develop a fire management plan

Little is known of the effects of fire on this species (see 1.3). Until additional surveying has been undertaken and the fire response of *A. pygmaea* has been determined, fire should, as far as possible, be prevented from occurring in the populations (see 1.4.2). A fire management plan for the areas will be developed in consultation with relevant authorities and land managers. Collation of historical fire data is essential in developing such a plan. It is likely that the species requires occasional fire for recruitment.

It is recommended that the fire management plan incorporates other priority and threatened flora species in the district (see Information dissemination 3.3.3).

Action:	Develop fire management plan
Responsibility:	CALM (Merredin District, Western Australian Threatened Species and Communities Unit (WATSCU))
Cost:	$450

3.2.2 Monitor populations

Monitoring of factors such as habitat degradation, population stability (expanding or declining), pollination activity, seed production, recruitment, and longevity is prescribed.

The populations require annual inspection as a requirement under CALM's Policy Statements No. 9 *Conservation of Threatened Flora in the Wild* and No 28 *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also below 3.2.4, *Development of a quadrat/transect based monitoring system for threatened plant species*.

Action:	Monitor populations annually
Responsibility:	CALM (Merredin District, WATSCU))
Cost:	$450 pa

3.2.3 Preserve genetic diversity of the species

Germplasm collections should be given a high priority if the extinction of populations of *A. pygmaea* is considered a high probability through disease, its limited distribution or low number of plants. If this is deemed to be the case, recovery of the species is likely to need *ex situ* conservation techniques.

Genetic diversity conservation of the species should be incorporated into the research component (see 3.2.4) and should include collection of seed from all populations, ensuring an adequate representation of genetic diversity.

If it is not possible to collect adequate quantities of viable seed, other more costly germplasm storage methodologies may need to be investigated. These can involve living collections from cutting or other source material, or storage of tissue culture material. If resources are limited these techniques will need to be carefully prioritised in relation to *in situ* conservation. This will be coordinated by the MDTFRT.

It is also important that the size and viability of the soil seed bank is determined and research undertaken to develop techniques for stimulating germination of soil stored seed. Care, however, should be taken as these processes inherently carry a significant risk of depletion of seed bank reserves.

Action:	Collect seed and/or other genetic material from all populations
Responsibility:	MDTFRT, KPBG, TFSC, CALM (WATSCU)
Cost:	$1600

3.2.4 Conduct research

Research designed to increase an understanding of the biology of the species will provide a scientific base for the management of *A. pygmaea* in the wild. Research should include:

1. The response of *A. Pygmaea* and its habitat to herbicide treatments.
2. Pollination biology and seed set.
3. Investigation of factors determining level of flower and fruit abortion.
4. Quantification of level of invertebrate grazing or removal of seed.
5. The size and viability of the soil seed bank.
6. The seed germination requirements of *A. pygmaea*.
7. The role of disturbance in regeneration.
8. The response of *A. pygmaea* and its habitat to fire.
9. Longevity of plants, and time taken to reach maturity.
10. Knowledge of the extent of genetic variation within and between populations. This is essential if new populations are to be established.
11. The development of a monitoring system. Specific protocols for rare flora will be outlined in a future CALM discussion paper "*Development of a quadrat/transect based monitoring system for threatened plant species*", A. Brown, P. Pigott and D. Coates (in prep).

Action:	Conduct research
Responsibility:	CALM (Science and Information Division (SID), WATSCU, Merredin District)
Cost:	$3000

3.3 Desirable recovery actions

3.3.1 Conduct further surveys

It is recommended that reserves with suitable habitats (lateritic breakaways) are surveyed on a systematic basis for the presence of *A. pygmaea*, particularly during its flowering period (November-March) and

following disturbances such as fire. Volunteers from the local community, wildflower societies and naturalist clubs could be involved in surveys supervised by CALM staff.

The following Class A nature reserves are vested in the NPNCA for the Conservation of Flora and Fauna and may contain suitable habitats for survey and future possible translocation of *A. pygmaea*. All reserves are located within the Wongan-Ballidu Shire.

Elphin NR ↑ 25808	Gathercole NR ↑ 20436	Rogers NR ↑ 39145
Fowler Gully NR ↑ 42375	Lake Ninan NR ↑ 27026	

Action:	Survey areas of suitable habitat
Responsibility:	CALM (Merredin District, WATSCU)
Cost:	$900 pa.

3.3.2 Land acquisition

To secure the long term survival of populations 1a and 2a, it is desirable that the areas of remnant bush on private property (south east of the reserve) be added to the Mount Matilda Nature Reserve. In addition, acquisition of adjacent narrow strips of cleared land (eg. 10 m wide) to function as fire breaks should be considered. Population 4 is located on private property in a relatively large area of remnant vegetation. This area should also be considered for acquisition as a nature reserve. Acquisition will only be by negotiated agreement. Close liaison between CALM and the landowners is essential. Conservation of other threatened and priority flora in the area should also be considered.

Action:	Liaise with landowners, determine possibility of land acquisition
Responsibility:	CALM (Merredin District, WATSCU)
Cost:	$unknown

3.3.3 Information dissemination

In order to increase the awareness of *A. pygmaea* with relevant CALM staff (Merredin District) and within the Shire of Wongan-Ballidu, the production of posters and vehicle dashboard stickers is recommended. Posters should illustrate the species and provide relevant information. Dashboard stickers should illustrate a rare flora marker and provide a contact telephone number if one is encountered.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted to the general public, however, it is recommended that the exact location of populations of *A. pygmaea* be kept confidential. Awareness can be sensitively encouraged throughout the community by a publicity campaign in the local print and electronic media and by providing poster displays in venues of high exposure. Formal links with local naturalist groups and interested individuals should also be encouraged.

Action:	Produce posters, dashboard stickers, publicity campaign
Responsibility:	CALM (Merredin District, Corporate Relations Division, WATSCU)
Cost:	$2000

3.3.4 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Some areas for consideration for translocation are listed in Conduct further surveys (see 3.3.1). Surveying potential habitat for possible future translocation sites is recommended within the scope of IRPs, with actual translocation addressed in full Recovery Plans where necessary. This should be

coordinated by the MDTFRT. All translocation proposals require endorsement by the Director of Nature Conservation.

Action: Survey potential habitats for translocation
Responsibility: MDTFRT, CALM (WATSCU)
Cost: See Section 3.3.1 (Conduct further surveys)

Table 2: Summary of recovery actions

Recovery Actions	Population	Priority	Responsibility	Completion date
Essential				
Develop a fire management plan	All	High	CALM (Merredin District)	June 1996, ongoing
Monitor populations	All	High	CALM (Merredin District, WATSCU)	1996, 1997,1998
Preserve genetic diversity of the species	All	High	MDTFRT, KPBG, TFSC, CALM (WATSCU)	1996, ongoing
Conduct research	All	High	CALM (SID, WATSCU, Merredin District)	ongoing
Desirable				
Conduct further surveys	-	Moderate	CALM (Merredin District, WATSCU)	1996, 1997, 1998
Land acquisition	1a, 2a	Moderate	CALM (Merredin District)	
Information dissemination	-	Moderate	CALM (Merredin District, WATSCU)	1996, ongoing
Translocation	-	Low	MDTFRT, CALM (WATSCU)	

3.4. Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Develop a fire management plan	200	250					
Monitor populations	200	250		200	250	200	250
Preserve genetic diversity of the species		500	1100				
Conduct research	1000			2000			
Sub-total	**$1400**	**$1000**	**$1100**	**$2200**	**$250**	**$200**	**$250**
Desirable							
Conduct further surveys	400	500		400	500	400	500
Land acquisition							
Information dissemination		500			1500		
Sub-total	**$400**	**$1000**		**$400**	**$2000**	**$400**	**$500**
Total	**$1800**	**$2000**	**$1100**	**$2600**	**$2250**	**$600**	**$750**

EA: Environment Australia (formerly ANCA)

Total of all costs $11 100 (+ costs relating to any land acquisitions)

ACKNOWLEDGMENTS

The following people have provided valuable assistance and advice in the preparation of this Interim Recovery Plan;

Mike Fitzgerald	District Manager, CALM Merredin
Claire Welbon	Former Assistant Conservation Officer, CALM Merredin
Nick Woolfrey	Former Conservation Officer, CALM Merredin

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Panetta, F.D. and Hopkins, A.J.M. (1991). *Weeds in Corridors: Invasion and Management.* Pp 341 - 351 in Nature Conservation 2 The Role of Corridors ed by D.A. Saunders and R.J. Hobbs. Surrey Beatty and Sons Pty Limited, Chipping Norton, NSW.

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Appendix One: Taxonomic description

Maslin, B.R. (1995). *Acacia* Miscellany 12. *Acacia myrtifolia* (Leguminosae: Mimosoideae: section *Phyllodineae*) and its allies in Western Australia. *Nuytsia* **10** (1):85-101.

6. Acacia pygmaea Maslin, *sp. nov.*

Typus: Wongan Hills area, 200 km northeast of Perth [precise locality withheld for conservation reasons], Western Australia, 27 October 1980, *K.F. Kenneally* 7496 (holo: PERTH 00197602; iso: CANB, K).

Dwarf, erect single-stemmed *sub-shrubs* 0.3-0.5(0.7) m tall. *Bark* grey at base of stems, light brown at ends of branchlets. *Branchlets* prominently ribbed, ribs yellow, glabrous. *Stipules* shallowly triangular, *c.* 0.5 mm long, dark brown. *Phyllodes* elliptic to obovate, slightly asymmetric, 20-30 mm long, 9-13 mm wide, length to width ratio 2.1-2.5, not significantly undulate, thin, erect, crowded towards ends of branchlets, shed with age, glabrous, green; *midrib* prominent on each face, often slightly eccentric, normally a minor second longitudinal nerve arising from the adaxial side of the midrib near the pulvinus and extending for about 1/2 the length of the phyllode; marginal nerves yellow (pale red when young); lateral nerves few and obscure; apex obtuse, minutely apiculate; pulvinus *c.* 0.5 mm long, yellow, not rugose. *Gland* not prominent, situated on upper margin of phyllode 4-7 mm above the base, elliptic, 0.3-0.5 mm long, 0.2-0.3 mm wide. *Inflorescences* simple, axillary, 1(2) per node. *Peduncles* 4-7 mm long, glabrous; basal peduncular bracts absent. *Heads* globular, filaments white but turning orange with age, 3-4-flowered. *Bracteoles* persistent, sessile, ovate, concave, *c.* 0.6 mm long, yellowish but turning brown with age. *Flowers* 4-merous, glabrous; mature buds large, 3.5 x 1.5 mm, ovoid-ellipsoid, bluntly acute, ± 4-angled. *Calyx* 1/5 the length of the corolla, gamosepalous, truncate to very shallowly divided into broadly triangular lobes separated by wide sinuses, the lobes not thickened; calyx tube nerveless and broad-based. *Petals* elliptic, 3.3-3.5 mm long, 1.8-2 mm wide, free to base at anthesis, greenish. *Gynandrophore* 0.5 mm long, capitate. *Ovary* 1 (very rarely 2) per flower, prominently deflexed on a terete gynophore 0.5-1 mm long. *Pods* narrowly oblong, acute, to 30 mm long, 3-4 mm wide, (1)2-4-seeded, retrorse by a strongly recurved stipe, crustaceous, light reddish brown, glabrous, normally not constricted between seeds, very slightly raised over the seeds, dehiscing at first along the dorsal suture with the seeds remaining attached for some time, valves recurved following their complete separation; margins not undulate, marginal nerves prominently thickened. *Seeds* longitudinal in the pod, oblongoid to ellipsoid but narrowed towards the hilum, 4-5 mm long, 2.5-2.8 mm wide, turgid (2 mm thick), shiny, dark brown except for the areolar area which is grey-brown, with a very shallowly concave peripheral band; pleurogram fine, open towards the hilum, often bordered by a narrow band of yellow tissue; areole *c.* 3 mm long, 1 mm wide; funicle filiform, *c.* 1 mm long, expanded into a normally once folded, yellowish aril which is brown near the hilum.

Other specimens examined. WESTERN AUSTRALIA: all from the one population at the type locality, *K.F. Kenneally* 5891 (BRI, MEL, NSW, NY, PERTH) and 7194 (PERTH); *B.R. Maslin* 4804, 4550 and 4550A (all PERTH).

Distribution. Southwest Western Australia in the Avon Botanical District (1:250,000 map H50-10). Known only from the type locality where less than 50 plants are known to occur.

Habitat. The species is confined to three adjacent ridges composed of massive laterite; it does not extend down the lateritic scree slopes. It grows in association with *Eucalyptus ebbanoensis, Dryandra comosa, D. hewardiana, D. pulchella, Allocasuarina campestris* and *Persoonia divergens.*

Flowering and fruiting periods. Flowering from about November to March. Pods take nearly a year to mature. Seed has been collected in late October at which time mature buds were present.

Affinities. The new species is perhaps most closely allied to *A. disticha* (see above). It appears also related to *A. obovata* Benth. which is also a dwarf sub-shrub with phyllodes similar to those of *A. pygmaea* in shape and size; furthermore, both species have pale-coloured, 4-merous flowers, reduced calyces and pods which dehisce by first splitting along their dorsal suture. However, besides being more widespread and occurring further west (i.e. Jurien Bay area south to Augusta), *A. obovata* is distinguished from *A. pygmaea* by its multi-stemmed growth habit, narrowly triangular stipules which are 1.5-4 mm long, frequently hairy branchlets and phyllodes, undulate phyllodes with conspicuous lateral veins and a raised marginal gland, heads (5)7-9-flowered, extremely reduced racemose inflorescences and its pods which reach 110 mm long and 5-6 mm wide.

Appendix Two: Associated species

PROTEACEAE
Dryandra comosa
Dryandra hewardiana
Dryandra pulchella
Dryandra sp. aff. *hewardiana*
Grevillea biternata
Hakea coriacea
Hakea scoparia
Isopogon divergens
Persoonia divergens
Petrophile shuttleworthiana

MIMOSACEAE
Acacia semicircinalis (DRF)
Acacia botrydion (P1)

PAPILIONACEAE
Bossiaea eriocarpa
Daviesia sp.
Daviesia spiralis
Gastrolobium spinosum

MYRTACEAE
Eucalyptus ebbanoensis
Eucalyptus flocktoniae
Eucalyptus salmonophloia
Melaleuca adnata
Melaleuca radula
Melaleuca uncinata

CASUARINACEAE
Allocasuarina campestris

RUTACEAE
Eriostemon wonganensis

LAMIACEAE
Microcorys sp.
Microcorys eremophiloides

MYOPORACEAE
Eremophila oldfieldii
Eremophila ternifolia

PHORMIACEAE
Dianella revoluta

INTERIM RECOVERY PLAN NO. 10

MOGUMBER BELL (*DARWINIA CARNEA*) INTERIM RECOVERY PLAN

1996-1999

by

Emma Holland, Kim Kershaw and Andrew Brown

June 1997

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March, 1997.

CONTENTS

FIGURES

TABLES

APPENDICES

SUMMARY

Mogumber Bell, *Darwinia carnea* **Family:** MYRTACEAE

Flowering period: September-December

CALM Region: Wheatbelt and Midwest **CALM District:** Narrogin and Moora

Shires: Narrogin and Victoria Plains

Current status: Declared as Rare Flora in January 1980, ranked as Critically Endangered in September 1995

Recovery team: Moora District Threatened Flora Recovery Team. A Recovery team will be established for CALM's Narrogin District in 1997.

Illustrations and/or further information: J. Leigh *et al. Extinct and Endangered Plants of Australia.* (1984); J Leigh and J. Briggs, *Threatened Australian Plants: Overview and Case Studies* (1992); S. D. Hopper, *et al., Western Australia's Endangered Flora* (1990); W. E. Blackall and B. J. Grieve, *How to Known Western Australian Wildflowers* (1980); S.J. Patrick & A.P. Brown *Declared Rare and Poorly Known Flora in the Moora District* (draft 1997).

Darwinia carnea is a small shrub 20-30 cm tall with linear-lanceolate opposite leaves 6-10 mm long. The flower head is nodding and surrounded by broad, ovate bracts which are coloured yellowish-green to pinkish-red. The bracts are c. 3 cm long and conceal 10-14 flowers within.

The species was first discovered near Mogumber (approximately 100 km north of Perth) by C.A. Gardner in 1922 and was described by him in 1928. The Narrogin population was first discovered in the 1950s by R. Durell. It was last seen at the type locality in 1970 and was presumed extinct in that area until 1990 when rediscovered by E. Griffin not far from the original locality. Currently, three extant populations containing about 269 plants (1995) are known over a geographical range of 245 km. All are located on private property (two at Mogumber and one at Narrogin). Plants in the Mogumber populations differ from plants in the Narrogin population in being shorter with a different habit. They also have smaller flowers with a different bract colour.

Due to agricultural development in the Mogumber and Narrogin regions, most suitable habitat has either been cleared or is badly degraded through grazing. The aim of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations of *Darwinia carnea* in order to conserve the wild genetic stock of the species. To achieve this aim the following essential and desirable recovery actions are prescribed:

Recovery actions:

Essential	Desirable
1. Fence subpopulation 5b	1. Conduct further surveys
2. Develop fire management plan	2. Implement weed control
3. Preserve genetic diversity of the species	3. Information dissemination
4. Implement rabbit control	4. Conduct research
5. Monitor populations	5. Land purchase
	6. Translocation

INTERIM RECOVERY PLAN NO. 12

KAMBALLUP DRYANDRA (*DRYANDRA IONTHOCARPA*) INTERIM RECOVERY PLAN

1996-1999

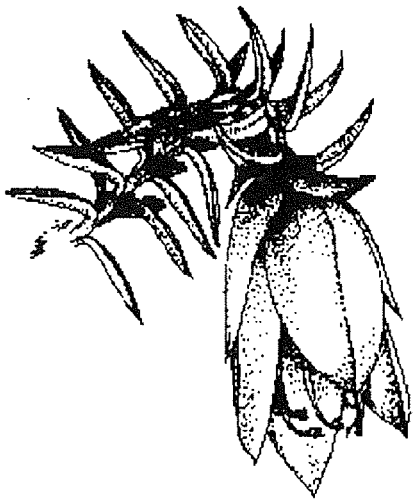
by

Kim Kershaw, Emma Holland and Andrew Brown

June 1997

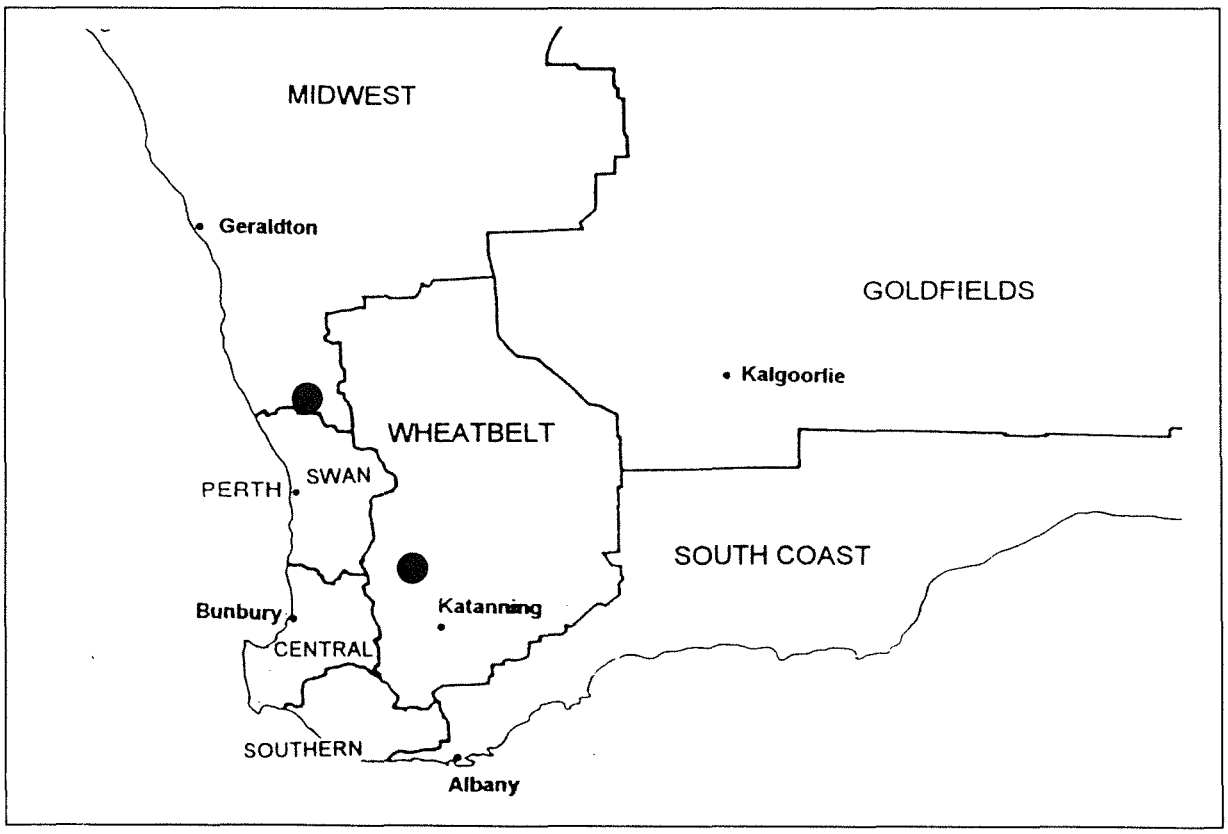
Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

Darwinia carnea



Margaret Pieroni

Distribution of *Darwinia carnea*



1. BACKGROUND

1.1 History, taxonomy and status

Darwinia carnea Gardner is a small shrub 20-30 cm tall. The leaves are 6-10 mm long, opposite, linear lanceolate in shape and keeled. The flower head is nodding and surrounded by broad, ovate, coloured bracts which are yellowish-green to pinkish-red in colour. The bracts are *c.* 3 cm long and conceal the 10-14 flowers within. Each flower is tubular with an unribbed calyx tube and short blunt lobes *c.* 1.5 mm long. The five petals are white and 4 mm long. There are short staminodes between the ten stamens and the style is 13.5 mm long with a curved, bearded tip. The fruits are small nuts. The plants in the Mogumber populations differ from plants in the Narrogin population in being shorter, with a different habit, smaller inflorescence and a difference in bract colour.

D. carnea was first discovered in 1922 by C.A. Gardner from an area near Mogumber (approximately 100 km north of Perth). The species was described by him in 1928 in Latin. An English translation is included in Appendix 1. The species is named from the Latin *carneus*, meaning flesh coloured, in reference to the unusual colour of the bells.

The species was last seen in the type locality at Mogumber in 1970 and was presumed extinct in that area (due to grazing). However in 1990 population 3 was discovered by E. Griffin not far from the original locality. Another population (population 5) was found by consultant botanist J. Gathe in late 1990 on private property at Mogumber, *c.* 2 km from population 3.

D. carnea was found south-east of Narrogin on private property in the 1950s by R Durell. When the area was proposed to be cleared in the mid 1970s, Mr Durell negotiated with the landowner (Mr Nottle) and was successful in conserving a small area of remnant bush comprising most of the population. The existing fenced area represents the total area that was saved from clearing. The population was brought to CALM's attention in 1978 when a site inspection was undertaken by Dr N. Marchant, Mr P. Lambert, Mr F. Lullfitz and Mr R. Durell, during which cutting material was collected (G. Durell[1] pers. comm.).

Cutting material was also collected prior to 1970 from the Mogumber population. This was the source material for Kings Park and Botanic Garden (KPBG) research and was later cloned by The Wildflower and Lullfitz Nurseries.

An attempt to reintroduce the species into the type locality was made by B. Jack, a local horticulturalist. However this failed due to drought and / or grazing. In July 1985, 50+ plants were planted from 12.5 cm pots in an area of private property of about 0.5 ha, which is believed to be the type locality. In 1990 the translocation site was surveyed by J. Gathe. No plants were found and local farmer, Mr M. Roley, believed the plants had been eaten by sheep.

In September 1992 an unconfirmed sighting of a single plant of *D. carnea* (Population 4) was made by Mrs Barratt-Lennard and Mrs Scott in State Forest south west of Narrogin. Searching for this population was undertaken by L. Silvester in 1993 and 1994, in October 1993 by P. Hussey and P. Murray and in October 1995 by E. Holland, J. Gathe and R. Hindmarsh. No plants were found.

Ms Rosanna Hindmarsh is currently studying the genetic differences between populations of *D. carnea* at Mogumber and the populations at Narrogin using electrophoresis. A loss of genetic variability through genetic drift may be the cause of the morphological differences between the populations.

[1] Mr Greg Durell (CALM Narrogin District)

1.2 Distribution and habitat

At Narrogin, *Darwinia carnea* is known from a single population on private property covering an area of approximately 0.5 ha. The population grows on an exposed lateritic hilltop in heath.

At Mogumber, *D. carnea* is known from two populations on private property covering an area of approximately 1 ha each. The populations are situated on the tops of lateritic breakaways, growing in gravelly brown loamy soils, in open *Eucalyptus wandoo* woodland over heath. Narrogin and Mogumber are geographically isolated, being 245 km apart.

Associated species include *Petrophile heterophylla, Adenanthos cygnorum, Banksia sphaerocarpa, Beaufortia incana, Dryandra polycephala* and *D. nobilis*. A list of associated species is included in Appendix 2.

Table 1: Summary of population information

Pop. No & Location.	Land Status	No. of plants	Condition	Threats
1. SE of Narrogin	Private	1983, 67 1995, 69	Moderate	Inadequate fencing, inappropriate fire, rabbits
2. NNE of Mogumber	Private	1985, 50+ (transplants) 1990, 0	Failed translocation due to grazing, drought	_
3. ESE of Mogumber	Private	1990, 200 1995, 110+	Good	Grazing, inappropriate fire
4. *WSW of Highbury	State Forest	1992, 1 1995, 0	_	_
5A. ESE of Mogumber	Private	1996, 70+	Poor	Inappropriate fire
5B. ESE of Mogumber	Private	1995, **20+	Poor	Grazing, clearing, inappropriate fire

* Unconfirmed sighting 19/9/92 by Mrs Barratt-Lennard and Mrs Scott; further surveys have failed to locate this single plant

** This is an estimate only as the numbers in past surveys have combined the subpopulation numbers. The only reference to numbers is "the vast majority of plants occur on 5a".

1.3 Biology and ecology

Endemic to south-western and south-eastern Australia, the genus *Darwinia* is closely related to *Chamelaucium* (wax plants) and *Verticordia* (feather flowers) (Keighery 1985). Many south-western species are characterised by their large inflorescences which are surrounded by coloured bracts and the common name "bells" is derived from this feature. A taxonomic study (Marchant and Keighery 1992) recognised 48 *Darwinia* species, two of which have subspecies, and an additional 15-20 unnamed species.

Darwinia carnea is the only member of the mountain bell group to occur outside of the Stirling Range. However, as is the case for the Stirling Range species, *D. carnea* is believed to be killed by fire and to later regenerate from soil-stored seed (no documentation of fire has been recorded in the known populations of *D. carnea*). *Darwinia* seeds have no specialised means of dispersal and remain stored in the soil below adult plants. Most Stirling Range *Darwinia* species flower two to four years after germination and reach maturity in seven to ten years (Keighery and Marchant 1993).

It is believed that *D. carnea* is pollinated by nectar feeding birds. Birds feed by day, have no sense of smell and locate food by sight, thus the bells flower in open areas in dense populations and are brightly coloured. The flowers are quite large (for birds to visit) and pendulous (to keep rain from the nectar) and positioned so that a bird can perch on them or probe up from the ground (Keighery and Marchant 1993).

