

8. STATUS, MONITORING AND MANAGEMENT OF NGAṆAMARA IN THE SOUTHERN ALINYTJARA WILUṆARA NATURAL RESOURCE MANAGEMENT REGION

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Abstract

In the Maralinga Tjarutja Lands, there have been numerous historic records of NgaṆamara (Malleefowl) and NgaṆamara signs; however no regular monitoring of NgaṆamara sites has occurred. A recent survey of animal tracks across the Maralinga Tjarutja lands found six locations with fresh NgaṆamara tjina (tracks), confirming the continued occurrence of NgaṆamara in the region. The habitat of these signs varied from dense mallee to open mulga woodland. Subsequently, a survey took place in August 2007, involving Aṅangu and ecologists, targeting known NgaṆamara mounds and searching areas for new NgaṆamara sites. The results of this survey are presented here, and will form the basis of future monitoring and management of NgaṆamara in the southern Alinytjara WiluṆara Natural Resource Management region. This monitoring should be aligned with monitoring occurring in the Aṅangu Pitjantjatjara Yankunytjatjara Lands and in Western Australia.

Background

The Alinytjara WiluṆara Natural Resource Management region in South Australia, which covers 26% of South Australia, is contiguous with the Western Australia border and stretches from the Northern Territory south to the Great Australian Bight (Figure 1). It encompasses the Aṅangu Pitjantjatjara Yankunytjatjara Lands, the Maralinga Tjarutja Lands, and Yalata Indigenous Protected Area, all Aboriginal managed lands. The region is one of the most intact and pristine wilderness areas in Australia, as most of the area has been untouched by the ravages of pastoralism and agriculture. As such, many important species of conservation significance still persist in the region, such as the Marsupial Mole *Notoryctes typhlops*, Tjakuṛa (Great Desert Skink) *Egernia kintorei*; Princess Parrot *Polytelis alexandrae*, Sandhill Dunnart *Sminthopsis psammophila* and NgaṆamara (Malleefowl) *Leipoa ocellata*.

Despite the vast tracks of contiguous and potentially suitable habitat across the arid zone, NgaṆamara numbers are thought to have declined markedly in central Australia since the onset of pastoralism and the spread of foxes. In the 1990s, surveys revealed that the species still occurred in the Aṅangu Pitjantjatjara Yankunytjatjara Lands, and subsequent surveys have recorded numerous sites in the Aṅangu Pitjantjatjara Yankunytjatjara Lands. This suggested that the species could potentially occur sporadically across the vast landscape, primarily within the Great Victoria Desert bioregion.

Historic records of NgaṆamara within the southern portion of the Alinytjara WiluṆara region (Maralinga Tjarutja Lands, Yumburra, Yellabinna and Yalata) are few in number, as summarised in Benshemesh (2007) and the Department for Environment and Heritage Biological Survey Database records (Figure 1). The scarcity of NgaṆamara records in the southern Alinytjara WiluṆara region is no doubt in part due to the low densities of NgaṆamara, the logistical difficulties involved in surveying for NgaṆamara and the lack of biological surveys conducted in the area. Furthermore, there is little

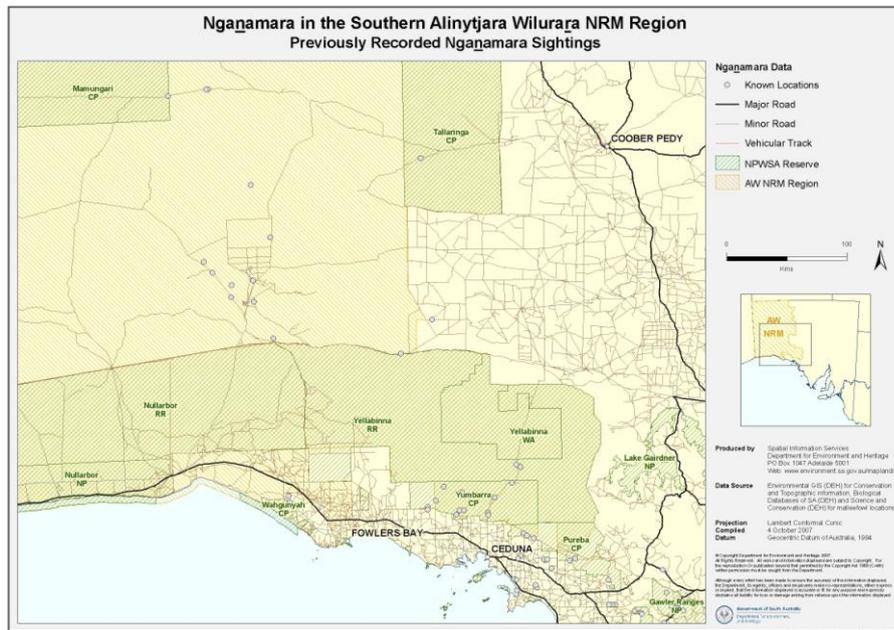


Figure 1. Previously recorded Nganamara sightings in the southern Alinytjara Wilurara Natural Resource Management region, pre July 2007.

recent information about the status of known Nganamara mounds / records within the region. Recently, however, Nganamara signs were detected at six locations in the Maralinga Tjarutja Lands, during an Animal Track survey of the Maralinga Tjarutja Lands designed to establish some ecological baseline data on the frequency of occurrence across the region of different native and non-native animals (Southgate *et al.* 2007). This indicated that Nganamara were still present in the region and that further information could be gathered on their status.

