Recovery Plan for the Sandhill Dunnart

(*Sminthopsis psammophila*)

Photo of Sandhill Dunnart (*Sminthopsis psammophila*) by Nigell Cotsell.

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Current Species Status

The Sandhill Dunnart, *Sminthopsis psammophila*, is currently listed nationally as "Endangered" under the *Environment Protection and Biodiversity Conservation Act 1999*. In South Australia it is listed as "Endangered" *under Schedule 7, National Parks and Wildlife Act 1972*, and in Western Australia as "Fauna that is likely to become extinct" under the *Western Australian Wildlife Conservation Act 1950*.

The reasons for this species being regarded as "Endangered" include

1. The Sandhill Dunnart has a large distribution but is known from few individuals and locations.
2. Its range is thought to have declined as no specimens have been recorded from the Northern Territory since 1894. This reduces the species' potential range by over 50%.
3. The species had not been recorded from Eyre Peninsula in South Australia for 30 years. Further reducing the species potential range.
4. Reasons for suspected range decline are unknown.
5. It is a Critical Weight Range species.
6. Virtually nothing was known of its ecology.

Re-assessment of the Sandhill Dunnart using the IUCN 2000 (version 3.1) criteria during this work, considers that the species should now be listed as **Vulnerable B1a+c(iv); B2a+c(iv).**

The re-evaluation of its status is based on the findings of recent research summarized in this report.

1. Two populations of Sandhill Dunnarts were located at Eyre Peninsula in 2000, confirming their distribution in the area and extending their range by 100 km to the east.
2. Three populations were located in the southern Great Victoria Desert of Western Australia and South Australia during 2000 to 2001, confirming the continued existence of the species over much of their previously recorded range.
3. Studied populations on Eyre Peninsula were found to have specific habitat needs, utilizing large spinifex (*Triodia* species) hummocks for nest sites. This habitat appears to be dependent on a specific fire history.
4. Ecological information was obtained regarding the diet, movement, home range, population density and nest requirements for the species. This information helps with assessing the species and highlights potential conservation measures to be taken.
5. The preferred habitat of Sandhill Dunnarts appears to be extensive.
6. Potential threats to the species have been examined but none have been identified.

Recovery Objectives

The objective for the next five years is to expand our knowledge of the distribution of the Sandhill Dunnart through further survey. There is a need to identify the habitat

requirements of the species and to conserve and manage areas of key habitat, particularly on Eyre Peninsula, South Australia, where habitat is threatened by land clearance and fire, and the density of feral predators is high. Further work is required on aspects of the species ecology, in particular their reproductive biology.

The current distribution of the Sandhill Dunnart is still uncertain, despite considerable survey effort over the last 25 years there have been no further records of the species from the Northern Territory since the type specimen was collected near Lake Amadeus in 1894. It is likely that the species no longer occurs in the area.

Within the southern portion of the Great Victoria Desert in South and Western Australia, there are only 6 known capture localities. Potential habitat is extensive but more survey work is required to ascertain if the population is highly fragmented or the species is just elusive.

These objectives would be achieved by the following actions

Recovery Actions

1. Preventing further clearance of suitable habitat on Eyre Peninsula.
2. Conduct a biological survey of Eyre Peninsula.
3. Conduct further surveys of the Great Victoria Desert.
4. Conduct a detailed survey of the known Eyre Peninsula populations.
5. Study the species in captivity to examine reproductive biology.
6. Conduct experimental burns in suitable habitat to promote the growth of spinifex on Eyre Peninsula.
7. Encourage the use of deep pitfall traps in small mammal surveys in central Australia and the northern regions of the Great Victoria Desert.
8. Implement monitoring programs for the key populations.

PART A: INFORMATION COMPONENTS

1. Background and recent findings

(a) Description of the Sandhill Dunnart

The Sandhill Dunnart is one of 19 species of the marsupial genus *Sminthopsis* that occur predominantly throughout the arid and semi-arid regions of Australia. All species are nocturnal and insectivorous. They are similar in appearance and are characterised by their long pointed snouts, large eyes and ears, and relatively long slender hind feet. The Sandhill Dunnart differs from other members of its genus by several features, most noticeably by its large size, 30 to 55 grams and distinctive tail that has a crest of stiff black hairs along the ventral surface of the distal portion. (Archer 1981).

(b) Key features of Species Ecology

(i) Nests and habitat use

Recent studies of the Sandhill Dunnart (Churchill 2001b) have shown that they favour large spinifex (*Triodia* species) hummocks for nest sites.

On Eyre Peninsula, Sandhill Dunnarts commonly nested in large spinifex hummocks that had started to die off in the centre. They enter these spinifex hummocks by leaping up onto the hummock and climbing over the needles to the centre before scrambling down through the central portion of dead leaves. In the centre of the hummock they build a circular depression or space within the dead spinifex needles. Adult female dunnarts occasionally dug burrows; starting from inside the spinifex the burrows spiral down under the plant. These burrows were up to 90 cm long and had a small terminal chamber that contained nesting material of leaves and shredded bark.

Male Sandhill Dunnarts were found to use a greater variety of nest sites than females, including small burrows between spinifex clumps, hollow logs, and Mitchell's Hopping-mouse (*Notomys mitchelli*) burrows.

At Ooldea, in the Great Victoria Desert, all the Sandhill Dunnarts monitored resided in burrows. They dug their burrows under the larger available spinifex hummocks. The burrows ranged from 12 to 110 cm long and penetrated up to 46 cm below the surface (Churchill 2001b).

(ii) Ambient temperature and nest microclimate

The climate over the distributional range of the Sandhill Dunnart shows a very high diurnal variation often fluctuating by over 35 degrees. Seasonal variation is also high with summer maximum temperatures commonly over 45^{o}C whereas the winter minimum temperature is often below –5^{o}C (Australian Bureau of Meteorology).

Spinifex hummocks were found to contain a moderated microclimate. Temperature within the hummock was significantly cooler than ambient at high temperatures (12.5^{o}C cooler on average when the ambient temperature was $\geq$ 40^{o}C) and warmer in low temperatures (6.5^{o}C warmer on average when the ambient temperature was $\leq$ 0^{o}C) (Churchill 2001b).

The use of burrows at Ooldea provided an even greater moderation of the microclimate with temperatures in the burrow, at 30 cm below the surface, showing virtually no variation throughout the day and night. Burrows also maintained a near constant humidity level (Churchill 2001b).

Sandhill Dunnarts were not observed to enter torpor. The moderated nest microclimate would presumably provide significant conservation of energy for the dunnarts. The presence of particular age and structure of spinifex hummocks is considered an important feature of the habitat (Churchill 2001b).

(iii) Diet

Sandhill Dunnarts are one of the largest species of dunnarts (30 to 55 g.). It might be expected that this would result in a preference for large invertebrates and perhaps small vertebrates. Instead, they were found to eat mainly small prey items.

The diet was examined through the analysis of 37 scats and found to consist almost entirely of invertebrates. These included a wide variety of items but most commonly ants, beetles, spiders, grasshoppers, termites, wasps and centipedes. The bones of a small reptile (probably a gecko) were found in one scat (Churchill 2001a).

There was little variation in the proportion of prey items eaten, most of the favoured items being eaten in all seasons. The diversity of prey items remained high in all seasons. No termites were recorded in January or March; vegetable matter was mostly encountered from January to May.

Sandhill Dunnarts are generalist feeders and are largely opportunistic, eating the majority of prey types in proportions similar to availability (Churchill 2001a).

(iv) Reproduction

Little information is available regarding the reproductive patterns of Sandhill Dunnarts. No laboratory studies have yet been conducted and all available information has been made from observations, from the literature and examination of museum material (Aitken 1971, Pearson 1995, Pearson and Robinson 1989). Female Sandhill Dunnarts possess 8 teats and have been recorded with up to 5 young. Both males and females reach sexual maturity in their first year.

The pattern of reproduction appears to be mating in September; with young being born in September/October; and pouch young weaned in December/January. However, young have also been captured in October and April. This shows that the species has a broader period of reproduction. It is likely that Sandhill Dunnarts usually produce only a single litter each year. During a period of good seasons, they may be able to vary or extend the timing of reproduction or perhaps produce a second litter.

Table 4 Summary of observed reproductive pattern

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Gular secretions												
Pouch swollen												
Pouch Young												
Dependent Young												
Weaned Young												

(v) Home range requirements

A radio-tracking study (Churchill 2001b) of fifteen individuals has found them to have an average home range size of 7.8 ha (range 1.8 ha to 19.0 ha). The males' home ranges overlap those of other males and females. The females may have exclusive home ranges. In general, they move 200 to 300 m per foraging period but they have the ability to traverse long distances in short periods of time with one movement of 1,940 m recorded in 2 hours. Limited data indicates that they remain within an area for at least 8 months, but the boundaries of the home range may drift over time.

At one site, five adult Sandhill Dunnarts occupied an area of 20 ha indicating a potential density, in suitable habitat, of up to 25 Sandhill Dunnarts per square km.