It has been noted within the Narrogin population that several associated species, eg, *Dryandra nobilis* and *Adenanthos cygnorum,* compete with *D. carnea* and may eventually displace the species. This appears to show the disturbance opportunistic nature of *D. carnea.*

Potted species of *Darwinia* are susceptible to dieback disease caused by *Phytophthora cinnamomi*, however they appear resistant in the wild (Keighery and Marchant 1993). No specific information is available for *D. carnea.*

1.4 Threatening processes

1.4.1 Causes of the critically endangered status of this species

Despite extensive searches for the species since 1990, only three populations with a combined total of about 269 plants (1995) are known to exist. Due to agricultural development in the Mogumber and Narrogin regions, much of the species habitat has been cleared or badly degraded.

Population 1 (Narrogin) is restricted to a small area of remnant vegetation, subjected to edge effects from management of the adjacent land. Edge effects include increased wind speeds, increased fertiliser runoff, modified hydrology and altered disturbance regimes, including fire regimes (Lynch 1987; Saunders *et al.* 1987; Taylor 1987). The fragmentation of the remnant vegetation, combined with edge effects subjects the vegetation to high levels of stress together with acute disturbances. The condition of the habitat of *D. carnea* initially improved after fencing but has declined since and will continue to decline into the future unless recovery actions are applied.

1.4.2 Threats to the ongoing survival of this species in the wild

- **Grazing** by sheep is an immediate threat to Sub-population 5b, and a minor threat to Population 3. Grazing has left the adult plants at Population 5 stunted with minimal foliage. If allowed to continue, recruitment of *D. carnea* will be interfered with and extinction may result.

- **Inappropriate fire regimes** during the reproductive phase of *D. carnea* (ie. flowering, pollination, seed growth and seed dispersal) may result in low/nil seedling recruitment. High fire frequency commonly leads to the degradation of natural communities due to factors such as depletion of soil seed banks, death of juveniles before maturity and a temporary increase in the availability of nutrients for weed establishment (Panetta and Hopkins 1991). A fire within population 1 at Narrogin would probably lead to the local extinction of the species, due to the small size of the remnant vegetation and great threat of weed invasion (G. Durell[2] pers. comm.).

- **Rabbits** (*Oryctolagus cuniculus*) have caused major disturbances in the past at Population 1 (Narrogin). Warren construction, increased nutrient levels from their droppings, introduction of weeds and grazing have had impacts on the habitat.

[2] Mr Greg Durell (CALM Narrogin District)

- **Weeds** are not a serious problem, however the potential for invasion may be increased if the populations are exposed to further disturbance (fire, continued grazing pressure). The three extant *D. carnea* populations have the potential to be both directly and indirectly affected by weeds due to:

  - direct competition, inhibiting growth and displacing the species
  - a decrease in habitat diversity
  - inhibiting recruitment
  - an alteration in nutrient cycling
  - a change in soil acidity
  - an increase in fire hazard due to easy ignition, high fuel loads produced annually, and the formation of a continuous bed permitting a fire to spread quickly (Hussey and Wallace 1993)

1.5 Conservation status

Darwinia carnea is known from three extant populations at Mogumber and Narrogin, all occurring on private property. No plants are known to exist on a conservation reserve.

1.6 Strategy for recovery

A Threatened Flora Recovery Team will be established for the Narrogin District and it, along with the Moora District Threatened Flora Recovery Team, will oversee the implementation of this IRP and report annually to CALM's Corporative Executive. The following essential strategies will be implemented:

1. Control of the most threatening factors currently affecting *D. carnea* as outlined at 3.2.
2. Preserve the genetic material of *D. carnea* by including it in cryostorage and/or *ex situ* cultivation (see 3.2.3).
3. Protect *D. carnea* from possible future threats (eg weeds, further habitat degradation), by appropriate management practices (see 3.2.4, 3.2.2).

The following desirable strategies will be implemented if resources permit:

1. Enhance plant numbers (eg by removal of a limiting factor or with direct propagation and translocation techniques) (see 3.3.6, CALM Policy Statement No 29, *Translocation of Threatened Flora and Fauna*).
2. Ensure that relevant land managers and CALM personnel are aware of the presence of *D. carnea*, and the need to protect it (eg notification) and ensure that all are familiar with the threatening processes identified in these guidelines (see 3.3.3).
3. Research the biology, ecology and management of *D. carnea* (see 3.3.4).
4. Seek funds for purchase and reservation of privately owned lands containing *D. carnea.*

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term preservation of the species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if identified threats have not abated within the three year period of this IRP or there has been a substantial decrease in the number of mature plants.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

The owners of private property at Narrogin (Population 1) were notified of the presence of *D. carnea* in November 1992. The owners of private property at Mogumber were notified in December 1994 (Populations 5a and 5b) and in January 1995 (Population 3).

Fencing materials were delivered to the owners of Population 5a on 30 April 1996 and erection was completed in September.

The Narrogin population (Population 1) was fenced in 1978 by the landowner, Mr R. Durell and several volunteers. The fence was repaired in 1994 by CALM after rabbit and sheep damage.

A rabbit control program is undertaken by CALM's Narrogin District at Population 1 when rabbits are reported to occur within rabbit proof fenced area. Several successful rabbit trappings were undertaken by R. Durell during 1978. The owner of the private property shoots rabbits in the adjoining paddock.

Cutting material was collected by KPBG in 1989 and 1990. Plants are in the nursery and on display at Kings Park.

The Threatened Flora Seed Centre (TFSC) at CALM's West Australian Herbarium have seed in storage from collections made in 1990 and 1995.

The Moora District Threatened Flora Recovery Team (MDTFRT) oversees the implementation of this IRP for the Mogumber populations and reports annually to CALM's Corporate Executive.

3.2 Essential recovery actions

3.2.1 Fencing

It is essential that subpopulation 5b (Mogumber) be fenced from stock (subpopulation 5a was fenced in September 1996). Fences excluding stock from population 3 (Mogumber) and population 1 (Narrogin) need to be routinely monitored and maintained. Liaison with land owners is essential.

Action:	Fence supopulation 5b, maintain fences at populations 1 and 3
Responsibility: and Cost:	CALM (Narrogin and Moora Districts, Western Australian Threatened Species Communities Unit (WATSCU)) $2450

3.2.2 Develop a fire management plan

Little is known about the effects of fire on *D. carnea* (see 1.3). It is recommended that a fire management plan for the areas of each population be developed in consultation with relevant authorities and land managers. It is likely that occasional fire is required for recruitment of this species.

Action:	Develop fire management plan
Responsibility:	CALM (Moora and Narrogin Districts, WATSCU)
Cost:	$450 pa.

3.2.3 Preserve genetic diversity of the species

Germplasm collections should be given a high priority if the extinction of populations *D. carnea* is considered a high probability through disease, its limited distribution or low number of plants. If this is deemed to be the case, recovery of the species is likely to need *ex situ* conservation techniques.

Genetic diversity conservation of the species should be incorporated into the research component (see 3.3.4) and should include collection of seed from all populations, ensuring an adequate representation of genetic diversity.

If it is not possible to collect adequate quantities of viable seed, other more costly germplasm storage methodologies may need to be investigated. These can involve living collections from cutting or other source material, or storage of tissue culture material. If resources are limited these techniques will need to be carefully prioritised in relation to *in situ* conservation. This will be coordinated by the MDTFRT and the yet to be established Narrogin District threatened Flora Recovery Team (NDTFRT).

It is also important that the size and viability of the soil seed bank is determined and research undertaken to develop techniques for stimulating germination of soil stored seed. Care, however, should be taken as these processes inherently carry a significant risk of depletion of seed bank reserves.

Action:	Collect seed and/or other genetic material from all populations
Responsibility:	MDTFRT, NDTFRT to be established, CALM (Narrogin and Moora Districts, TFSC, WATSCU), KPBG
Cost:	$1600

3.2.4 Implement rabbit control

A rabbit control program is currently operating in the Narrogin District for Population 1. It is essential that this program is maintained to ensure habitat degradation does not occur.

Action:	Maintain rabbit control program at Population 1 (Narrogin)
Responsibility:	CALM (Narrogin District)
Cost:	$400 pa.

3.2.5 Monitor populations

Monitoring of factors such as weed encroachment, habitat degradation, population stability (expanding or declining), pollination activity, seed production, recruitment, and longevity is prescribed.

Populations should be inspected annually as a requirement under CALM's Policy Statements, No. 9 *Conservation of Threatened Flora in the Wild* and No 28 *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also below 3.3.4, *Development of a quadrat/transect based monitoring system for threatened plant species.*

Action:	Monitor populations annually
Responsibility:	CALM (Narrogin and Moora Districts, WATSCU)
Cost:	$650 pa.

.3 Desirable recovery actions

3.3.1 Conduct further surveys

D. carnea has been extensively surveyed by CALM staff and consultant botanists in recent years, however it is recommended that further surveys are conducted on a systematic basis for the presence of the species, particularly during the flowering period (September-December) and one or two years following disturbance such as fire in both the Narrogin and Mogumber areas. Reserves with suitable habitats such as lateritic breakaways or lateritic hill tops with associated species (*Petrophile heterophylla, Adenanthos cygnorum, Banksia sphaerocarpa, Beaufortia incana, Dryandra polycephala, Dryandra nobilis)* should be considered for survey. Areas considered suitable for the species should be noted and considered for possible future translocation (see 3.3.6). Volunteers from the local community, wildflower societies and naturalist clubs should be involved in surveys supervised by CALM staff. Liaison between groups is essential.

Action:	Conduct further surveys
Responsibility:	CALM (Narrogin and Moora Districts, WATSCU)
Cost:	$900 pa.

3.3.2 Implement weed control

Although weeds are currently not a threat to *Darwinia carnea* populations, they may become so if not effectively controlled with the use of herbicides and hand pulling. The tolerance of native plant species to herbicides at *D. carnea* sites is unknown and it is recommended that weed control programs are undertaken in conjunction with research (see 3.3.4). The aim of weed control is to maintain the pre-invasion condition of the habitat (prevention), control or arrest ongoing weed invasion (intervention) and reverse the degraded condition of the habitat where applicable (rehabilitation) (Panetta and Hopkins 1991). A weed control program, if required, will involve:

1. Accurately mapping the boundaries of the populations.
2. Selection of an appropriate herbicide or other method of weed control after determining which weeds are present.
3. Controlling invasive weeds internal to the boundary by hand removal and spot spraying around individual *D. carnea* plants when weeds first emerge.
4. Scheduling to include weed spraying of other Declared Rare Flora populations requiring weed control within the Moora and Narrogin Districts.

Action:	Monitor weeds at all populations and implement a weed control program if required
Responsibility:	CALM (Narrogin and Moora Districts, WATSCU)
Cost:	$1000 pa.

3.3.3 Information dissemination

To promote an awareness of *D. carnea* among relevant CALM staff (Moora and Narrogin Districts) and Shires, the production of posters is recommended. Posters should illustrate and provide information on the species.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted with the general public, however, it is recommended that the exact location of populations of *Darwinia carnea* remain confidential. Awareness can be encouraged throughout the community by a publicity campaign using the local print and electronic media and by setting up poster displays in venues of high exposure. Formal links with local naturalist groups and interested individuals should also be encouraged. Such activities may lead to the discovery of new populations of the species.

Action:	Produce posters, implement a publicity campaign
Responsibility:	CALM (Corporate Relations Division, Moora and Narrogin Districts, WATSCU)
Cost:	$500 first year, $1500 second year

3.3.4 Conduct research

Research designed to increase an understanding of the biology of the species will provide a scientific base for management of *D. carnea* in the wild. Research should include:

1. Pollinator activity within populations of *D. carnea*.
2. Investigation of factors determining level of flower and fruit abortion.
3. Quantification of level of invertebrate grazing of seed.
4. The size and viability of the soil seed bank.
5. Seed germination requirements.
6. The role of disturbance in regeneration.
7. The response of *D. carnea* and its habitat to fire.
8. The longevity of plants, and time taken to reach maturity.
9. The extent of genetic variation within and between populations (essential knowledge if new populations are to be established).
10. Development of a monitoring system. Specific protocols for rare flora will be outlined in a future CALM discussion paper *Development of a quadrat/transect based monitoring system for threatened plant species*, (D. Coates, A. Brown and P. Pigott, in prep).

Action:	Conduct research
Responsibility:	CALM (Science and Information Division (SID), Narrogin and Moora Districts, WATSCU)
Cost:	$3000

3.3.5 Land purchase

CALM should seek funds for purchase and reservation of privately owned land containing *D. carnea* for the purpose of conservation and vesting in the National Parks and Nature Conservation Authority (NPNCA). CALM will liaise and negotiate with the land owner at the appropriate time.

Action: Seek funds, negotiate land purchase from land owners
Responsibility: CALM (Land Administration, Moora and Narrogin Districts, WATSCU), land owners.
Cost: To be negotiated

3.3.6 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Surveying potential habitat for possible future translocation sites is recommended within the scope of IRPs, with actual translocation addressed in full Recovery Plans where necessary. This should be coordinated by the MDTFRT and the Narrogin District Threatened Flora Recovery Team which is yet to be established. All translocation proposals require endorsement by the Director of Nature Conservation.

Action: Survey potential habitats for translocation
Responsibility: MDTFRT, NDTFRT to be established, CALM (Narrogin and Moora Districts, WATSCU)
Cost: See Section 3.3.1 (Further surveys)

Table 2: Summary of recovery actions

Recovery Actions	Priority	Responsibility	Completion date
Essential			
Fencing	High	CALM (Narrogin & Moora Districts, WATSCU)	1996
Develop a fire management plan	High	CALM (Narrogin & Moora Districts, WATSCU)	1996, ongoing
Preserve genetic diversity of the species	High	MDTFRT, CALM (TFSC, Narrogin District, WATSCU), KPBG	Ongoing
Implement rabbit control	High	CALM (Narrogin & Moora Districts, WATSCU)	Ongoing
Monitor populations	High	CALM (Narrogin & Moora Districts, WATSCU)	Annually
Desirable			
Conduct further surveys	Moderate	CALM (Narrogin & Moora Districts, WATSCU)	October-December 1996 - 1997
Implement weed control	Moderate	CALM (Narrogin & Moora Districts, WATSCU, SID)	Annually
Information dissemination	Moderate	CALM (Corporate Relations Division, Narrogin & Moora Districts, WATSCU)	1996 ongoing
Conduct research	Moderate	CALM (SID, WATSCU)	Ongoing
Land purchase	Moderate	CALM (Land Administration, Narrogin & Moora Districts, WATSCU), Land owners	Ongoing
Translocation	Low	MDTFRT, CALM (Narrogin, WATSCU)	Ongoing

3.4 Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Fencing	2200	250					
Develop a fire management plan	200	250		200	250	200	250
Preserve genetic diversity of the species		500	1100				
Implement rabbit control	400			400		400	
Monitor populations	400	250		400	250	400	250
Sub-total	**$3200**	**$1250**	**$1100**	**$1000**	**$500**	**$1000**	**$500**
Desirable							
Conduct further surveys	400	500		400	500	400	500
Implement weed control	500	500		500	500	500	500
Information dissemination		500			1500		
Conduct research	2000			1000			
Land purchase							
Sub-total	**$2900**	**$1500**		**$1900**	**$2500**	**$900**	**$1000**
Total	**$6100**	**$2750**	**$1100**	**$2900**	**$3000**	**$1900**	**$1500**

EA Environment Australia (formerly ANCA)

Total of all costs : $19250

ACKNOWLEDGMENTS

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Janette Gathe	Botanist

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Appendix One:

Taxonomic description taken from Leigh, J. *et al.* (1984). *Extinct and Endangered Plants of Australia.* Pp 338.

Darwinia carnea C.A. Gardner
Mogumber Bell
STATUS 2E
DESCRIPTION Open spreading shrub to 40 cm high. *Leaves* are crowded, opposite with alternate pairs at right angles to each other, linear-lanceolate and pointed at the tip, keeled, 5-15 mm long and about 1 mm wide, hairless, leathery in texture. *Flowers* are small, pale pink, arranged 10-14 together at the ends of the branches in large globular bell-shaped nodding heads 3 cm long which are enclosed by several ovate, hairless greenish-pink persistent bracts. Individual flowers have ovate-lanceolate blunt-tipped petals 4 mm long and about 2 mm wide and a shortly lobed cylindrical calyx 4 mm long and 2 mm wide. Fruit is a small nut but not described in detail. *Flowering* October to December.
DERIVATION *carnea*, Latin, meaning flesh-coloured, referring to the colour of the floral bracts.

Appendix Two: Associated species

CYPERACEAE
Lepidosperma tenuis

XANTHORRHOEACEAE
Xanthorrhoea preissii

ANTHERICACEAE
Laxmannia squarrosa
Laxmannia brachyphylla

HAEMODORACEAE
Conostylis villosa

CASUARINACEAE
Allocasuarina huegeliana

PROTEACEAE
Adenanthos cygnorum
Banksia sphaerocarpa var *caesia*
Dryandra nobilis
Dryandra polycephala
Dryandra sessilis

STYLIDIACEAE
Stylidium calcaratum

PROTEACEAE
Grevillea leptobotrys
Grevillea synaphea subsp. *synaphea*
Hakea incrassata
Hakea stenocarpa
Hakea undulata
Isopogon teretifolius
Petrophile divaricata
Petrophile heterophylla

RUTACEAE
Boronia ovata

POLYGALACEAE
Comesperma calymega

STACKHOUSIACEAE
Stackhousia monogyna

RHAMNACEAE
Trymalium ledifolium var *lineare*

LOBELIACEAE
Lobelia rhytidosperma

MYRTACEAE
Baeckea crispiflora
Beaufortia incana
Calothamnus quadrifidus
Melaleuca scabra
Eucalyptus wandoo
Eucalyptus accedens
Eucalyptus calophylla

EPACRIDACEAE
Astroloma microcalyx
Conostephium drummondii

GENTIANACEAE
* *Centaurium erythraea*

DILLENIACEAE
Hibbertia acerosa
Hibbertia hypericoides
Hibbertia lasiopus

*Introduced species

INTERIM RECOVERY PLAN NO. 11

NORSEMAN PEA (*DAVIESIA MICROCARPA*) INTERIM RECOVERY PLAN

1996-1999

by

Emma Holland, Kim Kershaw and Andrew Brown

June 1997

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March, 1997.

CONTENTS

SUMMARY

Norseman Pea, *Daviesia microcarpa* **Family:** PAPILIONACEAE

Flowering period: August-September

CALM Region: South Coast **CALM District:** Esperance **Shire:** Dundas

Current status: Declared as Rare Flora in September 1987, ranked as Critically Endangered in September 1995

Recovery team: A Threatened Flora Recovery Team will be established for CALM's Esperance District in 1996/1997

Illustrations and/or further information: S. D. Hopper *et al. Western Australia's Endangered Flora* (1990); E. M. Mattiske and Associates, *Assessment of Three Gazetted Rare Plants* (1994); M. D. Crisp, *Contributions Towards a Revision of* Daviesia *(Fabaceae: Mirbelieae) III A Synopsis of the Genus* (1995); T. Schwarten, *The Biology and Ecology of Threatened Daviesia Species in Western Australia* (1995).

Daviesia microcarpa is a sprawling shrub to 40 cm high and 1 m wide, with 8-20 mm long phyllodes which are spirally arranged on tangled stems. The flowers and pods are among the smallest in the genus. *D. microcarpa* was formally described by M. D. Crisp in 1995.

The first known collection of *D. microcarpa* was made by D. Whibley in 1974 just west of the currently known subpopulation.

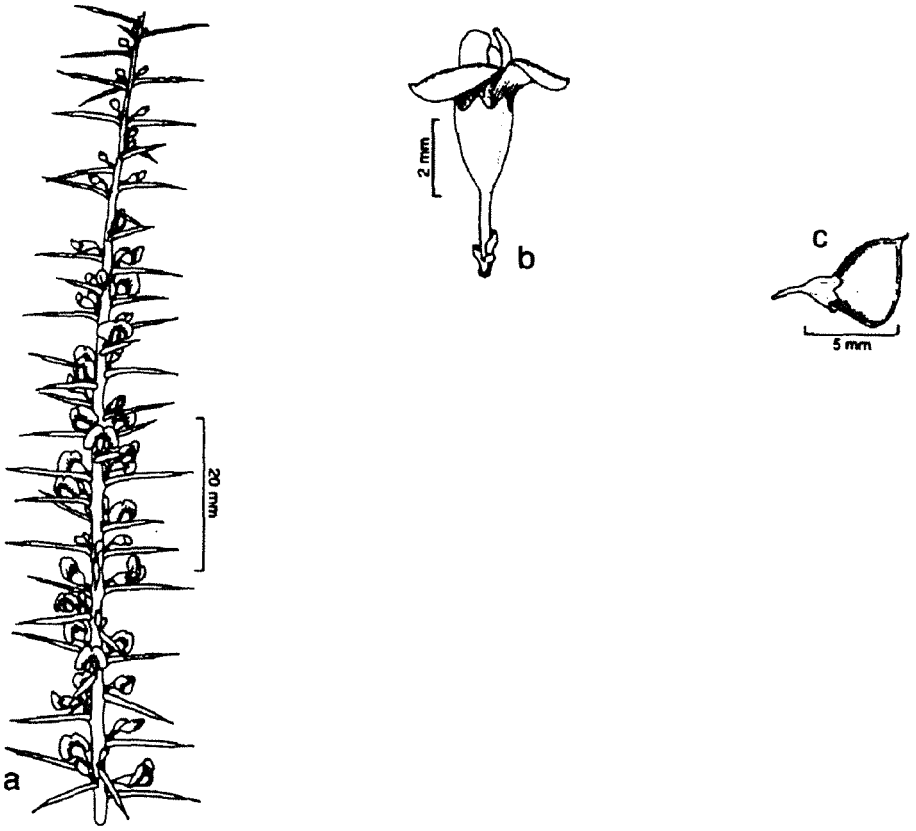
A single extant subpopulation of 15 plants is known from east of Norseman, growing adjacent to the Eyre Highway in disturbed, loamy red-brown soil with calcrete nodules.

Pastoral practices, resulting in loss of suitable habitat, and a lack of appropriate disturbance, ie. soil disturbance and fire, may be the cause of the critically endangered status of the species. The aim of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations of *D. microcarpa* in order to conserve the wild genetic stock of the species. To achieve this aim the following essential and desirable recovery actions are prescribed.

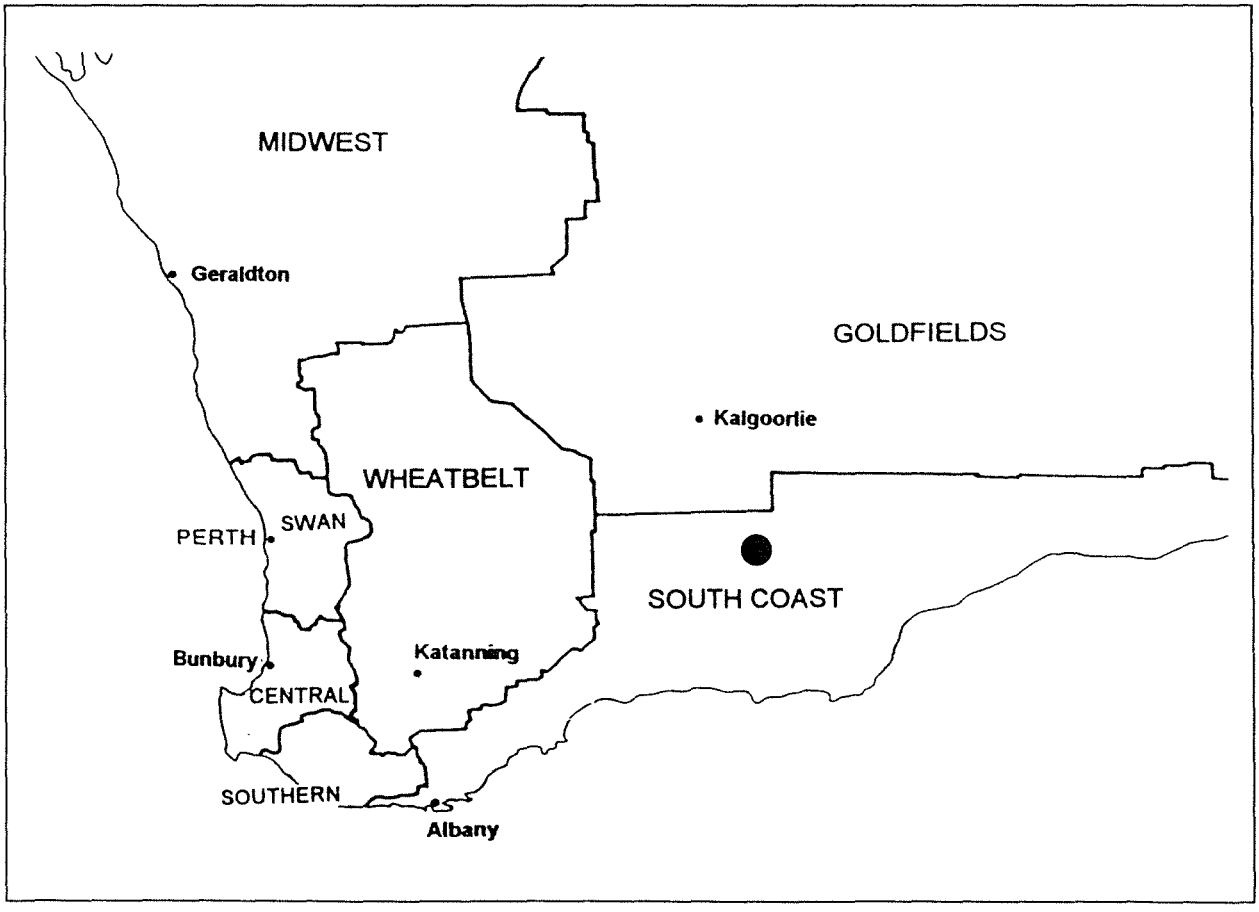
Recovery actions:

Essential		Desirable	
1.	Protect from road reconstruction	1.	Conduct further surveys
2.	Develop a fire management plan	2.	Information dissemination
3.	Install Declared Rare Flora markers	3.	Conduct research
4.	Monitor subpopulation	4.	Survey for possible translocation sites
5.	Preserve genetic diversity of the species		

Daviesia microcarpa



Distribution of *Daviesia microcarpa*



1. BACKGROUND

1.1 History, taxonomy and status

Daviesia microcarpa Crisp is a sprawling shrub to 40 cm high and 1 m wide, with 8-20 mm long needle-like phyllodes spirally arranged on tangled stems. The flowers, which are produced from August to September, are found towards the end of each stem. Each flower has a standard *c.* 4 mm long and 5 mm broad that is orange in colour with pinkish red veins. The wings are pinkish red with orange tips and the keel is pale orange pink. The flowers and pods (4-4.5 mm long) distinguish *D. microcarpa* from nearly all its relatives as they are amongst the smallest in the genus (Crisp 1985).

D. microcarpa was formally described by M. D. Crisp in 1995, a copy of which is included in Appendix 1.

The first known collection of *D. microcarpa* was made in 1974 by D. Whibley of the State Herbarium of South Australia, who located plants from a disturbed area in a roadside ditch, north-east of Norseman on the Eyre Highway (subpopulation 1a). Three other collections were made from the same area by M.D. Crisp (February and September 1979) and M.I.H. Brooker (August 1979). During the latter half of 1984, Main Roads Western Australia (MRWA) graded the road reserve and it was believed that the subpopulation was destroyed. However in March 1985, an unconfirmed report of thirteen plants was made from the same site by P. Collins from the Department of Fisheries and Wildlife. It is believed that soil disturbance during MRWA maintenance in 1984 stimulated the germination of the thirteen plants recorded in 1985. This was the last sighting of the species until 1992.

In 1990 MRWA was refused permission by CALM to disturb the *D. microcarpa* area, pending resolution of the status of the species. Engineering consultants, Halpern Glick Maunsell Pty Ltd were commissioned by MRWA to prepare an Environmental Assessment and Management Plan (EAMP), including a biological survey for *D. microcarpa*, pending the upgrading and realignment of the Norseman section of the Eyre Highway. No plants were found during surveys conducted by them in 1991 and 1992.