In line with Action 10.1 of the National Malleefowl Recovery Plan (Benshemesh 2007), data on the distribution, abundance and habitat preferences of Nganamara in the remote areas of South Australia and Western Australia needs to form the basis of future monitoring and management at a number of intensities. While the density of Nganamara in these areas may be low, the enormous areas involved suggest that they may be of great importance for Nganamara conservation (Bellchambers 2007).

Therefore, a survey for Nganamara was conducted for the southern portion of the Alinytjara Wilurara region. The primary aim of the survey was to establish known locations of Nganamara mounds to form the basis of future monitoring. This was deemed important and timely, because there is currently a considerable injection of funding for Natural Resource Management work in the Maralinga Tjarutja Lands, providing an opportunity for local community members to conduct Nganamara monitoring in the region. The basis of the 2007 survey was revisiting existing and reliable record locations (primarily recent records with high precision) from the Department for Environment and Heritage Biological Survey Database and areas where Nganamara tracks were recorded in the Animal Track survey.

The core objectives of the survey were to:

1. Determine the status of previously recorded Nganamara nest mounds in the southern parts of the Alinytjara Wilurara Natural Resource Management region, in particular Yellabinna, Yumbarra, Tallaringa and Mamungari Conservation Parks and Maralinga Tjarutja Lands,
2. Locate new Nganamara nest mounds in the southern parts of the Alinytjara Wilurara Natural Resource Management region, in particular Yellabinna, Yumbarra, Tallaringa and Mumungari Conservation Parks and Maralinga Tjarutja Lands,

3. Establish monitoring of located Ngan̄amara nest mounds in accordance with National Ngan̄amara Recovery guidelines,
4. Engage An̄angu consultants, in particular from Yalata and Oak Valley, in the searching and monitoring of Ngan̄amara nest mounds.

The following report discusses the methods and results of the survey, and the monitoring and management requirements for Ngan̄amara in the southern Alinytjara Wilurara Natural Resource Management region, as reported in detail in Bellchambers (2007) and Ward & Clarke (2007). The Ngan̄amara survey was conducted in August 2007 by Ardeotis Biological Consultants (Keith Bellchambers) and Desert Wildlife Services (Rachel Paltridge), organised by the Department for Environment and Heritage Aboriginal Lands Regional Ecologists and funded through the Department for Environment and Heritage and the Alinytjara Wilurara Natural Resource Management Board. Ardeotis arranged the survey for Ngan̄amara mounds, while the primary role of Desert Wildlife Services was to facilitate An̄angu employment in the survey. A detailed scientific report (Bellchambers 2007) and a plain language document and summary of An̄angu involvement (Paltridge *et al.* 2007) is available from the Department for Environment and Heritage.

Survey methods and results

A database of previous records of Ngan̄amara from the survey area was compiled to provide a starting point on which to base search effort. These records included nest mound locations, sightings of birds and observations of the Ngan̄amaras' characteristic tracks. Records were sourced from Department for Environment and Heritage biological databases, Birds Australia Atlas database, and previous surveys in the area such as Greenslade *et al.* (1986), Southgate *et al.* (2007) and Robinson *et al.* (1990).

Given the size of the area of interest and the probable sparse nature of the distribution and abundance of the species within it, the process of creating a database of known locations enabled the decision to be made to concentrate survey effort on the accessible portions of the Yellabinna, Yumberra, Tallaringa and Mamungari Conservation Parks and Maralinga Tjarutja Lands.

Previous observations from the survey area were relocated with a GPS. Most of these sites were re-visited and searched during this survey. In addition, new sites where nest mound, sightings of birds, observations of the Ngan̄amaras' characteristic tracks and opportune sites in suitable habitat were also searched during this current survey. Some of these sites were located during opportune searches in suitable habitat whereas others were located while slowly driving along roads and tracks in the area.

The general search protocol was to spend 1 hour actively searching at a site for any sign of Ngan̄amara. The effort involved in this active searching varied from 2 man-hours for most sites up to 8-10 man-hours when An̄angu consultants from Oak Valley were on site. These searches involved walked random transects or up and back transects through an area of at least 500m by 500m around a central point.