On Eyre Peninsula, Sandhill Dunnarts were trapped and radio-tracked only in areas that had been burnt 10 years earlier. They did not use an adjacent area of habitat that had remained unburnt for approximately 30 years. This unburnt area retained vestiges of spinifex but most of the spinifex was old and its structure had broken down into large broken rings that provided little cover for Sandhill Dunnarts.

2. Critical Habitat

The Sandhill Dunnart is known to occur on sandy substrates in arid and semi-arid regions. The most consistent features of the habitat are the presence of spinifex hummock grass, (*Triodia* species) and sand dunes. The remainder of the vegetation varies but is most commonly mallee or Marble Gum (*Eucalyptus gongylocarpa*), often with *Callitris verrucosa* and an associated complex shrub understorey (Pearson and Robinson 1989).

Although no detailed habitat assessment has been made for the Sandhill Dunnart there appear to be large areas of potentially suitable habitat types throughout the southern Great Victoria Desert. Suitable habitat on Eyre Peninsula is limited due to historical land clearance. Detailed descriptions of the habitat at each of the known locations are available in Appendix 1.

The presence of large hummocks of spinifex (*Triodia* spp) grasses appears to be a critical factor for this species on Eyre Peninsula where suitable spinifex occurs in areas approximately 8 to 20 years post-fire.

At Ooldea, in the Great Victoria Desert, the age of the spinifex is much older and not as suitable for nest sites, but the dunnarts at this site reside in burrows they have dug under the spinifex. The reason for the different nesting behaviour at the two sites is unknown.

3. Distribution

(a) Historical Records

See Figure 1

1. 1984. Owl pellets containing sub-fossil Sandhill Dunnart remains were found in deposits collected from Blacks Point Sinkhole, Venus Bay, Eyre Peninsula, SA. These deposits were radiocarbon dated at 3,030+60 yBP and 2,160 yBP (Baynes 1987, Copley *et al.* 1999).

2. 1894. The type specimen, a male, was captured at Lake Amadeus, NT (Spencer 1896).

3. 1959 and 1962. Owl pellets were collected from the caves at the base of Uluru, NT, by Michael Archer and later found to contain Sandhill Dunnart remains (Parker 1973, Archer 1981).

4. 1969. One Sandhill Dunnart was captured on 28 February 1969 at Mamblin, near Kyancutta on Eyre Peninsula, SA, during land clearing operations (Aitken 1971).

5. 1969. Four Sandhill Dunnarts were captured on the 23 April 1969 at Boonerdo on Eyre Peninsula, 50 km to the south-east of the Mamblin record (Aitken 1971).

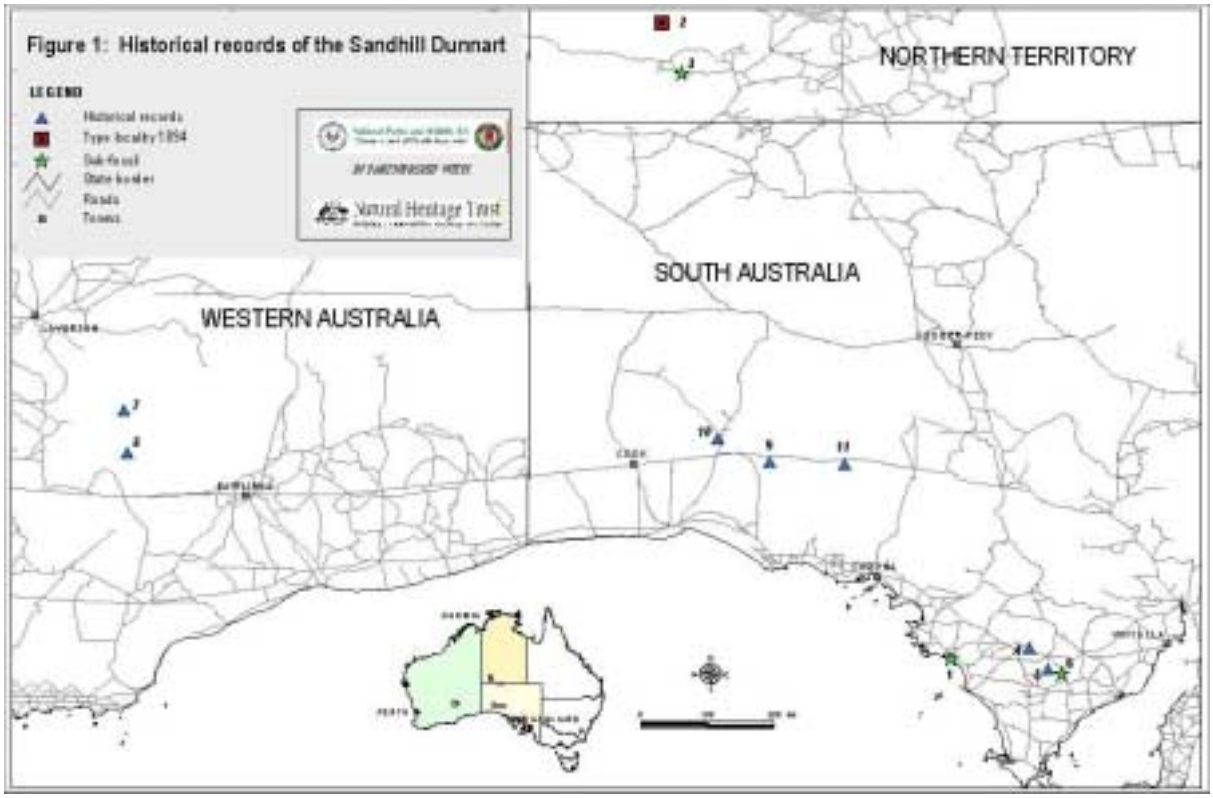
6. 1984. Owl pellet deposits containing Sandhill Dunnart remains were collected from caves at Darke Peak, Eyre Peninsula, SA (Baynes 1987).

7. 1985. Five Sandhill Dunnarts captured in June 1985 at Mulga Rock, south-western Great Victoria Desert, WA (Hart and Kitchener 1986).

8. 1987. Four Sandhill Dunnarts were captured between 9 June and 8 December 1987 at Queen Victoria Spring, south-western Great Victoria Desert, WA (Pearson and Robinson 1989). Since then David Pearson (pers. comm.) has trapped a further 12 Sandhill Dunnarts. This is the only locality where long-term annual surveys have been conducted.

9. 1987. Three Sandhill Dunnarts (2 males on 5 October 1987 and 1 female on 7 October 1987) were captured near Ooldea in the Yellabinna region, south-eastern Great Victoria Desert, SA (Copley and Kemper 1992).

Figure 1. Historical Records of the Sandhill Dunnart



10. 1987. One female Sandhill Dunnart (with 5 pouch young) was captured on 12 October 1987 at Yarle Lakes in the Yellabinna region, south-eastern Great Victoria Desert, SA (Copley and Kemper 1992).

11. 1987. One male Sandhill Dunnart was captured on the 18 October 1987 near Mt Christie in the Yellabinna region, south-eastern Great Victoria Desert, SA (Copley and Kemper 1992).

(b) Current Known Range

From August 1999 to May 2001 a survey for Sandhill Dunnarts in the southern Great Victoria Desert and Eyre Peninsula was conducted (Churchill 2001b). During this period, twenty-nine Sandhill Dunnarts were trapped at five locations (by several researchers) in the southern Great Victoria Desert and Eyre Peninsula.

See Figure 2. for locations. Numbers on map refer to the locations listed below.

1. January 2000. One sub-adult Sandhill Dunnart was captured by hand by Greg Johnston (pers. comm.) who had seen the animal while he was spotlighting for reptiles at night near Cowell, Eyre Peninsula, South Australia.

    - Trapping at Cowell site in January, March and May 2000 captured a further six individuals (Churchill 2001b).

2. March 2000. One Sandhill Dunnart was captured 25 km north north-east of Queen Victoria Spring by David Pearson (pers. comm.)

3. May 2000. Two adult Sandhill Dunnarts were captured near Ooldea, Great Victoria Desert, South Australia (Churchill 2001b).

    - An additional seven Sandhill Dunnarts were captured near Ooldea in April 2001 (Churchill 2001b).

