Kanyirninpa Jukurrpa
Martu Cultural Knowledge Program
Building Sustainable Martu Communities

KJ guide to mankarr monitoring using the mankarr survey method

The Nature Conservancy Australia
BHP
The University of Melbourne
Threatened Species Recovery Hub
National Environmental Science Programme

About this document

The purpose of this document is to help KJ ranger teams carry out monitoring of mankarr (bilbies). The framework was developed in a partnership between Kanyirninpa Jukurrpa (KJ), The Nature Conservancy (TNC), The University of Melbourne and the Threatened Species Recovery Hub of the National Environmental Science Program. It was designed following consultations with Martu and other KJ staff and from advice of other researchers working in the field.

The design process roughly included:

1. Consultations with KJ to define the objective and assess the outcome of the previous monitoring method
2. Consultations with other researchers on bilby survey methods
3. Time in the field with ranger teams to understand logistics and challenges, plus record Martu knowledge of mankarr
4. Field trials of different search methods
5. Habitat mapping and analyses
6. Trial of mankarr-search consultations with ranger teams in Jigalong, Parnngurr, Punmu and Kunawaritji
7. Discussions with ranger teams on where to have the mankarr-monitoring zones

Acknowledgements

We are grateful to all the people who shared their knowledge and time with the project team, especially the ninti KJ Martu Rangers and ranger coordinators. The work was made possible by funding and support from the Threatened Species Recovery Hub of the Australian Government's National Environmental Science Program, The Nature Conservancy, BHP and Kanyirninpa Jukurrpa. Photos were taken by Anja Skroblin or held by KJ unless indicated.

Jigalong rangers followed mankarr tracks to find this newly excavated burrow. The burrow has fresh tracks leading into it, but not out again, which tells the rangers it is occupied.

***Cover photos: Left**: Mankarr / greater bilby. Photo: Bernard DUPONT CC BY-SA 2.0.*
***Top right**: KJ Ranger carrying out mankarr survey Photo: Anja Skroblin and KJ.*
***Bottom right**: Bilby tracks Photo: Anja Skroblin and KJ.*

Glossary

Some Martu and scientific words are used in this document. They are described here:

Martu word	English Meaning
Jakipirri	Emu
Jawarnu	Diggings
Jila	Snake
Jina	Tracks
Jinjiwirrilyipa	Desert raisins
Jipuku	Rabbit
Juku	Small
Kalirtura	Young or baby
Karlaya	Emu
Kiparra	Bustard
Kirti-kirti	Hill kangaroo
Kirtilpa	Bilby grass or Yakirra grass
Kuna	Scat or poo
Langamarlu	Mulgara
Linyi	Place around brown claypans
Lunki	Grubs you can eat that live in the roots plants, sometimes called witchetty grubs
Malka-malka	Rabbit
Manguu	Big spinifex, old enough to burn
Mankarr	Bilby
Manyjurrpa	Termite
Marlu	Red kangaroo
Maruntu	Yellow spotted monitor
Mayi	Food plants
Minga	Ants
Minyarra	Desert onions
Mirrka	Food or food plants
Mulyamiji	Great desert skink
Ngurra	Burrow
Ninti	Intelligent
Nupanu	Dingo
Nyurkura	Time after fire when there are mature herbs with small spinifex
Nyurnma	Recent burn, still black
Paki	No / none
Pararra	Sand plain
Parnajalpa	Sand goanna
Pirti	Burrow
Putjikatu	Cat
Rirra	Laterite, rusty-red hard ground, sometimes like small pebbles
Tuwa	Sand dunes
Uwa	Yes

Martu word	English Meaning
Walytaki	Red fox
Wanapari	Dingo
Wanti	Female
Warla	Place at the edges of salt lakes
Waru-waru	Fresh shoots and plants growing after fire
Wilyki	Seeds
Wintamarra	Mulga woodlands
Winyjikirti	Spiny tailed monitor
Wiya	Not much / small amount
Yalapara	Perentie
Yirna	Male
Yurnara	Dense old spinifex hummocks
Yuwinji	A grass that provides seeds that Martu and bilby eat

Scientific word	Meaning
Assessing	Looking at or measuring
Herbivore	Animals that eat plants
Juvenile	Young
Mosaic	Pattern of different patches
Occupancy	If an animal is in an area or not
Omnivore	Animal that eats plants and insects or other animals
Persist	Continue, survive or remain
Predator	Animals that hunt other animals
Random	Chosen by chance
Resources	Things you need like food, water, shelter
Suitable	Good enough
Scat	Poo
Status	Condition. How things are right now
Trend	If things are staying the same or getting better or worse
Vegetation	Plants
Zone	Area

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Mankarr monitoring framework

Mankarr (called greater bilby in English) is a type of bandicoot that lives in Australian deserts. Looking after the mankarr is important because the other bandicoots and animals of this size are gone. Their continued survival is important to both the Traditional Owners of these countries and Australians in general. As the Martu Determination sits in the heart of the remaining bilby distribution, Martu people are very important for the future of this species.

This project has developed an approach to monitoring the bilby. The framework builds on previous work rangers have carried out looking at where mankarr occur on Martu country. This guide gives details about the monitoring framework.

Purpose of KJ bilby monitoring

The objectives of the monitoring program are:

- To see how mankarr are doing (scientists call this 'assessing the status and trends'), and
- To help Martu make sure mankarr populations continue to stay healthy.

Summary of monitoring framework

The monitoring framework has monitoring zones, sites and a survey method.

1. **Monitoring zones** are broad areas where we want to know how mankarr are doing and what threats are there. Monitoring zones will be places with good habitat for mankarr, and may be places where Martu have found them before. Each ranger team will have 3-5 monitoring zones (page 7).
2. **Sites** are places within the *monitoring zones* where teams do surveys. A site location is based on a central GPS point from which searches begin. Repeat searches start from this same point
3. **The survey method** to use at each site is a 20 minute mankarr-search (outlined page 11). At a site rangers use their tracking skills to find whether mankarr (and other animals) have visited that site, and if there are bush foods growing there.

The monitoring framework is recording the number of sites that have mankarr. Scientists also call this occupancy.

To have enough information (data) to tell if things are the same or changing (the trend), each ranger team needs to survey 25 or more sites each per year. With this data we can compare the number of sites with mankarr in different monitoring regions and in different years. We are looking to see if the number of sites with mankarr is going up or going down or staying the same, and to see whether there are threats like how many sites had cat tracks.

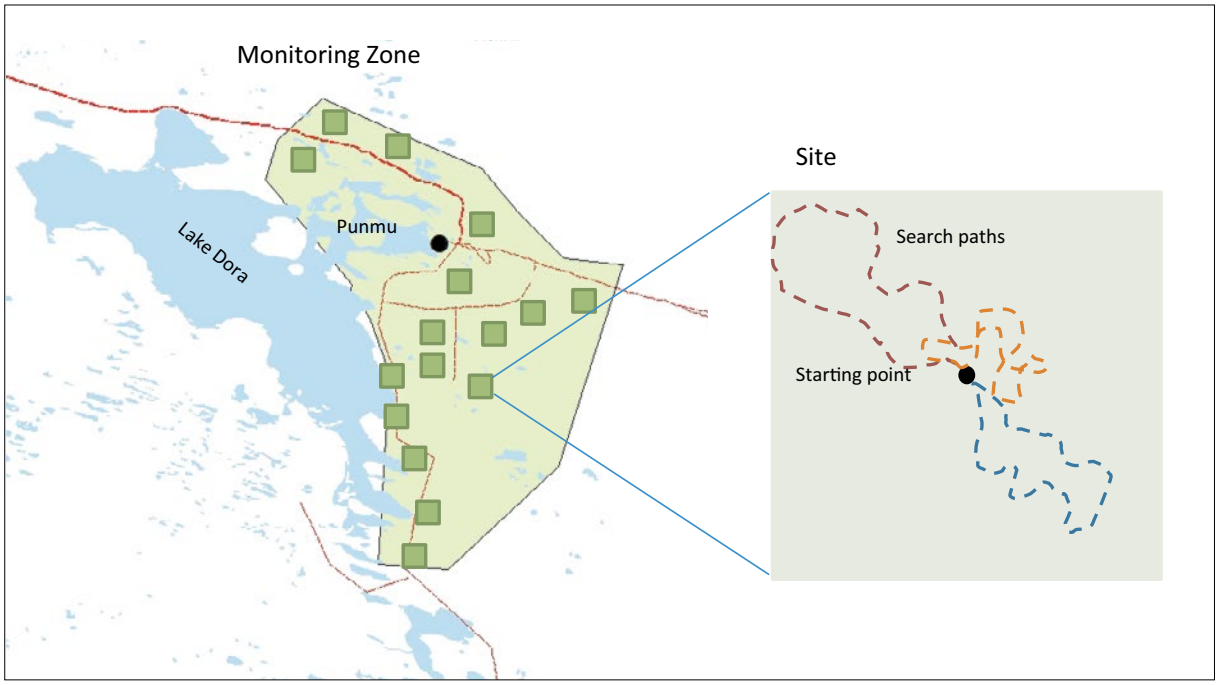


Figure 1. An example showing a monitoring zone (light green) along the edge of Lake Dora near Punmu. There is good habitat here and we want to see how mankarr are doing. The sites (dark green boxes) are the places that are surveyed by teams with 20-minute mankarr-searches.

Location of monitoring zones

> *Monitoring zones "are the places you go back to, to make sure that everything is alright."*
> (Gladys Bidu 2017)

Each community will have 2-4 monitoring zones that they will monitor over the next 10 years.

In some scientific survey methods sites are chosen randomly. This is not how the sites are being chosen for this mankarr monitoring program.