When nest mounds were located, a set of standardised data were collected, as outlined in the National Ngan̄amara Monitoring Manual (Natural Heritage Trust National Malleefowl Monitoring Project 2007). A photopoint was also established for future reference. An area of at least 500m by 500m around each mound was also searched in an effort to locate other mounds that may be nearby or other sign of Ngan̄amara. Ngan̄amara Monitoring Grids (Gillam 2005, 2007) were not set up at any mounds located during this survey due to the remoteness of the area and the sparse nature of the distribution and abundance of the species within it.

When Ngan̄amara or their tracks were located, an area of at least 500m by 500m around each sighting was searched or tracks were followed wherever possible in an effort to locate nest mounds that may be nearby or other sign of Ngan̄amara.

In addition to the sites where Ngan̄amara had been recorded during this or previous surveys, a number of opportune sites in suitable habitat were searched during this survey. An area of at least

500m by 500m around each point was searched for an hour in an effort to locate nest mounds or any other sign of Nganamara.

Major Results of Nganamara Survey

A total of 53 sites were assessed for the presence of Nganamara during this current survey, including 11 of 28 previously recorded Nganamara sites, and an additional 42 new sites (Figure 2).

The presence of Nganamara was detected at 20 sites during this current survey. Nest mounds were located at 8 sites, tracks were located at 11 sites and birds were observed at 5 sites. Several sites had a combination of Nganamara sign.

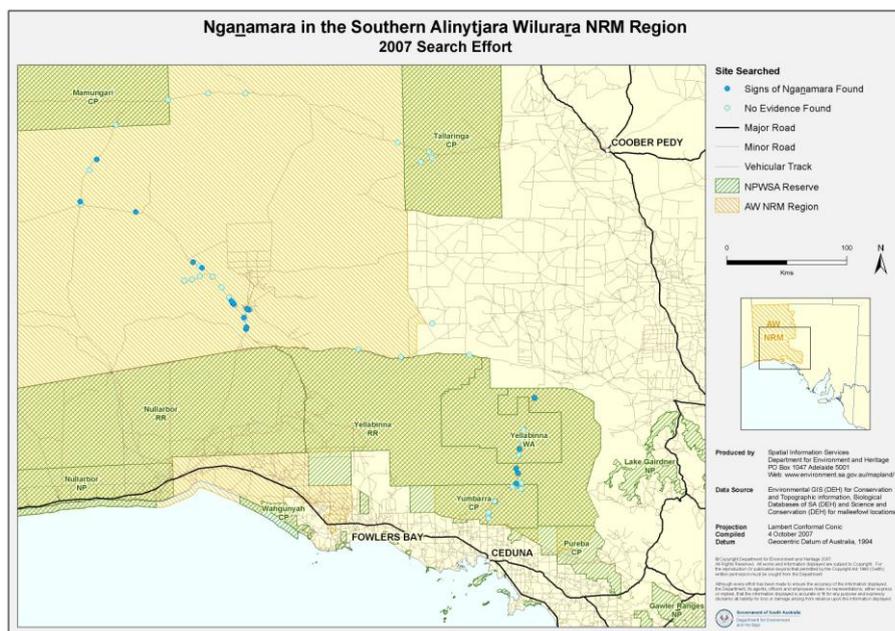


Figure 2. Sites where Nganamara were searched for in August 2007 survey in the southern Alinytjara Wilurara Natural Resource Management region.

The status and location of the 8 nest mounds located during this survey are summarised in Table 1 and Figure 3. Two nest mounds were known prior to this