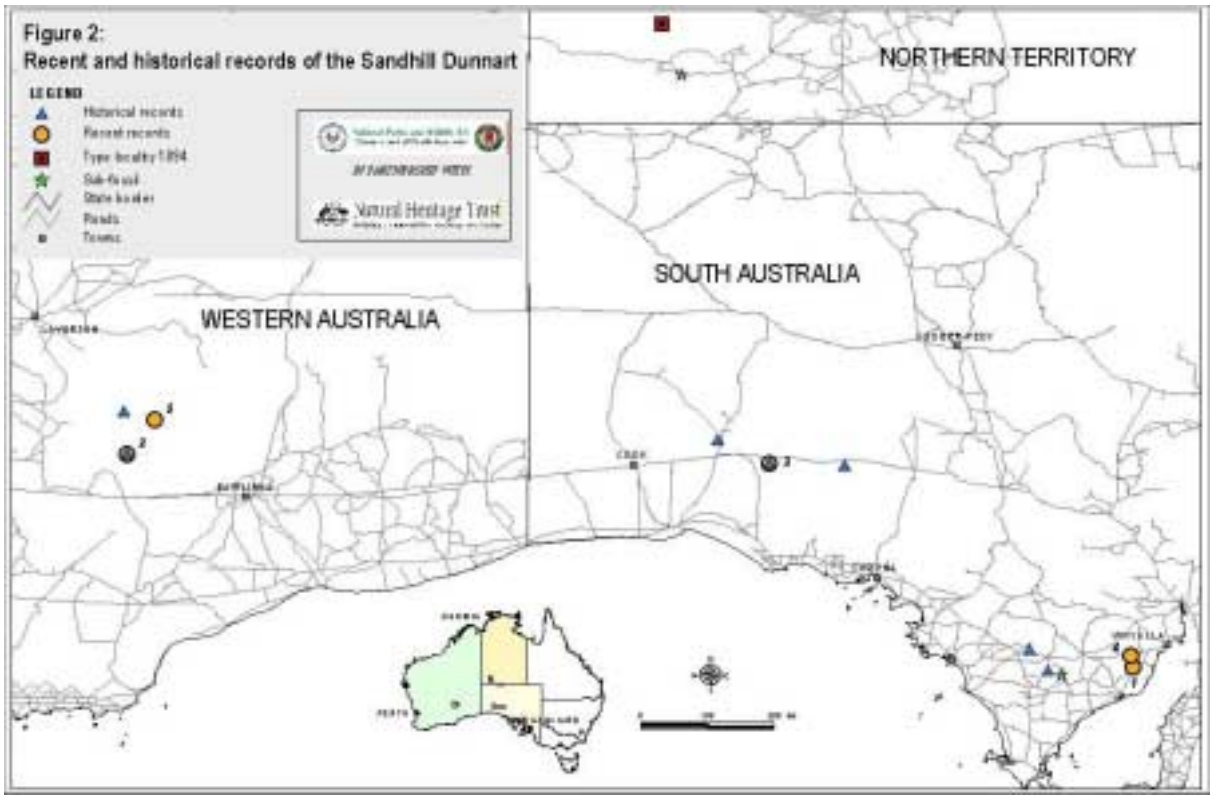
4. May 2000. Four Sandhill Dunnarts were captured by Clare Bradley (pers. comm.) near Middleback Range, Eyre Peninsula, South Australia.

    - Further trapping programs at the Middleback site in July, September, December 2000 and April 2001 captured 7 individuals (Churchill 2001b).

5. April 2001. Five Sandhill Dunnarts were captured 50 km east of Mulga Rock, Great Victoria Desert, Western Australia, by Glen Gaikhorst and Cathy Lambert (pers. comm.).

During 2000 and 2001, 29 Sandhill Dunnarts were captured at five locations. This compares with the 31 individuals captured between 1894 and 1999.

Figure 2. Recent and Historical Records of the Sandhill Dunnart



(c) Key Populations

The key populations of Sandhill Dunnarts occur near Whyalla on Eyre Peninsula, South Australia, in the Great Victoria Desert near Ooldea in Yellabinna Regional Reserve, South Australia and in and near Queen Victoria Springs Nature Reserve in Western Australia.

4. Factors influencing Distribution – Potential Threats

The absence of records in central Australia does not necessarily indicate that Sandhill Dunnarts no longer occur in the region. There has been considerable survey work conducted in Uluru-KataTjuta region, particularly in the last 20 years (Pip Masters and Rick Southgate pers. comm.) but no Sandhill Dunnarts have been captured.

However, in central Australia during the period since the species' original capture at Lake Amadeus in 1894, there has been a period of major extirpation and extinction of small-to medium-sized mammals.

The possible reasons for the disappearance of many desert mammal species has been discussed by several authors (Morton and Baynes 1985, Burbidge and McKenzie 1989, Morton 1990, Copley 1999) and these are discussed below.

(a) Critical weight range

Approximately one third of the species that once occurred in sandy deserts have become locally extinct (Burbidge *et al.* 1988, Burbidge and McKenzie 1989). These species are all within what is termed the "Critical Weight Range" of 35 to 5,500 grams. Adult Sandhill Dunnarts weigh 30 to 55 grams placing them within the lower limits of the critical weight range.

In central Australia there have been several hypotheses proposed for the extinction of critical weight range mammals. The most likely factors are the introduction of exotic predators (foxes and cats) and exotic herbivores (especially rabbits, sheep and cattle). Changed fire regimes, particularly in the arid grasslands, have also contributed to the decline and extinction of many species (Maxwell *et al.* 1996).

Critical weight range (CWR) species in greatest danger of extinction are those from arid and semi-arid regions and species confined to the ground surface (Burbidge and McKenzie 1989). Carnivorous and insectivorous species, such as the Sandhill Dunnart, are less likely than herbivores and omnivores to become extinct.

Thirteen species of CWR mammals on Eyre Peninsula and 17 species in the southern Great Victoria Desert have become locally extinct (derived from distribution maps in Strahan 1995). These species are either totally extinct (5), are expirtated on mainland Australia (7) or have significantly declined in range (10). Of the species that have declined in range, five have contracted their range northwards and five have contracted their range towards the south-west. The Sandhill Dunnart is the

only species of mammal that has maintained its distribution on Eyre Peninsula and the southern Great Victoria Desert, while its range declined in central Australia.

These data suggest that whatever processes have affected other CWR species do not appear to be affecting the Sandhill Dunnart in the same way.

(b) Introduced predators and herbivores

The invasion of introduced predators, foxes and cats, and the habitat destruction caused by cattle, sheep and rabbits have had a severe impact on the native mammals of inland Australia.

Introduced herbivores

Introduced herbivores have impacted on the survival of native species in a variety of ways.

1. Reducing the available food supply for herbivorous native mammals
2. Reducing the availability of cover
3. Changing the species composition of vegetation
4. Causing erosion and silting of waterholes
5. Having the greatest impact on refuge areas where native species would have survived prolonged periods of drought.
6. Encouraging the spread of introduced predators such as foxes and cats.

The southern Great Victoria Desert is not suitable for introduced stock, such as sheep, due to lack of water. Initially the spread of rabbits through the Great Victoria Desert had a considerable impact on the vegetation (Gara, unpublished) but there are now very few rabbits in the spinifex areas. Camels also appear to have minimal impact in spinifex.

On Eyre Peninsula the sites at Cowell and Middleback are grazed by sheep, goats and rabbits. However most of these animals appear to avoid the spinifex in favour of more nutritious plants in other habitat types.

There currently appears to be little habitat degradation caused by introduced herbivores in the favoured Sandhill Dunnart habitat.

Predation of Sandhill Dunnarts

In the southern Great Victoria Desert, the numbers of foxes are low, there are moderate numbers of dingos, and cats are present. During the Sandhill Dunnart survey (Churchill 2001b), 128 predator scats were collected through the Great Victoria Desert and Eyre Peninsula. These scats were analysed for the presence of Sandhill Dunnart hair or bones (Boulton and Foulkes 2000). Two scats were found to contain Sandhill Dunnart remains. They were thought to have been dingo scats and were collected from near Ooldea, one in August 1999 and the other in May 2000.

Currently at the key sites on Eyre Peninsula, there are large numbers of both foxes and cats. Interestingly none of the 36 fox scats collected at Cowell (where Sandhill Dunnarts were known to occur at the time) contained Sandhill Dunnart remains.

Sandhill Dunnarts are able to survive in (at least some) areas of high fox and cat densities.

The impact of introduced mammals does not appear to explain the reduction in range of the Sandhill Dunnart.

It should be noted that we still know very little about Sandhill Dunnarts. It is possible that feral animals effect Sandhill Dunnarts in more subtle ways; for example they may be surviving only in areas of optimal habitat where they can maintain their population at a level that can sustain predation. Alternatively their low abundance may be due to predation.

(c) Change in fire patterns

One of the proposed reasons for the decline and extinctions of central Australian mammals over the past 100 years is the change in fire patterns caused by the removal of traditional Aboriginal burning practices (Burbidge and McKenzie 1989). The Aboriginal “firestick farming” involved burning patches of old vegetation to encourage new vegetation growth. Over time, this established a complex mosaic of different fire-age communities that provided a greater structural diversity to the habitat, providing suitable cover in unburnt patches and increasing food availability in recently burnt areas.

In central Australia the removal of traditional fire practices has resulted in a reduction in the structural diversity of the habitat and an increase in large-scale wildfires, thereby further reducing the diversity. Latz (1995) considers that most vegetation communities throughout arid Australia have become dependent on a regime of fires lit by Aboriginal people, the only exception being areas of spinifex in waterless regions.

Latz (1995) considers that similar fire patterns still occur in the southern Great Victoria Desert whereas there have been great changes in the fire patterns of the northern Great Victoria Desert and central Australia.