The location and boundaries of monitoring zones were chosen following discussions with Rangers, Martu Elders and KJ staff. Each ranger team has defined their own monitoring zones depending on:

- the location and amount of suitable habitat for the mankarr in their work area,
- how easy or practical it is to visit these places
- areas identified as priorities for mankarr monitoring by Martu

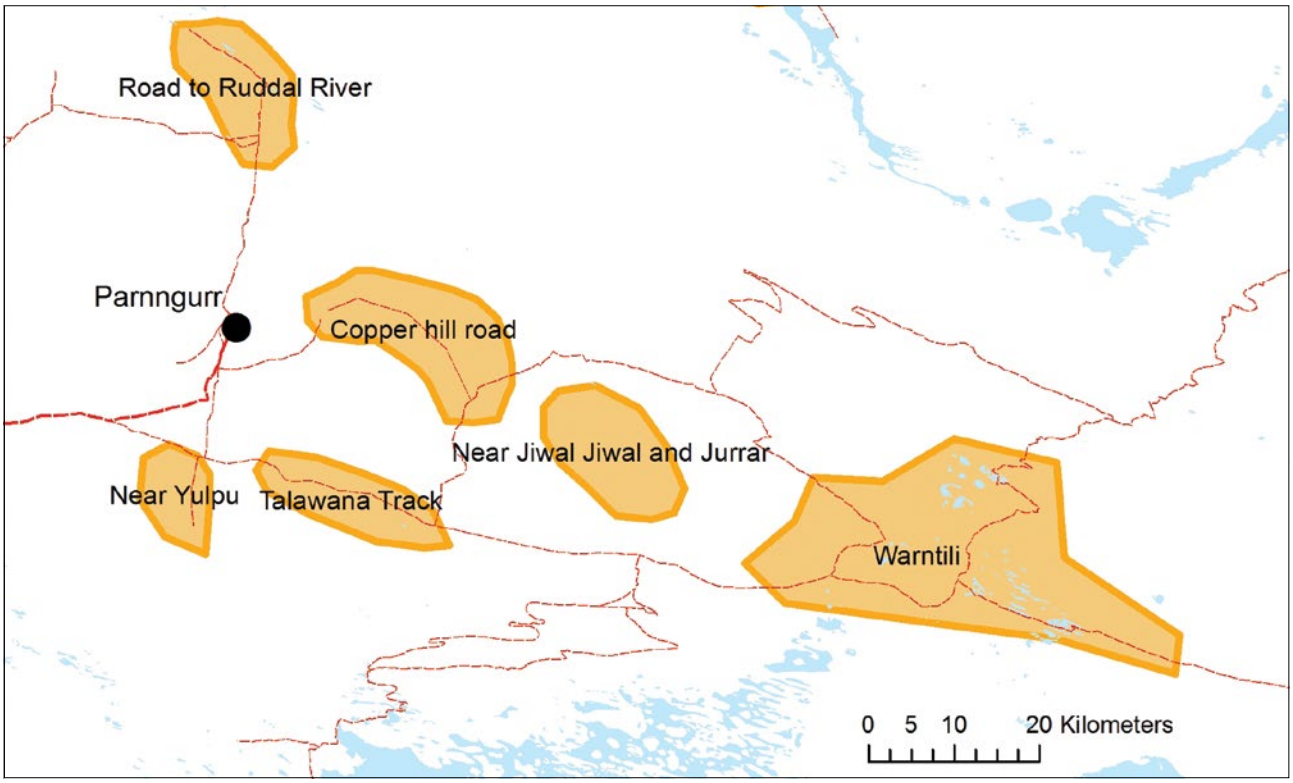
Monitoring zones are areas that have good habitat for mankarr. The zones should be large enough to fit at least 3 separate sites that are more than 3km apart and include habitat types that mankarr like to live in.

Always suitable	Suitable if fire is right
Warla - on the edges of salt lakes	Rirra - on laterite rise
Linyji - Around brown claypans	Pararra - sandplain
Wintamarra - Mulga woodlands	Tuwa - Sand dunes

In July 2017 each ranger team had created a plan of monitoring zones as follows.

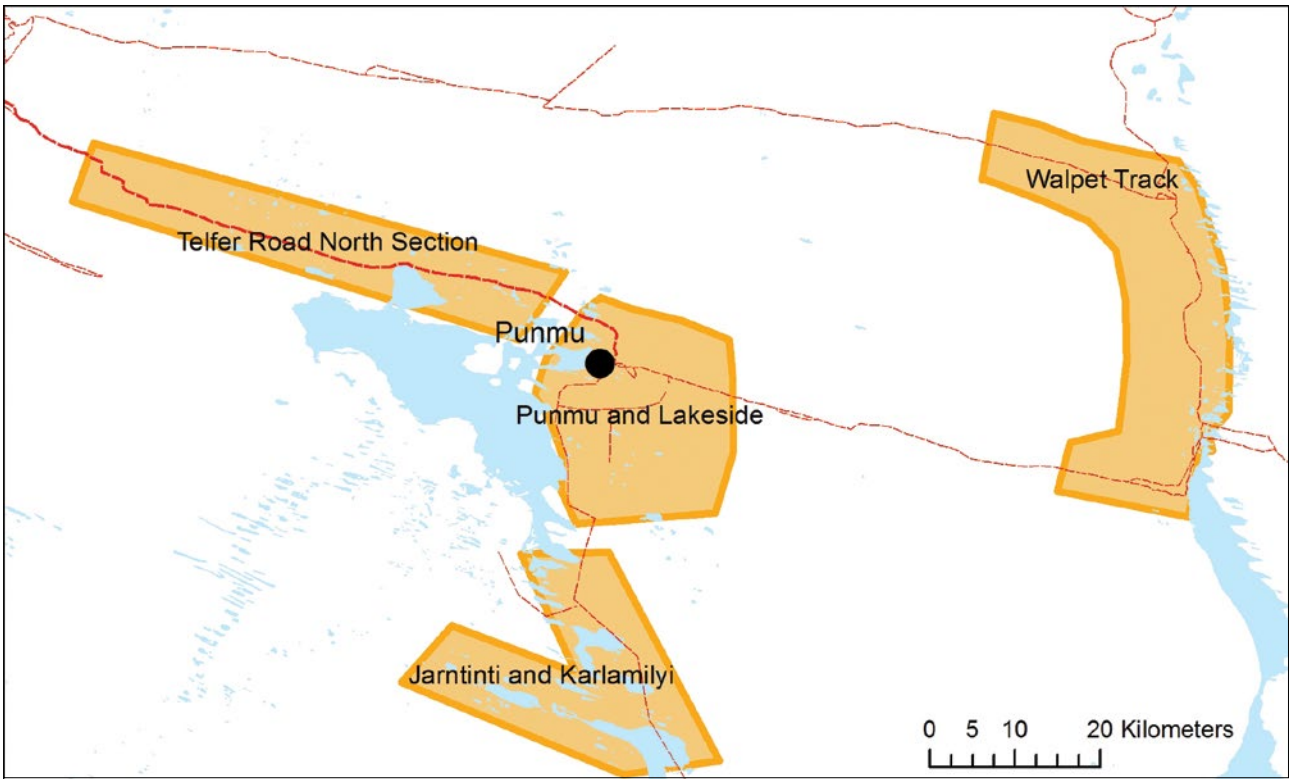
Punmu rangers carry out mankarr search in freshly burnt area.

Parnngurr monitoring zones



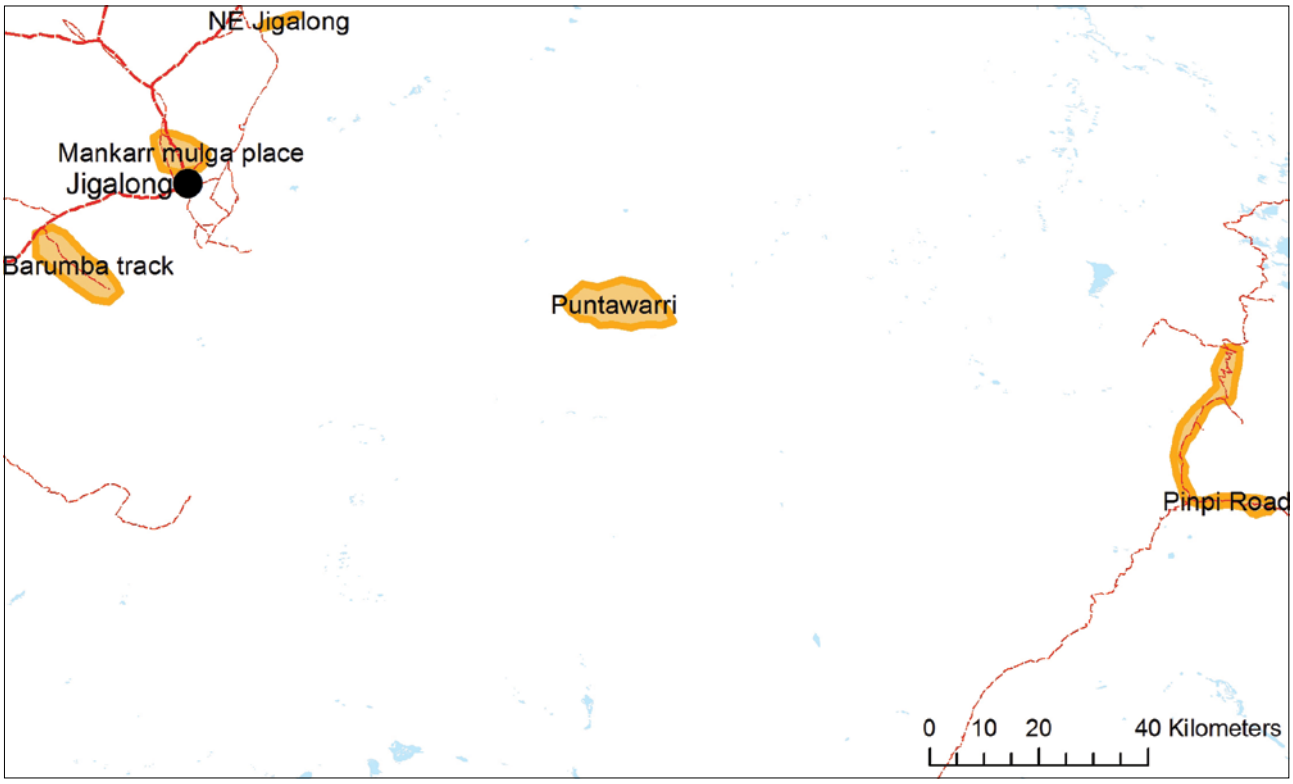
Team	Zone name	# sites	Reason for being chosen
Parnngurr	Warntili	5	Martu suggested area;
Parnngurr	Road to Ruddal River	5	Martu suggested area; once regular sightings
Parnngurr	Near Jiwal Jiwal and Jurrar	5	Martu suggested area; some sightings not recorded
Parnngurr	Near Yulpu	5	Martu suggested area; previous records
Parnngurr	Copper hill road	5	Martu suggested area; recent sightings