Mattiske Consulting Pty Ltd was commissioned by CALM in 1992 to survey for the species. Eighteen plants were found, of which two were dead (subpopulation 1b). This subpopulation was located approximately 500 m further north-east along the Eyre Highway from the last reported location of the species. The site was believed to have been graded four or five years prior to 1992. Extensive surveys for the species in other areas failed to locate more plants.

An opportunistic survey of subpopulation 1b in September 1993 by A. Brown found twelve plants in flower. In September 1995, fourteen plants in early fruit were recorded from the same area by E. Holland.

On 10 November 1994 MRWA was granted permission to take Declared Rare Flora from subpopulation 1a (no extant plants).

Road works for the realignment of the Eyre Highway commenced late 1995. In May 1996 the site was surveyed by A. Brown, E. Holland and F. Bunny. The area had been fenced and flagged by MRWA as per the recommended guidelines in the EAMP and fifteen live plants (plus one dead plant) were recorded. The embankment of the new road was, however, extremely close to the edge of the subpopulation and several trees within the fenced area had been cut down. Also, several Declared Rare Flora (DRF) markers had been removed.

The site was again surveyed by A. Brown in September 1996. The DRF markers had still not been re erected and a culvert had been positioned through the road into the middle of the subpopulation. In the process of building the culvert, two plants had been buried, one of which was unlikely to survive. It appeared likely that water would drain through the culvert into the low lying area of the subpopulation, possibly causing flooding.

Due to the low number of plants and the threats associated with growing on narrow, degraded road reserves, *D. microcarpa* was declared as Rare Flora in September 1987 and ranked as Critically Endangered in September 1995.

1.2 Distribution and habitat

D. microcarpa is known from a single subpopulation of 15 plants covering an area of 40 x 80 m along the Eyre Highway to the east of Norseman. The site has been highly modified due to previous road construction and little natural vegetation grows in association with the species. The subpopulation is restricted to disturbed soils over the underground Telecom line and graded soils between the line and the road.

The habitat consists of *Eucalyptus oleosa* var. *oleosa*, over *Melaleuca pungens, Allocasuarina helmsii, Acacia hemiteles* and *Westringia dampieri* over grasses of *Aristida contorta* and *Triodia* sp. in dry red-brown loamy clay with calcrete nodules.

A list of associated species is included in Appendix Two.

Table 1: Summary of population information

Pop no & location	Land status	No of plants	Condition	Threats
1a. ENE of Norseman	Road Reserve, MRWA	1985, 13 1995, 0	Moderate	Road works, inappropriate fire
1b. ENE of Norseman	Road Reserve, MRWA	1996, 15 alive, 1dead	Moderate	Road works, flooding, inappropriate fire

1.3 Biology and ecology

Daviesia is the second most diverse genus of pea-flowered legumes in Australia, with 135 known species and subspecies. Germination is known to be stimulated by fire and soil disturbance, such as grading (Crisp 1983). It is recognised from previous work on threatened species of *Daviesia* (Schwarten 1995) that some species have high incidences of flower and fruit abortion with a low seed set. However, *D. microcarpa* has been noted to have a high seed set.

Seed collected by CALM's Threatened Flora Seed Centre (TFSC) in 1993 had a 94% germination rate (A. Cochrane[1] pers comm 1995).

1.4 Threatening processes

1.4.1 Causes of the critically endangered status of the species

Pastoral practices, resulting in loss of suitable habitat, combined with a naturally restricted geographical range, may be the cause of the critically endangered status of the species. Poor germination of soil stored seed due to a lack of suitable disturbance (soil disturbance or fire) may also be contributing to the low numbers.

[1] Ann Cochrane (Western Australian Herbarium)

1.4.2 Threats to the ongoing survival of the species in the wild

- **Accidental destruction** to individual *D. microcarpa* plants and associated species as a result of soil disturbance and alterations to hydrology, may arise from MRWA highway realignment currently in progress (1996).

- **Inappropriate fire regimes** during the reproductive phase of *D. microcarpa* (ie. flowering, pollination, seed development and seed dispersal) may result in low/nil seedling recruitment. High fire frequency may also lead to the degradation of the habitat of *D. microcarpa* due to a depletion of soil seed banks and a temporary increase in the availability of nutrients for weed establishment (Panetta and Hopkins 1991). Irregular summer fire may be an important part of the life cycle of this species and be necessary for regeneration.

- **Weeds** are not currently a major problem within the subpopulation, however the potential for invasion may be increased if the area is exposed to disturbance (grading, fire).

1.5 Conservation status

D. microcarpa is known from a single subpopulation located on a road reserve vested in Main Roads Western Australia. No populations are known to exist on conservation reserves.

1.6 Strategy for recovery

A Threatened Flora Recovery Team is to be established for CALM's Esperance District which will oversee the implementation of this IRP and report annually to CALM's Corporative Executive. The following essential strategies will be implemented:

1. Control of the most threatening factors currently affecting *D. microcarpa* as outlined at 3.2.
2. Protect *D. microcarpa* from possible future threats (eg clearing, changes to hydrology), by appropriate management (see 3.2.1, 3.2.2).
3. Conserve the genetic diversity of *D. microcarpa* by including it in seed banks, cryostorage and/or *ex situ* cultivation (see 3.2.5).

The following desirable strategies will be implemented if resources permit:

1. Ensure that all relevant land managers and CALM personnel are aware of the presence of *D. microcarpa*, and the need to protect it (eg notification and DRF markers) and ensure that all are familiar with the threatening processes identified in these guidelines (see 3.3.2).
2. Conduct research into the biology, ecology and management of *D. microcarpa* (see 3.3.3).
3. Enhance plant numbers by the removal of limiting factors, direct interference with propagation or translocation (see 3.3.4 and CALM Policy Statement No 29 *Translocation of Threatened Flora and Fauna*).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term preservation of the species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if identified threats have not abated or there has been a substantial decrease in the number of mature plants within the three year period of this IRP.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

Kings Park and Botanic Garden (KPBG) has 300 seeds in storage (February 1996).

CALM's TFSC has a total of approximately 4 500 seeds in storage from two collections (1993 and 1995). Tests of the 1993 collection gave a 94 % germination rate.

Monitoring of the subpopulation has been routinely undertaken by CALM Esperance District staff. The following sites were surveyed by Mattiske Consulting Pty Ltd in 1992:

- North and south of Eyre Highway near subpopulation 1b, in recently burnt/regenerating area.
- Numerous tracks in the Jimberlana Hill area.
- Calcrete pits in the Jimberlana Hill area.
- Calcrete pits *c.* 2.5 kilometres north east of subpopulation 1b, north of the Eyre Highway.
- Unnamed road three kilometres north east of subpopulation, south of the Eyre Highway.

In late 1995 road works along the Eyre Highway commenced and subpopulation 1b was fenced and flagged. In January 1996, half of the area where subpopulation 1a had occurred (plants last seen 1985) was cleared (Haberley[2] pers comm 1996). The topsoil from this location was spread over a disused gravel scrape in the hope that soil stored seed might germinate.

3.2 Essential recovery actions

3.2.1 Protect from road works

Conservation strategies relating to *D. micrantha,* as outlined by MRWA Environmental Assessment and Management Plan (EAMP) prepared by Halpern Glick Maunsell (1992), should be implemented. Liaison between CALM Esperance District and MRWA is required to ensure the following actions are undertaken:

- Monitor the area where top soil potentially containing *D. microcarpa* seeds from the non extant subpopulation 1a was spread.
- Ensure minimal disturbance to subpopulation 1b (fencing, flagging, drainage).
- Control weed species invading the subpopulations following disturbance from roadworks (spraying in the vicinity of subpopulation 1a and 1b would require permission from CALM).

[2] Bernie Haberley (Esperance District Wildlife Officer)

Action:	Liaise closely with MRWA to ensure that management actions are undertaken, as outlined by MRWA Environment Assessment and Management Plan
Responsibility:	CALM (Esperance District, Western Australian Threatened Species and Communities Unit (WATSCU)), MRWA
Cost:	$1000

3.2.2 Develop a fire management plan

Little is known of the affects of fire on *Daviesia microcarpa* (see 1.3). However, it is likely that the species requires occasional fire for recruitment. It is recommended that a fire management plan for the area be developed in consultation with relevant authorities and land managers. Collation of historical fire data may prove useful in developing such a plan.

Action:	Develop a fire management plan
Responsibility:	CALM (Esperance District, WATSCU)
Cost:	$450

3.2.3 Install Declared Rare Flora Markers

DRF markers at subpopulations 1a and 1b require repositioning following removal during road works in the area. DRF markers alert road maintenance workers of the presence of rare flora.

Action:	Reposition DRF markers at subpopulations 1a and 1b
Responsibility:	CALM (Esperance District, WATSCU)
Cost:	$150

3.2.4 Monitor subpopulation

Monitoring of factors such as weed encroachment, habitat degradation, subpopulation stability (expanding or declining), pollination activity, seed production, recruitment and longevity is prescribed.

The subpopulation will be inspected annually as a requirement under CALM Policy Statement Nos. 9 *Conservation of Threatened Flora in the Wild* and No 28 *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also 3.3.3 *Development of a Quadrat/Transect Based Monitoring System For Threatened Plant Species.*

Action:	Monitor subpopulation
Responsibility:	CALM (Esperance District, WATSCU)
Cost:	$450 pa.

3.2.5 Preserve genetic diversity of the species

Seed is currently in storage at KPBG and at CALM's TFSC. Further germplasm collections should be given a high priority if the extinction of *D. microcarpa* is considered a high probability through disease, its limited distribution or low number of plants. If this is deemed to be the case, recovery of the species is likely to need *ex situ* conservation techniques.

Genetic diversity conservation of the species should be incorporated into the research component (see 3.3.3) and should include careful collection of seed, ensuring an adequate representation of genetic diversity.

If it is not possible to collect adequate quantities of viable seed, other more costly germplasm storage methodologies may need to be investigated. These can involve living collections from cutting or other source material, or storage of tissue culture material. If resources are limited these techniques will need to

be carefully prioritised in relation to *in situ* conservation. This will be coordinated by the Esperance District Threatened Flora Recovery Team (EDTFRT) when it is formed.

It is also important that the size and viability of the soil seed bank is determined and research undertaken to develop techniques for stimulating germination of soil stored seed. Care, however, should be taken as these processes inherently carry a significant risk of depletion of seed bank reserves.

Action:	Collect more seed and/or other genetic material from the subpopulation
Responsibility:	EDTFRT once established, CALM (Threatened Flora Seed Centre (TFSC), Esperance District, WATSCU)
Cost:	$1800

3.3 Desirable recovery actions

3.3.1 Conduct further surveys

D. microcarpa has been extensively surveyed for by CALM and consultants in recent years. However, it is recommended that surveying for the species in other suitable habitats is continued on a systematic basis, particularly during its flowering period (August-September) and following disturbances such as fire and grading. Volunteers from the local community and wildflower societies and naturalist clubs from Perth could be involved in surveys supervised by CALM staff. One area recommended for further surveying is Dundas Nature Reserve ↑36957, vested in the National Parks and Nature Conservation Authority (NPNCA) for the conservation of flora and fauna.

Action:	Conduct further surveys
Responsibility:	CALM (Esperance District, WATSCU)
Cost:	$1000 pa.

3.3.2 Information dissemination

To promote an awareness of *D. microcarpa* among relevant CALM staff and the Shire of Dundas, the production of vehicle dashboard stickers and posters is recommended. Dashboard stickers should illustrate a rare flora marker and provide a contact telephone number if one is encountered. Posters should illustrate and provide information on the species.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted to the general public, however, it is recommended that the exact location of *D. microcarpa* remains confidential. Awareness can be encouraged throughout the community by a publicity campaign using the local print and electronic media and by setting up poster displays in venues of high exposure. Formal links with local naturalist groups and interested individuals should also be encouraged. Such activities may lead to the discovery of new populations of the species.

Action:	Produce posters and dashboard stickers, implement a publicity campaign
Responsibility:	CALM (Corporate Relations Division, Esperance District, WATSCU)
Cost:	$500 first year, $1500 second year

3.3.3 Conduct research

Research designed to increase an understanding of the biology of *D. microcarpa* will provide a scientific base for management of the species in the wild. Research should include:

1. Pollinator activity within the subpopulation of *D. microcarpa*.
2. Investigation of factors determining level of flower and fruit abortion.
3. Quantification of the level of invertebrate grazing or removal of seed.
4. The size and viability of the soil seed bank.
5. The seed germination requirements of *D. microcarpa*.
6. The role of disturbance in regeneration and recruitment.
7. Longevity of plants, and time taken to reach maturity.
8. Response of *D. microcarpa* and its habitat to fire.
9. The extent of genetic variation within the subpopulation (essential knowledge if new populations are to be established).
10. The establishment of a monitoring system. Specific protocols for rare flora will be outlined in a future CALM discussion paper *Development of a Quadrat/Transect Based Monitoring System For Threatened Plant Species* (D. Coates, P. Pigott and A. Brown in prep).

Action: Conduct research
Responsibility: CALM (Science and Information Division (SID), WATSCU)
Cost: $3000

3.3.4 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Surveys for potential habitats for possible future translocation sites is recommended within the scope of this IRP and can be done at the same time further surveys are undertaken, with actual translocation addressed in a full Recovery Plan where necessary. This requires coordination by the District Threatened Flora Recovery team when established. All translocation proposals require endorsement by the Director of Nature Conservation.

Action: Survey potential habitats for translocation
Responsibility: EDTFRT, CALM (Esperance District, WATSCU)
Cost: See Section 3.3.1 (further surveys)

Table 2: Summary of recovery actions

Recovery Actions	Priority	Responsibility	Completion date
Essential			
Protect from road works	High	CALM (Esperance District, WATSCU), MRWA	Commenced Jan 1996, ongoing.
Develop a fire management plan	High	CALM (Esperance District, WATSCU)	1996
Install DRF markers	High	CALM (Esperance District, WATSCU)	ASAP
Monitor subpopulation	High	CALM (Esperance District, WATSCU)	ASAP, ongoing
Preserve genetic diversity of the species	High	EDTFRT, CALM (TFSC, Esperance District, WATSCU)	Commenced 1995, ongoing
Desirable			
Conduct further surveys	Moderate	CALM (Esperance District, WATSCU)	August-September 1997, annually
Information dissemination	Moderate	CALM (Corporate Relations Division, Esperance District, WATSCU)	Ongoing
Conduct research	Moderate	CALM (SID, WATSCU)	Ongoing
Translocation	Low	EDTFRT, CALM (Esperance District, WATSCU)	August-September 1997, annually

3.4. Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Protect from road works	1000						
Develop a fire management plan	250	200					
Install DRF markers	150						
Monitor subpopulation	450			450		450	
Preserve genetic diversity of the species		800	1100				
Sub-total	**$1850**	**$1000**	**$1100**	**$450**		**$450**	
Desirable							
Conduct further surveys	600	400		600	400	600	400
Information dissemination		500			1500		
Conduct research	1000			2000			
Sub-total	**$1600**	**$900**		**$2600**	**$1900**	**$600**	**$400**
Total	**$3450**	**$1900**	**$1100**	**$3050**	**$1900**	**$1050**	**$400**

EA Environment Australia (formerly ANCA)

Total cost: $12 850

ACKNOWLEDGMENTS

The following people have provided valuable assistance and advice in the preparation of this Interim Recovery Plan;

Bernie Haberley District Wildlife Officer, CALM's Esperance District

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Appendix One: Taxonomic description of *Daviesia microcarpa*

Crisp M. D. (1995). Contributions towards a revision of *Daviesia* (Fabaceae: Mirbelieae). III. A synopsis of the genus. *Australian Systematic Botany* **8**, 1155-1249.

Daviesia microcarpa Crisp, sp. nov.

Frutices caulibus multis longis debilibus implexis, *ramuli* adscendentes, *phyllodia* teretia pungentia, *racemi* 1-(raro 2-)-floribus, *legumen* perparvum (4–4.5 mm longum); species haec certe prope *D. ulicifoliam* Andrews praesertim formam ab Queensland phyllodiis angustis; qua ob ramulos divaricatos spinosos, phyllodia trigona, vexillum non auriculatum ungue laminam circa aequanti et legumen ad apicem acutum protractum differt.

HOLOTYPUS: Western Australia, Coolgardie District, 7 km NNE of Norseman, 32°09'S, 121°48'E, *M. D. Crisp 5943, J. Taylor & R. Jackson*, 19 Sept. 1979 (CBG); *isotypi*: CBG, K, NSW, PERTH.

ETYMOLOGY: This species has been named from the Greek word *microcarpos*, meaning bearing small fruit, because the pods of *D. microcarpa* are among the smallest in the genus.

Sprawling *shrubs* with many long, weak, tangled stems, to 0.4 m tall and 1 m broad, glabrous, grey-green; *branchlets* ascending, angular-terete with raised ribs. *Phyllodes* spreading at right angles, crowded (2.5–3.5 per cm), needle-like, articulate at base, 8–20 mm long, 0.5–0.75 mm diam., terete and smooth when fresh, angular with ribs when dry. *Racemes* 1-(rarely 2-)-flowered; rachis 0.5–1.5 mm long; pedicels 1 mm long. *Calyx* 3 mm long including the c. 1 mm stipitate receptacle to which it is abruptly contracted; lobes nearly uniform, acute, apiculate. *Standard* strongly sigmoid in profile and centrally channelled, auriculate, c. 4 mm long including the 1 mm claw, c. 5 mm broad, orange with pinkish red on veins and towards centre; *wings* obovate, incurved at apex, scarcely overlapping, pinkish red with orange tips; *keel* scarcely acute, pale orange-pink. *Stamens* strongly dimorphic, inner whorl of 5 with confluent anther-cells. *Pod* obliquely very broad-obtriangular, more or less obtuse, 4–4.5 mm long, with raised reticulate venation. Fig. 23.

REFERENCE: Hopper *et al.* (1990: 50, as '*D.* sp., Norseman').

DISTRIBUTION: Wco (Norseman).

NOTES: The small sizes of the flowers and pods distinguish *D. microcarpa* from nearly all its congeners. Despite a large geographic gap, it appears related to *D. ulicifolia*, especially the narrow-leaved form in coastal northern New South Wales and Queensland (named as *D. ulicina* forma *angustifolia*). As well as similar floral and fruiting morphology, these taxa have 1-flowered inflorescences in common (other forms of *D. ulicifolia* have umbelliform inflorescences). However, the phyllodes of *D. ulicina* forma *angustifolia* are trigonous in cross-section, the habit is open and divaricate, the branchlets are spinescent, the standard lacks auricles and has a claw nearly as long as the lamina, and the pod is acute.

Appendix Two: Associated species

POACEAE	MIMOSACEAE	MYRTACEAE
Aristida contorta	*Acacia hemiteles*	*Eucalyptus oleosa* var. *oleosa*
Triodia scariosa		*Melaleuca pungens*
	PAPILIONACEAE	
CASUARINACEAE	*Kennedia prorepens*	LAMIACEAE
Allocasuarina helmsii		*Westringia dampieri*

INTERIM RECOVERY PLAN NO. 12

KAMBALLUP DRYANDRA (*DRYANDRA IONTHOCARPA*) INTERIM RECOVERY PLAN

1996-1999

by

Kim Kershaw, Emma Holland and Andrew Brown

June 1997

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March, 1997.

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SUMMARY

Kamballup Dryandra, *Dryandra ionthocarpa* **Family:** PROTEACEAE

Flowering period: October

CALM Region: South Coast **CALM District:** Albany **Shire:** Plantagenet

Current status: Declared as Rare Flora in July 1989, ranked as Critically Endangered in September 1995

Recovery team: Albany District Threatened Flora Recovery Team

Illustrations and/or further information: A.S. George, *New taxa and a new infrageneric classification in Dryandra* R. Br. (Proteaceae: Grevilleoideae) (1996); S.D. Hopper *et al., Western Australia's Endangered Flora* (1990); C.J. Robinson *et al., Declared Rare and Poorly Known Flora in the Albany District* (1995).

Dryandra ionthocarpa is a caespitose, tufted prostrate shrub with long leaves (up to 50 cm), short stems and flowers borne close to the ground. It is known from 1200+ plants in one population consisting of two subpopulations on two Class C reserves in the Kamballup area.

This species was discovered and first collected by P. Luscombe in 1987. It was collected again a year later by M. Pieroni and P. Luscombe from the same locality. Three further collections have been made since then. Despite numerous surveys no other populations have been found.

The two subpopulations are exposed to threats associated with weed invasion, agricultural chemical drift, dieback (*Phytophthora* spp.) and fire. The aim of this Interim Recovery Plan is to abate identified threats and maintain a viable *in situ* population of *D. ionthocarpa* in order to conserve the wild genetic stock of this species. To achieve this aim the following essential and desirable recovery actions are prescribed:

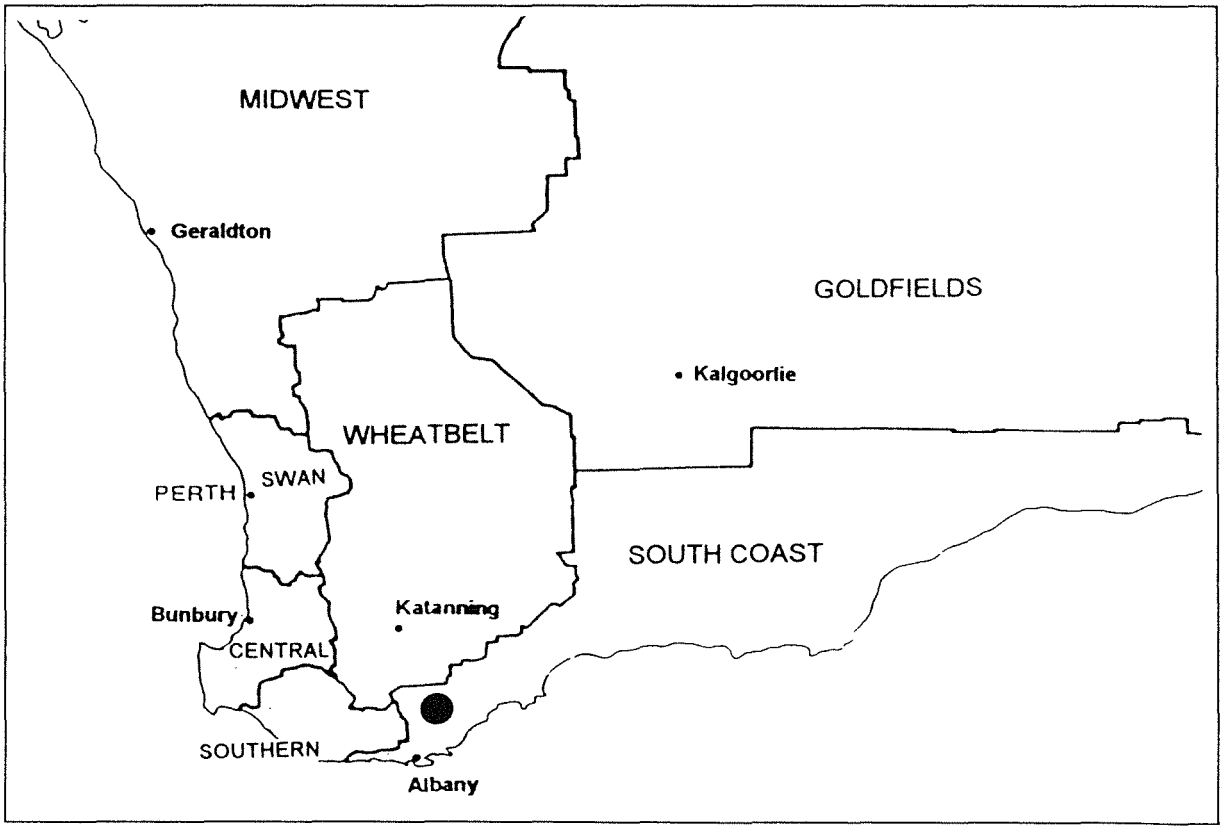
Recovery actions:

Essential	Desirable
1. Implement weed control	1. Change vesting and purpose of reserves
2. Develop a fire management plan	2. Preserve genetic diversity of the species
3. Information dissemination	3. Conduct further surveys
4. Monitor population	4. Conduct research
	5. Translocation

Dryandra ionthocarpa

Illustration not available

Distribution of *Dryandra ionthocarpa*



1. BACKGROUND

1.1 History, taxonomy and status

The genus *Dryandra* is endemic to south-western Australia, with the highest species richness occurring around Eneabba and the Stirling Range. These areas of richness lie in the 400 to 600 mm annual rainfall zone where they are closely correlated with extensive areas of Kwongan or sclerophyllous shrublands (Griffin 1985).

Dryandra ionthocarpa George is a caespitose, tufted prostrate shrub with a very short stem and leaves up to 30 cm long. The leaf lobes are broadly triangular, up to 8 mm and cut within 1.5 mm of the midrib. This species has characteristic follicles which are about 5 mm in size and covered in 7-8 mm long erect hairs. Pale yellow flowers are borne close to the ground within the leaves. The name is taken from the Greek *ionthas* (shaggy) and *carpos* (a fruit), in reference to the prominent tuft of hairs on the follicle (George 1996).

A full taxonomic description by A.S. George (1996) is included in Appendix 1.

This species was discovered and first collected by P. Luscombe near Kamballup in 1987 and again in 1988. It was also collected in 1988 by M. Pieroni from the same area. C.J. Robinson, during surveys for the Albany District Threatened Flora Management Program, inspected the population and took collections in 1992. J.A. Cochrane from CALM's Threatened Flora Seed Centre (TFSC) collected seed and further specimens in 1993.

Considerable survey effort throughout the surrounding district has failed to find another population despite searches of what appeared to be suitable habitat in Kalgan Plains Nature Reserve.

Due to the relatively low number of plants and the threats associated with a single population in a highly specific habitat, *D. ionthocarpa* was declared as Rare Flora in July 1989 and ranked as Critically Endangered in September 1995. An Albany District Threatened Flora Recovery Team (ADTFRT) has been established.

1.2 Distribution and habitat

D. ionthocarpa is known from 1200+ plants in a single population consisting of two subpopulations in the Kamballup area. Subpopulation 1a is on a Class C recreation reserve vested in the Shire of Plantagenet and subpopulation 1b in an adjacent unvested Class C reserve for the purpose of public utility. The unvested reserve has in the past been subject to mining for spongolite stone and the mine is in close proximity to the plants. Mining is not currently being undertaken.

The species occurs on gravelly red-brown loam over spongolite in open shrub mallee habitat dominated by *Eucalyptus falcata* and *Eucalyptus tetragona* over a thicket of *Melaleuca* spp. over dwarf scrub of *Allocasuarina thuyoides*, *Beaufortia micrantha*, *Isopogon buxifolius*, *Verticordia chrysantha* and *Xanthorrhoea platyphylla*.

Other associated species are listed in Appendix 2.

Table 1: Summary of population information

Pop no & location	Land status	No of plants	Condition	Threats
1a. North of Kamballup	Shire Recreation Reserve	700+	Moderate	Weeds, fire, dieback, canker, drought
1b. North of Kamballup	Unvested Public Utility Reserve	500+	Moderate	Dieback, fire, canker, drought, future mining

1.3 Biology and ecology

Very little is known about the biology of *D. ionthocarpa*. Currently, a Masters student from Curtin University (L. Monks) is carrying out research. *Dryandra* species in general are highly susceptible to dieback (*Phytophthora* spp.) and it is suspected that *D. ionthocarpa* is also susceptible. The response to fire is unknown, however it is suspected that fire may kill mature plants which rely on the soil seed bank for recruitment. There appears to be a sizeable soil seed bank (L. Monks, pers. comm.).

Little is known about the dispersal of seed which appears to collect at the base of the plant. They are, however, quite different to other *Dryandra* seeds in that they do not have a wing, instead, they have a small tuft of hairs which appears to be designed to stick to fur. Honey Possums (*Tarsipes rostratus*) or other small mammals may be responsible for seed dispersal.