The early European explorers to the southern Great Victoria Desert such as Giles (1889), Maurice (Gara 1989) and Lindsay (1893) recorded that there was little burning in this area, indicating that there were few Aboriginal people occupying the area at the time of their visits.

In South Australia, the lack of permanent water caused the southern Great Victoria Desert to be largely inhospitable in most years. Although several tribal boundaries extended through the region the area was not used as a permanent residence by any tribal group (Morelli 1992). Historic records indicate that Aboriginal people utilised the region only during good seasons, travelling in small groups, and relying

on small ephemeral waterholes. In dry years, they retreated to the limited permanent water holes, such as Ooldea soak (Gara 1989, Morelli 1992).

The Aboriginal people of the southern Great Victoria Desert left the desert much earlier than the people further north. This was mainly influenced by the construction of the Trans-Australian Railway (1915 to 1917). Although we know little of the previous fire history of the area it appears that there may have been far less burning than in the north and the change of fire regimes after the Aboriginal people left may have had a far less impact on this area than in the northern Great Victoria Desert.

Changes in the fire patterns may have deleteriously affected the Sandhill Dunnart in the northern part of its range in central Australia.

The impact of changes in fire ecology, if any, on the southern Great Victoria Desert is less obvious. It appears that the processes at work in the northern Great Victoria Desert may have been different to those in the south.

(d) Fire age of Spinifex

There is evidence that Sandhill Dunnart distribution and survival is governed by the presence of spinifex hummocks of specific maturity and structure. The growth and structure of spinifex plants vary according to spinifex species, rainfall, drainage, soil type and plant age. Fire history is a major determinant of spinifex growth in the mallee/spinifex habitat.

On Eyre Peninsula, the mallee regenerates from rootstock and for the first ten to fifteen years post-fire the trees are still small. The spinifex thrives in these conditions reaching a maximum size in about 10 years. After this, the large spinifex start to open out into rings. By 20 years post-fire, the mallee starts to shade out the undergrowth and the shrubs become denser. By thirty years post-fire there are few spinifex plants evident. Most of these have opened out into large rings and their structure has broken down. These spinifex plants provide little cover and are not used by Sandhill Dunnarts.

These time scales vary considerably according to the spinifex species. At Queen Victoria Spring, in the south-western Great Victoria Desert, one spinifex species (*Triodia desertorum*) takes more than 20 years to regrow after fire (D. Pearson pers. comm.).

Masters (1993) studied the effect of fire succession on small mammals in spinifex grasslands at Uluru National Park in central Australia. She found that species richness and diversity of small mammals was greatest in ten-year post-fire spinifex grassland.

On Eyre Peninsula, spinifex reaches the size and structure chosen by Sandhill Dunnarts for nest sites, five to ten years after a fire, and individual plants of suitable structure continue to be available for another ten years (Churchill 2001b).

This situation is well demonstrated in the sites where the key populations of Sandhill Dunnarts are found on Eyre Peninsula. Over 85% of their nest sites occur in large spinifex hummocks of a particular structure and maturity, although this type of plant constitutes only 5% of the available spinifex hummocks (Churchill 2001b). The nests are hollow areas, in the centre of the hummock, accessed from the top of the plant. They are relatively predator proof and have been shown to confer significant microclimate advantages (Churchill 2001b).

By contrast, in areas such as Ooldea, where there has been no fire for many decades the spinifex plants are very fragmented. Sandhill Dunnarts excavate burrows for shelter. The burrows are located under the largest available spinifex plants (Churchill 2001b).

Burrows were also occasionally dug by Sandhill Dunnarts on Eyre Peninsula, by adult females. These burrows were long and deep with a terminal chamber containing nesting material such as bark and leaves. They were most likely used for rearing young.

Why Sandhill Dunnarts choose to live in spinifex when they could dig burrows is not known, but may be explained by thermoregulatory requirements. The ambient temperatures on Eyre Peninsula are lower than at Ooldea and the soil temperature would therefore be lower. These conditions may be too cold and therefore energetically more expensive than the use of spinifex. At Ooldea where all the dunnarts lived in burrows (temperature of 21^{o}C), several were observed to sunbake during the day in ambient temperatures of up to 36^{o}C (Churchill 2001b)

At least for the key populations on Eyre Peninsula patterns of burning appear to be a significant component for determining the availability of suitable spinifex plants.

(e) Land Clearance

Land clearance for agriculture has caused a major reduction in suitable habitat for the Sandhill Dunnart on Eyre Peninsula. Currently 57% of land has been cleared for agriculture. The remaining vegetation (43%) is heavily fragmented with 88% in areas of less than 20ha and 96% in patches of less than 100ha.

Extensive land clearance has also caused fragmentation of the natural vegetation. Areas of native vegetation become isolated and are vulnerable to the impact of large fires. For example, in January 2000 a large fire swept through Hambidge Conservation Park in central Eyre Peninsula. Over 80% of the Park was burnt,

destroying virtually all the potentially suitable Sandhill Dunnart habitat. This Park is close to where Sandhill Dunnarts were captured in 1969 and had been targeted as a likely survey site prior to the fire. If Sandhill Dunnarts did occur in the park their survival is very unlikely and there is little potential for re-colonisation from surrounding sites.

On Eyre Peninsula, land clearance for agriculture has severely reduced the available habitat for Sandhill Dunnarts and fragmentation has reduced the chances for the species to recolonise.

There has been no land clearance for agriculture in the Great Victoria Desert.

(f) Inadequate Survey

Early specimens were collected in a variety of ways, the type specimen was hit with a thrown boot (Spencer 1896), another was caught under a hat and several were caught by hand as they fled from smouldering spinifex (Aitken 1971). Recently pitfall traps and Elliott traps have proven more effective.

Sandhill Dunnarts have been captured in both pitfall traps and Elliott traps. However, they have only been captured in deep pitfall traps (55 to 60 cm deep) and the use of shallower traps in biological surveys may limit or prevent their capture. Sandhill Dunnarts are capable of leaping high onto a spinifex hummock and can probably leap out of shallow pitfall traps. Many other biological surveys have been conducted within the range of the Sandhill Dunnart and they have used a range of pitfall trap sizes (eg Uluru Survey used 25 litre buckets 40 cm deep; Biological Survey of South Australia currently uses pitfall traps 30 cm deep).

Sandhill Dunnarts appear to be more likely to enter Elliott traps only after a period of familiarity. Most captures with Elliott traps have been made in areas where long-term trapping projects have been conducted (eg. at Queen Victoria Spring and at Middleback). At Middleback, new animals were slow to enter traps (as evidenced by tracks) but once captured, they readily become trap addicted. Radio-tracked animals were captured in Elliott traps up to 3 times in a single night. They are rarely recaptured in pitfall traps (Churchill 2001b).

The use of deep pitfall traps, 55 to 60 cm deep are considered essential to adequately survey for Sandhill Dunnarts.

(g) Size of the area to be surveyed

There has been a considerable amount of mammal survey conducted in central Australia during the last 20 years. Although not one Sandhill Dunnart has been captured, they may still occur in the region.

1. Surveys may not have been conducted in the right type or age of habitat.

2. Surveys may have been using inappropriate sized pitfall traps (less than 55 cm deep). However, this does not explain why they have not been captured in Elliott traps.
3. All surveys require an element of luck regarding the species and the number of individuals that occur at a particular site at the time of a survey.
4. Sandhill Dunnarts are most easily trapped in March and September. They appear to avoid Elliott traps during the warmer months from October to February. At Middleback there were numerous tracks of Sandhill Dunnarts during the warmer months but they did not enter the traps. With the onset of the cooler weather in March, the Sandhill Dunnarts again readily entered the traps (Clare Bradley pers. comm.; S. Churchill pers. obs.).

Further survey is required in suitable habitat, using deep pitfall traps and Elliott traps preferably from March to October

5. Contraction of Range

No Sandhill dunnarts have been recorded from Central Australia or the northern Great Victoria Desert since the original specimen was captured in 1894.

This constitutes an apparent range contraction of over 600 km to the south. The reduction in range is over 50%.

6. Existing Conservation Measures

Habitat Protection

(a) Great Victoria Desert

The Great Victoria Desert covers an enormous area, approximately 420,000 square kilometres, and is the largest dune desert in Australia. It extends from north of the Nullarbor Plain to the Gibson Desert in Western Australia and to the central Australian ranges in the Northern Territory. From west to east, it extends from Laverton in Western Australia to Coober Pedy in South Australia.

Approximately half of this land is under tenure to Aboriginal communities namely Anangu-Pitjantjatjara and Maralinga-Tjarutja lands in South Australia, and Ngaanyatjarra Council, Upurlupurlia Association and Tjuntjuntjara Council in Western Australia.

A further 100,000 square kilometres (about one quarter) is in Conservation Parks and Reserves. In Western Australia, this includes the Great Victoria Desert Nature Reserve, Queen Victoria Spring Nature Reserve, Plumridge Lakes Nature Reserve,

Neale Junction Nature Reserve, Yeo Lake Nature Reserve, and De La Poer Range Nature Reserve. In South Australia, it includes the Unnamed Conservation Park, Tallaringa Conservation Park, Yellabinna Regional Reserve, Yumbarra Conservation Park, and Pureba Conservation Park.