Punmu monitoring zones



Team	Zone name	# sites	Reason for being chosen
Punmu women	Wapet Track	5	Martu suggested area; previous records
Punmu women	Punmu and lakeside	10	Martu suggested area; previous records
Punmu men	Jarntinti and Karlamilyi	10	Martu suggested area; previous records
Punmu men	North section	5	Martu suggested area; previous records

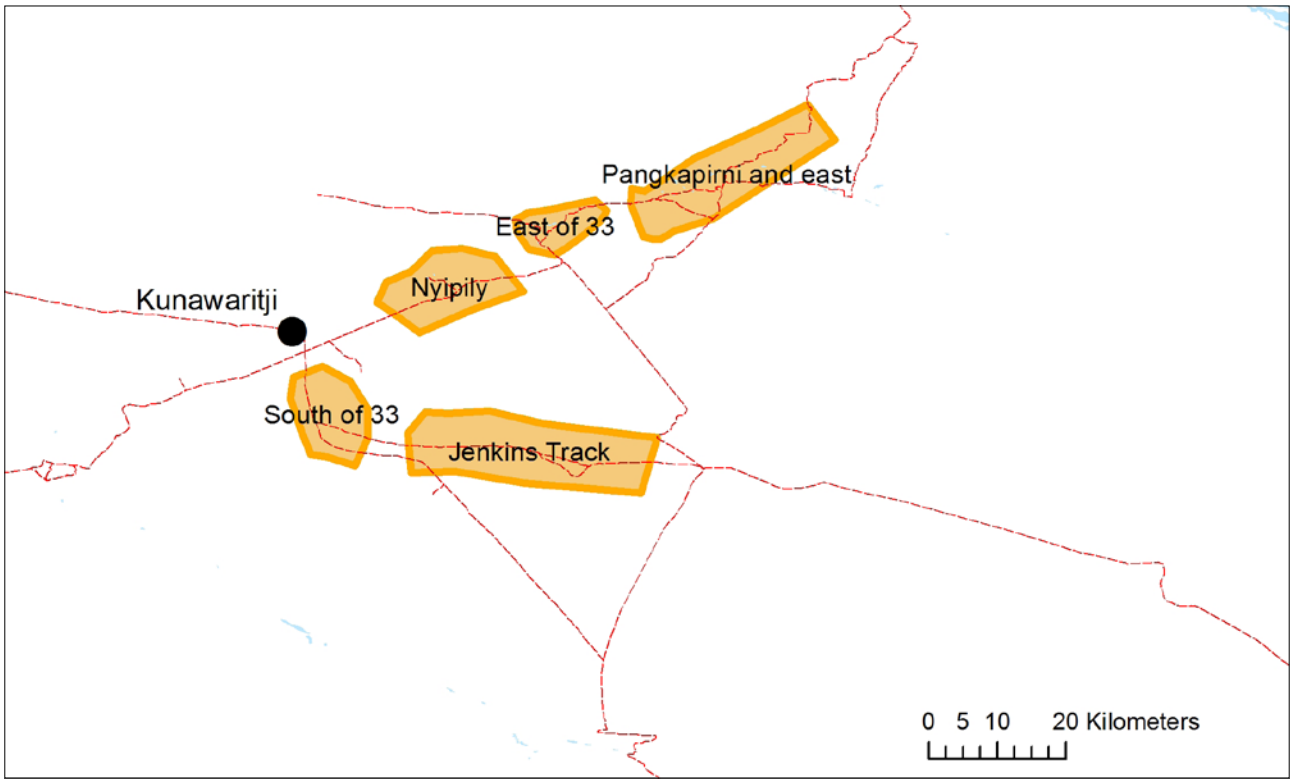
Jigalong monitoring zones



*Jigalong teams need to identify another zone

Team	Zone name	# sites	Reason for being chosen
Jigalong	Mankarr mulga place	5	Martu suggested area; many burrows
Jigalong	Barumba Track	5	Martu suggested area; old burrows and tracks
Jigalong	Puntawarri	5	Previous sightings
Jigalong	Pinpi Road	5	Martu suggested area; previous sightings
Jigalong	NE Jigalong	5	Previous sightings

Kunawaritji monitoring zones



*The locations of these zones may need to change with extra feedback from the Kunawaritji team.

Team	Zone name	# sites	Reason for being chosen
Kunawaritji	East of 33	5	Potential habitat
Kunawaritji	Nyipily	5	Previous sighting
Kunawaritji	South of 33	5	Previous record
Kunawaritji	Jenkins Track	5	Potential habitat
Kunawaritji	Pangkapirni and east	5	Previous records

Location of monitoring sites

Each monitoring zone should have between 3 and 15 monitoring sites. Each team chose how many sites to have per monitoring zone and where the sites should be located based on:

- The size of the monitoring zone – monitoring sites need to be at least 3km apart, but 4-5km apart is better. This is so that mankarr will not visit more than one site in one night.
- Sites should have good potential habitat (this could be where teams have previously surveyed).
- Logistics – is this a site people can get to quite easily?
- Sites (and people searching) should be more than 50m away from the edge of major roads, as mankarr and other animals might avoid these places. Sites can include minor vehicle tracks that animals won't stay away from.
- If a site is chosen in the first year, but people find it is bad for monitoring, for example it had bad surfaces for tracking, replace it with a new site that is better to monitor.
- Once sites are chosen, do not change the location of sites between years, even if there have been fires or other things that might affect mankarr. By searching the same sites each year we can learn how fire and habitat changes affect mankarr.

Naming sites

Name sites the first time they are visited:

- Use the name of the monitoring zone
- Plus a unique number for each site

For instance, sites in the Lake Dora monitoring zone could be: LD01, LD02; sites in Talawana could be TW01, TW02.

Keep using the same name for sites every year. This will make it easier for survey teams, data management and analysis.

Other sightings of mankarr

Other sightings of mankarr, where mankarr sign is found but not connected to a survey (sometimes called incidental sightings), could still be recorded. On the datasheet write "incidental" or "not at a monitoring site". A full survey could be carried out if the team has time, or just record mankarr location.

Data management

There is a database which is set up to store the information collected from the mankarr surveys, and automatically create some summaries and draw graphs. The excel database includes instructions on how to enter the data and to create summaries.

For good data management it is important to:

- Keep data sheets somewhere safe, or scan them and filed on the computer
- Enter data regularly into the database
- Backup the database

How to carry out a search

The aim of searching is to find out if mankarr have been, or are, at the site. To increase the chances of finding sign we are using the excellent tracking skills of Martu and Martu knowledge of where mankarr sign is likely to be.

- Searches begin from a central **start point** (that is marked on the GPS).

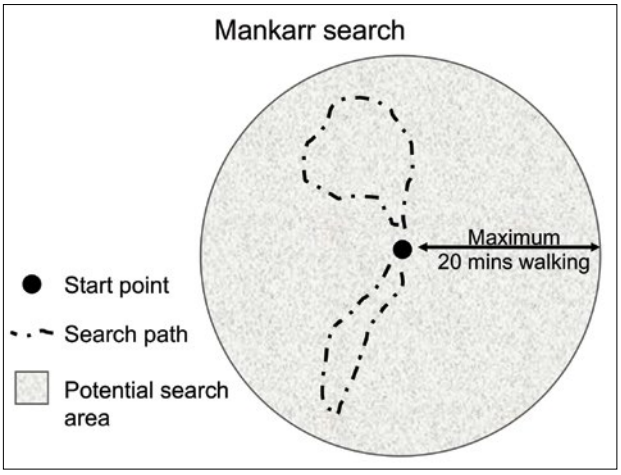
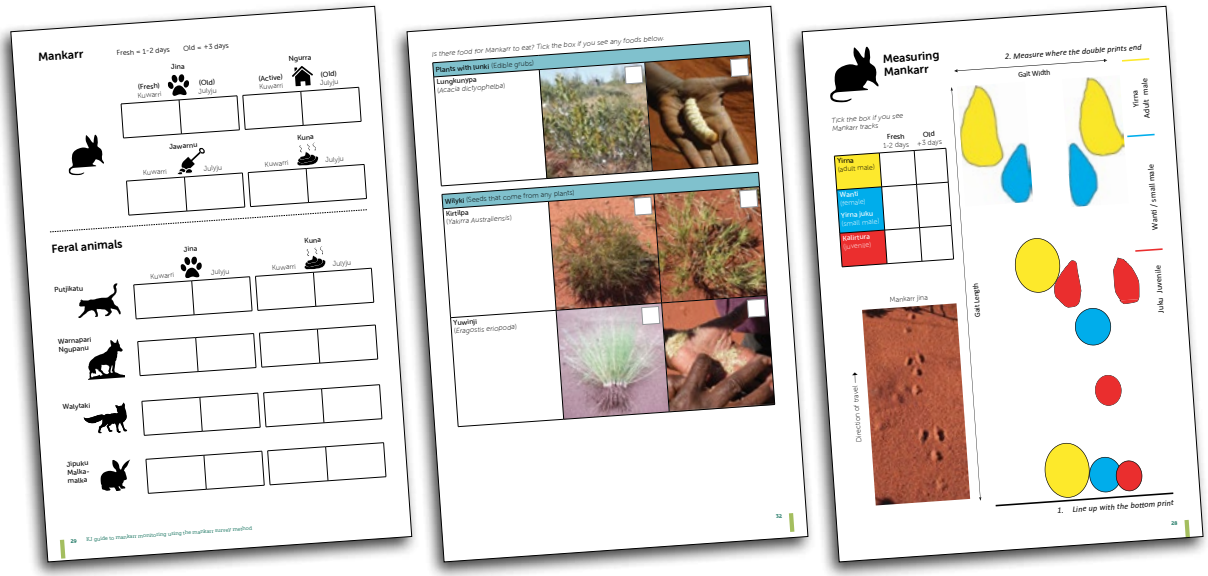