1.4 Threatening processes

1.4.1 Causes of the Critically Endangered status of this species

The rarity of *D. ionthocarpa* is probably due to the amount of clearing that has occurred for agricultural purposes in the Kamballup area. Another possible cause may be the loss of suitable habitat due to the introduction of *Phytophthora* spp. (dieback).

There has been a continuing decline in the size of the population for some 3-5 years. R. Wills[1] has discovered aerial cankers on this species and this may have been a compounding influence on their decline. This species also favours shallow sandy loams over spongolite. These sites appear to be drought prone during the summer months (M. Grant. pers. comm.). Observations made by L. Monks indicate that yellow coloured plants in summer show signs of drought stress. Dieback has not been identified with any plant deaths.

1.4.2 Threats to the ongoing survival of this species in the wild

- **Weed invasion** is a threat to subpopulation 1a. Weeds suppress early plant growth by competing for soil moisture, nutrients and light, and are blown in from adjoining pasture. Subpopulation 1a is subjected to influences from adjacent cleared farmland, commonly referred to as edge effects (Lynch 1987, Saunders *et al.* 1987, Taylor 1987). This includes increased fertiliser runoff, modified hydrology and altered disturbance and fire regimes.

- **Dieback** (*Phytophthora* spp.) is a pathogen which causes the roots to rot and results in the plant dying of drought stress. *D. ionthocarpa* is suspected to be susceptible to this pathogen. As this is the last known *in situ* population, the prevention of the spread of dieback into the area is important.

- **Fire** must be excluded from the population as little is known about its effect on either adult plants of *D. ionthocarpa* or the soil seed bank. High fire frequency may also lead to the degradation of the habitat of

[1] Ray Wills formerly of CALM, now at Kings Park and Botanic Garden

D. ionthocarpa due to a depletion of soil seed banks and a temporary increase in the availability of nutrients for weed establishment (Panetta and Hopkins 1991). It is recommended that firebreaks be regularly maintained and a fire management plan put in place for both reserves. It is important that relevant authorities and adjacent landowners are informed of the presence of this species and are involved in the fire management plan.

1.5 Conservation status

D. ionthocarpa is known from two subpopulations, one on a recreation reserve vested in the Shire of Plantagenet and the other on an unvested reserve for the purpose of public utility. No plants are known to occur on conservation reserves.

1.6 Strategy for recovery

The following essential strategies will be implemented:

1. Control the most threatening factors currently affecting *D. ionthocarpa* as outlined in 3.2.
2. Ensure that relevant land managers and CALM personnel are aware of the presence of *D. ionthocarpa*, and the need to protect it (eg. notification) and ensure that all are familiar with the threatening processes identified in these guidelines (see 3.2.3).

The following desirable strategies will be implemented if resources permit:

1. Protect *D. ionthocarpa* from possible future threats (eg. dieback) by appropriate management practices (see 3.3).
2. Conserve the genetic resource of *D. ionthocarpa* by including it in a seed bank, cryostorage and/or *ex situ* cultivation (see 3.3.2).
3. Conduct research into the biology, ecology and management of *D. ionthocarpa* (see 3.3.4).
4. Enhance plant numbers eg. by removal of limiting factors, direct propagation or translocation, see CALM Policy Statement No 29, Translocation of Threatened Flora and Fauna (see 3.3.5).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term preservation of this species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if identified threats have not abated or there has been a substantial decrease in the number of mature plants within the three year period of this IRP.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

Staff from CALM's Threatened Flora Seed Centre (TFSC) collected seed in 1990 and 1993. Approximately 3000 seeds were collected and have been stored at -18°C. As a result of germination of seed by A. Cochrane 62 plants are held in the Kings Park and Botanic Garden (KPBG) nursery.

L. Monks, a masters student at Curtin University, is currently carrying out research on this species. This includes estimating the size of the potential seed bank and estimating the age of plants at each subpopulation to determine when seed germinated. It also involves conducting prescribed burns on individual plants to determine their fire response. Transplant studies will be undertaken to determine other suitable substrates and habitats for this species. The effects of granivores on the seeds of *D. ionthocarpa* will be also determined.

All relevant authorities know of the existence of *D. ionthocarpa.*

The Albany District Threatened Flora Recovery Team (ADTFRT) oversees the implementation of this IRP and reports annually to CALM's Corporate Executive.

3.2 Essential recovery actions

3.2.1 Implement weed control

The western edge of subpopulation 1a is extremely weedy. *D. ionthocarpa* may have once extended to that edge of the reserve but has since disappeared. Effective weed control with the use of herbicides and hand pulling is required and will involve:

1. Accurately mapping the boundaries of subpopulation 1a.
2. Selection of an appropriate herbicide or other method of weed control after determining which weeds are present.
3. Controlling invasive weeds internal to the boundary by hand removal and spot spraying around individual *D. ionthocarpa* plants when weeds first emerge.
4. Scheduling to include weed spraying of other Declared Rare Flora populations requiring weed control within the Albany District.

As one of the subpopulations is on land vested in the Shire of Plantagenet a weed control program will be developed in consultation with the Shire.

Action:	Control weeds in subpopulation 1a
Responsibility:	CALM (Albany District, Western Australian Threatened Species and Communities Unit (WATSCU))
Cost:	$500 pa.

3.2.2 Develop a fire management plan

CALM Albany personnel will hold an on-site meeting with representatives from relevant authorities and land managers to outline the problems associated with inappropriate fire and develop a fire management plan. This should involve the maintenance of firebreaks in both reserves and the establishment and maintenance of firebreaks on adjoining land.

Action:	Develop a fire management plan
Responsibility:	CALM (Albany District, WATSCU), relevant authorities, land managers
Cost	$1200 pa.

3.2.3 Information dissemination

To promote an awareness of *D. ionthocarpa* among relevant CALM staff and staff of the Department of Minerals and Energy and Shire of Plantagenet, the production of vehicle dashboard stickers and posters is recommended. Dashboard stickers should illustrate a rare flora marker and provide a contact telephone number if one is encountered. Posters should illustrate and provide information on the species. Liaison between CALM, the landowners and the Shire of Plantagenet will be necessary to implement appropriate protective measures, especially in relation to fire management and dieback hygiene. Shire staff should be briefed about the need to check threatened flora records before arranging burns or undertaking clearing operations.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted to the general public, however, it is recommended that the exact location of populations of *D. ionthocarpa* remain confidential. Awareness can be encouraged throughout the community by a publicity campaign using the local print and electronic media and by setting up poster displays in venues of high exposure. Formal links with local naturalist groups and interested individuals should also be encouraged. Such activities may lead to the discovery of new populations of the species.

Action:	Produce posters, implement a publicity campaign
Responsibility:	CALM (Corporate Relations Division, Albany District, WATSCU)
Cost:	$500 first year, $1500 second year

3.2.4 Monitor population

Monitoring of factors such as weed encroachment, habitat degradation, population stability (expanding or declining), pollination activity, seed production, recruitment, and longevity is prescribed.

The population will be inspected annually as a requirement under CALM's Policy Statement No. 9 *Conservation of Threatened Flora in the Wild* and No. 28 *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also below 3.3.4 (8) *Development of a Quadrat/Transect Based Monitoring System For Threatened Plant Species*.

Action:	Monitor population
Responsibility:	CALM (Albany District, WATSCU)
Cost:	$350 pa.

3.3 Desirable recovery actions

3.3.1 Change vesting and purpose of reserves

It is recommended that CALM and the Shire of Plantagenet discuss the possibility of vesting the reserves with the National Parks and Nature Conservation Authority (NPNCA) as Class A for the purpose of Conservation of Flora and Fauna. Apart from containing the only known population of *D. ionthocarpa*, the reserves have high conservation value with several species of flora at the limits of their range and one unnamed *Eucalyptus* species. Ideally, the area should become a nature reserve, however, use by the local community and future quarrying activities (soapstone) may necessitate some other designation under the CALM Act (K. Atkins[2] pers comm.).

[2] Dr Ken Atkins, Senior Botanist, CALM Wildlife Branch

Action:	Liaise with the Shire of Plantagenet re: changing of vesting and purposes of the reserves
Responsibility:	CALM (Land Administration, Albany District, WATSCU) Shire of Plantagenet
Cost:	$350

3.3.2 Preserve genetic diversity of the species

Germplasm collections should be given a high priority if the extinction of the single known population of *D. ionthocarpa* is considered a high probability through disease, its limited distribution or low number of plants. If this is deemed to be the case, recovery of the species is likely to need *ex situ* conservation techniques.

Genetic diversity conservation of the species should be incorporated into the research component (see 3.3.4) and should include collection of seed from both subpopulations, ensuring an adequate representation of genetic diversity.

If it is not possible to collect adequate quantities of viable seed, other more costly germplasm storage methodologies may need to be investigated. These can involve living collections from cutting or other source material, or storage of tissue culture material. If resources are limited these techniques will need to be carefully prioritised in relation to *in situ* conservation. This will be coordinated by the ADTFRT.

It is also important that the size and viability of the soil seed bank is determined and research undertaken to develop techniques for stimulating germination of soil stored seed. Care, however, should be taken as these processes inherently carry a significant risk of depletion of seed bank reserves.

Action:	Collect seed and / or genetic material from both subpopulations
Responsibility:	ADTFRT, CALM (TFSC, Albany District), KPBG
Cost:	$1600

3.3.3 Conduct further surveys

It is recommended that reserves containing areas of suitable habitat in the Shire be surveyed on a systematic basis for the presence of this species. *D. ionthocarpa* is associated with sandy loams over spongolite and areas containing this soil type should be surveyed. M. Pieroni believes a population may be present on a spongolitic plateau in otherwise cleared farmland north east of Kamballup; this would be worth investigation even though there has been further clearing in that area (Robinson & Coates 1995).

Action:	Conduct further surveys
Responsibility:	CALM (Albany District, WATSCU)
Cost:	$500 pa.

3.3.4 Conduct research

In collaboration with existing research being conducted by L. Monks (see 3.1), research designed to increase understanding of the biology of *D. ionthocarpa* will provide a scientific base for management of the species in the wild. Research should include:

1. Habitat response to herbicide treatments.
2. The effect of weeds on recruitment and establishment.
3. The factors determining level of flower and fruit abortion.
4. Seed germination requirements.
5. The role of disturbance in regeneration.

6. Longevity of plants, and time taken to reach maturity.
7. The extent of genetic variation within and between populations (essential if new populations are to be established).
8. The development of a suitable monitoring system. Specific protocols for rare flora will be outlined in a future CALM discussion paper *Development of a Quadrat/Transect Based Monitoring System For Threatened Plant Species*, D. Coates, P. Pigott and A. Brown (in prep.).

Action: Conduct research
Responsibility: CALM (Science and Information Division (SID), Albany District, WATSCU)
Cost: $1000 first year, $2000 second year

3.3.5 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Surveying for potential habitats for possible future translocation sites is recommended within the scope of IRPs, with actual translocation addressed in full Recovery Plans where necessary. This will be coordinated by the ADTFRT. Any translocation proposals will require endorsement by the Director of Nature Conservation.

Action: Survey potential habitats for translocation
Responsibility: ADTRFT, CALM (Albany District, WATSCU)
Cost: See Section 3.3.3 (Conduct further surveys)

Table 2: Summary of recovery actions

Recovery Actions	Population	Priority	Responsibility	Completion date
Essential				
Implement weed control	1a	High	CALM (Albany District, WATSCU)	June 1996/97/98
Develop a fire management plan	1a, 1b	High	CALM (Albany District, WATSCU) relevant authorities, land managers	August 1996
Information dissemination	1a, 1b	High	CALM (Corporate Relations Division, Albany District, WATSCU)	Ongoing
Monitor population	1a, 1b	High	CALM (Albany District, WATSCU)	October-February 1996/97/98
Desirable				
Change vesting and purpose of Reserves	1a, 1b	Moderate	CALM (Land Administration, Albany District, WATSCU), Shire of Plantagenet	Ongoing
Preserve genetic diversity of the species	1a, 1b	Moderate	ADTFRT, CALM (TFSC, Albany District, WATSCU), KPBG	Ongoing
Conduct further surveys	-	Moderate	CALM (Albany District, WATSCU)	1997/98
Conduct research	1a, 1b	Moderate	CALM (Albany District, SID, WATSCU	Ongoing
Translocation	-	Low	ADTFRT, CALM (Albany District, WATSCU)	Ongoing

3.4 Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Implement weed control		500			500		500
Develop a fire management plan	1200			1200		1200	
Information dissemination		500			1500		
Monitor population		400			400		400
Sub-total	**$1200**	**$1400**		**$1200**	**$2400**	**$1200**	**$900**
Desirable							
Change vesting and purpose of Reserves	350						
Preserve genetic diversity of the species		500	1100				
Conduct further surveys	500			500		500	
Conduct research	1000			2000			
Sub-total	**$1850**	**$500**	**$1100**	**$2500**		**$500**	
Total	**$3050**	**$1900**	**$1100**	**$3700**	**$2400**	**$1700**	**$900**

EA Environment Australia (formerly ANCA)

Total of all Costs: $14750

ACKNOWLEDGMENTS

The following people have provided valuable assistance and advice in the preparation of this Interim Recovery Plan;

Dr Ken Atkins	Senior Botanist, Wildlife Branch, CALM Como
Ellen Hickman	Assistant Conservation Officer, CALM Albany District
Leonie Monks	Masters Student, Curtin University

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Appendix One: Taxonomic Description

George, A.S., (1996). New taxa and a new infrageneric classification in Dryandra R. Br. (Proteaceae: Grevilleoideae). *Nuytsia* **10** (3), 313-408.

Dryandra ionthocarpa A.S. George, sp. nov.

Frutex ad 60 cm latus. Caules prostrati, villosi, prophyllis multis linearibus tomentosis. Folia 8-25 cm longa, 5-20 mm lata, lobis 15-35 in quoque margine, triangularibus, obtusis, marginibus planis. Inflorescentiae terminales, confertae; bracteae involucrales lineares-subulatae, interiores lanceolatae, ad 2 cm longae, tomentosae; flores 40-60 per capitulum. Perianthium 39-43 mm longum, lilacino-salmoneum, ad basin crispo-tomentosum, supra pubescens, limbo 7-8 mm longo, flavo, appresso-puberulo. Pistillum 43-44(57) mm longum, in dimidio infero pilosum, supra glabrum; praebitor pollinis 3.5-4.8 mm longus. Folliculi 5-6 mm longi.

Typus: near Kamballup, Western Australia, 34°34'S 117°59'E, 11 October 1988, *P. Luscombe* (*holo*: PERTH 03462099; *iso:* AD, CANB, K, MEL, NSW, PERTH 03462102).

Shrub to 60 cm wide. *Stems* prostrate, short, ± underground, villous; prophylls many, linear, tomentose. *Leaves* pinnatifid, 8-25 cm long, 5-20 mm wide; margins flat; lobes 15-35 each side, triangular, obtuse, ± flat, rusty-villous when young, later glabrous except pits; petiole 4-6 cm long, ± glabrous. *Infloresence* terminal, subtended by leaves, closely successive; involucral bracts linear-subulate, the inner ones narrowly lanceolate, to 2 cm long, dark rusty-tomentose; flowers 40-60. *Perianth* 39-43 mm long, curled-tomentose in lower third, pubescent above, pink-mauve with yellow limb; limb 7-8 mm long, keeled, appressed-puberulous. *Pistil* 43-44(57) mm long, curved, pilose in lower half, cream; pollen presenter 3.5-4.8 mm long, ribbed, green. *Follicles* ± obovate, 5-6 mm long, with an apical tuft of long rusty hairs, glabrous below.

Selected collections examined. W of Kamballup, *M. McDonald* 1551-60 (PERTH); Kamballup, 20 September 1988, *M. Pieroni* (PERTH).

Distribution. Known only from the type locality.

Habitat. Grows in spongolitic gravel in low kwongan.

Flowering period. September-October.

Conservation status. Dept of Conservation & Land Management Conservation Code: Declared Rare. There are *c.* 200 plants at the type locality.

Etymology. The specific epithet is taken from the Greek *ionthas* (shaggy) and *carpos* (a fruit), in reference to the prominent tuft of hairs on the follicle.

Discussion. This very distinctive, rare species was discovered by Peter Luscombe in 1987. It is easily recognized by the fruit and is unusual in having floral bracts that do not elongate as the fruit develop. The robust pistils are prominently bowed before anthesis, then recurved very strongly afterwards.

Appendix Two: Associated species

CYPERACEAE
Lepidosperma brunonianum
Mesomelaena stygia subsp. *stygia*

ANTHERIACEAE
Borya sp.
Thysanotus gageoides

HAEMODORACEAE
Conostylis setigera subsp. *setigera*
Conostylis pusilla

CASUARINACEAE
Allocasuarina microstachya
Allocasuarina trichodon

PROTEACEAE
Adenanthos sp.
Banksia caleyi
Dryandra nivea
Dryandra tenuifolia
Isopogon buxifolius
Petrophile squamata
Petrophile teretifolia

SANTALACEAE
Choretrum lateriflorum

MIMOSACEAE
Acacia assimilis
Acacia nervosa
Acacia sulcata var. *planoconvexa*

PAPILIONACEAE
Bossiaea preissii
Daviesia dilatata
Gastrolobium bilobum
Jacksonia humulis

TREMANDRACEAE
Tetratheca hirsuta

MYRTACEAE
Agonis spathulata
Astartea fascicularis
Beaufortia micrantha
Beaufortia schaueri
Beaufortia sp.
Calothamnus microcarpus (Priority 3)

MYRTACEAE (cont.)
Eucalyptus falcata
Eucalyptus redunca
Eucalyptus tetragona
Eucalyptus wandoo
Melaleuca pentagona
Verticordia chrysantha
Verticordia pennigera

EPACRIDACEAE
Acrotriche plurilocularis
Astroloma compactum
Astroloma pallidum
Leucopogon cymbiformis
Leucopogon ? polymorphus
Leucopogon reflexus

GOODENIACEAE
Coopernookia polygalacea

ASTERACEAE
Argentipallum niveum

INTERIM RECOVERY PLAN NO. 13

STIRLING RANGE DRYANDRA (*DRYANDRA MONTANA*), INTERIM RECOVERY PLAN

1996-1999

by

Kim Kershaw, Emma Holland and Andrew Brown

June 1997

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March, 1997.

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FIGURES

TABLES

APPENDICES

SUMMARY

Stirling Range Dryandra, *Dryandra montana* **Family:** PROTEACEAE

Flowering period: November

CALM Region: South Coast **CALM District:** Albany **Shire:** Gnowangerup

Current status: Declared as Rare Flora in September 1987, ranked as Critically Endangered in September 1995

Recovery team: Albany District Threatened Flora Recovery Team

Illustrations and/or further information: A.S. George, New taxa and a new infrageneric classification in *Dryandra* R. Br. (Proteaceae: Grevilleoideae) (1996); S.D. Hopper *et al.*, *Western Australia's Endangered Flora* (1990); C.J. Robinson *et al.*, Declared Rare and Poorly Known Flora in the Albany District (1995).

Dryandra montana is an erect woody shrub up to 2.5 m high with very dense, rough foliage. Known from 106 plants, in three populations located in the Stirling Range National Park.

The species was first collected from the Stirling Range by F. Lullfitz in 1964 and later by K.R. Newbey from the same locality in 1966. One further collection was made by G.J. Keighery in 1986.

Anne Cochrane from CALM's Threatened Flora Seed Centre (TFSC) found an additional eight plants in February 1996. These were approximately two hundred metres downslope from the previously known plants, making the total population size twenty one plants.

In September 1996 a new population was found, consisting of 61 adults and 8 seedlings. The seedlings were sprayed with Phosphonate using the UVL (Ultra Low Volume) applicator.

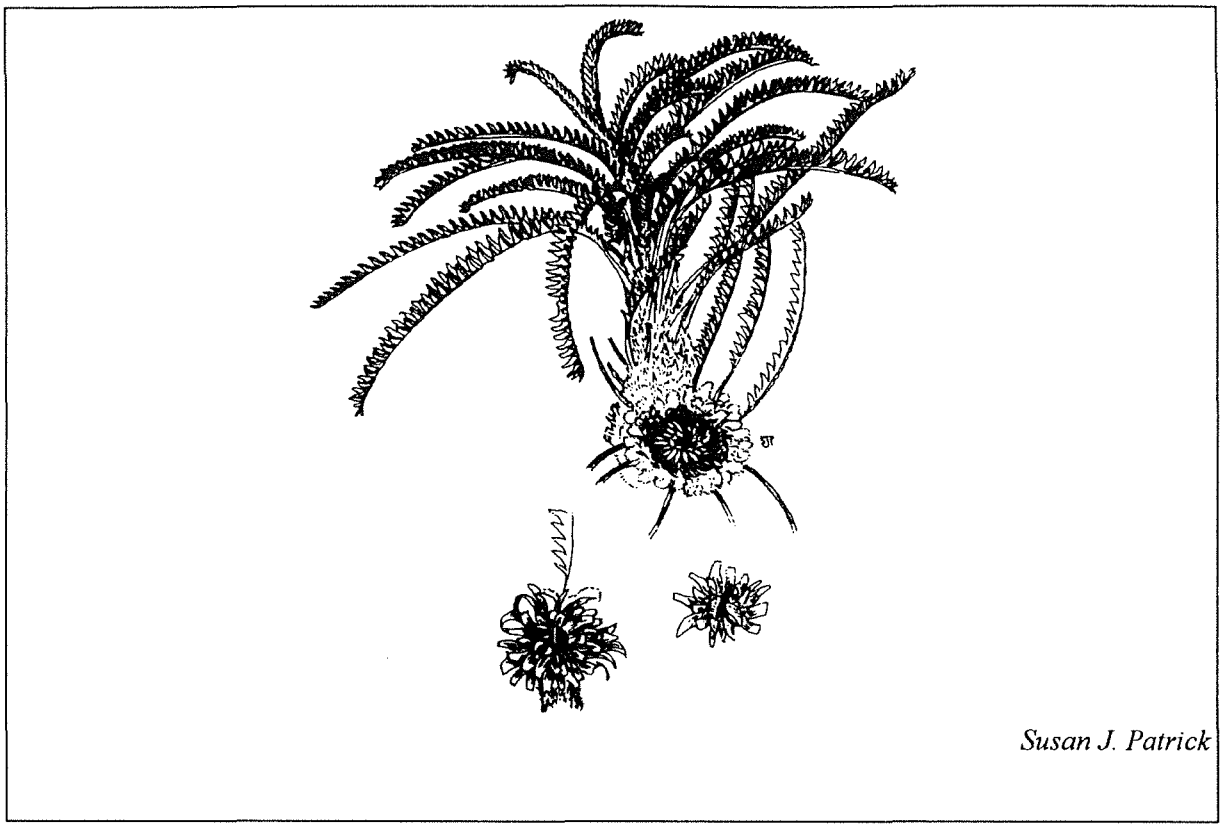
In October 1996 as part of the Ridge Walk survey another new population of 15 plants was found on another peak. One plant had recently died so it is assumed dieback is present at the site.

D. montana was distributed over a relatively large area in the late 1980s but is now known from just three populations, probably due to the impacts of dieback (*Phytophthora* spp.) and fire. All are exposed to threats associated with fire and plant pathogens. The aim of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations of *D. montana* in order to conserve the wild genetic stock of this species. To achieve this aim the following essential and desirable recovery actions are prescribed.

Recovery actions:

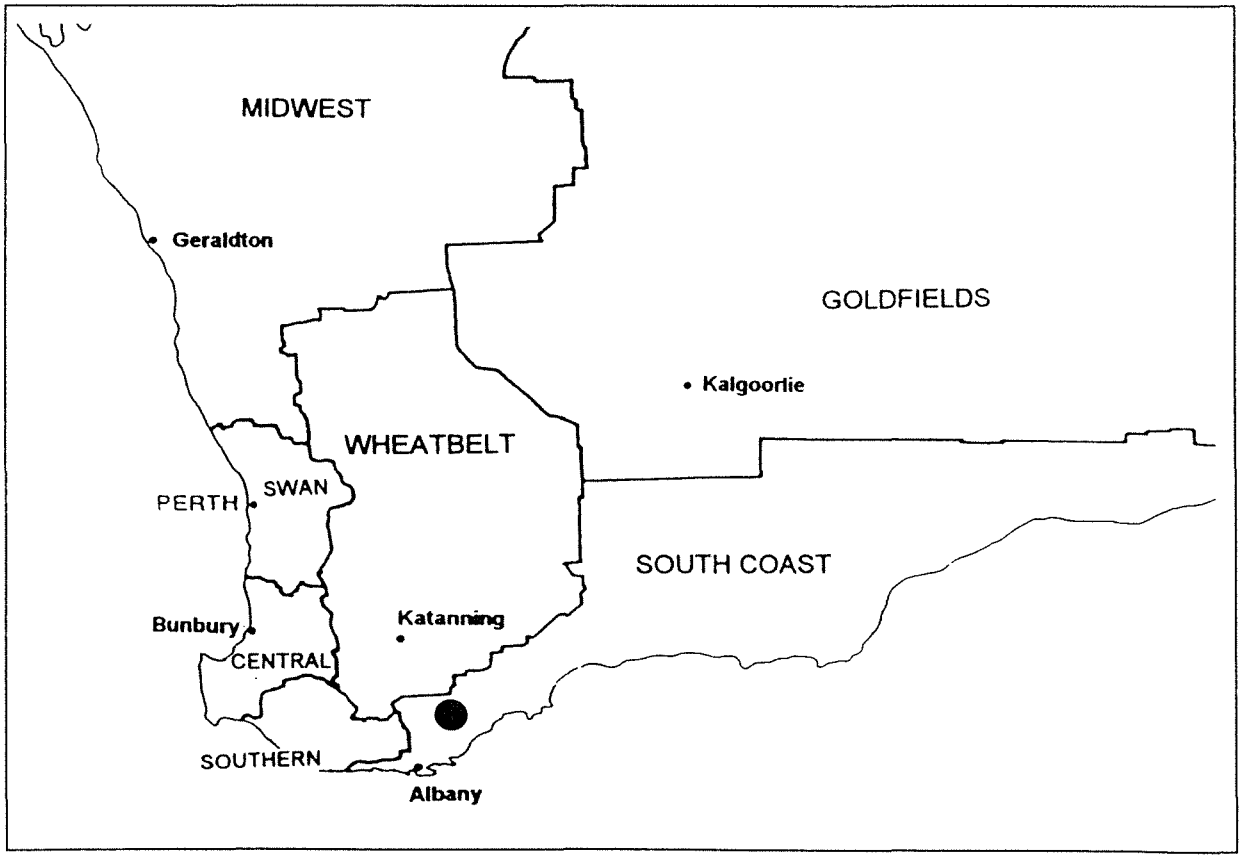
Essential		Desirable	
1.	Phosphonate spraying	1.	Information dissemination
2.	Preserve genetic diversity of the species	2.	Conduct further surveys
3.	Develop a fire management plan	3.	Conduct research
4.	Monitor populations	4.	Translocation

Dryandra montana



Susan J. Patrick

Distribution of *Dryandra montana*



1. BACKGROUND

1.1 History, taxonomy and status

The genus *Dryandra* is restricted to south-western Australia, with the highest species richness occurring around Eneabba and the Stirling Range. These areas of richness fall in the 400 to 600 mm annual rainfall zone, where they are closely correlated with extensive areas of Kwongan or sclerophyllous shrublands (Griffin 1985).

Dryandra montana George is an erect woody shrub to 2.5 m high with very dense, rough foliage. The leaves are up to 18 cm long, with elongated, triangular, close fitting 5-8 mm lobes, cut to the midrib and pointing towards the apex. The flowers are yellow and are borne on the old wood, inside the foliage. The upper stems and fruits are covered by short red hairs. The oval follicles are about 9 mm tall and 7-8 mm broad with a hairy base at the point of attachment (Robinson *et al.* 1995). Named from the Latin *montanus* (of mountains) in reference to the habitat (George 1996).

A full taxonomic description by A.S. George (1996) is included in Appendix 1.