Almost all the remaining area is Vacant Crown Land.

The Sandhill Dunnart is well protected in terms of habitat conservation under both the Aboriginal and Conservation tenures within the Great Victoria Desert.

(b) Eyre Peninsula

The degree of habitat protection on Eyre Peninsula is very different from the Great Victoria Desert. The majority of Eyre Peninsula (57%) has been cleared for agriculture and much of the uncleared property is under grazing lease.

One of the largest areas of remnant vegetation is the Central-northwest Linkage, from Hincks Conservation Park to the Poochera District, approximately 9,900 km^2. This area contains 6,820 km^2 (69%) native vegetation of which 3,170 km^2 (46%) is protected in either national parks, conservation areas or Heritage agreements.

There are several conservation areas that contain habitat potentially suitable for Sandhill Dunnarts. The primary ones are Pinkawillinie Conservation Park (1,271 km^2), Lake Gilles Conservation Park (451 km^2), Hambidge Conservation Park (380 km^2) and Munyaroo Conservation Park (123 km^2).

Brief surveys of Pinkawillinie Conservation Park (Churchill 2001b), Lake Gilles Conservation Park (Churchill 2001b, NPWS Rangers unpublished 1980, Eyre Peninsula Project Group 1973), and Hambidge Conservation Park (Nature Conservation Society of South Australia 1967) have failed to find Sandhill Dunnarts in these parks but further survey work is needed. Munyaroo Conservation Park has not been surveyed and Hambidge Conservation Park was badly damaged by extensive fires that burnt over 80% of the park in January 2000.

The two populations of Sandhill Dunnarts found at Cowell and Middleback sites in 2000 are only 19 km apart. They are both on the same grazing lease (Moola) and are subject to disturbance from clearing for agriculture, they are adjacent to iron–ore mines and the Middleback site is between cleared lines for high-voltage electricity cables and a railway line that services the mines. The Cowell site is adjacent to a major highway between Whyalla and Port Lincoln and is on the boundary of another pastoral property that has been cleared previously for wheat production.

There is a need for conservation action to be taken via heritage agreements or a change in land tenure to protect suitable habitat from clearing and degradation.

Part B. RE-EVALUATION OF CONSERVATION STATUS

Re-assessment of the Sandhill Dunnart using the IUCN 2000 (Version 3.1) Red List Categories.

A. Population Reduction

There has been no detected reduction in known range in the last 10 years.

B. Extent of occurrence, fragmented distribution, extreme population fluctuations.

1 *Extent of occurrence unknown but considered to be less than 20,000 km^2*

- ***a. Known to exist at less than 10 locations.***
- ***c. Extreme fluctuations in***
  - ***(iv) number of mature individuals***

2 *Area of occupancy unknown but considered to be less than 2,000 km^2*

- ***a. Known to exist at less than 10 locations.***
- ***c. Extreme fluctuations in***
  - ***(iv) number of mature individuals***

C. Population estimate, level of decline and fragmentation

Population size unknown (in suitable habitat they achieve a density of 25 dunnarts per km^2), population trend unknown, population may be fragmented but this may be an artefact of inadequate survey. Apparently suitable habitat is widespread.

D. Population of mature animals or acute range restriction

Population size unknown but not restricted in range.

E. Quantitative analysis showing probability of extinction in the wild.

Extinction in the wild is unlikely based on current knowledge

Conclusion

The Sandhill Dunnart was previously listed as Endangered based on IUCN criteria for 1994.

Re-evaluation of the status based on IUCN 2000 (Version 3.1) establishes that this species should be listed as **Vulnerable B1a+c(iv); B2a+c(iv).**

Recent work has increased the known sites by three and has established that the species still occurs on Eyre Peninsula where it had not been recorded since 1969.

Sandhill Dunnarts were recently captured at several sites across the southern Great Victoria Desert covering the species distribution in both the west and the east.

The presence of the species in central Australia remains unknown. The Sandhill Dunnart has not been recorded in central Australia since 1894 and it is likely that the species no longer occurs there. This constitutes a major range reduction of over 50% but this appears to be an historic reduction. There has been no recorded reduction of range in any other parts of the species distribution. The Sandhill Dunnart still occurs in the southern Great Victoria Desert and on north-west Eyre Peninsula.

Part C: PLANNING COMPONENTS

1. Recovery Objectives

- To clarify the distribution of the Sandhill Dunnart, and find new localities.
- To develop and implement appropriate management strategies to protect and conserve known populations.
- To increase our understanding of the ecology of the species, in particular their habitat requirements and reproductive biology.

2. Timelines

Additional survey in the Southern Great Victoria Desert and Eyre Peninsula over the next few years should enable this species to be down-listed if it is found to occur at an additional 3 locations (bringing the total to more than ten locations).

3. Recovery Actions

- ***Action 1.*** Prevent further clearance of suitable habitat on Eyre Peninsula.
- ***Action 2.*** Conduct a biological survey of Eyre Peninsula.
- ***Action 3.*** Conduct further surveys of the Great Victoria Desert.
- ***Action 4.*** Conduct a detailed survey of the known Eyre Peninsula populations.
- ***Action 5.*** Study the species in captivity to examine reproductive biology.
- ***Action 6.*** Conduct experimental burns in suitable habitat to promote the growth of spinifex and to protect critical habitat from too frequent and/or extensive fires on Eyre Peninsula
- ***Action 7.*** Encourage the use of deep pitfall traps in small mammal surveys in central Australia and the northern regions of the Great Victoria Desert.
- ***Action 8.*** Implement monitoring programs for the key populations.

Action 1. Prevent further clearance of suitable habitat on Eyre Peninsula.

Aim: Identify areas of potential habitat outside the conservation estate and liase with landholders and the relevant government departments to ensure that these areas are monitored. Any proposals to clear or modify land use must be carefully considered and only be approved after adequate surveys have been undertaken for Sandhill Dunnarts. Some areas may require fencing off from stock or other agreements with landholders to prevent habitat degradation.

Justification: At present the only known populations of Sandhill Dunnarts on Eyre Peninsula occur on a single pastoral lease. Due to previous land clearing activities there are few areas of suitable native vegetation available for conservation.

Method: Investigate the option of entering into Heritage Agreements with landholders of Moola property and adjacent properties with suitable habitat. Also liase with the mining companies currently mining iron-ore in the area to ensure that the area can be protected from clearing and degradation.

Responsibilities: The South Australia Department for Environment and Heritage is responsible for assessing clearance applications and Heritage Agreements with Landholders in the area.

Action 2: Conduct surveys in potential habitat on Eyre Peninsula.

Aim: To assess the distribution of the Sandhill Dunnart and identify key populations on Eyre Peninsula.

Justification: Sandhill Dunnarts were found at Boonerdo and Mamblin on the Eyre Peninsula during land clearing operations in 1969. In addition owl pellets containing Sandhill Dunnart remains were collected from caves at Darke Peak in 1984 (Baynes 1987). These three sites are less than 65 km apart.

Land clearance for agriculture has continued over the intervening 30 years although this had been considerably reduced since the Native Vegetation Management and Native Vegetation Acts were introduced. There is approximately only 43% of native vegetation remaining on Eyre Peninsula of which 54% is outside conservation areas. Several of these conservation areas are potentially suitable for Sandhill Dunnarts and surveys of these sites are required. There have been few mammal surveys conducted in the region.

Methods: Preliminary examinations of the conservation areas of Eyre Peninsula (Churchill 2001b) indicate that there is suitable habitat available in several of the Conservation Parks particularly Pinkawillinie, Hincks and Munyaroo Conservation Parks.

Possible survey sites.

Pinkawilline Conservation Park. Large areas of suitable habitat were found in the western portion of the park along the track from Peella Rocks to the northern

boundary. In the east, there were small amounts of suitable habitat on the main road from “Buckleboo” south to the Eyre Highway (near “Mullagundi”). There are also large areas of suitable habitat on private land around the western edge of the park.

Hincks Conservation Park. Suitable habitat was found in the western portion of the Park on the “Emu Hills” to “Braeville” track.

There is potentially suitable habitat in the western portions of Munyaroo Conservation Park (I didn’t visit this part) in the sand dunes. This area has continuous natural vegetation extending past Little Pine Hill to the Cowell study site on the southern boundary of “Moola” pastoral lease.

Lake Gilles Conservation Park contains some small areas of old spinifex along dunes in the southern portion of the Park near the Eyre Highway. This site does not look particularly suitable but may be better further off the road.

Bascome Well Conservation Park also contains small, scattered areas of spinifex habitat, but in general this area appears too rocky.

Hambidge Conservation Park and environs is regenerating after it suffered from an extensive fire in January 2000. It currently contains little suitable habitat but areas of natural vegetation on surrounding properties could be examined.

The area around Venus Bay could also be usefully surveyed as Sandhill Dunnart remains (sub-fossil material) have been found in a sinkhole and in old owl-pellets in a coastal cliff overhang in the area.