Figure 2. The mankarr search method showing example paths of two rangers who are following their knowledge to find mankarr sign

- The survey can be carried out by **three or more people**. If you have a large group of people (more than 6), the team could split up and survey different sites at the same time.
- It is important to **record the number of people** that are actively searching at the site, as a larger team may have better luck at finding mankarr sign. If there are rangers who are following others to learn, do not include them in the count of active searchers.
- From the start point, the team should **split up** to search for mankarr. By splitting up and not walking around together the team will cover as much ground as possible.
- Rangers **make their own path** to search from the starting point based on their expert knowledge. They do not need to follow any specific search/walking pattern.
- The aim is to **find mankarr sign**, and look for the **sign of other animals** (cats, foxes, dingos, rabbits) and **bush foods** while they are searching for mankarr. People could follow mankarr tracks if they find any, to locate burrows or diggings and get a feel for how mankarr are using that area.
- Teams should aim for **20 minutes** searches. Sometimes searches may be shorter or longer, make sure to **record the time spent searching**.
- There are laminated **"tick-sheets"** that rangers can use to record the species they find while they are searching (Fig. 3).
- After 20 minutes the team fills in the KJ MANKARR SURVEY DATA SHEET
- When a site is surveyed again the next year, the team starts walking from the central point, and choose a new path based on their knowledge of where mankarr are likely to be.



Top: Punmu rangers talking together after trying out the mankarr search. ***Bottom left:*** *Pumnu ranger finding mankarr burrow while carrying out mankarr search.* ***Bottom right:*** *Rangers find mankarr burrow under a termite mound.*

The new method values Martu knowledge of mankarr and makes use of it.
Gladys Bidu 2017

Mankarr sign

There are four types of mankarr sign to look for: tracks, diggings, burrows and scats. To make sure that mankarr have been to the site, try to find a few different types of sign: follow tracks to find diggings or burrows, which may be hidden under vegetation, look for scats around diggings.

Mankarr jina (tracks):

Mankarr tracks are distinctive. Scientists call the way mankarr move 'a bounding overstep' (Fig 4c): the foot prints from the front feet are one in front of the other (staggered), and the back feet are roughly side by side (parallel). The prints left by the back feet are longer and narrower than the front foot prints which are rounder. In very good tracking conditions, the three front toes and claws may leave parallel claw marks of similar length (Fig 4a).

Other animals have similar bounding over step gaits. Don't confuse with:

- *Rabbits, which have rounder prints, with the front and back feet leaving similar sized prints*
- *Mulgara, which leaves smaller tracks which are rounder.*

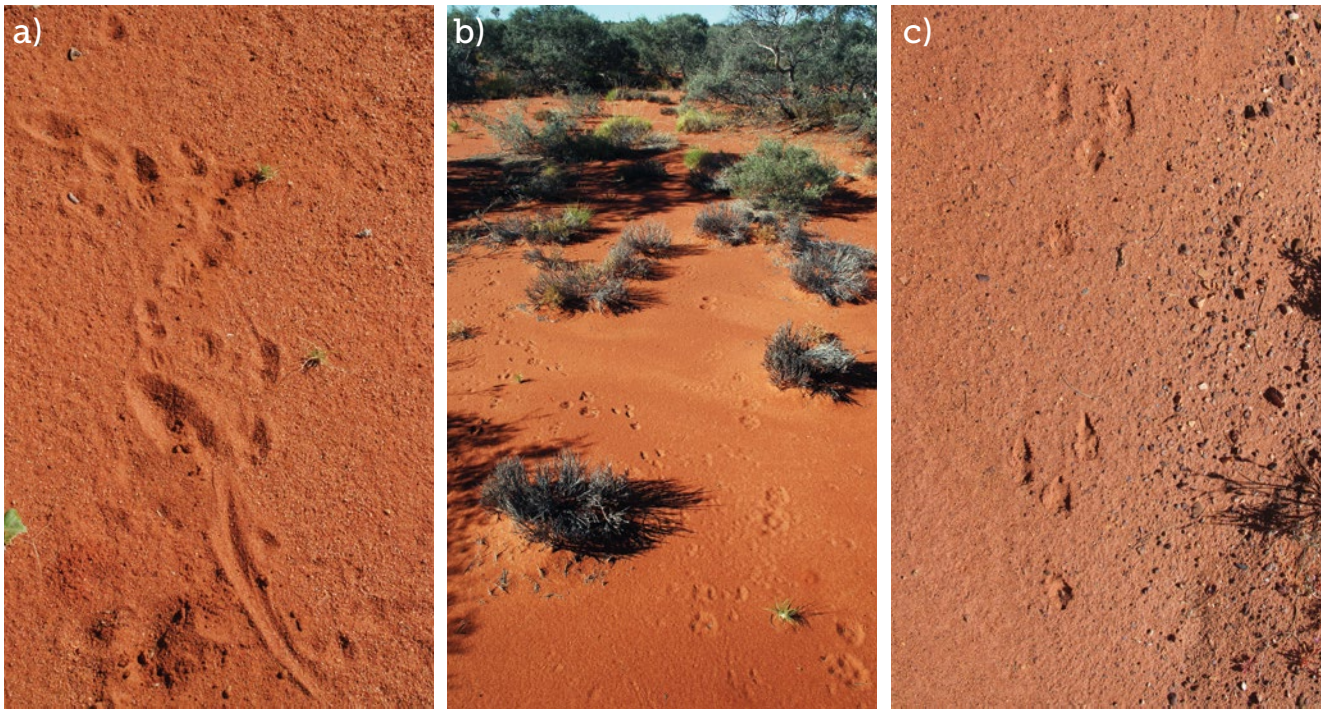


Figure 4. Mankarr jina: a) sign from the previous night with tail drags and three front toe marks, b) tracks breaking through soil in previously wet ground, with dingo tracks, c) on edge of brown claypan

We need to do this work to look after mankarr and the other animals because my father told me we need to look after them.
Heather Samson Jigalong 2017

Mankarr jawarnu (diggings):

Mankarr use their powerful front legs with sturdy claws to dig for insects (lunki (and other insects) and minyarra (or other tubers). Mankarr diggings can be quite conspicuous and numerous (Fig 5a). Many other desert animals also leave diggings, but mankarr are the only animals that dig and rip open the roots of plants to eat lunki. Diggings can last for months in areas which don't get washed away by rain.

- *Don't confuse with diggings by goanna, dingo, echidna or Martu*
- *Look for diggings into roots or a pile of mankarr scats next to a digging (Figure 5b)*

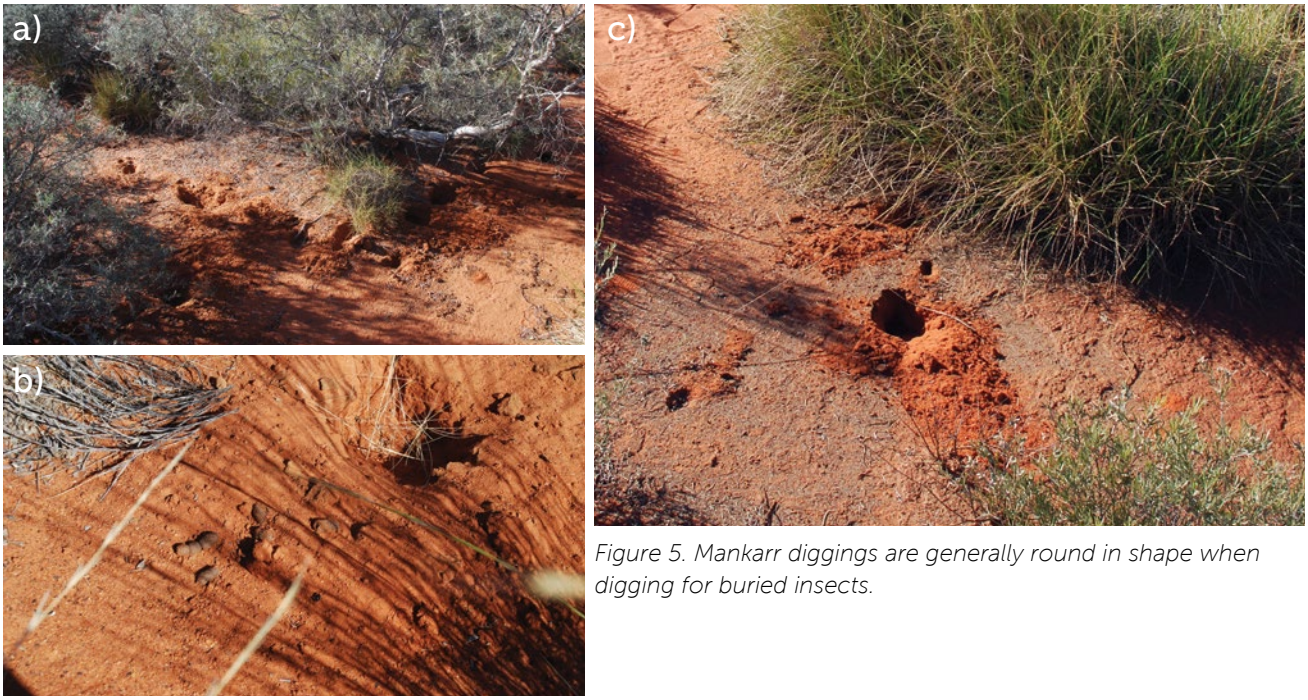


Figure 5. Mankarr diggings are generally round in shape when digging for buried insects.