D. montana was distributed over a relatively large area in the late 1980s, but is now known from just three populations, probably due to the impacts of dieback (*Phytophthora* spp.) and fire.

The species was first collected by F. Lullfitz in the Stirling Range in 1964 and again by K.R. Newbey in 1966 from the same area. One further collection was made by G.J. Keighery in 1986, also from the same locality. Some 13 plants were known from this site in 1995.

A. Cochrane from CALM's Threatened Flora Seed Centre (TFSC) found an additional eight plants in February 1996. These were approximately two hundred metres downslope from the previously known plants, making the total population size 21 plants. Additional seed collections were also made at this time.

In September 1996 a new population was found, consisting of 61 adults and 8 seedlings. The seedlings were sprayed with Phosphonate using the UVL (Ultra Low Volume) applicator.

In October 1996, as part of the Ridge Walk survey, a second new population of 15 plants was found on another peak. One plant had recently died and it is assumed dieback is present at the site.

Due to the low number of plants and the threats associated with a highly specific habitat, *D. montana* was declared as Rare Flora in September 1987 and ranked as Critically Endangered in September 1995. An Albany District Threatened Flora Recovery Team (ADTFRT) has been established.

1.2 Distribution and habitat

D. montana is currently known from 106 plants (95 adults, 11 seedlings) in three populations on plateaus in the Stirling Range National Park.

Habitat is brown loam on schist/quartz in very dense heath, dominated by *Kunzea montana*, *Banksia oreophila*, *Sphenotoma* aff. *dracophylloides*, *Darwinia collina* (also Declared Rare Flora, DRF), *Hakea varia* and *Andersonia axilliflora* (DRF).

Other associated species are listed in Appendix 2.

Table 1: Summary of population information

Pop. No & Location.	Land Status	No. of plants.	Condition	Threats
1. Stirling Range	National Park	22	Healthy	Dieback, inappropriate fire regime
2. Stirling Range	National Park	69	Healthy	Dieback, inappropriate fire regime
3. Stirling Range	National Park	15	Healthy	Dieback, inappropriate fire regime

1.3 Biology and ecology

Very little is known about the biology of *D. montana*. It is highly susceptible to the pathogen *Phytophthora* spp. (dieback) and fire appears to kill adult plants.

1.4 Threatening processes

1.4.1 Causes of the Critically Endangered status of this species

The rarity of *D. montana* is probably due to the loss of suitable habitat as a result of the introduction of the pathogen *Phytophthora* spp. (dieback), combined with the extremely hot fires of 1991.

In 1992 Kings Park and Botanic Garden (KPBG) staff commented on the high level of insect predation on collected seed. This may be a factor which contributes to the low number of plants.

1.4.2 Threats to the ongoing survival of this species in the wild

- **Dieback** (*Phytophthora* spp.) is a pathogen which causes plants to die from drought stress from root dysfunction. Dieback has been introduced to parts of the Stirling Range by walkers carrying infected soil on their footwear. *D. montana* is known to be susceptible and, as there are just three populations *in situ*, controlling the spread of dieback in the surrounding areas is vital.
- **Fire** is known to kill adult plants and must be excluded from all populations. Since the fire in 1991 there has been no seedling recruitment in areas where this species was previously found and, with the exception of a few plants in an unburnt patch of heath, all adult plants have been killed in population 1.

1.5 Conservation status

D. montana is known from a three populations in Stirling Range National Park.

1.6 Strategy for recovery

The following essential strategies will be implemented:

1. Control the most threatening factors currently affecting *D. montana* as outlined in 3.2.
2. Preserve the genetic resource of *D. montana* by including it in a seed bank, cryostorage and/or *ex situ* cultivation (3.2.2).
3. Protect *D. montana* from possible future threats (eg. fire) by appropriate management practices.

The following desirable strategies will be implemented if resources permit:

1. Ensure that relevant CALM personnel are aware of the presence of *D. montana*, and the need to protect it and ensure that they are familiar with the threatening processes identified in these guidelines (see 3.3.1).
2. Conduct research into the biology, ecology and management of *D. montana* (see 3.3.3).
3. Enhance plant numbers (eg. by removal of limiting factors, propagation or translocation, see CALM Policy Statement No 29, Translocation of Threatened Flora and Fauna (see 3.3.4).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term preservation of this species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if identified threats have not abated within the three year period of this IRP or there has been a substantial decrease in the number of mature plants.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

Cutting material and seeds were collected by KPBG staff in 1991 and 1993 with the establishment of two plants which are in good health. KPBG collected seed in 1992 and seed germination trials carried out by TFSC have led to the germination of two plants in the nursery at Kings Park, however, these are in poor health.

A. Cochrane from the TFSC collected seed material in April 1994. This seed had an initial germination rate of 18.75%. Twenty six seeds were collected in February 1996.

All relevant authorities know of the existence of *D. montana.*

The ADTFRT oversees the implementation of this IRP and reports annually to CALM's Corporate Executive.

3.2 Essential recovery actions

3.2.1 Phosphonate spraying

Both *D. montana* and the plant community in which it grows are severely infected with dieback. Recent research in CALM has shown phosphonate to be effective in controlling dieback disease in native plant communities, and aerial application of phosphonate to the summit of Bluff Knoll is recommended. Application to the entire plant community will have the added benefit of protecting a number of endangered plant species endemic to the Knoll and will allow regeneration of the plant community as a whole. Long term protection will result from a decrease in the inoculum level of the pathogen in the soil.

Action:	Spray population and community with phosphonate
Responsibility:	CALM (Albany District, Western Australian Threatened Species and Communities Unit (WATSCU))
Cost:	$25000, every third/fourth year

3.2.2 Preserve genetic diversity of the species

Due to a high threat of dieback infection and the low number of extant plants, germplasm collections of *D. montana* should be given a high priority as the recovery of this species may in the future be dependant on *ex situ* conservation techniques. The main problem with developing a translocation program for *D. montana* is finding mountain top habitat that is dieback free and is not under threat of becoming infected.

Genetic diversity conservation of the species should be incorporated into the research component (see 3.3.3) and should include collection of seed from all populations, ensuring an adequate representation of genetic diversity.

If it is not possible to collect adequate quantities of viable seed, other more costly germplasm storage methodologies may need to be investigated. These can involve living collections from cutting or other source material, or storage of tissue culture material. If resources are limited these techniques will need to be carefully prioritised in relation to *in situ* conservation. This will be coordinated by the ADTFRT.

It is also important that the size and viability of the soil seed bank is determined and research undertaken to develop techniques for stimulating germination of soil stored seed. Care, however, should be taken as these processes inherently carry a significant risk of depletion of seed bank reserves.

Action:	Preserve genetic diversity of the species
Responsibility:	ADTRFT, CALM (TFSC, Albany District, WATSCU), KPBG
Cost:	$1600

3.2.3 Develop a fire management plan

A fire management plan needs to be developed, with particular emphasis being placed on the locality of *D. montana*, and included in the Management Plan for the Stirling Range National Park (in draft).

Action:	Develop a fire management plan
Responsibility:	CALM (Albany District), relevant authorities
Cost:	$200 pa.

3.2.4 Monitor populations

Monitoring of factors such as dieback encroachment, habitat degradation, population stability (expanding or declining), pollination activity, seed production, recruitment, and longevity is prescribed.

The known populations will be inspected annually as a requirement under CALM's Policy Statements, No. 9 *Conservation of Threatened Flora in the Wild* and No 28 *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also below 3.3.3, *Development of a quadrat/transect based monitoring system for threatened plant species.* Inspection will be subject to dieback hygiene procedures and will be carried out only with permission of CALM South Coast Region.

Monitoring should include post fire regeneration and dieback (*Phytophthora* spp.) impact and spread.

Action:	Monitor populations
Responsibility:	CALM (Albany District, WATSCU)
Cost:	$400 pa.

3.3 Desirable recovery actions

3.3.1 Information dissemination

To promote an awareness of *D. montana* among relevant CALM staff (Albany District) the production of posters are recommended. Posters should illustrate and provide information on the species.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted to the general public, however, it is recommended that the exact location of populations of *D. montana* be kept confidential. Awareness can be encouraged throughout the community by a publicity campaign using the local print and electronic media and by setting up poster displays in venues of high exposure. Formal links with local naturalist groups and interested individuals should also be encouraged. Such activities may lead to the discovery of new populations of the species.

Action:	Produce posters, implement a publicity campaign
Responsibility:	CALM (Corporate Relations Division, Albany District, WATSCU)
Cost:	$500 first year, $1500 second year

3.3.2 Conduct further surveys

Opportunistic surveying by A. Cochrane (TFSC) in February 1996, located eight new plants just downslope from the known population and further surveys in September and October 1996 located two new populations, one of which is on a different mountain peak. It is likely that other populations occur on other peaks and further surveys are recommended.

Action:	Conduct further surveys
Responsibility:	CALM (Albany District, WATSCU)
Cost:	$550 pa.

3.3.3 Conduct research

Research designed to increase understanding of biology of this species will provide a scientific base for management of *D. montana* in the wild. Research should include:

1. Application strengths of phosphonate in order to assess effectiveness versus phytotoxicity.
2. Factors determining level of flower and fruit abortion.
3. The level of invertebrate grazing of seed.
4. The size and viability of seed bank.
5. Seed germination requirements.
6. The role of disturbance in regeneration.
7. The longevity of plants, and time taken to reach maturity.
8. The extent of genetic variation within and between populations (essential if new populations are to be established).
9. The development of a monitoring system. Specific protocols for rare flora will be outlined in a future CALM discussion paper *Development of a quadrat/transect based monitoring system for threatened plant species*, D. Coates, P. Pigott and A. Brown (in prep).

Action:	Conduct research
Responsibility:	CALM (Albany District, Science and Information Division (SID), WATSCU)
Cost:	$1000 first year, $2000 second year

3.3.4 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Surveying for potential habitats for possible future translocation sites is recommended within the scope of IRPs, with actual translocation addressed in full Recovery Plans where necessary. This will be coordinated by the ADTFRT. Any translocation proposals will require endorsement by the Director of Nature Conservation.

Action: Survey potential habitats for translocation
Responsibility: ADTFRT, CALM (Albany District, WATSCU)
Cost: See Section 3.3.2 (Conduct further surveys)

Table 2: Summary of recovery actions

Recovery Actions	Population	Priority	Responsibility	Completion date
Essential				
Phosphonate spraying	1	High.	CALM (Albany District, WATSCU)	April 1996, 97, 98
Preserve genetic diversity of the species	1	High.	ADTFRT, CALM (TFSC, Albany District, WATSCU), KPBG	Ongoing
Develop a fire management plan	1	High.	CALM (Albany District), relevant authorities	Ongoing
Monitor populations	1	High.	CALM (Albany District, WATSCU)	Ongoing
Desirable				
Information dissemination	1	Moderate.	CALM (Corporate Relations Division, Albany District, WATSCU)	Ongoing
Conduct further surveys	-	Moderate.	CALM (Albany District, WATSCU)	November 1996/97/98
Conduct research	1	Moderate.	CALM (SID, Albany District, WATSCU)	Oct-Feb 1996-97
Translocation		Low.	ADTFRT, CALM (Albany District, WATSCU)	Ongoing

3.4 Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Phosphonate spraying	8000	17000					
Preserve genetic diversity of the species		500	1100				
Develop a fire management plan	200			200		200	
Monitor populations	400			400		400	
Sub-total	**$8600**	**$17500**	**$1100**	**$600**		**$600**	
Desirable							
Information dissemination		500			1500		
Conduct further surveys	550			550		550	
Conduct research	1000			2000			
Translocation							
Sub-total	**$1550**	**$500**		**$2550**	**$1500**	**$550**	
TOTAL	**Year 1 $ 29250**			**Year 2 $ 4650**		**Year 3 $ 11550**	

EA Environment Australia (formerly ANCA)

Total of all costs: $45450

ACKNOWLEDGMENTS

The following people have provided valuable assistance and advice in the preparation of this Interim Recovery Plan;

Anne Cochrane: CALM Threatened Flora Seed Centre, W.A. Herbarium
Malcolm Grant: CALM Albany District
Ellen Hickman: CALM Albany District

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Hopper, S., Van Leeuwen, S., Brown, .A. and Patrick, S. (1990). *Western Australia's Endangered Flora*. Department of Conservation and Land Management, Perth.

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Appendix One: Taxonomic description

George, A.S., (1996). New taxa and a new infrageneric classification in Dryandra R. Br. (Proteaceae: Grevilleoideae). *Nuytsia* **10** (3): 313-408.

Dryandra montana C.A. Gardner ex A.S. George, sp. nov.

Ab *D. plumosa* R. Br. et *D. pseudoplumosa* A.S. George foliis coriaceis pinnatisectis lobis tortis marginibus revolutis, et bracteis involucralibus obtusis vel acutis ad 15 mm longis, praecipue differt.

Typus: Bluff Knoll, Stirling Range, Western Australia, 16 Jan. 1966, *K. Newbey* 2226 (*holo:* PERTH 03322726; *iso:* CANB).

Shrub to 2.5 m, without lignotuber. *Stems* rusty-villous. *Leaves* pinnatisect; lamina 8-25 cm long, 6-11 mm wide, hirsute, glabrescent above, closely tomentose below but reticulum evident and midrib prominent; lobes 35-60 each side, obliquely triangular, slightly overlapping at base, strongly curved adaxially and twisted so that underside faces apex of leaf; margins revolute; petiole 10-30 mm long. *Inflorescence* sessile on branchlet 1 or 2 years old; involucral bracts linear to lanceolate, obtuse to acute, villous outside, glabrous inside, the innermost *c.* 15 mm long; flowers 50-60 per head. *Perianth* 17-19 mm long, villous grading to hirsute on claws, yellow; limb 3 mm long, closely pubescent and with a few long hairs towards apex. *Pistil* 18-21 mm long, gently bowed, glabrous except long hairs at apex of ovary, pale yellow; pollen presenter scarcely thickened, ribbed, 0.8-1 mm long. *Follicles* obliquely obovoid, 9-11 mm long, sculptured, sparsely hairy, dark red-brown.

Selected collection examined. Summit of Bluff Knoll, *F. Lullfitz* 3267 (PERTH).

Distribution. Confined to the higher slopes of Bluff Knoll, Stirling Range National Park.

Habitat. Grows in rocky soil in kwongan.

Flowering period. January.

Conservation status. Dept of Conservation & Land Management Conservation Code: Declared Rare. Almost extinct in the wild. The only known population is infected with *Phytophthora* and may be eliminated within a few years.

Etymology. Named from the Latin *montanus* (of mountains), in reference to the habitat. The epithet was chosen but not published by the late Charles Gardner, Government Botanist of Western Australia 1929-1960.

Discussion. The twisted leaf lobes are distinctive. The leaves are much more coriaceous than those of *D. plumosa* and *D. pseudoplumosa*.

Appendix Two: Associated species

PROTEACEAE	APIACEAE	MYRTACEAE
Banksia brownii	*Xanthosia rotundifolia*	*Beaufortia decussata*
Banksia oreophila		*Darwinia collina* (DRF)
Hakea varia	PAPILIONACEAE	*Kunzea montana*
	Aotus genistoides	
GOODENIACEAE	*Gastrolobium bilobum*	EPACRIDACEAE
Velleia foliosa	*Nemcia leakeana*	*Andersonia axilliflora* (DRF).
		Sphenotoma aff. *dracophylloides*
MIMOSACEAE	RESTIONACEAE	*Sphenotoma squarrosum*
Acacia drummondii subsp. *candolleana*	*Desmocladus flexuosus*	

DRF- Declared Rare Flora

INTERIM RECOVERY PLAN NO. 14

METALLIC FLOWERED EREMOPHILA (*EREMOPHILA VENETA* MS) INTERIM RECOVERY PLAN

1996-1999

by

Kim Kershaw, Emma Holland and Andrew Brown

June 1997

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March 1997.

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SUMMARY

Metallic-Flowered Eremophila, *Eremophila veneta* ms Family: MYOPORACEAE

Flowering period: October-December

CALM Region: Wheatbelt **CALM Districts:** Katanning, Narrogin

Shires: Corrigin, Gnowangerup, Kent, Kondinin, Kulin, Lake Grace

Current status: Declared as Rare Flora in May 1991, ranked as Critically Endangered in September 1995

Recovery teams: Threatened Flora Recovery Teams will be established in the Katanning and Narrogin Districts in 1997

Illustrations and/or further information: S. Hopper, *et al. Western Australia's Endangered Flora* (1990); G. Durell *et al. Narrogin District Threatened Flora Management Program* (in prep.); M. Graham *Katanning District Threatened Flora Management Program* (in prep).

Eremophila veneta ms is a low, open shrub to 60 cm high and 1 m in diameter with metallic blue-green flowers. It is known from approximately 170 plants in nine mostly small populations, spread over a distance of 175 km from north of Kondinin to west of Ongerup. Four populations are on narrow, degraded road reserves, one on a railway reserve, one on a Shire reserve and three on nature reserves. Two nature reserve populations are by far the most substantial.

The species was first found in 1962 by K. Newbey (north-west of Ongerup) and F. Lullfitz (east of Gorge Rock). It was then not seen again until 1976 when L. Haegi found a population east of Bendering Railway Siding. In 1981, R.J. Chinnock found a further population, north of Ongerup. Since then, there have been only three further populations found, one by K.J. Atkins in 1990 (south-east of Kulin), one in 1994 by M. Graham (west of Pingrup) and one by S Murray south-east of Kulin in a Shire reserve vested for the purpose of conservation of flora. A specimen from the latter area was confirmed in March 1996. Two new subpopulations of *Eremophila veneta* ms were discovered by E. Holland and K. Kershaw in December 1995 during the survey phase of this Interim Recovery Plan (IRP). Both are in nature reserves.

All roadside populations are exposed to threats associated with weed invasion, agricultural chemical drift, grazing and road maintenance activities. Populations located on nature reserves and a railway reserve are exposed to threats associated with firebreak maintenance, salinity, inappropriate fire regimes, erosion and the encroachment of weeds. The aim of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations of *Eremophila veneta* ms in order to conserve the wild genetic stock of this species. To achieve this aim the following essential and desirable recovery actions are prescribed.

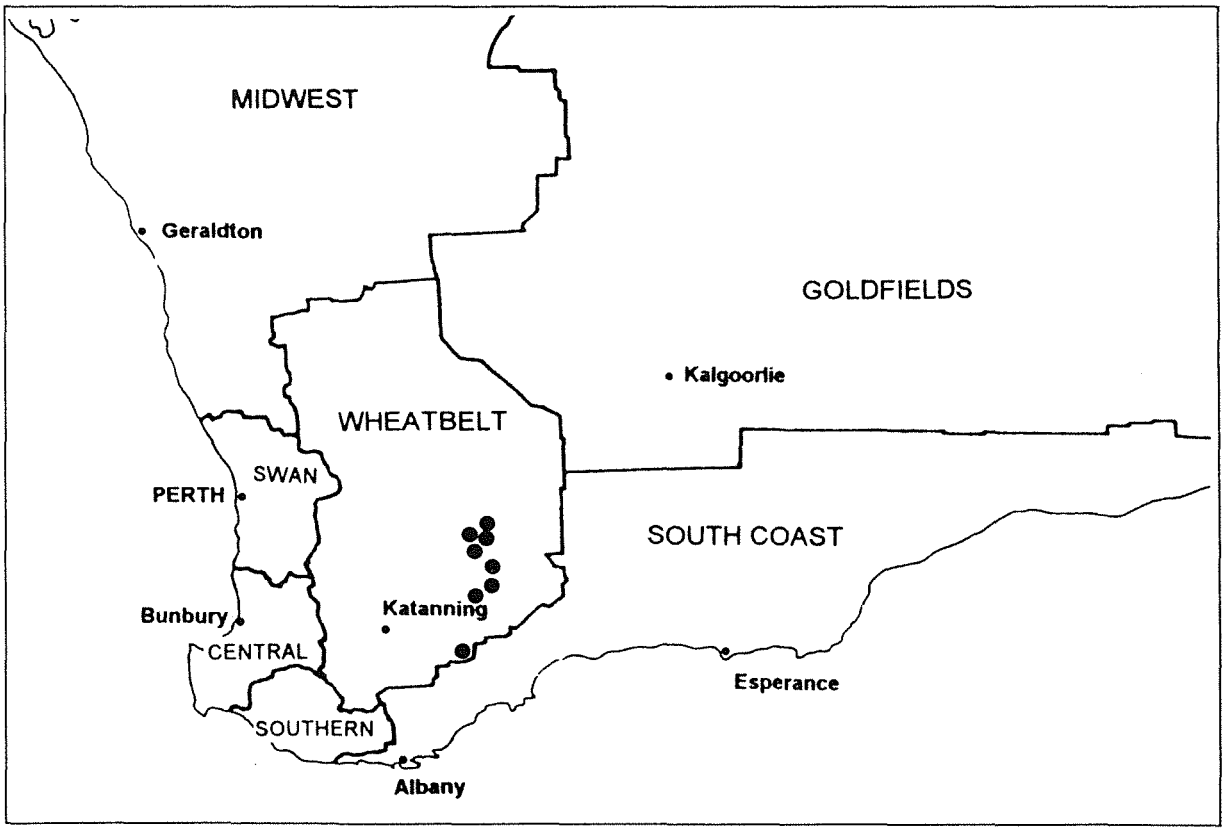
Recovery actions:

Essential	Desirable
1. Install Declared Rare Flora (DRF) markers	1. Conduct further surveys
2. Implement weed control	2. Information dissemination
3. Develop a fire management plan	3. Preserve genetic diversity of the species
4. Monitor populations	4. Conduct research
	5. Habitat rehabilitation
	6. Translocation

Eremophila veneta ms

Ludwik Dutkiewicz (Botanic Gardens of Adelaide and State Herbarium)

Distribution of *Eremophila veneta* ms



1. BACKGROUND

1.1 History, taxonomy and status

Eremophilas are commonly known as poverty bushes, emu bushes and desert fuchsias. The resin of some *Eremophila* species was used by Aboriginals as a form of glue and for tanning kangaroo and possum skins. Approximately 180 species of *Eremophila* are found in Western Australia, 14 have been declared rare, a further 50 have been priority listed and one wheatbelt species is presumed extinct (Department of CALM 1995).

Eremophila veneta ms is a low, open shrub to 60 cm high and 1 m in diameter with glandular-resinous branches and densely-clustered, inversely lanceolate leaves. Flowers are solitary, supported by a long flattened pedicel 3-4.5 mm in length. Flowers are metallic blue-green, yellow below, and inside. Lobes of the upper lip are close together and the corolla 17-18 mm long (Narrogin District Threatened Flora Management Program, in prep.).

A full taxonomic description of *Eremophila veneta* ms will be provided by Dr. R.J. Chinnock when he formally describes the species in 1997. This work is still in draft, however, a copy is included in Appendix 1.

Eremophila veneta ms was first collected by K. Newbey (north-west of Ongerup) and F. Lullfitz (east of Gorge Rock) in 1962. It was then not seen again until 1976 when L. Haegi found a population east of Bendering Railway Siding. In 1981, R.J. Chinnock found another population, north of Ongerup. Between 1986-1988 extensive surveys were carried out by R.J. Chinnock and M. Graham, with no further populations being found.

Since 1988, three more populations have been discovered, one by K.J. Atkins in 1990 (south-east of Kulin), one in 1994 by M. Graham (west of Pingrup) and one by S. Murray south-east of Kulin in a Shire reserve vested for the purpose of conservation of flora. A specimen from the latter area was confirmed in March 1996. Additionally, in December 1995 two new subpopulations of *Eremophila veneta* ms were discovered by E. Holland and K. Kershaw during the survey phase of this Interim Recovery Plan (IRP). Both were found in nature reserves, one south-east of Kulin and the other south of Newdegate. Currently 170 plants are known from nine populations between Kondinin and Ongerup.

E. veneta ms appears to be restricted to a specific habitat type, most of which has been cleared for farming. Due to the small size of most populations and little remaining suitable habitat, much of which is vulnerable to weed invasion and destruction from road maintenance activities, fire and grazing, *Eremophila veneta* ms was declared as Rare Flora in May 1991 and ranked as Critically Endangered in September 1995. Threatened Flora Recovery Teams will be established in the Narrogin and Katanning Districts in 1996/97.

1.2 Distribution and habitat

Eremophila veneta ms is known from nine populations, scattered over a distance of 175 km from north of Kondinin to west of Ongerup.

This species occurs on white sandy-clay flats under low *Eucalyptus* woodland over open shrub mallee of *Eucalyptus annulata,* and open dwarf scrub of *Atriplex* sp., *Rhagodia preissii*, *Acacia merrallii* and *Enchylaena tomentosa.*

Other associated species are listed in Appendix 2.

Table 1: Summary of population information

Pop. No & Location.	Land Status	No. of plants.	Condition	Threats
1. East of Buniche Wheat Bin	Railway Reserve	1990, 6 1995, 12	Healthy	Weeds, salinity, accidental destruction and fire
2a. Hopkins Nature Reserve	Nature Reserve, Class C	1990, 2 1995, 5	Moderate	Fire, water and soil erosion
2b. Hopkins Nature Reserve	Nature Reserve, Class C	1991, 8 1995, 30	Healthy	Weeds and fire
2c. Hopkins Nature Reserve	Nature Reserve, Class C	1995, 23	Healthy	Roadworks and fire
3. East of Kondinin	Shire Road Reserve	1995, 7	Moderate	Roadworks, grazing, weeds and fire
4. Lockhart Nature Reserve	Nature Reserve, Class A	1993, 12 1995, 72	Healthy	Accidental destruction, fire and salinity
5. West of Pingrup	Shire Rd. Reserve	1993, 2 1995, 2	Healthy	Recreational activities, roadworks, weeds, salinity and fire
6. Bendering Nature Reserve	Nature Reserve, Class A	1995, 4	Healthy	Accidental destruction, weeds and fire
7. East of Gorge Rock	Shire Road Reserve	1995, 6	Moderate	Roadworks, grazing, weeds and fire
8. North of Ongerup	Shire Road Reserve	1981, 12 1995, 7	Moderate	Roadworks, grazing, weeds and fire
9. SE of Kulin	Shire Reserve, Native Flora	1995, 1	Healthy	Roadworks, grazing, weeds and fire

1.3 Biology and ecology

Many *Eremophila* species are regarded as disturbance opportunists as they appear in large numbers following roadworks, partial clearing or fire, then gradually disappear over several years. Following damage or destruction of the aerial parts of the parent plant, suckering is the most obvious form of *Eremophila* regeneration in disturbed sites. Germination of *Eremophila* species from soil stored seed is also common after roadside disturbance and may be due to a reduction in competition from other flora and the increased soil-moisture status along roadside reserves (Chinnock 1986).

Like other *Eremophila* species, *Eremophila veneta* ms is probably a disturbance opportunist. Plants in three populations were found growing on firebreaks and three populations occur along drainage lines. Little is currently known about the ecology and life history of this species.

Observations made by staff of CALM's Threatened Flora Seed Centre (TFSC) in February 1996, showed that many *E. veneta* ms fruit had either not formed or had aborted. It was also discovered that ants were taking *E. veneta* ms seeds to their nests, where they were deposited around the edge of the entrance hole.

1.4 Threatening processes

1.4.1 Causes of the Critically Endangered status of this species

The rarity *of E. veneta* ms is probably due to the loss of habitat from wide scale clearing for agriculture. Only small remnants of uncleared native vegetation remain in the wheatbelt areas between Kondinin and Ongerup.

Reproductive factors may also contribute to the plant's low numbers due to the low levels of viable seed that are produced. *E. veneta* ms is thought to be a disturbance opportunists and the low numbers of natural fires that have occurred in the areas of known populations, may have contributed to poor seedling recruitment and regeneration.