What to look for.

Potentially suitable habitat consists of areas of large spinifex hummocks. Typically, there are mixed sizes of spinifex plants but the presence of plentiful large hummocks of approximately 40cm high and 70 to 100 cm diameter make ideal nest sites for dunnarts. Sandhill Dunnarts show a preference for large hummocks that form an intact mound (Fig. 1) or have just started to die off in the centre (Fig. 2).

The Sandhill Dunnart builds a nest in the centre of the hummock, usually this is just spherical hollow of 10 to 15 cm diameter. These nests can be seen most easily in the spinifex hummocks that have started to die off in the centre. In some cases they dig a burrow under the spinifex. The burrow usually starts slightly off centre beneath the spinifex and spirals down underneath the plant. They may extend for up to 100cm but most extend only 20 to 30 cm.

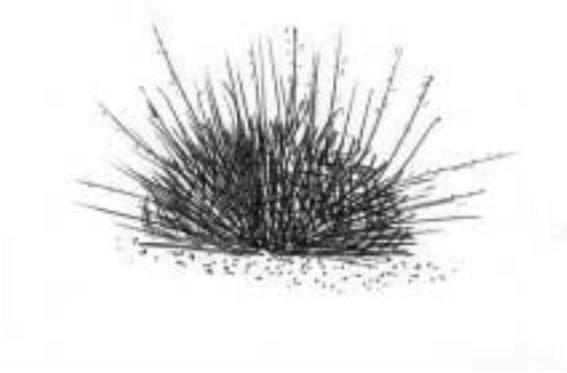


Figure 1 Large intact spinifex hummock

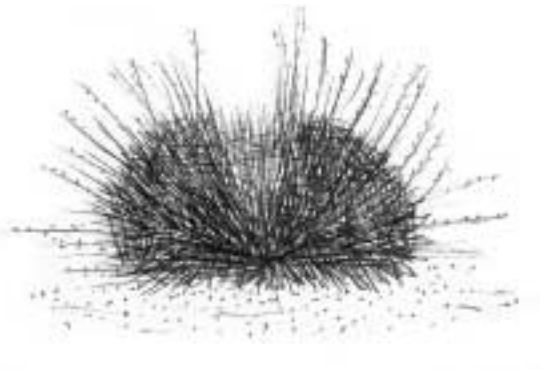


Figure 2. Hummock that has started to die-off in the center

Sandhill Dunnart trapping has been most successful on or adjacent to sand dunes. On Eyre Peninsula, these sites are associated with mallee communities. Early regrowth of mallee (less than 10 years old) appears to favour spinifex growth but by 20-year regrowth the spinifex plants have become sparse, dissected and are shaded by mallee and shrub regrowth. Thirty years after fire the spinifex has virtually gone.

The sites where Sandhill Dunnarts have been trapped on Eyre Peninsula have all been close to unburnt areas. Radio-tracking has shown that they do not use these unburnt sites but they may have been a suitable age prior to burning or perhaps provided important refuge areas during the fire.

The South Australian Department for Environment and Heritage has been undertaking a detailed biological survey of all regions of South Australia. Fauna surveys of Eyre Peninsula will be conducted over the next few years.

It is strongly recommended that, in this region, the Biological Survey Unit use deep pitfall traps (60cm deep and 25 cm diameter), particularly on sandy soils in suitable age stands of spinifex.

Responsibilities:

The Biological Survey Unit of the South Australian Department for Environment and Heritage is responsible for biological surveys in South Australia.

Biological Surveys of South Australia are conducted over 3 years in each region. They require approximately 72 weeks of scientific staff per year at $55,00 pa, 3 vehicles for 2 x 2-week surveys each year and considerable volunteer support. Costs met by DEH and others.

Funding ($1,000's)

Year	2001	2002	2003	2004	2005	Total
Funds	125	125	70			320

Action 3: Conduct further surveys of the Great Victoria Desert.

Aim: To assess the distribution of the Sandhill Dunnart and identify key populations.

Justification: The species is known from only seven sites in the Great Victoria Desert. This large desert region has been poorly surveyed and further site surveys are required before evaluation of the species habitat requirements and potential distribution can be assessed with confidence.

Methods: The South Australian Department for Environment and Heritage has been undertaking a detailed biological survey of all regions of South Australia. This process is to be continued in the South Australian portion of the Great Victoria Desert during the next few years.

Sandhill Dunnarts in the southern Great Victoria Desert (at Ooldea) reside in burrows under spinifex plants (see notes in Action 2).

It is highly recommended that deeper pitfall traps (60 cm deep) be used wherever possible in areas of sandy soils with spinifex cover during biological surveys.

Areas likely to be suitable for Sandhill Dunnarts in South Australia are the mallee/spinifex habitat of the Yellabinna Bioregion, the Unnamed Conservation Park in Spinifex / Marble Gum communities.

In Western Australia there have been extensive fires in the Mulga Rock area (probably in 1997). Unburnt areas in this region such as those surveyed by Cathy Lambert and Glen Gaikhorst, could be further surveyed with a reasonable chance of success. Large areas of apparently suitable habitat occur along the Anne Beadell Highway between Neale Junction and the South Australian border.

Responsibilities:

The Biological Survey Unit of the South Australian Department for Environment and Heritage is responsible for biological surveys in South Australia.

The Western Australian Department of Conservation and Land Management is responsible for the surveys undertaken in Western Australia.

Biological Surveys of South Australia are conducted over 3 years in each region. They require approximately 72 weeks of scientific staff per year at $55,00 pa, 3 vehicles for 2 x 2-week surveys each year and considerable volunteer support. Costs met by DEH and others.

Funding ($1,000's)

Year	2001	2002	2003	2004	2005	Total
Funds	125	125	70			320

Action 4. Detailed survey of the known Eyre Peninsula populations.

Aim: To determine the distribution of Sandhill Dunnarts at the two known sites on Eyre Peninsula and assess population size, trends and habitat preferences.

Justification: Currently two populations of Sandhill Dunnarts are known to occur on a single pastoral lease (Moola Station) on Eyre Peninsula. These two populations are 19 km apart and are separated by a large tract of potentially suitable habitat. A survey of this vicinity would provide essential information regarding the population size and habitat preferences of Sandhill Dunnarts.

Methods: Conduct a survey of Moola pastoral lease and the surrounding area, using both Elliott and 60 cm deep pitfall traps. The survey should sample a variety of sites of varying age stands of spinifex.

Several previous studies in the area involving both pit and Elliott trapping have been conducted at this site during the last 10 years (1991 to1994 Carthew and Keynes 2000; 1996 to 1998 Bos 1999). An examination of the trapping history of the region could be a useful start. All previously trapped sites could be revisited to assess their habitat characteristics.

There are two possible reasons why no Sandhill Dunnarts were captured during these studies. One likely reason is that trapping was conducted in vegetation that had not been burnt for approximately 30 years. Radio-tracking and trapping studies at this site has shown that Sandhill Dunnarts do not use this unburnt habitat (Churchill 2001b). The other reason is that these surveys used 25 litre buckets, 40 cm deep and 28cm diameter for pitfall traps (Bos 1999). Sandhill Dunnarts were probably capable of jumping out of these pits.

An assessment of the fire history, using aerial photographs, information from Landholders and the Country Fire Service could provide information on potentially suitable survey sites.

Responsibilities:

Administration: Biodiversity Conservation Programs, Department for Environment and Heritage. Funding by DEH, Universities and/or other sources.

Field work: Post-graduate student or contract employee with the support of volunteers.

Funding ($1,000's)

Year	2001	2002	2003	2004	2005	Total
Funds		15	15			30

Action 5. Study the species in captivity to examine reproductive ecology.

Aims: Determine the reproductive patterns of this species

Justification: Understanding the reproductive biology of a species is valuable for conservation. It allows predictions to be made on population growth and species dispersal.

Methods: Maintain a captive population of Sandhill Dunnarts for several years to examine the reproductive biology and behaviour of the species.

Responsibilities:

One or more established and experienced captive breeding and management facilities. For example the Native Species Breeding Program at Perth Zoo, WA and/or Cleland Conservation Park, National Parks and Wildlife, SA. Dr Patrica Woolley at Monash University in Melbourne has extensive experience in research into reproductive biology of dasyurids in captivity.

Funding ($1,000's)

Year	2001	2002	2003	2004	2005	Total
Funds		10	4	4	4	22

Action 6. Conduct experimental burns in suitable habitat to promote the growth of spinifex on Eyre Peninsula.

Aims: Promote the growth of various patches of different age spinifex to secure appropriate habitat for the future survival of Sandhill Dunnarts.

Justification: At the Eyre Peninsula sites, (Middleback and Cowell study sites on Moola Station) the dunnarts were captured in areas that had been burnt 9 to 10 years previously. Initial research (Churchill 2001b) indicates that this growth stage of spinifex is important for Sandhill Dunnart nest sites. After 30 years post-fire, the mallee has regenerated to the extent that the spinifex is almost entirely excluded. It appears that if Sandhill Dunnarts are to remain in the region then suitable areas of spinifex will need to be provided.