Mankarr ngurra / pirti (burrow):

Mankarr dig burrows that can be up to 2m deep. Burrows can have side branches or circle downwards. Mankarr shelter in the burrows during the day and come out between sunset and sunrise to forage. During the night, mankarr may visit multiple burrows across their territory, and retreat down burrows when there are predators around. Burrows can be used by one or more mankarr, and generally mankarr swap burrows each day. The burrow entrance is either round or shaped like an archway (Fig 6). Generally there is one burrow entrance, but sometimes there are groups of burrows and entrances close to each other. Burrows are often next to or under vegetation. Entrances can be under spinifex, bushes, logs or termite mounds.

Don't confuse with goanna burrows which are more crescent shaped (wider than they are tall).

Figure 6. Active burrows usually have freshly dug soil at the entrance, and generally have mankarr tracks leading to the burrow if the soil is soft enough for leaving tracks.

Mankarr kuna (scat):

Mankarr kuna is generally found near diggings or burrows, it is often on top of the soil, but can be buried under the soil pile that mankarr make as it digs. Generally you will find 2-5 pellets in a pile. Kuna is long shaped, smooth coated with rounded ends (Fig 7a). You may see parts of insects, and sand when the scat is broken open.

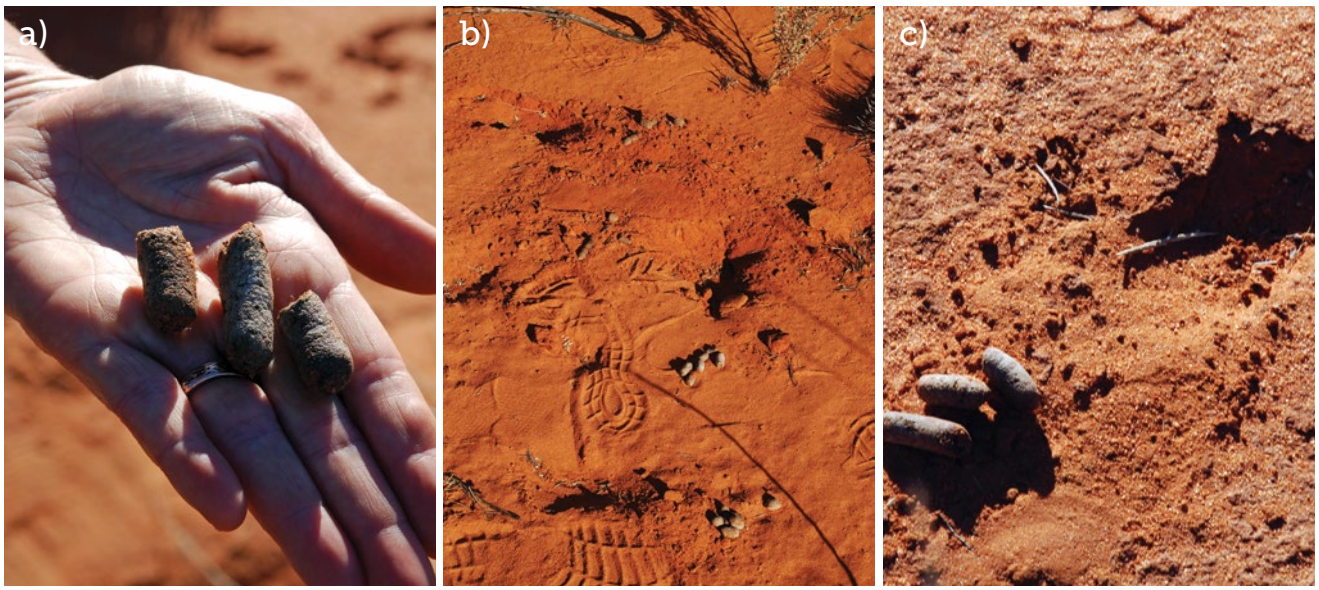


Figure 7. Mankarr kuna, a) kuna of large male, b) lots of piles of kuna next to diggings, c) often small pile of 2-5 pellets next to a digging.

Is there much mankarr sign?

If there is lots of mankarr sign at a site, this means that mankarr have been at that site for quite some time, and that there was plenty of food available for mankarr at the site. The presence of young mankarr (juvenile) sign indicates that conditions at the site were good for breeding.

A single track or old burrow could show that mankarr passed through, or that threats like cats or dingos are affecting mankarr in the area.

Based on the experience of all the rangers while they were searching the team decides whether there was plenty of mankarr sign at the site and if there adults, young or both. Depending on where people walked, some rangers may have found no sign, while another ranger may have found a lot of sign. The rangers who detected sign should decide if they think the mankarr had been at the site for some time based on the sign they found.

Is there much adult mankarr sign?	*Uwa (plenty)*	*Paki/wiya (only small amount)*
Is there much juvenile mankarr sign?	*Uwa (plenty)*	*Paki/wiya (only small amount)*

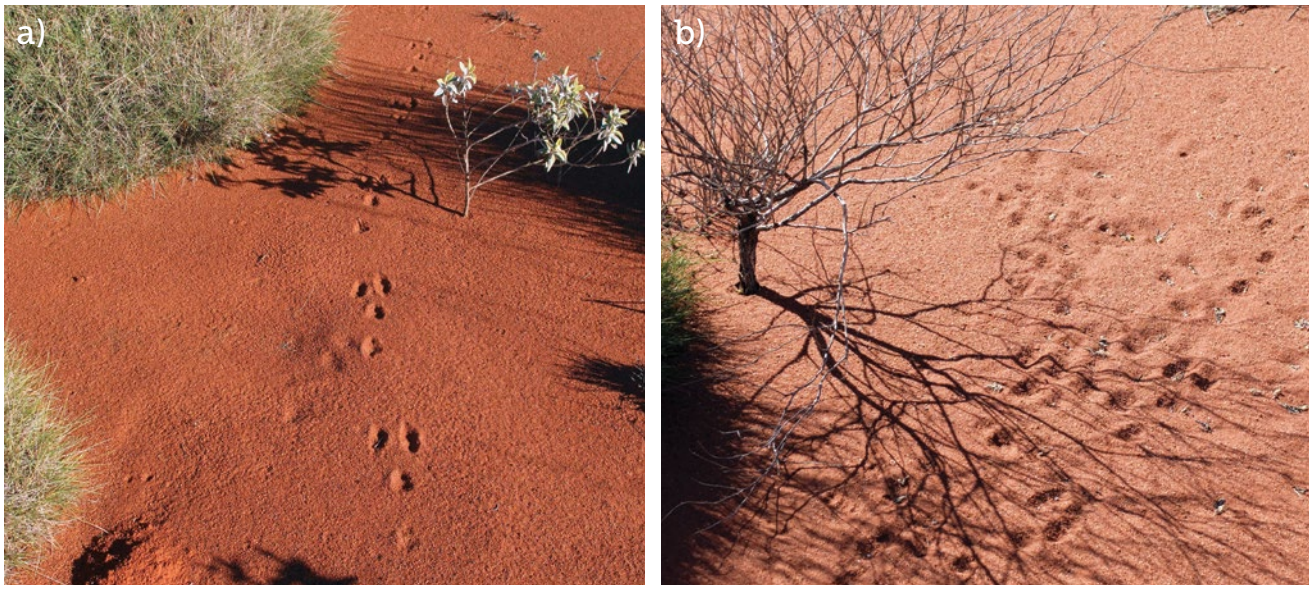


Figure 8. a) Single mankarr track through site, versus b) evidence of continued use.

Using the gait measurement sheet

Gait is how an animal places its feet.

When mankarr tracks are found, the gait measure sheet can be used to work out if the animal is a yirna (adult male), wanti (female) / yirna juku (small male), or kalirtura (young) mankarr (Fig 8).

Having different sized mankarr tracks at the site means that there is more than one mankarr, and if there is sign of young mankarr it shows that the area is good enough for breeding.

If the site has more than one mankarr and young mankarr it shows that the area is being well managed for healthy mankarr populations.

When working out the size of the mankarr from its foot prints, it's best to place the card next to a few of the tracks that are in a row.

Mankarr "running" have a longer gait length than when moving slowly.

Make sure that rangers look at the gait width and size of the foot prints to make sure that different length prints are not the same individual moving at different speeds.

Use the gait measure sheet when another set of mankarr tracks are found, or when it looks like there are different sized footprints next to each other.

Is there more than one mankarr at this site? Are there baby mankarr?