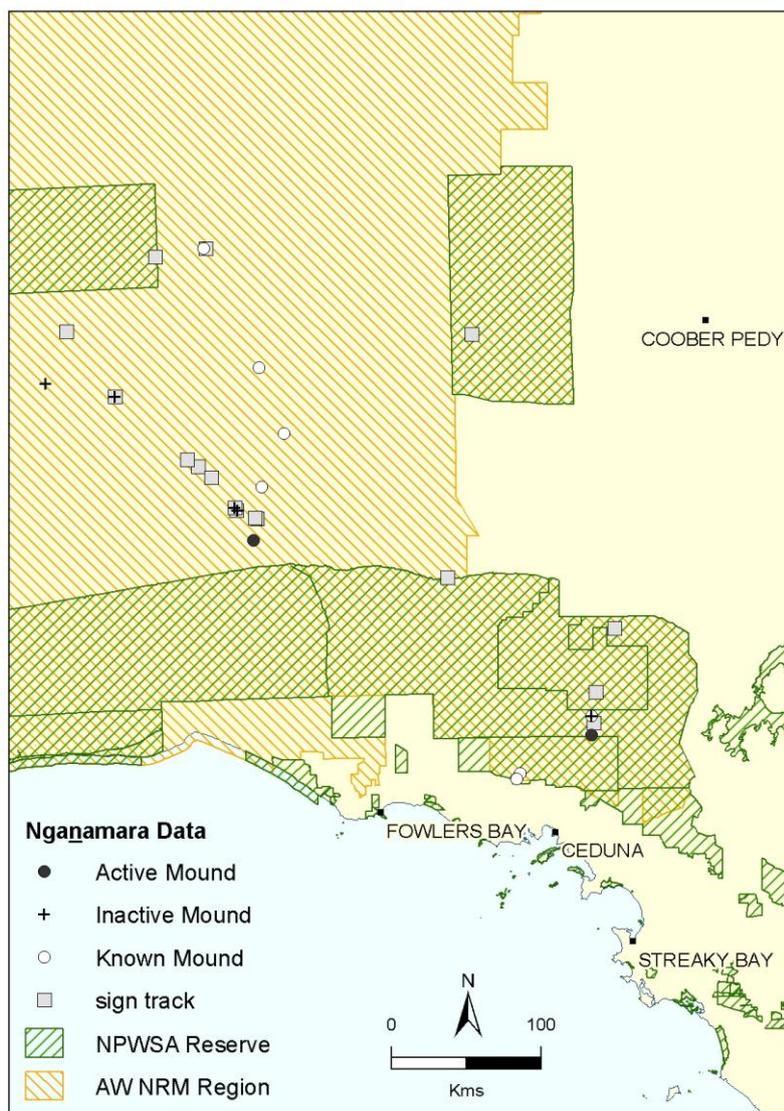


Figure 3. Location of all known mounds (including active, inactive and mounds of unknown status) and sites with Nganamara tracks in the southern Alinytjara Wilurara Natural Resource Management region, January 2008.

current survey with the other 6 being located during this survey. Only 1 of the mounds was active at the time of the survey with birds raking litter into the nest in preparation for egg laying at a later date. Another mound had been active over the past couple of years (Robert Sleep *pers. comm.* - Department for Environment and Heritage Ceduna senior ranger), but inactive in this survey, whilst another had newly built into a spoil heap but inactive. The remaining mounds had not been in use for some time. One mound was located as a result of information from an Anangu

Table 1. List of sightings recorded in this 2007 Nganamara survey in MT Lands.

Sighting	Comments
Mound AWMF 1	New mound, not previously used. Low open mallee over shrubs with Spinifex groundcover. Sandy soil. Tall dunes and narrow swales.
Mound AWMF 2	Inactive, used for past 2 years. Low open mixed species mallee over shrubs with Spinifex and annual grasses. Sandy soil. Tall dunes and narrow swales. Old fire scar area.
Mound AWMF 3	Inactive, not used for >2 years. Low open mixed species mallee over shrubs with Spinifex and annual grasses. Sandy soil. Tall dunes and narrow swales. Old fire scar area.
Mound AWMF 4	Active, being prepared for use. Open mixed species Acacia shrubland with few emergent mallee over annual grasses. Sandy soil. Complex dunes.
Mound AWMF 5	Inactive, not used for 5 years. Low open mixed species mallee over sparse shrubs with Spinifex groundcover. Sandy soil. Low dunes and broad swales.
Mound AWMF 6	Inactive, not used for >5 years. Low open mixed species mallee over sparse shrubs with Spinifex groundcover. Sandy soil. Low dunes and broad swales.
Mound AWMF 7	Inactive, not used for >5 years. Tall Mulga shrubland over shrubs within open woodland vegetation. Hard red soil. Broad plain.
Mound AWMF 8	Inactive, not used for >5 years. Low open mixed species mallee over sparse shrubs with Spinifex groundcover. Hard sandy soil. Low dunes and broad swales.
Tracks	1 day old. 1 bird. Low open mixed species mallee over shrubs with Spinifex groundcover. Sandy soil. Tall dunes and narrow swales. Old fire scar area.
Tracks	1 day old. 1 bird. Low open mixed species mallee over shrubs with Spinifex groundcover. Sandy soil. Tall dunes and narrow swales.
Tracks	1 day old. 1 bird. Open mixed species shrubland with few emergent mallee over annual grasses. Sandy soil. Broad plain.
Tracks	1 day old. 2 birds. Associated with AWMF 4 and recent sightings nearby. Open mixed species Acacia shrubland with few emergent mallee over annual grasses. Sandy soil. Complex dunes.
Tracks	1 week old. 1 bird. Tracks also recently observed in area. Low open mixed species mallee over shrubs with Spinifex groundcover. Hard sandy soil. Broad plain.
Tracks	Today up to 1 week old. 2 birds. Bird sighted today and bird and tracks also recently observed in area. Low open mixed species mallee over shrubs with Spinifex groundcover. Hard sandy soil. Broad plain.
Tracks	1 week old. 1 bird. Low open mixed species mallee over sparse shrubs with Spinifex groundcover. Sandy soil. Low dunes and broad swales.
Tracks	Today up to 1 week old. 2 birds. Low open mixed species mallee over sparse shrubs with Spinifex groundcover. Sandy soil. Low dunes and broad swales.
Tracks	1 week old. 1 bird. Low open mixed species mallee over sparse shrubs with Spinifex groundcover. Sandy soil. Low dunes and broad swales.
Tracks	Today up to 1 week old. 2 birds. Associated with AWMF 7 and sightings today. Tall Mulga shrubland over shrubs within open woodland vegetation. Hard red soil. Broad plain.
Tracks	1 day old. 2 birds. Open mixed species Acacia shrubland with few emergent mallee over annual grasses. Sandy soil. Complex dunes.
Birds	Seen last week. 2 birds. Associated with AWMF 4. Open mixed species Acacia shrubland with few emergent mallee over annual grasses. Sandy soil. Complex dunes.
Birds	Seen last week. 2 birds. Low open mixed species mallee over shrubs with Spinifex groundcover. Hard sandy soil. Broad plain.
Birds	Today. 1 bird. Tracks of 2 birds sighted today and bird and tracks also recently observed in area. Low open mixed species mallee over shrubs with Spinifex groundcover. Hard sandy soil. Broad plain.
Birds	Seen 2 months ago. 1 bird. Low open mixed species mallee over sparse shrubs with Spinifex groundcover. Sandy soil. Low dunes and broad swales.
Birds	Today. 2 birds. Associated with AWMF 7. Tall Mulga shrubland over shrubs within open woodland vegetation. Hard red soil. Broad plain.