Methods: The use of small-area high-intensity fires would burn the mallee and may promote the regeneration of spinifex. Trials would need to be conducted to assess the best method of burning, as mallee is notoriously difficult to burn in small patches. It is desirable that areas of various fire ages are burnt to make the fire mosaic more complex. It should be noted that this region contains the Malleefowl (*Leipoa ocellata*), a vulnerable species that has a need for areas that have not been burnt for

at least 30 years. Fire management must be careful not to compromise suitable Malleefowl habitat for potential Sandhill Dunnart habitat.

The use of burning practices as used traditionally by Aboriginal people in central Australia may be appropriate with small, scattered patches of spinifex being burnt individually.

Responsibilities:

Permission would need to be sought from the leaseholder, Mr Laurie Jacobs, at Moola Station.

Fire experiments could be conducted by the Fire Management Unit at The Department for Environment and Heritage. Funding by DEH and other. Approvals would be needed for the Native Vegetation Act. Permission from the Country Fire Service.

Funding ($1,000's)

Year	2001	2002	2003	2004	2005	Total
Funds		5	5			10

Action 7. Encourage the use of deep pitfall traps in small mammal surveys in central Australia and the northern regions of the Great Victoria Desert.

Aim: Increase the opportunities for incidental captures of Sandhill Dunnarts in central Australia.

Justification: There is probably limited justification at this time for specific surveys of Sandhill Dunnarts in the central Australia and the northern regions of the Great Victoria Desert but other small mammal surveys (in appropriate habitats) could incorporate techniques suitable for the capture of Sandhill Dunnarts.

Methods: Pitfall traps 60 cm deep and 25 cm diameter are strongly recommended. Pit traps are used in conjunction with drift fences. Six pit traps along 60 m lengths of 30 cm high drift fence were used during the Sandhill Dunnart survey.

Responsibilities:

The Scientific Permits sections of the Department for Environment and Heritage, SA, the Parks and Wildlife Commission of the Northern Territory, and Environment Australia. The Biological Survey and Monitoring Section of the Department for Environment and Heritage SA. Parks and Wildlife Commission of the Northern Territory, Alice Springs. Environment Australia, Uluru Kata-Tjuta National Park.

Action 8. Monitoring programs for the key populations.

Aim: To determine Sandhill Dunnart population trends over different seasonal conditions.

Methods: Trapping methods using Elliott traps and Pitfall traps (60 cm deep) should be employed. Best time to survey is between March and May as dunnarts are more likely to enter Elliott traps. At this time the populations are likely to contain recently weaned young animals which are more likely to be trapped than adults. Surveys could be conducted at least every year and preferably twice yearly.

Volunteer groups such as the Friends of the Great Victoria Desert could conduct surveys. The Friends of the Great Victoria Desert have been heavily involved with the Sandhill Dunnart Survey during 1999 to 2001 and have had experience with the use of pitfall traps and Elliott traps. However it is essential that a wildlife biologist accompany the group to help with species identification and animal handling.

Responsibilities:

Biodiversity Conservation Programs Section, South Australian Department for Environment and Heritage have had a long involvement with the Friends of the Great Victoria Desert and would be in a good position to support this work.

An ongoing monitoring program may be appropriate for the Ooldea, Cowell and Middleback sites in SA. It is not considered that these could be carried out by volunteer groups such as the Friends of the Great Victoria Desert, without the assistance of a wildlife biologist.

In Western Australia, further monitoring of the population at Queen Victoria Spring Nature Reserve and the Mulga Rock area would be desirable. It would be valuable to radio-track Western Australian Sandhill Dunnarts to determine if they are using spinifex or burrows for nest sites. This may have a major impact on the management methods used in their conservation, particularly in relation to fire. The Western Australian Department of Conservation and Land Management is responsible for surveys undertaken in Western Australia.

South Australian monitoring with volunteers and one biologist.

Funding ($1,000's)

Year	2001	2002	2003	2004	2005	Total
Funds		8	8	8	8	32

Western Australian monitoring would require field trips by biologists to Queen Victoria Springs and Mulga Rock region. Probably 3-week field trips with two people.

Funding ($1,000's)

Year	2001	2002	2003	2004	2005	Total
Funds		10	10	10	10	40

Part D: GUIDE TO DECISION MAKERS

Sandhill Dunnarts are known to occur on Eyre Peninsula in South Australia and in the southern Great Victoria Desert of Western Australia and South Australia. They may still exist in the central ranges of the Northern Territory although there have been no records since 1894. (See figure 2 for all records of the species.)

The species potential habitat is apparently extensive but we have yet to determine the Sandhill Dunnart's specific habitat needs. They occur primarily in mallee and eucalypt woodland with sandy soils, usually associated with dunes, and an understory of spinifex hummock grass (*Triodia* species). Currently the species appears to be patchily distributed and the known populations are large distances apart.

The responsibility for the conservation of this species rests with a wide variety of decision-makers. The Department for Environment and Heritage in South Australia and Conservation and Land Management in Western Australia are the major government agencies concerned. However much of the suitable habitat is on Aboriginal land, agricultural land, pastoral lease, mining lease and crown land.

The responsibility for fire control and management is an important issue, particularly on Eyre Peninsula where Sandhill Dunnarts are known to have a preference for specific age-structure of spinifex (approximately 5 to 15 years post-fire). The diligent use of fire and possible introduction of fire management practices to encourage the growth of suitable age-stands of spinifex may become a major component for species conservation. The responsibility for fire management rests largely with landholders, the Country Fire Service and the Fire Management Unit in the Department for Environment and Heritage.

Similarly, land clearance practices on Eyre Peninsula needs to be carefully managed in areas of potentially suitable Sandhill Dunnart habitat. Applications for land clearance activities for agriculture, mining and other activities such as roads, electricity transmission lines and railways need to be assessed carefully, particularly in areas of mallee with high densities of spinifex vegetation cover.

There are few management options for Sandhill Dunnarts currently available for the Great Victoria Desert. There appear to be few threatening processes currently at work within the region. One major threat may be the increasing number of large-scale wild fires in the region but more work is needed to determine this. Much of the land is currently within Conservation Areas with most of the remainder within Aboriginal land. Current land use practices appear to be compatible with the long term survival of Sandhill Dunnarts in this region.

There is a potential threat from mineral exploration and mining development in some areas, eg Yumburra Conservation Area in South Australia.

Tools to assist implimentation

Funding for research into the ecology of the Sandhill Dunnarts should be sought from a wide range of government grants, conservation organisations and scholarships. The research work at Eyre Peninsula (Action 4, Action 5) could be conducted by university post-graduate students in association with relevant government agencies and zoological gardens (for captive breeding.

Community groups could be involved with monitoring projects. For example the Friends of the Great Victoria Desert have already been heavily involved in initial

survey work in 1999 to 2001. Their support with manpower, vehicles and knowledge of the desert was invaluable to this project.

Assessing performance.

This recovery plan will need to be reviewed in 2003 to ascertain its level of performance. By that time there should be considerably more survey information available from both Eyre Peninsula and the southern Great Victoria Desert of South Australia due to the Biological Surveys currently being undertaken in these regions.

Further reviews should be conducted every two to three years by the species recovery team.

Part E: IMPLEMENTATION SCHEDULE

Funding ($1,000's)

Action 1. Prevent further clearance of suitable habitat on Eyre Peninsula.

Action 2: Conduct surveys in potential habitat on Eyre Peninsula.

Year	2001	2002	2003	2004	2005	Total
Funds	125	125	70			320

Action 3: Conduct further surveys of the Great Victoria Desert.

Year	2001	2002	2003	2004	2005	Total
Funds	125	125	70			320

Action 4. Detailed survey of the known Eyre Peninsula populations.

Year	2001	2002	2003	2004	2005	Total
Funds		15	15			30

Action 5. Study the species in captivity to examine reproductive ecology.

Year	2001	2002	2003	2004	2005	Total
Funds		10	4	4	4	22

Action 6. Conduct experimental burns in suitable habitat to promote the growth of spinifex on Eyre Peninsula.

Year	2001	2002	2003	2004	2005	Total
Funds		5	5			10

Action 7. Encourage the use of deep pitfall traps in small mammal surveys in central Australia and the northern regions of the Great Victoria Desert.

Action 8. Monitoring programs for the key populations.

South Australian monitoring.

Year	2001	2002	2003	2004	2005	Total
Funds		8	8	8	8	32

Western Australian monitoring.

Year	2001	2002	2003	2004	2005	Total
Funds		10	10	10	10	40

TOTAL FUNDS FOR 2001 TO 2005

Year	2001	2002	2003	2004	2005	Total
Funds	250	298	182	22	22	774

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The Maralinga-Tjarutja community gave us permission to work on their land in the Great Victoria Desert and allowed us access to fuel and supplies at the Oak Valley Community. The Area Administrator of the Defence Support Centre allowed us access to the Woomera Prohibited Area. Peter Reed of the Department of Defence gave us permission to work in Maralinga Section 400.