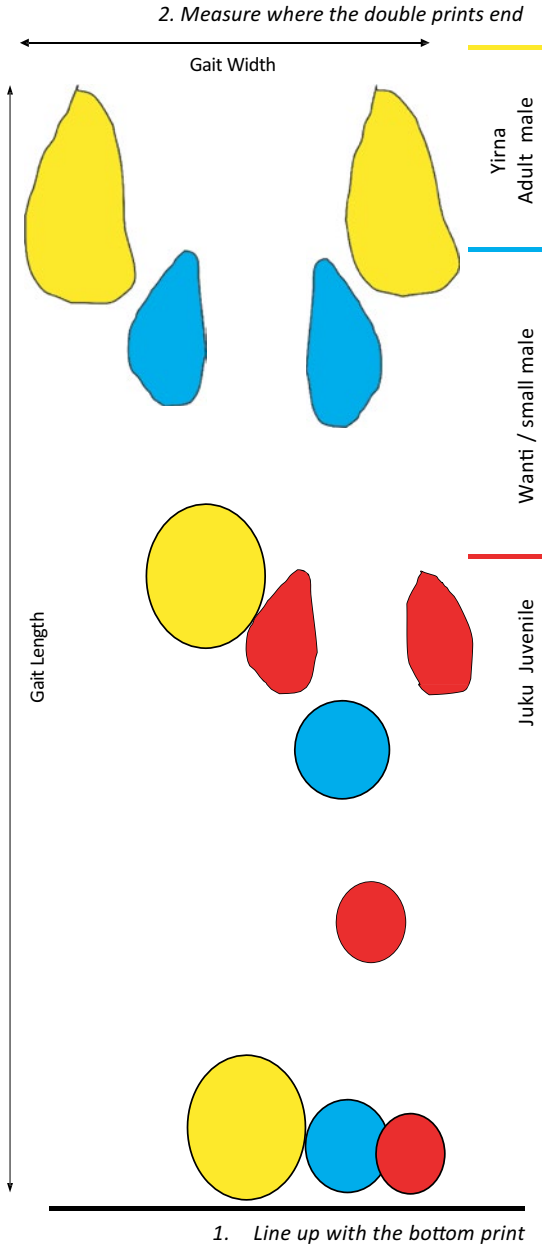


Figure 9. Copy of gait measurement ruler, ***this is not correct size and should not be used to measure.***

Figure 10. Punmu ranger coordinator Bridget using the gait measurement sheet to find that there are juvenile mankarr (red prints) at the site.

Recording threats

We are also recording other animals that can impact mankarr at a site. These include predators (cats, foxes, dingos) and competitors (rabbits).

Putjikatu (cat)

Putjikatu leave rounded foot prints, where the front and back feet are similar in size and rarely leave claw prints. Cats often leave only a faint print unless sand is very soft.

Cats often place their back feet into the prints left by the front print (direct register). When moving at high speed the four prints are grouped together with a large gap to the next prints.

Cats sometimes burry their kuna (scats), and in sandy country you may see the marks left when cats scrape sand over their kuna.

Figure 11. Cat tracks in coarse sand.

Walytaki (red fox)

Walytaki tracks are diamond-shaped and you can often see claw marks. Prints may be in a straight line. Prints from front and back feet are about the same size.

Walytaki likes to leave kuna (scats) on top of objects like rocks or tree stumps. Scats are smaller than those from dogs. They are often lumpy and you can sometimes see hair and bone.

Figure 12. Fox track K. Moseby.

Figure 13. Fox scat R. Paltridge.

> *We need to get rid of cats to protect mankarr and those other animals.*
> Phillipa Charles 2017

> *Fox eats more mankarr than the cat, because the fox goes into the mankarr hole.*
> Minyawu Miller 2016

Wanapari / nupanu (dingo)

Wanapari tracks are large and round with distinct claw marks. The front feet are bigger than the back feet. When walking the smaller back foot leaves a print in front and slightly to the side of the larger front foot.

Kuna (scat) is smooth and large, with less obvious hair and bone than fox.

Not to be confused with fox tracks

Figure 14. Old dingo prints on the right with old mankarr prints that were left in wet sandl

Jipuku / malka-malka (rabbit)

Rabbits have a bounding overstep walk (like the bilby).
The prints for the two back feet are side by side and at the front.
The prints for the back feet are one in front of the other.

Rabbit prints are round, with all feet similar in size, not to be confused with mankarr tracks.

Rabbit kuna (scat) is round like a ball. Sometimes it is left in piles with many kuna called buckheaps.

Figure 16. Rabbit buckheap K. Moseby

Figure 17. Rabbit print K. Moseby

Recording other animals

Rangers can also record if they have seen sign from other animals that are culturally important, or commonly recorded with track-based monitoring. For these animals we are not recording the age of the sign.

- *Marlu (red kangaroo)*
- *Kirti-kirti (hill kangaroo)*
- *Langamarlu (mulgara)*
- *Spinifex hopping mouse*
- *Kiparra (bustard)*
- *Karlaya, Jakipirri (emu)*
- *Parnajalpa (sand goanna)*
- *Maruntu (yellow spotted monitor)*
- *Yalapara (perentie)*
- *Winyjikirti (spiny-tailed monitor)*
- *Mulyamiji (great desert skink)*
- *Jila (snake)*

When you can't identify a track

When you find animal sign, sometimes it can be very difficult to tell what animal made those tracks, diggings, burrows or scats. Sometimes the ground is too hard for tracks to be detailed, or its been windy and tracks are half blown away, or searchers find animal sign they haven't seen before. Even experts sometimes have trouble.

Rangers can use field guides to try to identify the sign, or take photos to try to identify them later.

It's very important to avoid recording the wrong animal, or include animals that were not at the site!

If rangers cannot identify sign, it is better to leave it blank, than to guess.

Learning how to track

There will be different tracking skills among rangers depending on their experience. Carrying out mankarr surveys is an opportunity for rangers to learn skills from each other, and from Elders and other experienced trackers.

More experienced / competent trackers should be encouraged to mentor less experienced trackers, to help rangers to learn to read the signs and identify different bush foods.

If someone finds something really interesting, it's a good opportunity for everyone to have a look, talk about it and learn. If people stop searching to investigate one place, just stop the clock for this time, and start searching again after. Rangers can bring bush foods back to the car to show others and help with learning.

Consider carrying out training activities prior to the field season if the ranger teams have inexperienced trackers.

Searching country where mankarr may be found.

Recording mankarr mirrka (bilby food)

Mankarr eat large amounts of insects like beetle larvae, termites, ants, and root dwelling larvae as well as seeds and tubers. When doing mankarr searches rangers are looking for the main foods mankarr consume on Martu country:

Plants with lunki (edible grubs)

There are several acacia and senna species that have edible grubs living in their roots that mankarr eat.

Wilyki

Seeds that come from any plants.
The main seed that mankarr consume are:

Kirtilpa
(*Yakirra australiensis*) bilby grass

Yuwinji
(*Eragostis eriopoda*)

Mirrka/Mayi

Food plants that have fruits or roots to eat:

Jinjiwirrilyipa
(*Solanum Central*) Desert raisin

Minyarra
(*Cyperus bulbosus*)
Bush onion

Digging for:

Manyjurrpa
(termite)

Minga
(ants)

Mankarr mirrka is recorded during surveys to understand if a site is good for mankarr. Having certain plants growing at a site can tell Martu about the waru that happened in the area, and help them make decisions on how to manage.

Martu knowledge of growing conditions for mankarr mirrka

	Mankarr mirka (food)	Importance of waru (fire) and kalyu (rain)	Where you find them
Plants with lunki	Lunki (witchetty grub)	Waru varies depending on species of plant.	Generally sand plain country. Main Acacia species: *Acacia hilliana, Acacia dictyophleba & Acacia kempeana* and *Codonocarpus cotinifolius* (Karntarangu/ desert poplar). Mulga.
Wilyki Seeds	Kirtilpa (*Yakirra australiensis*)	Needs waru and kalyu	Sand plain, sand dune, mulga
	Yuwinji (*Eragostis eriopoda*)	Needs waru and kalyu	Sand plain, sand dune, mulga
Mirrka/Mayi Food plants that have fruits or roots to eat	Jinyjiwirrilypa (bush tomato; *Solanum central*)	Needs waru and kalyu	Sand plain
	Minyarra (bush onion; *Cyperus bulbosus*)	Doesn't like waru, needs kalyu	Near drainages or salt lakes
Insects	Manjurl (termites)		
	Minga (ants)		
	Wuukarta (honey ants, Camponotus spp.) (*Acacia aneura*)	Doesn't like waru, needs kalyu	Mulga habitat

Carol Williams showing how to find the lunki that mankarr and Martu like to eat.

Country for mankarr

Country types at the sites are recorded following the categories that are recognized by Martu and considered as representing habitat types for the bilby.

Martu recognize several types of country where mankarr occur. These country types all have the right type of ground for mankarr to create burrows. Where the soil is too soft, you won't find mankarr because the burrows would collapse. Likewise, mankarr can't live where the ground is too hard to dig.

> ***Mankarr are not south of the Parnngurr where it is too rocky.***
> Waka and Karnu Taylor 2016

Warla (salt lakes)

Wintamarra (mulga)

Rirra (laterite)

Pararra (sandplain)

Linyji (claypan)

Tuwa (dune field)

Country types where mankarr may be found.

Each of these country types needs different types of management to stay healthy. We collected some descriptions of the waru and rain/water that are needed for each.

Martu descriptions on how to care for different country types

Mankarr ngurra (home)	What waru is needed	Food resources
Tuwa (sand dune)	Not too much waru	Lunki, wilyki, mirrka
Rirra, wiltu (little rocks/laterite)	Not too much waru	
Pararra (sand plain)	Waru Martu way	Food few years after fire
Wintamarra (mulga)	No hot waru	Permanent food, lunki other insects
Warla (edge of salt lake)	No waru	Minyarra (doesn't need fire), wilyki, mirrka
Karrul (creek)	Waru on side sands	Wilyki, minyarra, mirrka
Linyji (claypan)	Waru Martu way	Manyjurrpa (termite)
Yapulyukurru (rocky country)	Not too much waru	

Recording habitat conditions

Country type

Country types follow the way Martu describe country and bilby habitat.