consultant who indicated that she had visited it approximately 5 years ago and removed 12 eggs from it (*Brown pers. comm.*). It appeared not to have been used since that time. Most mounds were located in low open mallee over shrubs with spinifex groundcover on sandy soil in dune and swale systems, however mounds were found in a variety of vegetation types and land systems.

The 11 locations at which *Nganamara* tracks were observed during this survey are summarised in Table 1 and their locations are shown in Figure 3. Observed track patterns varied from single birds foraging over large areas where tracks could be followed for several kilometres over the terrain to relatively small, high use areas by several birds, associated with nest mounds or feeding habitat. None of the sites where tracks were observed during this survey were associated with previous observations of *Nganamara* from the survey area.

The 5 locations at which *Nganamara* were recorded during this survey are summarised in Table 1 and their locations are shown in Figure 3. Two of the observations were made while on the field survey and the other three were recent reports from locals familiar with the species. Two of these reports were from the Oak Valley store truck driver who frequently travels through the area and the other reported sighting was made by the Land Management Officer for Maralinga Tjarutja based in the Oak Valley community (*Dodd pers. comm.*).

The single bird observed during the survey was quietly feeding amongst low shrubs and in the litter under low mallee. There were numerous tracks of 2 birds in the area and a bird had previously been sighted in the area (*Ashton pers. comm.*, *Joseph and Pedler pers. comm.*). The pair of birds observed during the survey was quietly feeding amongst thick litter under tall Mulga shrubland and were close to an inactive mound. There were numerous tracks of 2 birds and feeding sign in the area. None of the sites where *Nganamara* were observed during this survey were associated with previous observations of *Nganamara* from the survey area.

In summary, 53 sites were assessed for the presence of *Nganamara* during this survey. 20 sites had some sign (nest mound, tracks or sighting) and 33 sites had no sign of *Nganamara*. When combining old sighting with new sightings, there are now a total of 44 sites within the search area from the southern part of the Alinytjara Wilurara Natural Resource Management region at which *Nganamara* have been recorded.

Distribution

The results obtained from this survey confirm that the *Nganamara* is widespread but at very low densities in the southern part of the Alinytjara Wilurara Natural Resource Management region. The number of sites at which *Nganamara* have been recorded in the survey area was nearly doubled at the completion of this survey, however, there are still less than 50 sites at which the species has been recorded.

Nganamara observations from the region have been recorded by explorers, amateur ornithologists, site specific biological surveys, track surveys and this current survey yet little is known about the species away from the few areas that can be accessed. It is assumed that the species is also widespread but at very low densities in those enormous areas of country away from the road and track system. Given the size of the area, there does not need to be a high density of birds for there to be a potentially large population of *Nganamara* in the region.

The historical database combined with the results of this and other recent fauna surveys in the region indicate that, while the *Nganamara* is distributed widely throughout the region, its abundance in the region is highest in the south and around the Maralinga area. There are fewer records from the Vokes Hill Corner and Anne Beadell Highway section of the region and then another grouping of records in the north-west of the state in the Anangu Pitjantjatjara Lands.

It is not known if this reflects survey effort or is a measure of habitat preferences by the *Nganamara*. The results of this current survey and previous observations indicate that the species utilises a number of habitat types but the south of the region is dominated by low open mixed species mallee over shrubs with spinifex groundcover with sandy soil on dunes and swales. Farther north in the

region the mallee becomes more open and the dunes become lower and the swales become broader. North of Maralinga and Oak Valley the vegetation becomes dominated by open mixed species Acacia shrubland with few emergent mallee over annual grasses with harder sandy loam soils on broad plains or complex dunes. Photographs of Ngaṅamara mounds at Walalkara even farther north show low very open Acacia shrubland (*Acacia minura*) over Spinifex on harder sandy soils.