1.4.2 Threats to the ongoing survival of this species in the wild

- **Weed invasion** is a threat to rail and road reserve populations all of which are being invaded by weed seeds blown in from adjoining pasture. Weeds suppress early plant growth by competing for soil moisture, nutrients and light and also exacerbate grazing pressure. Populations which are restricted to narrow road and rail reserves (populations. 1, 3, 5, 7, and 8), experience high perimeter to area ratios. This results in virtually the whole corridor being subjected to influences of the adjacent land, commonly referred to as edge effect (Lynch 1987; Saunders *et al.* 1987; Taylor 1987). Effects include increased wind speed, increased fertiliser runoff, modified hydrology and altered disturbance regimes, including fire.

- **Road maintenance** has threatened one road reserve population in the past and construction of drainage channels, grading activities and other road maintenance activities are potentially future threats. Relevant authorities need to be informed of recently discovered road reserve populations and appropriate protective measures carried out. The adjacent landowners should be informed of this species presence, so as to prevent possible grazing damage (ie. if road reserves are used for grazing in times of poor feed).

- **Fire** must be excluded from all populations until its effect is better understood. High fire frequency commonly leads to degradation of natural plant communities due to factors such as depletion of soil seed banks and a temporary increase in the availability of nutrients for weed establishment (Panetta and Hopkins 1991).

- **Salinity** and **soil erosion** will need to be monitored at several population sites (1, 2a and 4).

1.5 Conservation status

Eremophila veneta ms is known from four populations on narrow, degraded road reserves, one on a railway reserve, three on nature reserves and one on a Shire reserve.

Two of the three populations found on nature reserves are by far the most substantial, these being Lockhart Nature Reserve, Class A, for the purpose of Conservation of Flora and Fauna and Hopkins Nature Reserve Class C, for the purpose of Conservation of Flora. The other population occurs on Bendering Nature Reserve Class A, for the purpose of Conservation of Flora and Fauna. All nature reserve populations are vested in the National Parks and Nature Conservation Authority.

1.6 Strategy for recovery

The following essential strategies will be implemented:

1. Control of the most threatening factors currently affecting *E. veneta* ms as outlined in 3.2.
2. Ensure that relevant land managers and CALM personnel are aware of the presence of *E. veneta* ms and the need to protect it (eg. notification and roadside markers), and ensure that all are familiar with the threatening processes identified in these guidelines (see 3.2.5).
3. Threatened Flora Recovery Teams will be established for the Katanning and Narrogin Districts in 1997. The Recovery Teams will oversee the implementation of this IRP and report annually to CALM's Corporate Executive.

The following desirable strategies will be implemented if resources permit:

1. Protect *E. veneta* ms from possible future threats by appropriate management practices (see 3.3).

2. Enhance plant numbers (eg. by removal of a limiting factor or with direct propagation and translocation techniques (see 3.3.4), and CALM Policy Statement No 29 on Translocation of Threatened Flora and Fauna).
3. Preserve genetic material of *E. veneta* ms by including it in a seed bank, cryostorage and/or *ex situ* cultivation (see 3.3.1).
4. Research into the biology, ecology and management of *E. veneta* ms (see 3.3.2).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term conservation of this species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if identified threats have not abated within the three year period of this IRP or there has been a substantial decrease in the number of mature plants.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

Declared Rare Flora (DRF) markers have been erected for populations 1 and 5. These alert road maintenance workers to the presence of each population, and enable them to take appropriate care.

CALM's Science and Information Division (SID) is undertaking research into weed control in populations 7 and 3.

Cutting material was collected by Kings Park and Botanic Garden (KPBG) staff in 1991 which has produced eight plants in good health. A small amount of seed was collected from subpopulations 2a, 2b and population 7 by CALM's Threatened Flora Seed Centre (TFSC) in February, 1996.

3.2 Essential recovery actions

3.2.1 Install Declared Rare Flora Markers

DRF markers are in place for population 1, but one of these needs to be moved west 150 metres to encompass several recently discovered plants. One DRF marker has fallen over and needs to be re-erected.

DRF markers need to be put in place for the following populations:

- Subpopulation 2c, which was recently discovered along Hopkins Road.

- Population 3, which occurs on both sides of the Kondinin-Hyden Road, east of Kondinin (one plant occurs on the north road verge and six plants on the south side).

- Population 4, which is partially growing along a firebreak in Lockhart Nature Reserve. Markers are required to prevent accidental destruction during firebreak maintenance.

- Population 6, which is growing along a firebreak and drainage line in Bendering Nature Reserve. Markers are required to prevent accidental destruction during firebreak maintenance.

- Population 7, which is east of Gorge Rock on the north side of the road only.

- Population 8, which is west of Ongerup, along both sides of a narrow road reserve.

For all the above populations, it is recommended that DRF markers are positioned up to 50 m either side of the population boundary to provide a habitat buffer and allow seedling recruitment.

Action:	Install DRF markers
Responsibility:	CALM (Katanning and Narrogin Districts, Western Australian Threatened Species and Communities Unit (WATSCU))
Cost:	$1200

3.2.2 Implement weed control

Populations 3, 7 and 8 are affected by the massive invasion of wild oats and other introduced grass species. All require weed control but, as the tolerance of native plant species to herbicides at *E. veneta* ms sites is unknown, it is recommended that this be undertaken in conjunction with research (see 3.3.2). The aim of weed control is to maintain the pre-invasion condition of the habitat (prevention), control or arrest ongoing weed invasion (intervention) and reverse the degraded condition of the habitat where applicable (rehabilitation) (Panetta and Hopkins, 1991). A weed control program will involve:

1. Accurately mapping the boundaries of the populations.
2. Selection of an appropriate herbicide or other method of weed control after determining which weeds are present.
3. Controlling invasive weeds internal to the boundary by hand removal and spot spraying around individual *E. veneta* ms plants when weeds first emerge.
4. Scheduling to include weed spraying of other Declared Rare Flora populations requiring weed control within the Katanning and Narrogin Districts.

Populations 3, 7 and 8 are on road reserves vested with three different Shires (Kondinin, Corrigin and Gnowangerup). Accordingly, weed control is partially the responsibility of these agencies. However, it is recommended that a weed control program for this critically endangered species be developed by CALM in consultation with each Shire. Such a program should be implemented in autumn/winter 1997 and be ongoing.

Action:	Control weeds at populations 3, 7 and 8
Responsibility:	CALM (Katanning and CALM Narrogin Districts, WATSCU, SID)
Cost:	$750 pa.

3.2.3 Develop a fire management plan

A recently discovered population (population. 9), which consisted of a single plant, was burnt during a wildfire in January 1996. As the fire response of this species has never been studied, this is a good site to

monitor its effect (see 3.3.2). Until this has been done, and more is known about the effect of fire on this species, all populations need to be protected against such an event. A weed control program for populations 3, 7 and 8 will decrease the potential fire hazard that weeds create over the summer period.

CALM Katanning and CALM Narrogin personnel will hold on-site meetings with representatives from relevant Shires, authorities and land managers to outline the problems associated with inappropriate fire.

Action:	Develop a fire management plan
Responsibility:	CALM (Katanning and Narrogin Districts, WATSCU), relevant authorities and land managers
Cost:	$500 pa.

3.2.4 Monitor populations

Monitoring of factors such as weed encroachment, response to fire, habitat degradation, population stability (expanding or declining), pollination activity, seed production, recruitment, and longevity is prescribed.

All populations will be inspected annually as a requirement under CALM's Policy Statements, No. 9 *Conservation of Threatened Flora in the Wild* and No 28 *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also below 3.3.4, *Development of a Quadrat/Transect Based Monitoring System For Threatened Plant Species*.

Action:	Monitor populations
Responsibility:	CALM (Katanning and Narrogin Districts, WATSCU, SID)
Cost:	$500 pa.

3.3 Desirable recovery actions

3.3.1 Conduct further surveys

Areas of suitable habitat, particularly in reserves will be further surveyed on a systematic basis for the presence of this species. This should be conducted by CALM district staff and be carried out during the flowering period (October -December).

Action:	Conduct further surveys
Responsibility:	CALM (Katanning and Narrogin Districts, WATSCU), Newdegate Rare Flora Volunteer Group
Cost:	$1100 for 1st year, $650 for 2nd and 3rd year

3.3.2 Information dissemination

To promote an awareness of *E. veneta* among relevant CALM staff, local government staff and members of the public, the production of vehicle dashboard stickers and posters is recommended. Dashboard stickers should illustrate a rare flora marker and provide a contact telephone number if one is encountered. Posters should illustrate and provide information on the species. Shire staff should be briefed about the need to check threatened flora records before arranging burns, road maintenance or undertaking clearing operations.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted to the general public, however, it is recommended that the exact location of populations of *E. veneta* remain confidential. Awareness can be encouraged throughout the community by a publicity campaign using the local print and electronic media and by setting up poster displays in venues of high

exposure. Formal links with local naturalist groups and interested individuals should also be encouraged. Such activities may lead to the discovery of new populations of the species.

Hopkins Nature Reserve has had the nature reserve signs removed or damaged. These need to be replaced.

Action:	Produce posters and dashboard stickers, implement a publicity campaign
Responsibility:	CALM (Corporate Relations Division, Katanning and Narrogin Districts, WATSCU)
Cost:	$500 first year, $1500 second year

3.3.3 Preserve genetic diversity of the species

Germplasm collections should be given a high priority if the extinction of populations *E. veneta* is considered a high probability through disease, its limited distribution or low number of plants. If this is deemed to be the case, recovery of the species is likely to need *ex situ* conservation techniques.

Genetic diversity conservation of the species should be incorporated into the research component (see 3.3.4) and should include collection of seed from all populations, ensuring an adequate representation of genetic diversity.

If it is not possible to collect adequate quantities of viable seed, other more costly germplasm storage methodologies may need to be investigated. These can involve living collections from cutting or other source material, or storage of tissue culture material. If resources are limited these techniques will need to be carefully prioritised in relation to *in situ* conservation. This will be coordinated by the soon to be formed Katanning and Narrogin District Threatened Flora Recovery Teams (KDTFRT, NDTFRT).

It is also important that the size and viability of the soil seed bank is determined and research undertaken to develop techniques for stimulating germination of soil stored seed. Care, however, should be taken as these processes inherently carry a significant risk of depletion of seed bank reserves.

Action:	Preserve genetic diversity of the species
Responsibility:	KDTFRT, NDTFRT (both to be established), CALM (TFSC, Katanning and Narrogin Districts), KPBG
Cost:	$1600

3.3.4 Conduct research

Research designed to increase understanding of the biology of the species will provide a scientific base for management of *Eremophila veneta* ms in the wild. Research should include:

1. The effect of weeds on recruitment and establishment.
2. Habitat response to herbicide treatments.
3. Pollination biology and seed set.
4. The factors determining level of flower and fruit abortion.
5. Quantification of level of invertebrate grazing of seed.
6. The size and viability of the seed bank.
7. Seed germination requirements.
8. The role of disturbance in regeneration.
9. The longevity of plants, and time taken to reach maturity.
10. The species sensitivity to fire and response to different fire regimes. This would provide valuable information on the consequences to the populations of uncontrolled or unplanned fire events.
11. The extent of genetic variation within and between populations (essential if new populations are to be established).

12. The development of a monitoring system. Specific protocols for rare flora will be outlined in a future CALM discussion paper *Development of a Quadrat/Transect Based Monitoring System For Threatened Plant Species*, D. Coates, P. Pigott and A. Brown (in prep).

Action:	Conduct research
Responsibility:	CALM (SID, Katanning and Narrogin Districts, WATSCU)
Cost:	$1000 first year, $2000 second year

3.3.5 Habitat rehabilitation

Rehabilitation of *Eremophila veneta* ms habitat by re-introduction of local native plant species into the areas of populations 3, 7 and 8 is recommended. This would ideally include acquisition of a strip of adjoining farmland for road reserve populations. Due to massive weed invasion, it is proposed that in conjunction with Research (3.3.4) and Weed Control (3.2.2), the area between known plants be lightly scarified, removing weeds and possibly stimulating the soil seed bank.

Action:	Rehabilitate habitat of populations 3, 7 and 8
Responsibility:	CALM (Katanning and Narrogin Districts, WATSCU)
Cost:	$1500

3.3.6 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Surveying potential habitats for possible future translocation sites is recommended within the scope of IRPs, with actual translocation addressed in full Recovery Plans where necessary. This will be coordinated by the proposed Threatened Flora Recovery Teams for the Katanning and Narrogin Districts. All translocation proposals require endorsement by the Director of Nature Conservation.

Action:	Survey potential habitats for translocation
Responsibility:	NDTFRT, KDTFRT (both to be established), CALM (Katanning and Narrogin Districts, WATSCU)
Cost:	See Section 3.3.1 (Conduct further surveys)

Table 2: Summary of recovery actions

Recovery Actions	Population	Priority	Responsibility	Completion date
Essential				
Install DRF markers	1, 2c, 3, 4, 6, 7 & 8	High	CALM (Katanning, Narrogin, WATSCU)	Completed in March, 1996
Implement weed control	3, 7 & 8	High	CALM (SID, Katanning and Narrogin Districts, WATSCU)	1996, 97, 98
Develop a fire management plan	1-9	High	CALM (Katanning and Narrogin Districts), relevant authorities, land managers	1996, ongoing
Monitor populations	1-9	High	CALM (Katanning and Narrogin Districts, WATSCU)	1996, 97, 98
Desirable				
Conduct further surveys	–	Mod	CALM (Katanning and Narrogin Districts, WATSCU), Volunteers	1996, 97, 98
Information dissemination	1-9	Mod	CALM (Corporate Relations Division, Katanning and Narrogin Districts, WATSCU)	1996 ongoing
Preserve genetic diversity of the species	1-9	Mod	KDTFRT, NDTFRT (both to be established), CALM (TFSC, Katanning and Narrogin Districts), KPBG	Ongoing
Conduct research	1-9	Mod	CALM (SID, Katanning and Narrogin Districts, WATSCU)	1996, ongoing
Habitat rehabilitation	3, 7 & 8	Mod	CALM (Katanning and Narrogin Districts, WATSCU)	1996, 1997
Translocation		Low	NDTFRT, KDTFRT (both to be established), CALM (Katanning District and Narrogin Districts, WATSCU)	See 3.3.1

3.4 Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Install DRF markers	900	300					
Implement weed control	750			750		750	
Develop a fire management plan	500			500		500	
Monitor populations	500			500		500	
Sub-total	**$2150**	**$300**		**$1750**		**$1750**	
Desirable							
Conduct further surveys	1100			650		650	
Information dissemination		500			1500		
Preserve genetic diversity of the species		500	1100				
Conduct research	1000			2000			
Habitat rehabilitation	1500						
Sub-total	**$3600**	**$1000**	**$1100**	**$2650**	**$1500**	**$650**	
Total	**$5750**	**$1300**	**$1100**	**$4400**	**$1500**	**$2400**	

EA Environment Australia (formerly ANCA)

Total of all Costs: $16 450

ACKNOWLEDGMENTS

The following people have provided valuable assistance and advice in the preparation of this Interim Recovery Plan;

Dr. R.J. Chinnock: The Botanic Gardens of Adelaide and State Herbarium
Ludwik Dutkiewicz: The Botanic Gardens of Adelaide and State Herbarium

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Appendix One: Taxonomic description

A full taxonomic description of *Eremophila veneta* ms will be provided by Dr. R.J. Chinnock in Magnum Opus late in 1997. The following is a draft.

195. *Eremophila veneta* Chinnock, sp. nov.

Frutex aromaticus resinosus glaber foliis alternis crassis oblanceolatis raro obovatis, obtusis, integris vel serratis ad dentabis apicem versus; sepalis imbricatis, inequalibus, glabris; corolla super veneta ad indica, dilute lutea infra, glandulifero-pubescentia, lobis acutis; staminibus exsertis; ovario biloculario; fructu sicco, oblongo; endocarpo woody, compresso distincto complanato apicem versus, paginis compressis sulcatis in medio, rugoso basin versis.

Type: 13.4km E of Kondinin, Western Australia, 3.xi.1981, *R.J. Chinnock 5392* (holotype: AD; isotypes: K, MEL, PERTH).

Low spreading aromatic resinous shrub 0.3–1.2 m tall. *Branches* terete, obscurely tuberculate, glabrous, glandular-papillose, extremely resinous, resin drying yellow and at length flaky. *Leaves* alternate, thick, oblanceolate to rarely obovate, obtuse with mucro or acute, margins entire or serrate to dentate in distal third to half but often irregularly so, surfaces rugose, 12–19 × 2.2–5.0 (-7.0) mm, glabrous, glandular-papillose, extremely resinous. *Flowers* 1 per axil; pedicel terete or slightly flattened, 3.0–7.0 mm long, glabrous, glandular-papillose, resinous. *Sepals* 5, imbricate, unequal, posterior one largest, inner pair smallest, narrowly triangular to lanceolate, acute, 4.0–5.5 × 1.0–2.7 mm, outer and inner surfaces with transluscent tubercles, glabrous, glandular-papillose, resinous. *Corolla* 15–20 mm long, metallic bluish-green to bluish-purple above, pale yellow below, unspotted, tuberculate especially below lobes of upper lip, outside and inside surfaces of lobes and tube glandular-pubescent; lobes acute. *Stamens* 4, exserted; filaments glandular-pubescent, anthers glabrous. *Ovary* conical, laterally compressed, bilocular with 1 ovule per locule, 1.5 –1.8 × 1.0–1.1 mm, glabrous; style glabrous. *Fruit* dry, oblong, obtuse, 5.5–7.5 × 2.0–3.0 mm; exocarp adhering to endocarp, glabrous; endocarp woody, compressed but distinctly flattened in distal third, compressed faces with a medial furrow at least distally, often rugose in basal part. *Seed* oblong, c. 3.5 × 1.0 mm, white. *Chromosome number* unknown.

Distribution and ecology

Eremophila veneta is restricted to the Kondinin - Newdegate - Ongerup area, Roe Botanical District of Western Australia where it grows on brown clay loams in *Eucalyptus* including mallee woodlands often with a *Melaleuca* understorey.

Conservation status: 3VC. Many of the populations of this species are small and restricted to roadside vegetation.

Derivation of epithet

Latin *veneta*, bluish-green; referring to the corolla colour.

Notes

The flower colour of *E. veneta* is most unusual in that the upper lip is coloured a metallic bluish-green to greyish-green, while the lower lobe and underside is a dull yellow to greyish-yellow.

This species is closely allied to *Eremophila glabra* but differs in the flower colour and the fruit.

Specimens examined

WESTERN AUSTRALIA: Hopkins Nature Reserve SE of Kulin, xi.1989, *K.J. Atkins 89023* (PERTH); Hopkins Nature Reserve, 5.iv.1990, *K.J. Atkins 90004 & 90011* (PERTH); 10 km N of Newdegate, 18.ix.1985, *M.E. Ballingall 2022* (AD); 14.1 km E of Kondinin, 6.x.1976, *R.J. Chinnock 3263* (AD); 5 km N of Ongerup on the North Ongerup road, 2.xi.1981, *R.J. Chinnock 5382* (AD, MEL, PERTH); 14.4 km E of Kondinin, 3.xi.1981, *R.J. Chinnock 5391* (AD); 44.3 km W of Hyden, 4.x.1990, *R.J. Chinnock 8250* (AD, PERTH); 3.6 km E of Buniche Wheat Bin on railway reserve, 25.ii.1988, *M.S. Graham s.n.* (AD); C. 5 km E of Bendering Railway siding on

Appendix Two: Associated species

CYPERACEAE
Lepidosperma pruinosum

PHORMIACEAE
Dianella revoluta

CASUARINACEAE
Allocasuarina acutivalvis

PROTEACEAE
Dryandra aff. *proteoides*
Grevillea huegelii
Hakea preissii

CHENOPODIACEAE
Atriplex sp.
Enchylaena tomentosa
Halosarcia indica subsp. *bidens*
Halosarcia lepidosperma
Maireana brevifolia
Rhagodia drummondii
Rhagodia preissii

MIMOSACEAE
Acacia hemiteles
Acacia lanuginophylla (DRF)
Acacia merrallii
Acacia orbifolia
Acacia ? xiophylla

PAPILIONACEAE
Daviesia spiralis

AIZOACEAE
Carpobrotus sp.

SANTALACEAE
Exocarpus aphyllus
Santalum acuminatum

ASTERACEAE
Olearia dampieri subsp. *eremicola*
Olearia muelleri

SOLANACEAE
Lycium australe

MYRTACEAE
Eucalyptus annulata
Eucalyptus gracilis
Eucalyptus latens
Eucalyptus longicornis
Eucalyptus salmonophloia
Eucalyptus salubris
Melaleuca adnata
Melaleuca depauperata
Melaleuca lateriflora subsp. *lateriflora*
Melaleuca radula
Melaleuca ? spicigera
Melaleuca thyoides
Melaleuca uncinata
Melaleuca viminea

MYOPORACEAE
Eremophila decipiens
Eremophila serpens

DRF - Declared Rare Flora

INTERIM RECOVERY PLAN NO. 15

MAJESTIC SPIDER ORCHID (*CALADENIA WINFIELDII* MS), INTERIM RECOVERY PLAN

1996-1999

by

Emma Holland, Kim Kershaw and Andrew Brown

June 1996

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 7 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March, 1997.

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SUMMARY

Majestic Spider Orchid, *Caladenia winfieldii* ms **Family:** ORCHIDACEAE

Flowering period: October - November

CALM Region: Southern Forest **CALM District:** Pemberton **Shire:** Manjimup

Current status: Declared as Rare Flora in December 1993, ranked as Critically Endangered in September 1995

Recovery team: Southern Forest Region Threatened Flora Recovery Team

Illustrations and/or further information: *Southern Forest Region Threatened Flora Management Program* (in draft). N. Hoffman and A. Brown, *Orchids of South West Australia*. 2nd Ed. (1992).

An attractive dark pink flowered spider orchid, *Caladenia winfieldii* ms is found in an open low woodland of *Eucalyptus rudis, Melaleuca preissiana* and *Banksia littoralis* along a subdued drainage line and flat adjacent to a creek south-east of Manjimup. It is closely related to *C. harringtoniae* ms with which it grows and which is also declared as Rare Flora.

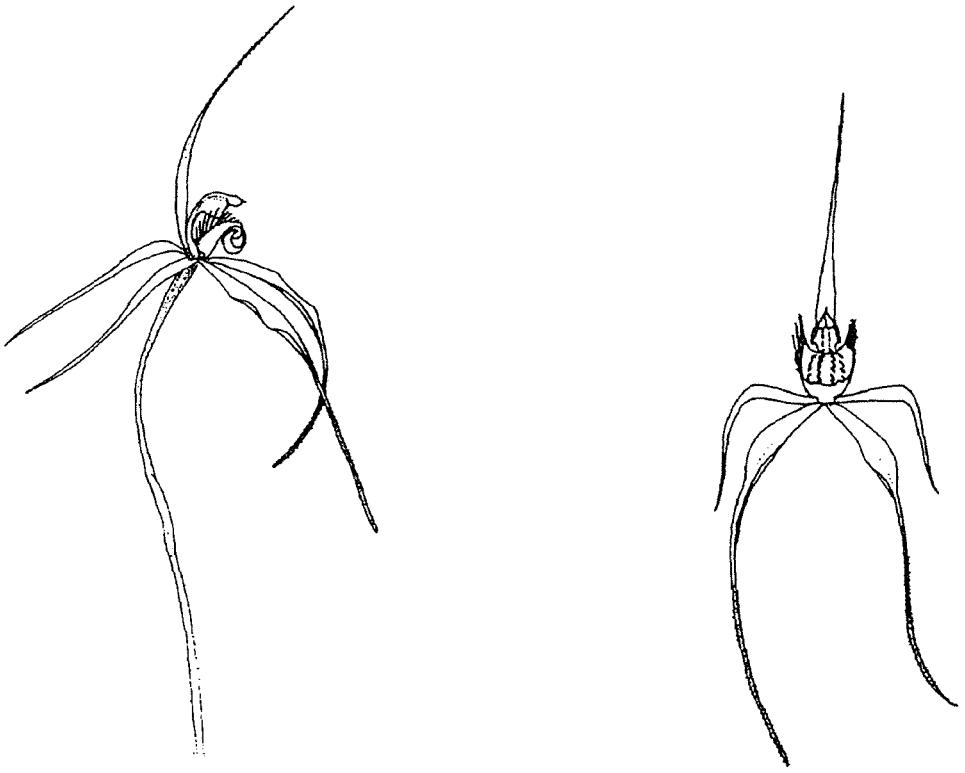
The species is to be named in honour of Mr Harry Winfield who first discovered it in the 1970s and bought it to the attention of the Department of Conservation and Land Management (CALM) in 1987. The species is currently known (March 1997) from one population of 12 plants. Although extensive surveys of suitable habitat by Pemberton and Manjimup CALM District staff, members of the Western Australian Native Orchid Study and Conservation Group (WANOSCG) and volunteers have been undertaken no additional populations have been discovered.

The cause of *C. winfieldii* ms geographic restriction is unknown, however it may be related to a dependence on specific factors in the ecosystem, eg, rare localised pollinators or associated micorrhizal fungi. Little is known of the biology of *C. winfieldii* ms and research into the following fields is recommended: pollination biology, seed production, seed germination requirements, population genetics and response to fire. The aim of this Interim Recovery Plan is to abate identified threats and maintain a viable *in situ* population of *Caladenia winfieldii* ms in order to preserve the wild genetic stock of the species. To achieve this aim the following essential and desirable recovery actions are prescribed.

Recovery actions:

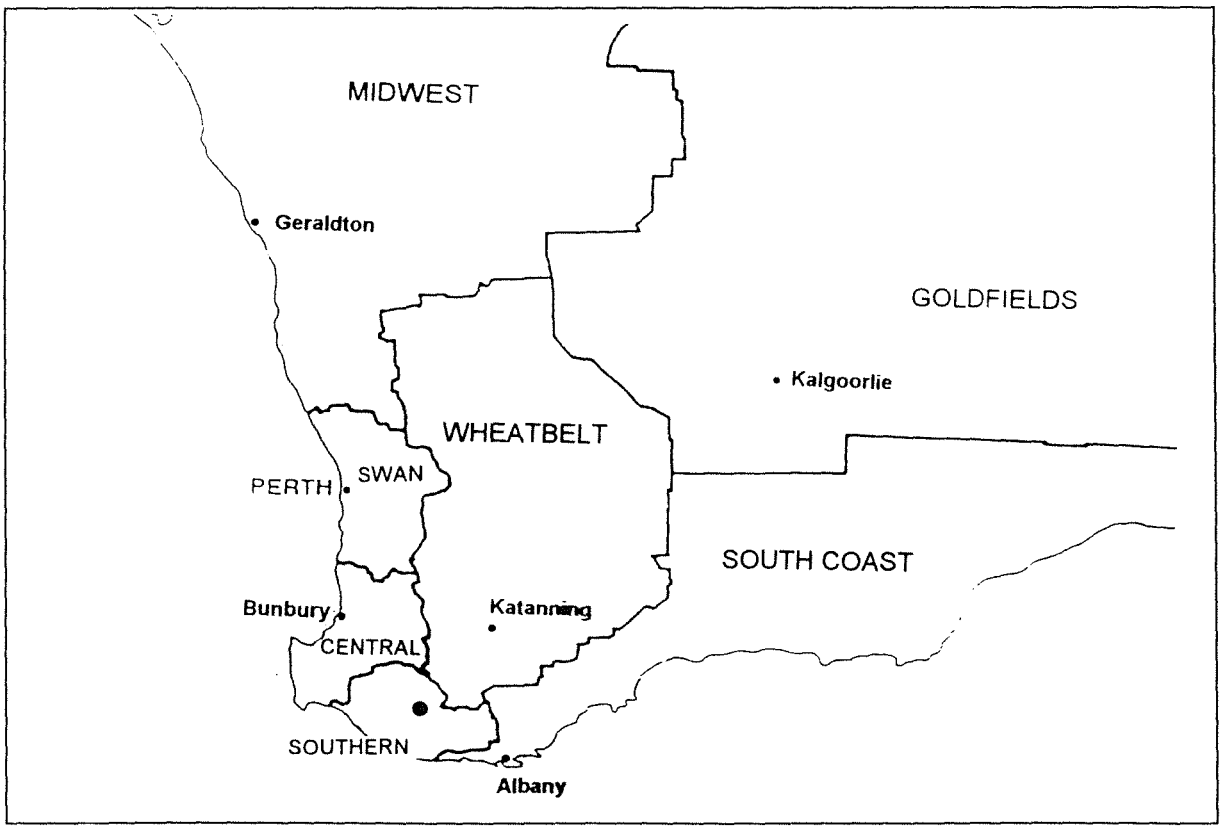
Essential	Desirable
1. Control feral pigs	1. Conduct further surveys
2. Exclude the population from prescribed burns	2. Information dissemination
3. Monitor population	3. Research
4. Extend the exclusion fencing	4. Survey for translocation sites
5. Defer further timber extraction in the catchment	
6. Implement disease control	
7. Preserve genetic diversity of the species	

Caladenia winfieldii ms



Catherine Vasiliu

Distribution of *Caladenia winfieldii* ms



1. BACKGROUND

1.1 History, taxonomy and status

Caladenia winfieldii ms is an erect, tuberous herb 30-60 cm tall with pink flowers (5-10 cm across). The species is closely related to *C. harringtoniae* ms with which it grows, but has larger, all pink flowers, broader petals and broader, slightly clubbed sepals. *C. winfieldii* ms also resembles *C. gardneri* ms in its pink colouration, but is darker and has tapering sepals, which lack prominently swollen clubs.