Ground cover

Ground cover provides further information on fire history and resources available for bilbies at sites like food and good places to hide.

Fire age

Martu recognize different stages following fire, and also recognize the impact fire has on resources (food and shelter) for mankarr. Mankarr generally leave an area directly after a fire, but return when plants that provide food have regrown. A fire mosaic (patches) of different ages that provides food yet leaves old vegetation to provide cover from predators is good for mankarr. Burning is practiced in different ways between habitat types (e.g. sandplain, rirra, lake edge) to encourage food resources.

> *"On the sandplain, a little patch burnt with old spinifex on both sides, that's the right habitat for mankarr"*
> Parrngurr ranger 2017

When carrying out surveys, tick all the fire stages that are encountered. Be aware that the different communities may use only some of the Martu terms listed or may use other words also. These terms are most relevant to sand plain country:

- *Nyurnma (recent burn, still black)*
- *Waru-waru (fresh shoots and plants growing)*
- *Nyurkura (mature herbs with small spinifex)*
- *Manguu (big spinifex, old enough to burn)*
- *Yurnara (dense old spinifex hummocks)*

Fire type

We are recording how the fire was started (hunting, ranger, lighting) to know what sort of management is happening at each site.

Feral herbivores

We are keeping track of places where there is sign of feral herbivores (cattle, donkey, camel, or horse).

Is there space for mankarr to hop between ground cover?

Bilbies need clear paths between vegetation (plants) to move around their territory looking for food. Places with too much thick vegetation of tall grasses or herbs may not be good habitat. Look at the vegetation that is growing at the height of the bilby and think whether a bilby could hop around.

- *Uwa (plenty)*
- *Paki/wiya (no/not much)*

Recording tracking condition

Conditions at the sites may influence how easy it is to find animal sign (detectability). The main things influencing detectability are:

Clear ground for tracking

How much bare ground is there where tracks can be made? If the ground is covered with leaf litter or low growing grasses, it may be impossible to see tracks. In these places foxes, cats and dingos may not be detected as they won't leave tracks. Diggings, scats and/or recently used burrows will need to be detected to indicate that mankarr are present.

Softness of ground for leaving tracks

Is the ground soft and good for tracks? If ground is hard fresh mankarr diggings and burrows may be evident, but no tracks may be found. Cats, foxes and dingos are mainly detected by finding tracks, so even if they have been at a site, you may not be able to detect them at sites where the ground is hard. Sites should be in places where the ground is soft enough for the animals we are interested in to leave tracks.

Track disturbance

Have things happened that could have removed tracks? Rainy or windy weather may remove tracks of animals that have used a site. Sign of small animals may also be disturbed where large animals (e.g. horses, cattle, camels) have trampled sites. If possible don't survey until tracking conditions improve, or record if there have been disturbances that could have removed sign.

Tracy Carboon talking with Parnngurr women Rangers.

Mankarr search: cheat sheet

Arrive at site:

1. **Choose a Team leader:** This is the person who will write down the data and also can be asked questions about the survey later, if need be.
2. **Complete the pre-search** part of the data sheet. Check that:
   - Sites and monitoring zones are named
   - Write down location details (Management Zone, Site ID).
   - **Write down the number of people searching.** Do not count people who are learning and following others (not searching on their own).
3. **Go to the central start point.** This could be from the car or further away. Do not start searches on the edge of major roads, or near places that animals might avoid.
4. **Take a GPS point** and record the latitude and longitude on the data sheet.

20 minute search:

5. Each searcher has a laminated card where they can tick animal sign and bush foods they see.
6. The team splits up and searches for 20 minutes. Rangers choose their own search path, and use their own knowledge to target areas that may be more likely to have mankarr sign.
7. Record every type of sign that is found for mankarr, predators and rabbits, plus bush foods.
8. If *mankarr tracks* are found, use the gait measurement sheet:
   - Look at a series of mankarr tracks. Compare the gait length to the gait measure sheet and work out if yirna (adult male), wanti (female)/ yirna juku (small male) or kalirtura (young) mankarr.
   - Repeat this when another path of mankarr tracks are found. Is this mankarr the same size?
9. At 20 minutes everyone walks back to the central point.
10. Only record animals when you are very sure of what animal left the track. If you are not sure what animal it was, leave it blank.
11. **Mark the time everyone stops searching.** Although searches should be around 20 minutes, sometimes they may be shorter or longer, so it's important to record this to get an idea of total search effort.

Talk at the end and fill in the KJ MANKARR SURVEY DATA SHEET:

12. Everyone shares what they saw and what they think about the site. The team leader asks everyone what animal sign and bush foods they saw and marks this on the datasheet. Rangers use their laminated cards to help them remember.
13. Describe the habitat at the site. From looking around and what the rangers found when walking, pick which country and ground cover types there are at the site.
14. Mark the fire ages the team found. Talk about whether this was the right kind of fire for mankarr, and if burning needs to happen.
15. Talk about the quality of the ground for tracking. Was it soft? Was there too much leaf litter or thick plants? Has something disturbed tracks like wind or big animals?
16. Collect the laminated cards and wipe clean for the next site.

Mankarr. Photo: Bernard DUPONT CC BY-SA 2.0 Wikimedia

Talking together about the mankarr site

Rangers enjoy the opportunity to come together at the end of a survey to talk about what everyone saw at the site, fill in the datasheet and talk about potential fire management or other work they could carry out in the area.

Martu have knowledge that helps with caring for country and mankarr, which includes:

- Knowing which country to look to find mankarr
- Tracking skills to find where mankarr are
- Carrying out surveys to record data on bilby tracks, diggings, burrows, scats
- Remembering whether mankarr populations and habitat has changed
- Making small hunting fires that reduce large hot wildfires and encourage foods to grow
- Cat hunting to reduce predation pressure

Ranger teams could work with the Elders to talk about country when they do the mankarr searches.

Data sheets

The last section contains field resources and datasheets.

There are three types of tick-sheets to help record sign or bush foods as they are found at survey sites.
These should be laminated. Use white-board markers, then wipe them clean after a survey for reuse at the next site:

- Measuring mankarr datasheet – includes gait measure
- Recording key animal sign – there are two versions for animals, as the teams preferred different layouts
- Recording mankarr mirrka

The final page is the datasheet to fill in as a group after surveys:

- KJ MANKARR SURVEY DATASHEET – to record survey data

Parnngurr rangers recording data after a mankarr search.

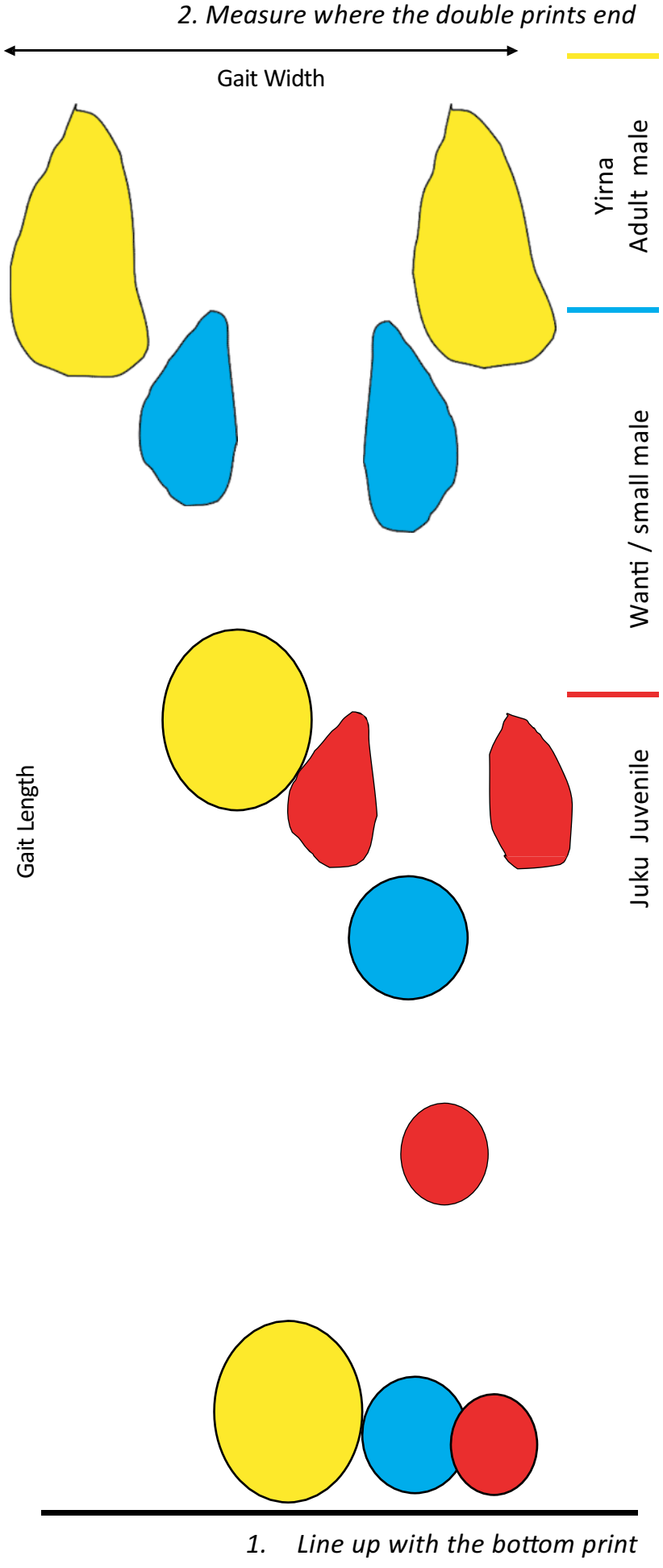
Measuring Mankarr

Tick the box if you see Mankarr tracks

	Fresh 1-2 days	Old +3 days
Yirna (adult male)		
Wanti (female) **Yirna juku** (small male)		
Kalirtura (juvenile)		