Monitoring Ngaṅamara in the Alinytjara Wiluṛara Natural Resource Management region

Traditional monitoring of Ngaṅamara, which involves grid based searches, is not appropriate in the Alinytjara Wiluṛara region because of the sparse nature of Ngaṅamara mounds, the low density of birds, and the fact that many records of Ngaṅamara are not of mounds but simply of tracks and traces. With such low numbers and the difficulties in managing such a vast landscape, there are questions as to whether monitoring of Ngaṅamara is necessary in this landscape. Below we outline why monitoring of Ngaṅamara should occur in the Alinytjara Wiluṛara region.

Legislative

Recently, the South Australian Government endorsed No Species Loss; A Nature Conservation Strategy for South Australia (Department for Environment and Heritage 2007), which has an aspirational goal of losing no native species to extinction from the state. Ngaṅamara is listed as Vulnerable, both nationally (Environment Protection and Biodiversity Conservation Act 1999), and in South Australian (National Parks and Wildlife Act 1972). These acts require the Alinytjara Wiluṛara Natural Resource Management Board and Department for Environment and Heritage to undertake efforts to conserve the species.

There is also an imperative to monitor Ngaṅamara within a Natural Resource Management framework. Short-term Management Action Target 9.1 for the Maralinga Tjarutja Lands in the Alinytjara Wiluṛara Integrated Natural Resource Management Plan is to "ensure adequate monitoring programs are in place for native plant and animals by June 2005" (Aboriginal Lands Integrated Natural Resource Management Group 2004).

There is, therefore, a legislative mandate to monitor Ngaṅamara populations to be able to determine population trend, better clarify conservation status and determine whether active management is necessary.

Conservation / Ecological

Current trends in Ngaṅamara populations across Australia indicate a decline in numbers. Ngaṅamara populations have declined by at least 20% over the past three generations (estimated at 15 years each), and it is likely that populations may decline by at least another 20% over the next three generations (Benshemesh 2007). Monitoring of Ngaṅamara in the southern Alinytjara Wiluṛara is, therefore, important in determining whether Ngaṅamara are following the national trend of decline.

Monitoring of Ngaṅamara is also an essential component of the adaptive management framework adopted by the National Malleefowl Recovery Team at the 2007 National Malleefowl forum. By monitoring and establishing baseline information on persistence of Ngaṅamara, conservation managers will have more information at hand should the implementation of different management scenarios be deemed appropriate or necessary.

In the southern Alinytjara Wiluṛara Natural Resource Management region, monitoring of Ngaṅamara will provide a focus around which other ecological monitoring could occur, therefore providing a broader scope of baseline ecological information for the region. For example, the monitoring of Ngaṅamara should be combined with regular track transects and 2-ha sand-plot animal track surveys (Southgate *et al.* 2007), which will provide information on predator dynamics over time.

Social

Ngaṅamara hold their own place within Aboriginal society of central desert regions, featuring in Aboriginal mythology and associated with certain 'Tjukurpa' or 'Dreaming' sites and trails in central Australia (Benshemesh 2007). Ngaṅamara were also an important food and protein source - their eggs (ngampu) were harvested as a traditional food source and birds would probably also have been harvested occasionally. Traditionally, individual Ngaṅamara mounds were under the custodianship of individual Traditional Owners (Donald Fraser, *pers. com.*). After the broader conservation plight of Ngaṅamara was explained to Traditional Owners in the Anangu Pitjantjatjara Yankunytjatjara Lands, local communities and Traditional Owners have demonstrated a serious conservation concern and custodianship for Ngaṅamara.

Given this, Anangu in the Alinytjara Wilurara region need to be given every possible opportunity to take responsibility for the custodianship and monitoring of Ngaṅamara (i.e. appropriate resources and incentives, both financial and logistical). Anangu have many skills and knowledge to contribute to the monitoring of Ngaṅamara in the region, and should be consulted in all aspects of future monitoring and survey. For example, capturing indigenous knowledge regarding the location of Ngaṅamara mounds was an initial step in the recent Ngaṅamara surveys. Also, Anangu have generations of experience in looking after country, and should always be consulted and engaged in land management work associated with Ngaṅamara. This consultation should continue throughout and beyond the lifespan of projects, to ensure that the most up-to-date knowledge of the region and of Ngaṅamara is at hand.