A full taxonomic description of *C. winfieldii* ms will be provided by A.P. Brown and S.D. Hopper, when they formally describe the species in 1997. A draft copy is included in Appendix 1.

C. winfieldii ms is named in honour of the late Mr Harry Winfield, a former field officer with the Western Australian Forests Department for 42 years, who knew of and had cultivated the species since the late 1970s. He brought the single known population to the attention of the Department of Conservation and Land Management (CALM) in 1987. Although extensive surveys of suitable habitat by Pemberton and Manjimup CALM District staff, members of the Western Australian Native Orchid Study and Conservation Group (WANOSCG) and volunteers have been undertaken no additional populations have been discovered.

C. winfieldii ms was declared as Rare Flora in 1993 and was ranked as Critically Endangered in September 1995. This is the only plant species currently ranked as Critically Endangered in the Southern Forest Region.

1.2 Distribution and habitat

C. winfieldii ms is known from a single population south east of Manjimup where it is found over an area approximately 150 x 20 m in size. It grows in a subdued drainage line adjacent to a seasonal creek, in grey sandy loam, rich in humus. The associated vegetation is a low woodland of *Eucalyptus rudis*, *Melaleuca preissiana* and *Banksia littoralis* over *Acacia saligna*, *Hakea varia* and *Xanthorrhoea preissii* and open herbs.

Associated species are listed in Appendix Two. A detailed description of the location of the population is included in Appendix Three.

Table 1: Summary of population information

Pop. No & Location.	Land Status	No. of plants.	Condition	Threats
1. SE of Manjimup	State Forest	1989, 200+ 1996, 12	Good	Feral pigs, kangaroo grazing, inappropriate fire regimes (late April-early December), rise in water table, flooding and siltation, dieback

1.3 Biology and ecology

It has been observed that most *C. winfieldii* ms plants grow through the skirts of *Xanthorrhoea preissii* or close to associated shrubs, presumably as these areas provide some protection from grazing kangaroos. The response of *C. winfieldii* ms to fire has not been documented. However, as is the case with the closely related *C. harringtoniae* ms, it is likely that flowering will be stimulated by summer fire. Anecdotal evidence suggests that *C. winfieldii* ms may be killed by fire during its active growing period (late April-November).

It appears likely that the appropriate insect pollinator is rare in the area, as during a survey of the *C. winfieldii* ms population in 1995, it was discovered that the flowers had shrivelled by early November and had failed to set seed, and just one naturally pollinated plant was found in November 1996. Flowers were hand pollinated in November 1996 and all developed healthy seed capsules, indicating that there is no internal mechanism that prevents seed set.

As with other geophytic Western Australian orchids, seed germination is aided by a specific micorrhizal soil fungus. The same fungus sends hyphae into the outer cells of the underground stems of adult plants where they are digested, providing essential starches for the plant.

1.4 Threatening processes

1.4.1 Causes of the Critically Endangered status of this species

Despite extensive surveys for the species since it was first bought to CALM's attention in 1987 only the original population is known. This natural geographic restriction suggests that the species is naturally rare and requires specific components within the ecosystem for reproduction and survival.

1.4.2 Threats to the ongoing survival of this species in the wild

- **Feral pigs** and evidence of their diggings have been observed in the area of the population over a period of several years. In early January 1996 a sow and her piglets were recorded in a swamp 2 - 3 km north of the population. Pig diggings can destroy the underground storage tubers of the orchid and affect the growth of symbiotic fungi essential for providing starches for the plant and seed germination (Hoffman and Brown 1992).

- **Inappropriate fire regimes** may interfere with the reproduction phase of the orchid (flowering, pollination, seed development, seed dispersal) resulting in low/nil seedling recruitment and the possible death of the parent plant.

It is known that the flowering of many orchid species is stimulated by summer wildfire (December-March), however, observation of many populations of orchid species suggests that plants may be killed by fire during their active growing period in late April-November (A. Brown pers comm.). Seedlings can be destroyed by inappropriately timed fire in the first couple of years before the tubers are fully developed (Hoffman and Brown 1992). Due to the restricted distribution and low numbers of the species, it is of concern that the single known population may be seriously reduced in size or destroyed if burnt in the late autumn, winter or spring, ie. late April to early December (Hoffman and Brown 1992).

- **Kangaroo grazing** is likely to have an impact upon the species in open sites. The orchid has been observed to grow under *Xanthorrhoea preissii* skirts and amongst other shrubs providing physical protection from grazing.

- **Potential hydrological changes** as a result of timber extraction in the catchment containing the *C. winfieldii* ms site may impact on the ecosystem in which the species occurs due to a rise in the water table. If this occurs it may cause flooding and silting (due to the close proximity of the stream and the naturally high water table at the site). Research has been undertaken (Borg *et al.* 1987) into the ground water and stream flow impacts of timber extraction in intermediate rainfall zones (eg, the area <20 km north of the *C. winfieldii* ms population). Results have shown an immediate rise in the ground water table within the lower parts (stream zone) of catchments of at least a meter. This was sustained beyond the completion of the study at 10 years post timber extraction.

- **Dieback** (*Phytophthora cinnamomi*) is present at the *C. winfieldii* ms site, and may impact on the species due to the death of susceptible plants such as *Xanthorrhoea preissii*, *Eucalyptus marginata, Banksia littoralis*, and several *Melaleuca* and *Hakea* spp. Such a loss will remove some of the protective cover of the orchid and may expose it to increased grazing pressure.

1.5 Conservation status

Caladenia winfieldii ms is known from a single population in State Forest near Manjimup. No populations are known to occur in conservation reserves. The area is listed on the Register of the National Estate by the Australian Heritage Commission.

1.6 Strategy for recovery

The following essential strategies will be implemented (see 3.2):

1. Protect the population from pig diggings by continuing feral pig control (see 3.2.1).
2. Protect the population from possible damage from controlled burns (autumn, winter, spring) until the orchids response to such fire is better understood, by developing a fire management plan (see 3.2.2).
3. Monitor population (see 3.2.3).
4. Protect *C. winfieldii* ms from possible future threats (eg, kangaroo grazing, altered hydrology, sedimentation, dieback), by appropriate management practices (see 3.2.4, 3.2.5, 3.2.6).
5. Preserve the genetic diversity of *C. winfieldii* ms by including it in cryostorage and/or *ex situ* cultivation (see 3.2.7).

The following desirable strategies will be implemented if resources permit (see 3.3):

1. Ensure that relevant land managers and CALM personnel are aware of the presence of *C. winfieldii* ms, and the need to protect it (eg, notification) and ensure that all are familiar with the threatening processes identified in these guidelines (see 3.3.2).
2. Research the biology and ecology of *C. winfieldii* ms (see 3.3.3).
3. If deemed necessary, enhance plant numbers (eg, by removal of a limiting factor or by using propagation and translocation techniques, see CALM Policy Statement No 29, *Translocation of Threatened Flora and Fauna* (see 3.3.4).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term conservation of the species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if threats identified have not abated within the three year period of this IRP or there has been a substantial decrease in the number of mature plants.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

Feral pig activity was reported in the area in 1994. Six pigs were shot in the area in March 1996 by CALM Pemberton District staff. Monitoring of pig pellet and grain feeding stations is ongoing.

Further timber extraction within the catchment has been deferred until potential impacts on *C. winfieldii* ms have been identified and addressed (see 1.4.2).

The population was excluded from the 1995/96 spring burn of the surrounding area and will be excluded from future prescribed burns, apart from approved research burns.

A fence was erected around the population in 1996 to exclude feral pigs and kangaroos. Inspection during the subsequent flowering season revealed that some plants were outside the fence.

Individual plants are now marked in the field, each with an assigned number for long term monitoring.

Seed of *Caladenia winfieldii* was collected in November - December 1996 and has been sent to Kings Park and Botanic Garden (KPBG). Seed taken for storage in 1996 is of known parentage for three plants with the mother plant known for the fourth. Associated micorrhizal soil fungi were also collected in 1996 and are now in culture at KPBG.

The Threatened Flora Recovery Team for the Southern Forest Region is overseeing the implementation of this IRP and will include information about it in its annual report to CALM's Corporate Executive.

3.2 Essential recovery actions

3.2.1 Continue feral pig control

Pemberton and Manjimup CALM Districts will continue the monitoring of pig pellet and grain feeding stations and undertake appropriate measures to control pig numbers and potential impacts.

Action:	Monitor pellet and feeding stations and implement other measures to control feral pigs
Responsibility:	CALM (Pemberton District, Western Australian Threatened Species and Communities Unit (WATSCU))
Cost:	$3500

3.2.2 Develop a fire management plan

To protect the population from the possible detrimental effects of autumn, winter and spring burns (see 1.3 and 1.4.2) the habitat of *C. winfieldii* is currently excluded from prescribed burns. This no planned burn policy should be maintained until further scientific information becomes available regarding the species' response to fire (see Research 3.3.3). Fire exclusion of the area will be maintained by both Pemberton and Manjimup Districts. Research burns may take place after the approval of a science project proposal by the Directors of Science and Information and Nature Conservation.

Action:	Develop a fire management plan for the species habitat
Responsibility:	CALM (Pemberton District, WATSCU)
Cost:	$1000

3.2.3 Monitor population

Regular monitoring of factors such as pig activity, habitat degradation, population stability (expanding or declining), pollination activity, seed production, recruitment, and longevity is essential.

The population should be inspected annually as a requirement under CALM's Policy Statements, No. 9 *Conservation of Threatened Flora in the Wild* and No 28 *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also below 3.3.3, *Development of a quadrat/transect based monitoring system for threatened plant species.*

Action:	Monitor population annually
Responsibility:	CALM (Pemberton District, WATSCU)
Cost:	$500 pa

3.2.4 Extend the exclusion fencing

To ease the pressure from kangaroo grazing and pig activity, it is recommended that the existing fence be extended to include the whole population. Once fenced, a monitoring program is recommended to study seedling recruitment and survival rate and should be done in conjunction with several of the research projects outlined in 3.3.3.

Action:	Fence whole population
Responsibility:	CALM (Pemberton District, WATSCU)
Cost:	$1800

3.2.5 Defer further timber extraction

Until potential impacts have been identified and addressed, ie. changes to the hydrology or initiation of sedimentation at the site, further timber extraction should be deferred within the catchment (see 1.4.2, 3.1).

Action:	Defer timber extraction within catchment
Responsibility:	CALM (Manager Southern Forest Region Business Unit, Pemberton District, WATSCU)
Cost:	$200

3.2.6 Implement disease control

The site should be routinely monitored for *Phytophthora cinnamomi* (dieback) and the area treated if required. Selective or broad scale treatment with Phosphonate at the site is recommended if deaths of associated species occur, ie. *Xanthorrhoea preissii*, *Eucalyptus marginata*, *Banksia littoralis*. Two sprays would be required, six weeks apart, each year to keep the Phosphonate concentrations within the plant tissue high enough to fight the pathogen. Ultra low volume (ULV) of 20 % Phosphonate is recommended (F. Bunny pers comm.).

Action:	Monitor *Phytophthora* impact and spray if required
Responsibility:	CALM (Pemberton District, WATSCU)
Cost:	$1200

3.2.7 Conserve the genetic diversity of the species

Due to the possible future extinction of *Caladenia winfieldii* ms in the wild from disease (dieback), its limited distribution and low numbers of extant plants, some germplasm storage has been undertaken, with seed being collected in November - December 1996 and stored at KPBG. Due to the low numbers of adult plants remaining, taking of further seed may cause a significant reduction in seedling recruitment and must be carefully monitored. The first aim of a germplasm collection should be the recovery of the species in the wild.

Due to the apparent low numbers of insect pollinators (see 1.3) flowers were hand pollinated in November 1996 and will continue to be hand pollinated in future years to promote a high seed set. A proportion of seed will be collected from the population annually, attempting to ensure an adequate representation of its genetic diversity. Collections in future years will target parents not yet in storage; those already represented in storage to be left for dispersal in the field and *in situ* recruitment.

If it is not possible to collect adequate quantities of viable seed in future years, other more costly methodologies may need to be investigated such as living collections obtained from other source material (tubers or tissue culture material). If resources are limited these techniques will need to be carefully prioritised in relation to *in situ* conservation. This should be coordinated by the Southern Forest Threatened Flora Recovery Team (SFTFRT).

Genetic conservation of the species should be incorporated into the research component (see 3.3.3).

Action:	Collect seed and/or other genetic material from the population, conduct hand pollination annually
Responsibility:	SFTFRT, CALM Pemberton District and Threatened Flora Seed Centre (TFSC), KPBG
Cost:	$1600

3.3 Desirable recovery actions

3.3.1 Conduct further surveys

Surveying areas of suitable habitat for translocation and possible further populations of *C. winfieldii* ms should be undertaken on a systematic basis during the flowering period of the species (October - early November), particularly in the season following summer wildfire (December-March). Volunteers from the local community, Wildflower societies, Naturalist Clubs and WANOSCG could be involved in these surveys which should be supervised by CALM staff.

Action:	Survey areas of suitable habitat for *C. winfieldii* ms
Responsibility:	CALM (Pemberton District, WATSCU)
Cost:	$1500

3.3.2 Information dissemination

To promote an awareness of *C. winfieldii* among relevant CALM staff and members of the public the production of an information leaflet or poster, which illustrates and provides information on the species, is recommended.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted to the general public, but the exact location of *C. winfieldii* should remain confidential. Awareness can be encouraged throughout the community by a publicity campaign using the local print and electronic media and by setting up poster displays in venues of high exposure. Formal links with local naturalist groups and interested individuals should also be encouraged. Such activities may lead to the discovery of new populations of the species.

Action:	Produce information leaflets and posters, implement a publicity campaign
Responsibility:	CALM (Corporate Relations Division, WATSCU, Pemberton District)
Cost:	$1500

3.3.3 Research

Research designed to increase understanding of the biology and ecology of *C. winfieldii* ms will provide a scientific base for the management of the species in the wild. Research would ideally include:

1. **Monitoring** of the population is essential to determine pollinator activity, seed set, recruitment rates, longevity of individual plants, effects of disturbance (ie. fire) and the effects of competition. A quadrat/transect based monitoring system is in the process of being developed and will be outlined in a future CALM discussion paper *Development of a quadrat/transect based monitoring system for threatened plant species*, A. Brown, D. Coates and P. Pigott (in prep).

2. **Seed development, seed germination and protocorme** research is essential for understanding the seed biology, seed germination requirements and how the subsequent development of protocormes and juvenile plants of *C. winfieldii* ms takes place. Any seed collection must be carefully managed due to the significant risk of a future reduction in the size of the population if too little seed is left on the plants for natural recruitment.

3. The **response to summer fire** is well documented for many Western Australian orchid species, however little information is currently available for *C. winfieldii* ms. Determination of *C. winfieldii* ms response to summer fire and sensitivity to different fire regimes (autumn, winter, spring) would provide valuable information on the future effects of unplanned fire events on the species. Due to the low numbers of plants, burning and smoke trials should be limited to a small part of the population. All trials should be incorporated with monitoring.

4. The **pollination biology** of many Western Australian orchid species is known to be highly selective with many being pollinated by different insect species. To date, no pollinator activity has been observed on *C. winfieldii* ms, however it is likely that the species is wasp pollinated as it shares morphological features found in several other *Caladenia* species known to be visited by flower wasps. It is possible that the appropriate pollinator is very rare at the site. Research could be incorporated into a larger study of the pollination of the genus *Caladenia*.

Other areas of research are:

5. Investigation of factors determining level of flower and fruit abortion.
6. The longevity of individual plants, and time taken to reach maturity.
7. Quantification of level of invertebrate damage to seed capsules.
8. Knowledge of the extent of genetic variation within the population is essential if new populations are to be established (3.2.7).

Action:	Conduct research
Responsibility:	CALM (Science and Information Division (SID), WATSCU, Southern Forest Region)
Cost:	$2000

3.3.4 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Surveying potential habitat for possible future translocation sites is recommended within the scope of IRPs, with actual translocation addressed in full Recovery Plans where necessary. This should be coordinated by the Southern Forest Region Threatened Flora Recovery Team (SFRTFRT). All translocation proposals require endorsement by the Director of Nature Conservation.

Action:	Survey potential habitats for translocation
Responsibility:	CALM, SFRTFRT
Cost:	See Section 3.3.1

Table 2: Summary of recovery actions

Recovery Actions	Priority	Responsibility	Completion date
Essential			
Continue feral pig control	High	CALM Pemberton District, WATSCU	Ongoing
Develop a fire management plan	High	CALM Pemberton District, WATSCU	February 1996, ongoing
Monitor population	High	CALM Pemberton District, WATSCU	Commenced September-October 1996, ongoing
Extend exclusion fencing	High	CALM Pemberton District, WATSCU	September 1997
Defer further timber extraction	High	CALM SFR Business Unit, Pemberton District, WATSCU	Ongoing
Implement disease control	High	CALM Pemberton District, WATSCU	Ongoing
Preserve genetic diversity of the species	High	SFRTFRT, CALM Pemberton District & TFSC, KPBG	September-October 1996,1997,1998
Desirable			
Conduct further surveys	Mod	CALM Pemberton District, WATSCU	September-October 1996,1997,1998
Information dissemination	Mod	CALM Corporate Relations, WATSCU, CALM Pemberton District	February 1996
Research	Mod	CALM SID, WATSCU, Southern Forest Region	Commence September-October 1996, ongoing
Translocation	Low	CALM, SFRTFRT	see further surveys

3.4. Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Continue feral pig control	1500			1000		1000	
Develop a fire management plan	500			500			
Monitor population	200	300		200	300	200	300
Extend exclusion fencing	1600	300		500			
Defer further timber extraction	200			200			
Implement disease control	400			400		400	
Preserve genetic diversity of the species		500	1100				
Sub-total	**$4400**	**$1100**	**$1100**	**$2800**	**$300**	**$1600**	**$300**
Desirable							
Conduct further surveys	300	200		300	200	300	200
Information dissemination		500			1500		
Research	1000			1000			
Sub-total	**$1300**	**$700**		**$1300**	**$1700**	**$300**	**$200**
Total	**$5700**	**$1800**	**$1100**	**$4100**	**$2000**	**$1900**	**$500**

EA Environment Australia (formerly ANCA)

Total of all costs : $17 100

ACKNOWLEDGMENTS

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Roger Hearn	Southern Forest Region, CALM
Ian Wilson	Manjimup District, CALM
Bill Jackson	Volunteer, Walpole
Andrew Burbidge	WATSCU, CALM

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CALM (1995). Policy Statement No. 29 *Translocation of Threatened Flora and Fauna* Department of Conservation and Land Management, Perth.

CALM (In prep.). Discussion paper (No. to be allocated) *Development of a quadrat/transect based monitoring system for threatened plants*. Department of Conservation and Land Management, Perth.

Hoffman, N. and Brown, A. (1992) *Orchids of South West Australia.* 2nd Edition. University of Western Australia Press, Nedlands.

Appendix One: Extract from a draft taxonomic description of *Caladenia winfieldii* by S.D. Hopper and A. P. Brown, in prep.

Caladenia winfieldii can be distinguished from other members of the *C. huegelii* complex in its rich pink colouration, its petals and sepals stiffly held near the base with drooping apices; its lateral sepals 4.5-7.5 cm long and 4-6.5 mm wide, usually splayed out at 45° below horizontal before drooping vertically as slender filiform greyish-pink clubs 15-35 mm long; its petals 3-5.5 cm long by 3-4.5 mm wide, splayed horizontally or slightly ascending before curving downwards as finely tapering sometimes glandular acute apices, lacking conspicuous clubs; its labellum 15-23 mm long and 8-11 mm wide, the basal lamina pale pink with prominent to inconspicuous pink radiating stripes; its labellum fringe of slender to robust dark pink segments to 5 mm long with enlarged or tapering pale pink or white-tipped apices; and its small column 13-16 mm tall and 7-8 mm wide across the wings.

Appendix Two: Associated species

LINDSAEACEAE
Lindsaea linearis

CYPERACEAE
Cyathochaeta avenacea

XANTHORRHOEACEAE
Xanthorrhoea preissii

ANTHERICACEAE
Sowerbaea laxiflora
Johnsonia lupulina

HAEMODORACEAE
Anigozanthos bicolor
Anigozanthos flavidus

IRIDACEAE
Patersonia occidentalis

ORCHIDACEAE
Caladenia flava

GOODENIACEAE
Lechenaultia biloba

SANTALACEAE
Leptomeria cunninghamii

RANUNCULACEAE
Clematis pubescens
Ranunculus colonorum

DROSERACEAE
Drosera gigantea
Drosera modesta

MIMOSACEAE
Acacia saligna

PAPILIONACEAE
Bossiaea linophylla
Chorizema ilicifolium
Kennedia ?glabrata

TREMANDRACEAE
Platytheca galioides
Tetratheca affinis

STERCULIACEAE
Thomasia pauciflora

DILLENACEAE
Hibbertia amplexicaulis

MYRTACEAE
Agonis ? parviceps
Eucalyptus marginata
Eucalyptus rudis
Kunzea recurva
Melaleuca preissiana

EPACRIDACEAE
Leucopogon australis
Leucopogon ? unilateralis
Leucopogon verticillatus
Leucopogon sp.

PROTEACEAE
Banksia littoralis
Hakea varia
Hakea oleifolia

INTERIM RECOVERY PLAN NO. 16

SWAMP STARFLOWER (*CALYTRIX BREVISETA* SUBSP. *BREVISETA*) INTERIM RECOVERY PLAN

1996-1999

by

Kim Kershaw, Emma Holland and Andrew Brown

June 1996

Department of Conservation and Land Management
Western Australian Threatened Species and Communities Unit
PO Box 51, Wanneroo, WA 6065

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50. IRPs are designed to run for three years only and will be replaced by full Recovery Plans where required.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This IRP was approved by the Director of Nature Conservation on 17 May 1997. Approved IRPs are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at March, 1997.

CONTENTS

SUMMARY

Swamp Starflower, *Calytrix breviseta* subsp. *breviseta* Family: MYRTACEAE

Flowering period: September-October

CALM Region: Swan **CALM District:** Perth **Shire:** Gosnells

Current status: Declared as Rare Flora in May 1991, ranked as Critically Endangered in September 1995

Recovery Team: Swan Region Threatened Flora Recovery Team

Illustrations and/or further information: A.E. Kelly, *et al. Declared Rare Flora and Other Plants in Need of Special Protection in the Metropolitan Area* (1993); S.J. Patrick, *Wildflower Society of Western Australia Newsletter* (1991); N.G. Marchant, *et al. Flora Of The Perth Region.* (1987); S. Curry and A.E. Kelly, *Landscope* (1993).

Calytrix breviseta subsp. *breviseta* is an erect or spreading shrub to 40 cm tall with linear to narrowly elliptic leaves and purple-blue flowers. It is known from 750+ plants in two populations. Population 1 is on private property (subpopulation 1a) and an adjacent property owned by the Ministry for Planning (subpopulation 1b). Population 2 is on private property. Both populations occur in the Kenwick area.

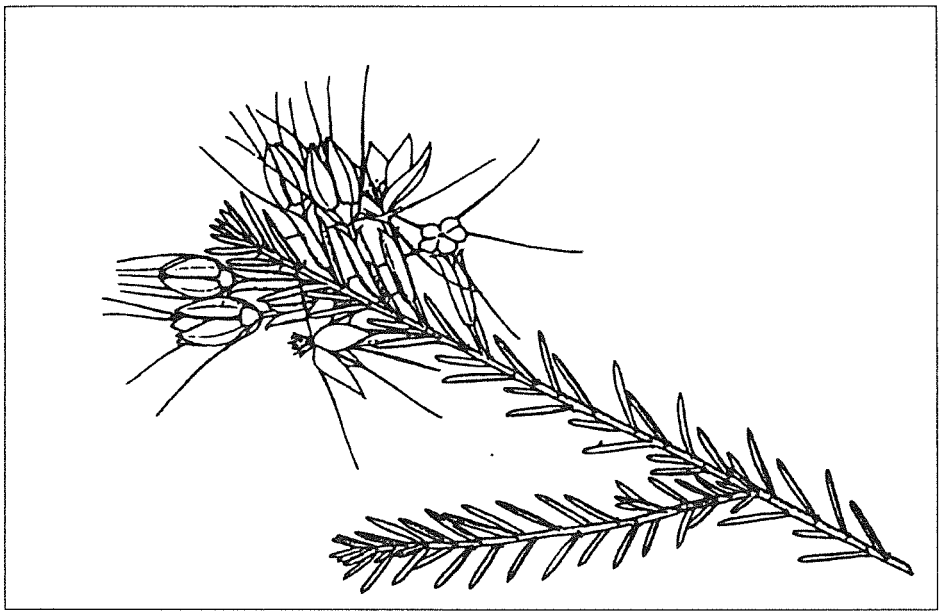
Recorded from the Bellevue and Gosnells areas in 1901 and 1915 respectively, *Calytrix breviseta* subsp. *breviseta* was then thought to have become extinct until it was rediscovered in 1990 during field work for CALM's Metropolitan Region Threatened Flora Management Program. Clearing on the Swan Coastal Plain has removed most suitable habitat and is the most obvious cause of the subspecies current critically endangered status.

Both populations are exposed to threats associated with little remaining habitat, weed invasion, accidental destruction, inappropriate fire and dieback. The aim of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations of *C. breviseta* subsp. *breviseta* in order to preserve the wild genetic stock of the subspecies. To achieve this aim the following essential and desirable recovery actions are prescribed.