Mankarr jina

Direction of travel →



Mankarr

Fresh = 1-2 days Old = +3 days

Jina

(Fresh) Kuwarri (Old) Julyju

Ngurra

(Active) Kuwarri (Old) Julyju

Jawarnu

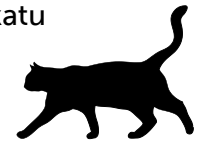
Kuwarri Julyju

Kuna

Kuwarri Julyju

Feral animals

Putjikatu



Jina

Kuwarri Julyju

Kuna

Kuwarri Julyju

Warnapari Ngupanu

Walytaki

Jipuku Malka-malka

Mankarr

Fresh = 1-2 days Old = +3 days

Jina

Kuwarri (Fresh)	Julyju (Old)

Ngurra

Kuwarri (Active)	Julyju (Old)

Jawarnu

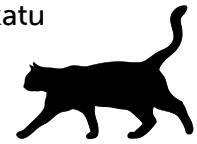
Kuwarri (Fresh)	Julyju (Old)

Kuna

Kuwarri (Fresh)	Julyju (Old)

Feral animals

Putjikatu



Warnapari Ngupanu

Walytaki

Jipuku Malka-malka

Jina

Kuwarri (Fresh)	Julyju (Old)
Kuwarri (Fresh)	Julyju (Old)
Kuwarri (Fresh)	Julyju (Old)
Kuwarri (Fresh)	Julyju (Old)

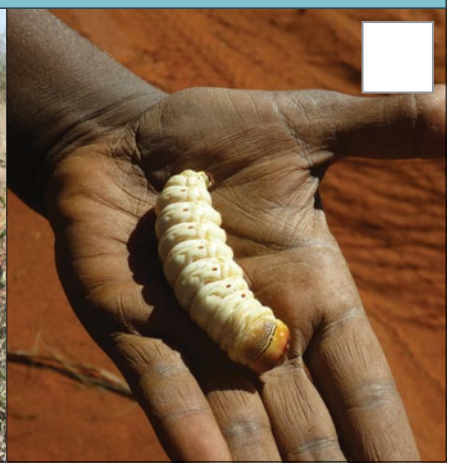
Kuna

Kuwarri (Fresh)	Julyju (Old)
Kuwarri (Fresh)	Julyju (Old)
Kuwarri (Fresh)	Julyju (Old)
Kuwarri (Fresh)	Julyju (Old)

Tick the box if you see any of these animals

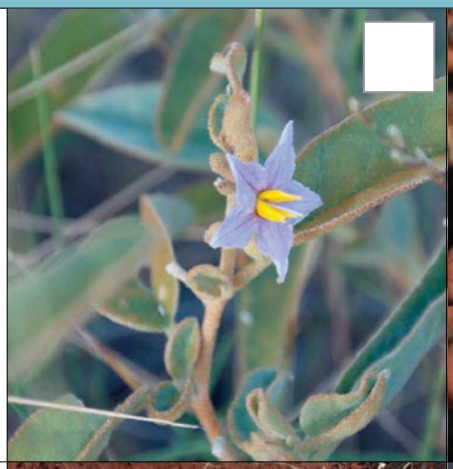
Mammals		
Marlu (red kangaroo) ☐	**Kirti-kirti** (hill kangaroo) ☐	**Langamartu** (mulgara) ☐
Mammals	**Birds**	
Spinifex hoppir mouse ☐	**Kiparra** (bustard) ☐	**Karlaya, Jakipirri** (emu) ☐
Reptiles		
Pamajalpa (sand goanna) ☐	**Maruntu** (yellow spotted monitor) ☐	**Yalapara** (perentie) ☐
Reptiles		
Winyjikiri (spiny-tailed monitor) ☐	**Mulyamiji** (great desert skink) ☐	**Jila** (snake) ☐

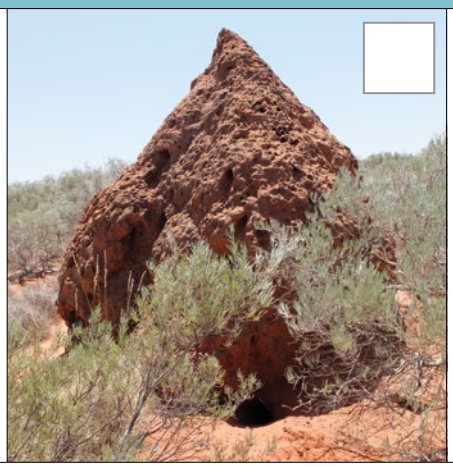
Is there food for Mankarr to eat? Tick the box if you see any foods below.

Plants with lunki (Edible grubs)		
Lungkunypa (*Acacia dictyophelba*)		

Wilyki (Seeds that come from any plants)		
Kirtilpa (*Yakirra Australiensis*)		
Yuwinji (*Eragostis eriopoda*)		

Is there food for Mankarr to eat? Tick the box if you see any foods below.

Mirrka/Mayi (Food plants that have fruits or roots to eat)		
Jinyjiwirrilypa (Solanum Central)	 ☐	 ☐
Minyarra (*Cyperus bulbosus*)	 ☐	 ☐

Mirrka/Mayi (Ants)		
Manyjurrpa (termite)	 ☐	

KJ MANKARR SURVEY DATA SHEET

Date: ___/___/___ Team Leader: _____

☐ Jigalong ☐ Punmu ☐ Parnngurr ☐ Kunawaritji Number people searching: _____

Monitoring zone: _____ Site no: _____

or random *I.e. M01*

Starting point for search: GPS Lat: _____ Long: _____

20-minute search. Start time: _____ Finish time: _____

After search, team discusses what they saw, and fills in below:

Tick F = fresh (1-2 days), O = old (more than 3 days), leave blank if nothing

Animal	Jina		Kuna		Ngurra		Jawarnu		Yirna (Adult male)		Wanti / Yirna Juku (F/ small M)		Kalirtura (Young)	
	F	O	F	O	F	O	F	O	F	O	F	O	F	O
Mankarr														
Cat														
Dingo														
Fox														
Rabbit														

If there is mankarr at the site:

Is there much Adult Mankarr sign? ☐ Uwa (plenty) ☐ Paki/wiya (only small amount)

Is there much Kalirtura Mankarr sign? ☐ Uwa (plenty) ☐ Paki/wiya (only small amount)

Tick all you saw

Mirrka (bush foods)

- ☐ Lunki warta (acacia)
- ☐ Kirtilpa (Yakirra grass)
- ☐ Yuwinyji (Eragostis)
- ☐ Jinyjiwirrilypa(Solanum central)
- ☐ Minyarra (bush onion)
- ☐ Digging for manyjurrpa (termites)
- ☐ Digging for minga (ants)
- ☐ Other:

Look at country all around and tick all

Country type

- ☐ Pararra (sand plain)
- ☐ Tuwa (dune field)
- ☐ Warla (salt lake)
- ☐ Ririra (laterite)
- ☐ Wintamarra (mulga)
- ☐ Linyji (claypan)
- ☐ Yapulyukurru (rocky)
- ☐ Other:

TIck all you saw

Ground cover

- ☐ Paru / janpi (spinifex)
- ☐ Soft grass
- ☐ Herbs
- ☐ Buffel grass
- ☐ Small trees/ shrubs
- ☐ None
- ☐ Other:

Tick all you saw

Fire age classes

- ☐ Recent burn, still black (nyurnma)
- ☐ Fresh shoots and plants growing (waru-waru)
- ☐ Mature herbs with small spinifex (nyurkura)
- ☐ Big spinifex, old enough to burn (manguu)
- ☐ Dense old spinifex hummocks (yurnara)

Fire type

- ☐ Hunting
- ☐ Ranger
- ☐ Lighting

Other animals

- ☐ Marlu (red kangaroo)
- ☐ Kirti-kirti (hill kangaroo)
- ☐ Langamarlu (mulgara)
- ☐ Spinifex hopping mouse
- ☐ Kiparra (bustard)
- ☐ Karlaya, Jakipirri (emu)
- ☐ Parnajalpa (sand goanna)
- ☐ Maruntu (yellow spotted monitor)
- ☐ Yalapara (perentie)
- ☐ Winyjikirti (spiny tailed monitor)
- ☐ Mulyamiji (great desert skink)

Is there space for mankarr to hop between ground cover?

- ☐ UWA (plenty)
- ☐ Paki/wiya (no/not much)

Track disturbance

- ☐ Rain / wet
- ☐ Windy
- ☐ Trampled
- ☐ None

Clear ground for tracking

- ☐ Lots of clear ground
- ☐ Some clear ground
- ☐ Very little/no clear ground

Softness of ground for leaving tracks

- ☐ Soft, lots of little tracks
- ☐ Bit hard for little animal tracks
- ☐ Hard, only tracks of big animals

Feral herbivores

- ☐ Camel
- ☐ Cattle
- ☐ Horse
- ☐ Donkey

Extra notes:

This project is a collaboration between Kanyirninpa Jukurrpa, The Nature Conservancy, BHP, The University of Melbourne and The Threatened Species Recovery Hub.

This Threatened Species Recovery Hub is supported through funding from the Australian Government's National Environmental Science Programme.

www.nespthreatenedspecies.edu.au