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Appendix 1. Habitat descriptions.

Throughout its range the observed habitat of the Sandhill Dunnart is in sandy areas usually in or near to sand dunes. The vegetation is mallee or Marble Gum woodland (*Eucalyptus gongylocarpus*) usually with a diverse shrub layer and a ground cover of spinifex (*Triodia* species) hummocks (10 to 70% cover). This habitat type is widespread throughout the Great Victoria Desert.

Northern Territory

The habitat at the type locality near Lake Amadeus is 30 m high parallel sand dunes covered with hummocks of spinifex (*Triodia* spp.). Between the dunes were small flats covered with stands of Desert Oaks (Spencer 1896a).

Great Victoria Desert, Western Australia.

At Mulga Rock, south-east of Lake Minigwal, in Western Australia, five specimens were caught in scattered locations in June/July 1985. The area is a mosaic of Marble Gum (*Eucalyptus gongylocarpa*) and mallee woodland, both over Hard Spinifex (*Triodia basedowii*) with some shrubs. Two animals were caught in a small area of Broombush (*Melaleuca uncinata*) shrubland up to 2.5 m high with very little spinifex. The other three specimens were caught in areas of 20 to 30 percent cover of spinifex. The area consists of undulating sand plain with areas of well-defined parallel sand ridges up to 30 m high (Hart and Kitchener 1986).

(Photo. S. Churchill)

Figure 3. Typical Marble Gum (*E. gongylocarpa*) vegetation at the Mulga Rock site.

At Queen Victoria Spring (approximately 35 kms to the south of the Mulga Rock site) the vegetation is low open woodland of Marble Gum (*E. gongylocarpa*) with occasional mallees and a diverse shrub layer. Beneath this shrub layer, Hard Spinifex (*Triodia basedowii*) provided 25% ground cover. The landform is an area of sand plain with low dunes present 1 km to the north and north-east (Pearson and Robinson 1989).

Great Victoria Desert, South Australia

Yarle Lakes site, South Australia, is within a corridor of parallel dunes that run north-west from Ooldea and is part of the Ooldea Range. The vegetation is a low open woodland of mallee (*E. oleosa* and *E. socialis*), Bullock Bush (*Alectryon oleifolium*), Quandong (*Santalum acuminatum*), Mulga (*Acacia aneura*) and Black Oak or Belah (*Casuarina pauper*) with a diverse and very open shrub layer. Beneath this shrub layer Spinifex (*Triodia scariosa*) provides 10 to 30% ground cover (Pearson and Robinson 1989).

(Photo. S. Churchill)

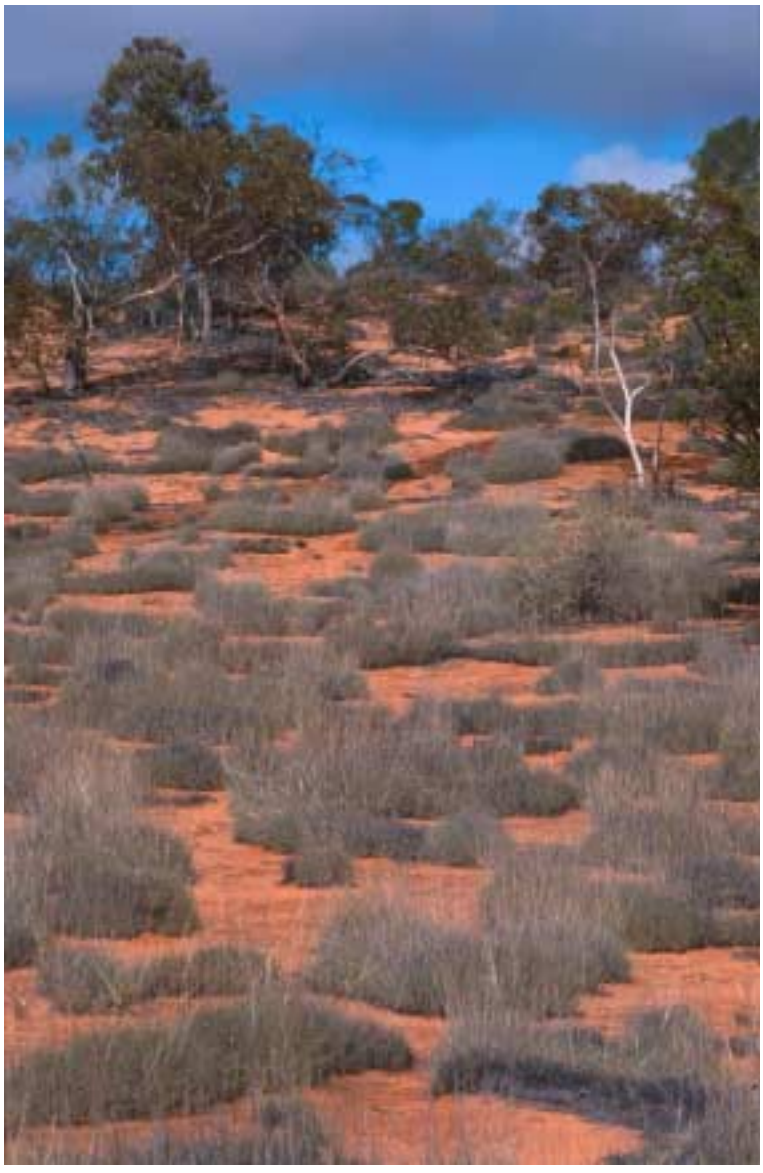

Figure 4. Sand dune with spinifex and mallee at Ooldea.

The Ooldea site is within a large area of confused sand dunes, 30 to 50m high. The vegetation is low mallee woodland (*E. concinna*, *E. oleosa* and *E. socialis*) with False Sandalwood (*Myoporum platycarpum*) and denser clumps of Scrub Cypress Pine (*Callitris verrucosa*). The shrub layer is diverse but very open with dense Spinifex (*Triodia scariosa*) providing 30 to 70% of the ground cover (Pearson and Robinson 1989).

The Mt Christie site is also in sand dunes. The vegetation is low open mallee (*E. striaticalyx*, *E. oleosa* and *E. socialis*) with False Sandalwood (*Myoporum platycarpum*)), Bullock Bush (*Alectryon oleifolius*), Quandong (*Santalum acuminatum*), Mulga (*Acacia aneura*) and Black Oak or Belah (*Casuarina pauper*). The shrub layer is diverse and Spinifex (*Triodia scariosa*) provides 10 to 30% of the ground cover (Pearson and Robinson 1989).

(Photo. S. Churchill)

Figure 5. Vegetation on sand dunes at Mt Christie site, South Australia.

Eyre Peninsula, South Australia

At Mamblin in the Eyre Peninsula the country consists of parallel sand dunes 10 to 15 m high separated by valleys 200 to 300 m wide. The original vegetation was a uniform covering of mallee with an understorey of Broombush (*Melaleuca uncinata*) and other shrubs. Semi-open areas of Woolly Spinifex (*Triodia lanata*) appeared intermittently on the dune slopes. In the 1950's and 1960's large areas of scrub were being cleared from the interdune valleys but the vegetation on the sand dunes has been left largely intact, or was allowed to regrow after the initial clearances (Aitken 1971). This area has since been cleared for agriculture.

At Boonerdo, the vegetation and topography is very similar to Mamblin. All four specimens were captured, during land clearing operations, from an area immediately adjacent to the Hambidge Conservation Park (Aitken 1971). Unfortunately a large proportion of Hambidge Conservation Park was burnt in a wildfire, in January 2000, which burnt approximately 80% of the vegetation.

At the Cowell site the dunnarts were captured on a series of white sand dunes 10 to 25 m high along a property boundary. The vegetation to the south has been cleared for agriculture. The vegetation on the dunes comprised of mallee (*E. gracilis, E. incrassata, E. oleosa* and *E. socialis*) with Scrub Cypress Pine, (*Callitris verrucosa*) and *Hakea francisciana*. There is an understorey of mixed shrubs and 30 to 85% ground cover of Spinifex (*Triodia irritans*). The area was extensively burnt in a wildfire on 8 November 1990.

(Photo. S. Churchill)

Figure 6. Dune vegetation at the Cowell site. This vegetation did not get burnt in the 1990 fire and supports a denser shrub layer and less spinifex than the burnt areas.

(Photo. S. Churchill)

Figure 7. Vegetation at the Middleback site. This is regrowth vegetation from the 1990 fire. Middleback Range is in the background.

The Middleback site is to the west of the Middleback Range and comprises parallel sand dunes 10 to 20 m high. The vegetation consists of mallee overstorey containing a mix of species including *Eucalyptus socialis*, *E. gracilis, E. incrassata, E. oleosa* and *E. brachycalyx.* The understorey contains a variety of shrubs such as *Alyxia buxifolia*, *Eremophila scoparia*, *Senna artemissioides*, *Hakea francisiana* and *Melaleuca lanceolata* and *Dodonaea viscosa*. *Triodia irritans* is the dominant ground cover and provides 10 to 90% cover.