Recovery actions:

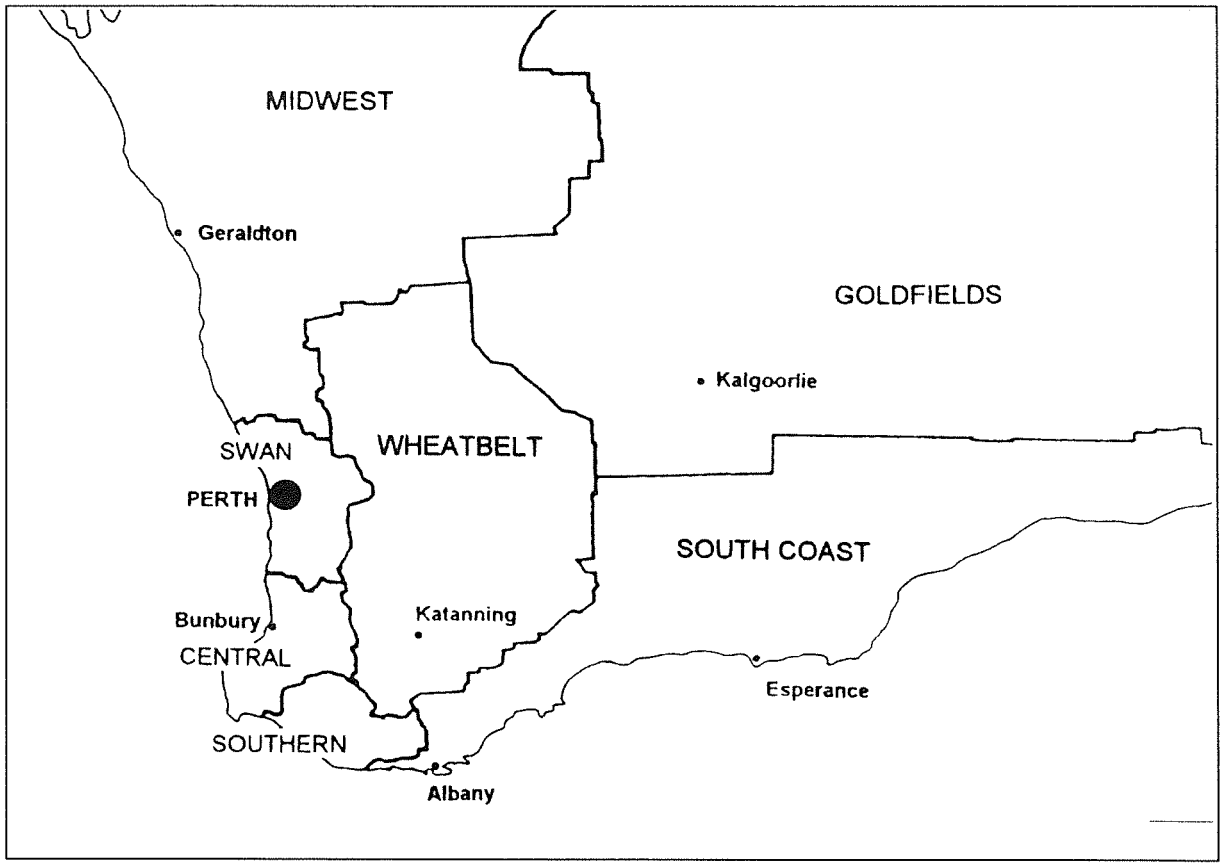
	Essential		Desirable
1.	Install Declared Rare Flora markers	1.	Preserve genetic diversity of the subspecies
2.	Implement weed control	2.	Buffers and habitat rehabilitation
3.	Develop a fire management plan, ensure dieback hygiene	3.	Land title transfer
4.	Information dissemination	4.	Conduct further surveys
5.	Monitor populations	5.	Conduct research
		6.	Translocation

Calytrix breviseta subsp. *breviseta*



Donna Terrington

Distribution of *Calytrix breviseta* subsp. *breviseta*



1. BACKGROUND

1.1 History, taxonomy and status

Calytrix breviseta subsp. *breviseta* is an erect or spreading shrub to 40 cm high with linear to narrowly elliptic leaves and attractive purple-blue flowers. It differs from *C. breviseta* subsp. *stipulosa*, which is widespread in mallee and heath communities east of the Darling Range, in having longer, usually linear leaves, longer petals, a greater number of stamens, equal bracteoles, and a swampy clay flat habitat (Kelly *et al.* 1993).

A full taxonomic description is provided by L. A. Craven (1987) is included in Appendix 1.

Initially recorded from the Bellevue area (20 km E of Perth) in 1901 and Gosnells in 1915, this taxon was then thought to have become extinct until November 1990 when rediscovered by A. Kelly and A. Spooner during field work for the Department of Conservation and Land Management (CALM) Metropolitan Region Threatened Flora Management Program. In 1995 these populations were again surveyed and two populations containing a total of c. 750 plants were located. One population consists of 350+ seedlings which germinated following a summer wildfire in January 1994.

Recent surveys in the Bellevue area were not successful in locating populations of *C. breviseta* subsp. *breviseta*. The area has been largely cleared and no suitable habitat was found. Surveys of Ellen Brook Nature Reserve and heath near the Mundijong Road-Kargotich Road junction also failed to locate plants. Other areas surveyed include Tonkin Highway and the Railway Marshalling Yard, Guildford Cemetery, Hartfield Country Club in Forrestfield, areas near Forrestdale Lake, Keane Road and Passmore Road in Gosnells, Turner Road in Byford and the junction of High and Nicholson Roads in Canning Vale.

Due to the low number of plants, restricted distribution and the threats associated with growing in a specialised habitat, *Calytrix breviseta* subsp. *breviseta* was declared as Rare Flora in May 1991 and ranked as Critically Endangered in September 1995.

1.2 Distribution and habitat

Although originally recorded from Gosnells and Bellevue *C. breviseta* subsp. *breviseta* is now apparently confined to the Kenwick area. It is endemic to Western Australia.

It is found on a low lying, sandy clay flat amongst low heath of *Verticordia acerosa*, *Verticordia plumosa*, *Calothamnus hirsutus* and *Melaleuca uncinata* over very open low sedges. A list of associated species is included in Appendix 2.

Summary details of the two known populations are outlined in Table 1. A detailed description of each populations location is included in Appendix 3 (Confidential and not for publication).

Table 1: Summary of population information

Pop. No & Location.	Land Status	No. of plants.	Condition	Threats
1a. Kenwick	Ministry for Planning	350+ (seedlings)	Moderate	Frequent fire, accidental destruction during firebreak maintenance, weed invasion, dieback
1b. Kenwick	Private Property	130 (mature) 5 (seedlings)	Good	Accidental destruction during clearing and firebreak maintenance, dieback
2. Kenwick	Private Property	270 (mature) 30 (seedlings)	Good	Accidental destruction during clearing and firebreak maintenance, dieback

1.3 Biology and ecology

Very little is known about the biology and ecology of *C. breviseta* subsp. *breviseta*, both of which are currently being researched by Kings Park and Botanic Garden (KPBG). Subpopulation 1a consists of seedlings only which germinated following fire in January 1994 and indicates that the taxon is likely to be highly smoke responsive (K. Dixon. pers. comm.).

1.4 Threatening processes

1.4.1 Causes of the Critically Endangered status of this subspecies

The rarity of *C. breviseta* subsp. *breviseta* is probably due to the amount of clearing that has occurred for agriculture, housing and industry on the Swan Coastal Plain. Keighery (1994) states that more than 98% of the eastern side of the Swan Coastal Pain has been cleared, a higher percentage than for the wheatbelt. Habitat may have also been lost as a result of the pathogen *Phytophthora* spp. (dieback). The susceptibility of *C. breviseta* subsp. *breviseta* to *Phytophthora* spp is unknown, however many other members of the Myrtaceae family are known to be susceptible.

1.4.2 Threats to the ongoing survival of this subspecies in the wild

- **Accidental destruction** of some plants is possible during firebreak maintenance. All relevant authorities and land owners have been provided with locality information and made aware of the presence of this taxon.

- **Frequent burning** could result in the destruction of populations of *C. breviseta* subsp. *breviseta* . Although the fire that occurred in January 1994 on Ministry for Planning land (subpopulation 1a) stimulated the germination of soil stored seed it killed adult plants. This in itself is not a threat but it is possible that most seed germinated and few, if any, remain in the soil. If this is the case, any further burning before flowering and seed set could be detrimental.

- **Weeds** are invading subpopulation 1a and are competing with seedlings of *C. breviseta* subsp. *breviseta* for moisture and sunlight. Weeds also increase the fire risk of the area.

- **Dieback** is a serious threat to many ecological communities of the south-west. The susceptibility of *C. breviseta* subsp. *breviseta* to *Phytophthora* spp. is unknown, but many members of the Myrtaceae are susceptible to the pathogen.

1.5 Conservation status

C. breviseta subsp. *breviseta* is known from two populations. Population 1 is on private property (subpopulation 1a) and an adjacent property owned by the Ministry for Planning (subpopulation 1b). Population 2 is on private property. No plants are known to exist on a conservation reserve.

1.6 Strategy for recovery

The following essential strategies will be implemented:

1. Control the most threatening factors currently affecting *C. breviseta* subsp. *breviseta* as outlined in 3.2.
2. Protect *C. breviseta* subsp. *breviseta* from possible future threats (eg dieback) by appropriate management practices (see 3.2.3).
3. Ensure that relevant authorities, land owners and CALM personnel are aware of the presence of *C. breviseta* subsp. *breviseta*, and the need to protect it (eg. notification and roadside markers) and ensure that all are familiar with the threatening processes identified in these guidelines (see 3.2.1, 3.2.4).

The following desirable strategies will be implemented if resources permit:

1. Preserve the genetic diversity of *C. breviseta* subsp. *breviseta* by including it in a seed bank, cryostorage and/or *ex situ* cultivation (see 3.3.1).
2. Maintain buffers of natural vegetation around populations of *C. breviseta* subsp. *breviseta* and allow disturbed areas to revegetate naturally (see 3.3.2).
3. Ensure that the land title transfer occurs with the land containing Population 1a (currently owned by the Ministry for Planning) being vested with the National Parks and Nature Conservation Authority (NPNCA) and managed by CALM (see 3.3.3).
4. Conduct further surveys for *C. breviseta* subsp. *breviseta* on land containing suitable habitat (see 3.3.4).
5. Research the biology and ecology of *C. breviseta* subsp. *breviseta* (see 3.3.5).
6. Enhance plant numbers (eg by removal of a limiting factor or direct propagation and translocation techniques, see CALM Policy Statement No 29, *Translocation of Threatened Flora and Fauna* (see 3.3.6).

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

The objective of this Interim Recovery Plan is to abate identified threats and maintain viable *in situ* populations to ensure the long term preservation of the species in the wild.

2.2 Criteria

2.2.1 Criteria for success

Recovery will be deemed a success if threatening processes identified within this IRP have been reduced or removed within the three year period.

2.2.2 Criteria for failure

The recovery process will have been unsuccessful if threats identified have not abated within the three year period of this IRP or there has been a substantial decrease in the number of mature plants.

3. RECOVERY ACTIONS

3.1 Existing recovery actions

Declared Rare Flora (DRF) markers are now in place.

All relevant authorities and land managers know of the location of *C. breviseta* subsp. *breviseta*.

CALM's Science and Information Division (SID) is conducting weed control research on subpopulation 1a.

KPBG collected seed and cuttings in 1995.

Staff from CALM's Threatened Flora Seed Centre (TFSC) collected seed in 1994 and 1995. Some seed collected in 1994 was given to KPBG and seed material collected in 1995 was infertile. Due to the fire that occurred in the area of subpopulation 1a, and the subsequent poor flowering and seed set of juvenile plants, little seed was collected in 1996. Staff from the TFSC will collect more seed in 1997.

The Swan Region Threatened Flora Recovery Team (SRTFRT) is overseeing the implementation of this IRP and reports annually to CALM's Corporate Executive.

3.2 Essential recovery actions

3.2.1 Install Declared Rare Flora (DRF) markers

During an inspection of *C. breviseta* subsp. *breviseta* populations in late November 1995, it was noticed that recent earthworks had occurred along the south east fenceline of the Ministry for Planning property (subpopulation 1a). The north west road reserve had been graded and vehicles had also entered the property and graded along the firebreak. During these activities, DRF markers were moved. As the subpopulation is adjacent to the firebreak, the potential for accidental destruction is high.

Action:	Install three DRF markers
Responsibility:	CALM (Perth District, Western Australian Threatened Species and Communities Unit (WATSCU))
Cost:	$200

3.2.2 Implement weed control

The south east edge of subpopulation 1a is becoming severely weed infested. Although the subpopulation was subject to weed control research in 1996 by SID, a weed control program is required and will involve:

1. Accurately mapping the boundaries of the subpopulation.
2. Selection of an appropriate herbicide or other method of weed control after determining which weeds are present.
3. Controlling invasive weeds internal to the boundary by hand removal and spot spraying around individual *C. breviseta* subsp. *breviseta* plants when weeds first emerge.
4. Scheduling to include weed spraying of other DRF populations requiring weed control within the Swan Region.

Action:	Implement weed control
Responsibility:	CALM (Perth District, SID, WATSCU), Gosnells Shire
Cost:	$500 pa.

3.2.3 Develop a fire management plan, ensure dieback hygiene

The fire hazard that weeds create in summer may be a threat to subpopulation 1a. *C. breviseta* subsp. *breviseta* seedlings in this subpopulation have had few flowers and are not mature enough to have produced enough seed to replenish the soil seed bank.

It is recommended that CALM Perth District personnel hold an on-site meeting with representatives from relevant authorities and land managers to outline the problems associated with inappropriate fire regimes and develop a fire management plan. Part of the fire management plan will involve the maintenance of firebreaks, especially those on the Ministry for Planning land (subpopulation 1a). Close liaison between all relevant land managers is required due to the close proximity of plants to firebreaks. CALM supervision of firebreak maintenance is recommended for both private property and Ministry for Planning land.

Due to the likely susceptibility of *C. breviseta* subsp. *breviseta* to dieback, all vehicles entering these sites should be subjected to dieback hygiene procedures.

Action:	Develop a fire management plan, dieback hygiene
Responsibility:	CALM (Perth District, WATSCU), relevant authorities and land owners
Cost:	$850

3.2.4 Information dissemination

To promote an awareness of *C. breviseta* subsp. *breviseta* among relevant CALM and Shire staff, the production of posters and dashboard stickers is recommended. Dashboard stickers should illustrate a DRF marker and provide a contact telephone number if one is encountered. Posters should illustrate and provide descriptive information on the subspecies.

The importance of biodiversity conservation and the preservation of critically endangered species need to be promoted to the general public, however, it is recommended that the exact location of *C. breviseta* subsp. *breviseta* remain confidential. Awareness can be encouraged throughout the community by a publicity campaign using the local print and electronic media and by setting up poster displays in venues of high exposure. Formal links with local naturalist groups and interested individuals should also be encouraged.

Action:	Produce posters and dashboard stickers, implement a publicity campaign
Responsibility	CALM (Corporate Relations Division, Perth District, WATSCU)
Cost:	$500 first year, $1500 second year

3.2.5 Monitor populations

Monitoring of factors such as weed encroachment, habitat degradation, population stability (expanding or declining), pollination activity, seed production, recruitment, and longevity is prescribed.

Populations will be inspected annually as a requirement under CALM's Policy Statements No. 9. *Conservation of Threatened Flora in the Wild* and No. 28. *Reporting Monitoring and Re-evaluation of Ecosystems and Ecosystem Management*. See also below 3.3.5 (11) *Development of a Quadrat/Transect Based Monitoring System For Threatened Plant Species*.

Action:	Monitor populations
Responsibility:	CALM (Perth District, WATSCU)
Cost:	$350 pa.

3.3 Desirable recovery actions

3.3.1 Preserve genetic diversity of the subspecies

Germplasm collections should be given a high priority if the extinction of populations of *C. breviseta* subsp. *breviseta* is considered a high probability through disease, its limited distribution or low number of plants. If this is deemed to be the case, recovery of this subspecies is likely to need *ex situ* conservation techniques.

Genetic diversity conservation of the species should be incorporated into the research component (see 3.3.5) and should include collection of seed from both populations, ensuring an adequate representation of genetic diversity of each.

If it is not possible to collect adequate quantities of viable seed, other more costly germplasm storage methodologies may need to be investigated. These can involve living collections from cutting or other source material, or storage of tissue culture material. If resources are limited these techniques will need to be carefully prioritised in relation to *in situ* conservation. This will be coordinated by the SRTFRT.

It is also important that the size and viability of the soil seed bank is determined and research undertaken to develop techniques for stimulating germination of soil stored seed. Care, however, should be taken as these processes inherently carry a significant risk of depletion of seed bank reserves.

Action:	Collect seed and/or genetic material from both populations, determine the size and viability of soil seed banks
Responsibility:	SRTFRT, CALM (TFSC), KPBG
Cost:	$1600.

3.3.2 Buffers and habitat rehabilitation

The remnant vegetation surrounding Populations 1 and 2 should be maintained as a buffer to prevent the encroachment of weeds. It also provides habitat for a population of the threatened Quenda (Southern Brown Bandicoot).

It is recommended that the track through the middle of the south-west section of the Ministry for Planning property be allowed to revegetate naturally. If weed control is necessary along this track, it should be carried out at the same time weed control is implemented for subpopulation 1a.

Action:	Buffers and habitat rehabilitation
Responsibility:	CALM (Perth District, WATSCU)
Cost:	Nil, unless weed control needed

3.3.3 Land title transfer

The Ministry for Planning property (subpopulation 1a) is managed for conservation. In time it will be vested with the NPNCA and managed by CALM. This land provides continuity with several other relatively undisturbed natural plant communities, including the adjacent remnant pockets of native vegetation on the Yule Brook property owned by The University of Western Australia (which is effectively managed as a reserve), Bickley Road area and the proposed Brixton Street Reserve (Mattiske and Associates 1992a).

The addition of the property containing *C. breviseta* subsp. *breviseta* to the conservation reserve system will be particularly valuable as the subspecies occurs on Guildford clays which are found only on the eastern side of the Swan Coastal Plain. These soils are very fertile and occur in areas that have been almost entirely cleared for agriculture and urban use.

The proposed Brixton Street Reserve and associated wetlands are currently under assessment by the Australian Heritage Commission for inclusion on the Register of the National Estate. These areas, when combined, support several threatened species which are currently being studied by KPBG as well as a number of taxa on the Priority Flora list and rare hybrids (see list below).

Declared Rare Flora:

Aponogeton hexatepalus, *Hydrocotyle lemnoides* and *Diuris purdiei*.

Priority Flora:

Priority 1
Calandrinia aff. *composita*, *Eryngium pinnatifidum* subsp. *palustre* ms, *Eryngium subdecumbens* ms, *Grevillea thelemanniana* subsp. *thelemanniana* and *Lepidosperma rostratum*.

Priority 2
Andersonia gracilis, *Comesperma rhadinocarpa*, *Hydatella dioica* and *Schoenus capillifolius*.

Priority 3
Baeckea tenuifolia, *Eleocharis* sp. (GJK 5180), *Helipterum pyrethrum*, *Isopogon drummondii*, *Rhodanthe pyrethrum*, *Schoenus benthamii* and *Synaphea acutiloba*.

Priority 4
Anthotium junciforme, *Comesperma undulatum*, *Drosera occidentalis*, *Verticordia lindleyi* subsp. *lindleyi* and *Villarsia submersa*

Rare Hybrids:

Anigozanthos bicolor x. *viridis*, *A. bicolor* x. *manglesii*, *A. manglesii* x. *viridis*, *Tribonanthes brachypetala* x. *australis* and *T. australis* x. *uniflora*.

Action:	Land title transfer (Ministry for Planning land to be vested with the NPNCA and managed by CALM)
Responsibility:	CALM (Land Administration, Perth District), Ministry for Planning
Cost:	$150 pa. (for 2 years)

3.3.4 Conduct further surveys

Areas of uncleared land containing suitable habitat will be further surveyed on a systematic basis for the presence of *C. breviseta* subsp. *breviseta*. This should be conducted by CALM District and Regional staff and be done when the subspecies is in flower (September-October).

Action:	Conduct further surveys
Responsibility:	CALM (Perth District, Swan Region)
Cost:	$500 pa.

3.3.5 Conduct research

Weed control research is currently being carried out. Further research designed to increase an understanding of the biology and ecology of *C. breviseta* subsp. *breviseta* will provide a scientific base for management of this subspecies in the wild. Research should include:

1. The response of *C. breviseta* subsp. *breviseta* to herbicide treatments.
2. Pollination biology and seed set.
3. Investigation of factors determining level of flower and fruit abortion.
4. Quantification of level of invertebrate grazing or removal of seed.
5. The size and viability of seed bank.
6. Seed germination requirements.
7. The role of disturbance in regeneration.
8. Longevity of plants, and time taken to reach maturity.
9. Knowledge of the extent of genetic variation within and between populations. This is essential if new populations are to be established.
10. The development of a monitoring system. Specific protocols for rare flora will be outlined in a future CALM discussion paper "*Development of a quadrat/transect based monitoring system for threatened plant species*", A. Brown, P. Pigott and D. Coates (in prep).

Action:	Conduct research
Responsibility:	CALM (SID, Perth District, WATSCU)
Cost:	$1000 first year, $2000 second year

3.3.6 Translocation

Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29. Surveying potential habitats for possible future translocation sites is recommended within the scope of IRPs, with actual translocation addressed in full Recovery Plans where necessary. This should be coordinated by the SRTFRT. Any translocation proposal will have to be endorsed by the Director of Nature Conservation.

Action:	Survey potential habitat for translocation
Responsibility:	SRTFRT, CALM (Perth District, Swan Region)
Cost:	See Section 3.3 4 (Conduct further surveys)

Table 2: Summary of recovery actions

Recovery Actions	Population	Priority	Responsibility	Completion date
Essential				
Install DRF markers	1a & 2	High	CALM (Perth District, WATSCU)	Done 17th September 1996
Implement weed control	1a	High	CALM (Perth District, SID, WATSCU), Gosnells Shire	April 1996, ongoing
Develop a fire management plan, ensure dieback hygiene	1a, 1b & 2	High	CALM (Perth District, WATSCU), relevant authorities and landowners	September 1996/98
Information dissemination	1a, 1b & 2	High	CALM (Corporate Relations Division, Perth District, WATSCU)	Ongoing
Monitor populations	1a, 1b & 2	High	CALM (Perth District, WATSCU)	August - October 1996/97/98
Desirable				
Preserve genetic diversity of the subspecies	1a & 1b	Moderate	SRTFRT, CALM (TFSC), KPBG	November 1995
Buffers and habitat rehabilitation	1a	Moderate	CALM (Perth District, WATSCU)	April - May 1996
Land title transfer	1a	Moderate	CALM (Land Administration, Perth District), Ministry for Planning	In negotiation/ongoing
Conduct further surveys		Moderate	CALM (Perth District, Swan Region)	September -October 1996/97/98
Conduct research.	1a, 1b & 2	Moderate	CALM (SID, Perth District, WATSCU)	Ongoing
Translocation.		Low	SRTFRT, (CALM Perth District, WATSCU)	No date set

3.4. Costs

Table 3: Summary of costs for each recovery action

Recovery Action	1996			1997		1998	
	CALM	EA	KPBG	CALM	EA	CALM	EA
Essential							
Install DRF markers	200						
Implement weed control	500			500		500	
Develop a fire management plan, ensure dieback hygiene	850					500	
Information dissemination		500			1500		
Monitor populations	350			350		350	
Sub-total	**$1900**	**$500**		**$850**	**$1500**	**$1350**	
Desirable							
Preserve genetic diversity of the subspecies	500		1100				
Land title transfer	150			150			
Conduct further surveys	500			500		500	
Conduct research	1000			2000			
Sub-total	**$2150**		**$1100**	**$2650**		**$500**	
Total	**$4050**	**$500**	**$1100**	**$3500**	**$1500**	**$1850**	

EA Environment Australia (formerly ANCA)

Total of all costs over three years: $12 500

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Appendix One: Taxonomic description

Craven, L.A. (1987). A taxonomic revision of *Calytrix* Labill. (Myrtaceae). *Brunonia* **10**, 1-138. CSIRO, Melbourne.

63A. *Calytrix breviseta* subsp. *breviseta*

Calycothrix cuspidata Turcz., Bull. Soc. Imp. Naturalistes Moscou 20: 162 (1847). — *Calythrix cuspidata* (Turcz.) Benth., Fl. Austral. 3: 45 (1867), *nom. inval.* [pro *syn.*]. — Syntypi: Western Australia. *Gilbert 333*, *335* (KW).

Leaves widely spaced, spreading-ascending; stipules to 1·25 mm long; petiole 0·1-0·75 mm long; blade linear, linear-lanceolate, lanceolate, or narrowly elliptic, 2-9 mm long, 0·5-1·25 mm wide, slightly incurved, or straight or slightly recurved, in transverse section obtriangular with the adaxial surface concave to convex, or sometimes semiorbicular or broadly obtriangular. Inflorescences scattered. Cheiridium narrowly funnel-shaped, 7-11 mm long; lobes elliptic to obovate, 5-7 mm long (the lobes ± equal in length), the apex rounded and mucronate, recurved. Hypanthium 6·5-10 mm long, the ovarian region 0·5-0·6 mm wide, the adnate region 0·4 mm wide, the staminal disc slightly prominent. Calyx segments with the blade depressed obovate to shortly ovate, 1·75-2·5 mm long, 2-2·8 mm wide, the apex produced into an awn to 11 mm long, the awn ± straight to sinuous in bud. Petals (colour unknown) elliptic to lanceolate, 7·25-10 mm long, 3-3·8 mm wide, the apex acute. Stamens *c.* 40-65, ± regularly 3- or 4-seriate (when 3-seriate sometimes partly 2- or 4-seriate in one flower), the filaments (colour unknown) 2-6 mm long. Style 4-5 mm long.

Distribution and Ecology

Western Australia: Perth district. See Map 45.

Recorded as occurring on swampy clay flats, and in damp situations in open sandy forest of *Eucalyptus marginata*. Flowering period: October and November.

Other Specimens Examined

WESTERN AUSTRALIA: Bellevue, 20 km E. of Perth, *Andrews 312* (PERTH); Gosnells, Sept. 1915, *Alexander s.n.* (PERTH); base of Darling Range, Nov. 1902, *Fitzgerald s.n.* (NSW). Without definite locality: *Drummond 1st coll. 157* (MEL, NSW); *Pritzel 837* (AD, NSW).

Notes

The longer, usually linear, leaves and longer petals of *C. breviseta* subsp. *breviseta* are the main features by which it is separated from *C. breviseta* subsp. *stipulosa*. Additional differences are that subsp. *stipulosa* has fewer stamens than subsp. *breviseta*, and that the cheiridium is often slightly asymmetrical in subsp. *stipulosa* due to one lobe being slightly shorter than the other.

A rather small specimen in MEL (*Bussell s.n.*, Wallcliff) may belong to *C. breviseta* subsp. *breviseta*. If so it would extend the known range of this subspecies considerably further southwards.

No specimens were cited by Lindley when he described *Calytrix breviseta* and I have selected as lectotype a Drummond specimen from Lindley's herbarium in CGE.

Appendix Two: Associated species

CUPRESSACEAE
Actinostrobus pyramidalis

POACEAE
**Avena fatua*
**Briza maxima*
**Briza minor*
Danthonia setacea
**Eragrostis curvula*
**Polypogon monspeliensis*
**Vulpia* sp.

RESTIONACEAE
Isolepis nodosa
Leptocarpus canus

CENTROLEPIDACEAE
Centrolepis aristata

DASYPOGONACEAE
Lomandra integra

ANTHERICACEAE
Borya sphaerocephela

MIMOSACEAE
Acacia lasiocarpa var. *lasiocarpa*

COLCHICACEAE
Burchardia multiflora

HAEMODORACEAE
Anigozanthos viridis
Conostylis filifolia
Haemodorum simplex

IRIDACEAE
**Romulea rosea*

THYMELAEACEAE
Pimelea imbricata

PROTEACEAE
Banksia telmatiaea
Grevillea thelemanniana subsp. *thelemanniana*

PAPILIONACEAE
**Lotus suaveolens*
**Trifolium campestre*

ASTERACEAE
Podolepis lessonii

STYLIDIACEAE
Stylidium divaricatum

MYRTACEAE
Calytrix aurea
Calothamnus hirsutus
Eremaea pauciflora
Hypocalymma angustifolium
Melaleuca rhaphiophylla
Melaleuca thymoides
Melaleuca uncinata
Verticordia acerosa
Verticordia huegelii
Verticordia plumosa

GENTIANACEAE
**Centaurium erythraea*

SCROPHULARIACEAE
**Parentucellia viscosa*

LOBELIACEAE
Isotoma scapigera
**Monopsis simplex*

GOODENIACEAE
Goodenia filiformis
Lechenaultia expansa
Scaevola lanceolata

* Introduced species