The monitoring of Ngaṅamara also has the potential to deliver numerous positive social benefits for local indigenous communities. As discussed already, Ngaṅamara surveys in the Maralinga Tjarutja lands provided an opportunity for members of the Oak Valley community to take part in land management work. As a result, significant employment was gained through the survey (a total of 332 employment days, or roughly \$11,000 of employment). The monitoring of threatened species can provide a focal point for land management work, through which a number of other positive social outcomes are generated, including:

- training in land management skills (e.g. GPS, Cybertracker);
- consolidation of natural history skills (e.g. tracking);
- intergenerational transfer of skills and indigenous ecological knowledge;
- employment; and
- positive health benefits.

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Landscape monitoring of Ngaṅamara persistence and area of occupancy

It is difficult to measure and determine the persistence of Ngaṅamara over a landscape such as the Alinytjara Wilurara Natural Resource Management region, because of the vast areas of potentially suitable habitat, the scarcity of animals and the difficulty in finding animals. Furthermore, finding tracks in an area does not necessarily indicate a sedentary pair, as often tracks are those of dispersing birds.

Because of these difficulties, it will be useful to report the persistence and status of Ngaṅamara in the Alinytjara Wilurara region (both southern portion and northern Anangu Pitjantjatjara Yankunytjatjara portion), in terms of the "area of occupancy".

The "area of occupancy" is a criteria used by the International Union for the Conservation of Nature. It is defined as the area within its 'extent of occurrence' that is occupied by a taxon, excluding cases of vagrancy. It is important to note that the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon, the nature of the threats and the available data (International Union for the Conservation of Nature 2001).

One way of determining area of occupancy is to establish consistent grid cells of a certain size, and each year report on the extent of occurrence and area of occupancy of Ngaṅamara (and other animals) within these networks of grid cells. A recent project initiated by the Department for

Environment and Heritage for the Northern and Yorke Region is attempting to determine the status of threatened species within that Natural Resource Management region by determining the area of occupancy of taxa using a 10km x 10km grid of cells developed for the entire state for extent of occurrence, and 1km x 1km cells for area of occupancy. Given the aforementioned project, it may be timely to implement a similar monitoring and reporting structure for biodiversity (in particular animals) across the Alinytjara Wilurara Natural Resource Management region.

Although there are issues with scale (are 10 km x 10 km cells appropriate for the Alinytjara Wilurara region, given its size?), using a grid consistent with other parts of the state would be valuable. Furthermore, the monitoring and reporting of threatened species area of occupancy, such as Nganamara, could be restricted to those grid cells which occur close to main tracks. This is where, realistically, the majority of the information about threatened species occurrence would occur.

Broad objectives for Nganamara monitoring in southern Alinytjara Wilurara region, 2008-2012

Monitoring of Nganamara in other parts of Australia has taken place for many years. As such, specific parameters such as breeding density of Nganamara pairs can be quantified, as well as the population trend in a particular region (i.e. increasing / decreasing).

Monitoring of Nganamara in the southern Alinytjara Wilurara region is in its very early stages, and there are many logistical and social difficulties that must be considered in conducting such work. Therefore, the aims of Nganamara monitoring in the southern Alinytjara Wilurara region should be relatively simple, and not necessarily all scientific. For example, land managers and government agencies need to initially demonstrate that monitoring can actually take place in a regular and consistent manner.

The broader aims of Nganamara monitoring in the southern Alinytjara Wilurara region for 2008 - 2012 should be to:

- 1) Establish monitoring guidelines for Nganamara
- 2) Communicate these with relevant staff (Alinytjara Wilurara project staff, land management staff, Department for Environment and Heritage rangers)
- 3) Establish a database for Nganamara monitoring in the region
- 4) Establish capacity of land management authorities to conduct monitoring, including equipment, resources and work plans
- 5) Conduct consistent annual monitoring of known Nganamara sites
- 6) Conduct surveys for Nganamara in new areas of the region; and
- 7) Review monitoring data

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Management of Nganamara in the southern Alinytjara Wilurara region

Management of Nganamara in other parts of Australia often focuses on potential threats to Nganamara, as listed in the National Recovery Plan: clearing; fragmentation and isolation; grazing; predation; fire (wildfire and intentional burns); disease and inbreeding; and climate change (Benshemesh 2007). Of these, predation and wildfire are realistic threats to Nganamara in the Alinytjara Wilurara Natural Resource Management region.

Direct 'management' of Nganamara in the southern Alinytjara Wilurara Natural Resource Management region is difficult, because of the massive area over which animals occur. Any consideration of management activities must consider the following questions:

- Is it financially sustainable over a long time and large spatial area?
- Is it logistically possible over a long time and large spatial area?
- Can we measure its potential impact and intended outcome?

Predation

Research has demonstrated that Ngan̄amara chicks of any age suffer heavy mortality as a result of fox predation. Foxes are most common in mallee near agricultural land where high densities may be maintained by the ready availability of rabbits, mice and sheep carrion (Saunders *et al.* 1985).

That said, there is little clear evidence that Ngan̄amara populations have increased following fox control operations, even though fox control is widely practised in areas where Ngan̄amara conservation is a concern (Benshemesh 2007). This is due to varying effectiveness of baiting programs, the fluctuating nature of Ngan̄amara breeding effort and success, the varying effect of predation in different habitat types, and importantly, the lack of adequately controlled and replicated studies (Benshemesh 2007). It must also be noted that recent analysis of Ngan̄amara monitoring data has indicated that variation in rainfall has a significant effect on Ngan̄amara breeding success.

For arid areas north of the dog fence, it must also be noted that foxes are not the only ground predator of Ngan̄amara, and the nature of the relationship between foxes, cats and dingoes / dogs is very important. For example, there is evidence that dingoes might suppress the numbers of foxes and cats (Glen *et al.* 2007), and any baiting may lead to a localised increase in fox or cat activity. Furthermore, there is little chance of controlling foxes over an area as vast and inaccessible as the Maralinga Tjarutja Lands.

Given the preliminary nature of Ngan̄amara and other ecological monitoring in the Alinytjara Wiluṛara region, the sole target for management of predation should be to collect regular and consistent information on predator dynamics in areas associated with Ngan̄amara. This is in line with the discussion paper produced by Department for Environment and Heritage on 1080 baiting in the Alinytjara Wiluṛara Natural Resource Management region (Clarke & Ward 2007). In the past, regular monitoring of predators has yet to be achieved in the Alinytjara Wiluṛara Natural Resource Management region. In 2007, however, the Warru (Black-flanked Rock-wallaby *Petrogale lateralis* MacDonnell Ranges race) Recovery Team began to collect good information on predator dynamics around a remnant colony, but only through a dedicated and continuous project focus.

The most effective and consistent way of collecting information on predator dynamics associated with threatened species sites (e.g. Ngan̄amara, Sandhill Dunnart) will be to monitor dedicated track transects and 2-ha sand-plots (see Southgate *et al.* 2007), as described in Ward & Clarke (2007).

Such predator dynamic monitoring is critical to adopting a successful adaptive management framework for Ngan̄amara and other threatened species in the region. This adaptive management framework has been adopted by the Natural Heritage Trust National Malleefowl Monitoring Project. Any future effort to assess and address fox predation pressures should be in line with a national approach. Recent analysis of the Ngan̄amara data across the country has indicated that fluctuations in breeding activity of Ngan̄amara are also related to rainfall, and, therefore, declines in breeding activity are not always tied to predation pressures.

Patch-burning

In central Australia, traditional burning practices created a mosaic of different aged habitats. A heterogeneous post-fire habitat would have benefited Ngan̄amara (and biodiversity in general) by providing long-unburnt habitat required by Ngan̄amara for nesting and shelter (Benshemesh 1990). These burning practices were interrupted by pastoral activities, as well as the move away from a traditional lifestyle by Aboriginal inhabitants of central Australia. As a result, a single large wildfire has the potential to temporarily remove large tracts of suitable habitat. The effects of large wildfires on biodiversity are worse when compounded with long periods of low rainfall and explosions of feral herbivores such as rabbit and camels.

Information on the historic frequency and nature of patch burning in the southern Alinytjara Wiluṛara Natural Resource Management region, however, is currently not readily available. Before fire management is prescribed across the region, a well researched, comprehensive and well resourced fire strategy for the region needs to be developed. For threatened species such as Ngan̄amara, this should aim to capture the knowledge of traditional burning practices around Ngan̄amara mounds from Traditional Owners. There also needs to be the consideration of whether fire is to be used for site

protection and threat mitigation, or to promote a heterogenous vegetation mosaic that provides a range of food sources, as their prescription could be quite different.

In the short-term, patch burning around Ngan̄amara sites should be limited and aimed simply at protection of Ngan̄amara sites. *This should be done on a case by case basis, depending on the habitat surrounding the mound. It is very important that this is carried out at an appropriate time of year by An̄angu with a lot of knowledge and experience in patch-burning, to prevent larger wildfires.* There have been instances where inappropriate burning in the Alinytjara Wilurara region has lead to large wildfires that have burnt for months.

Conclusions

As a result of two recent widespread surveys in the southern Alinytjara Wilurara Natural Resource Management region, we can confirm that Ngan̄amara continues to persist in the vast tracts of mallee and mulga scrub in the Maralinga Tjarutja Lands, and the Yumburra and Yellabinna conservation reserves. However, Ngan̄amara occur across this vast landscape in low densities and are sparsely distributed, and only one known mound was active in 2007. However, An̄angu, land managers and scientists now have the capacity to begin monitoring of Ngan̄amara in the southern Alinytjara Wilurara Natural Resource Management region, and across the Great Victoria Desert bioregion as a whole. Monitoring of Ngan̄amara in the southern Alinytjara Wilurara region will be based around Ngan̄amara "sites", including mounds, and known location of tracks and birds, and will attempt to measure persistence over time by using area of occupancy measures.

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