Pungalina–Seven Emu Wildlife Sanctuary

Ecohealth Report 2021

australian wildlife conservancy

Summary

Australian Wildlife Conservancy (AWC) has implemented an Ecological Health Monitoring Program (Ecohealth) across Pungalina-Seven Emu Wildlife Sanctuary (Pungalina-Seven Emu) to measure the changes in the status and trend of conservation assets, and threats to those assets. Metrics from the program are reported in annual Ecohealth Reports and Scorecards. This is the Ecohealth Report for 2021. Values of metrics derived in this report were based on data collected during surveys carried out between 2017 and 2021. The complete set of metrics and their values are summarised in the accompanying Ecohealth Scorecard.

In implementing the Ecohealth program for Pungalina-Seven, AWC undertook standard live-trapping (4,470 live trap nights), standard camera trap surveys (2,906 camera trap nights) and four nights of microbat trapping. These surveys detected 25 species of mammal, 41 species of reptile and 8 amphibian species which were targeted using these survey techniques, and incidentally recorded 23 bird species on camera.

Our Standard Trapping Fauna Survey occurred at 38 sites, and recorded 43 native species including six mammals, 31 reptiles and 6 frogs. Concurrently with the Standard Trapping Fauna Survey, the Standard Camera Survey occurred across 47 sites (38 in common with those in the standard trapping survey; and 9 inaccessible sites accessed via helicopter). Thirty native species were detected comprising 14 mammals, 19 birds and 1 reptile. Camera traps were used to target larger mammals (e.g. macropods) and showed the abundance of the macropod guild was higher in 2021 compared to surveys undertaken in 2017, and occupancy and richness levels equivalent to the previous surveys. Higher abundance appeared to be due to increased activity of Agile Wallabies (*Macropus agilis*) around camera sites. Other interesting non-target species detected by the cameras included the endangered Eastern Purple-crowned Fairywren (*Malurus coronatus*) and the threatened Yellow-spotted Monitor (*Varanus panoptes*). Introduced vertebrates recorded during our camera surveys included feral cats (*Felis catus*), feral cattle (*Bos taurus*), donkeys (*Equus asinus*), pigs (*Sus scrofa)* and cane toads (*Rhinella marina*). Feral cattle and cats were the most abundant feral animals detected occupying 15% and 6% of camera sites, respectively. Both feral pigs and cane toads occupied 4% of sites and donkeys 2% of sites.

A Rocky Gorge Camera Survey, targeting small-medium mammals, in Pungalina-Seven Emu escarpment country was conducted across 22 sites. This survey detected 16 native species, and three invasive species (feral cats, pigs, and cane toads). Small-medium mammals were detected on 86% of sites, similar to the 2018 results (87% of sites). The escarpment country specialists were the most abundant mammals, with Common Rock-rat (*Zyzomys argurus*), Wilkin's Rock Wallaby (*Petrogale wilkinsi*) and Carpentaria Pseudantechinus (*Pseudantechinus mimulus*) were recorded at greater than 20% of sites. Rock Ringtail Possum (*Petropseudes dahli*) were also regularly recorded (9% of sites). Perhaps not unexpectedly, there were 117 images of cane toads collected across six sites that all had water close to the camera traps. There are also small, but concerning, numbers of pigs and cats recorded in these areas.

Microbat trapping was undertaken at three sites over four nights. Five bat species were recorded including the Near Threatened Orange Leaf-nosed Bat (*Rhinonicteris aurantia*).

The relatively high abundance of cats that occur across the region is problematic for native wildlife, with their removal being a challenging endeavour. However, re-establishing appropriate fire regimes is recognised to reduce the impacts of these feral animals and restore ecological processes. AWC's fire management has substantially reduced the extent of wildfires on the property. The ecology teams' assessment of recent fire management strategies (storm-burning, followed by early dry season mosaics where required) was that there was significant cover across the sanctuary to provide resources (shelter, food) for native species. Long-term monitoring will help AWC understand how fire management changes feral cat (and other species including cane toad) abundance and occupancy across the property and improve conservation outcomes.

Contents

Document citation: Palma A, Mulder E, Watson A, Diete R, Wauchope M, Pierson J, Khoury R, Aylen O, Joseph L, Kanowksi J (2022) Pungalina-Seven Emu Ecohealth Report for 2021. Australian Wildlife Conservancy, Perth, WA.

Introduction

Australian Wildlife Conservancy (AWC) currently owns, manages, or works in partnerships across 31 properties in Australia, covering almost 6.5 million hectares, to implement our mission: *the effective conservation of Australian wildlife and their habitats*. AWC relies on information provided by an integrated program of monitoring and research to measure progress in meeting its mission and to improve conservation outcomes.

AWC's Ecohealth Monitoring Program has been designed to measure and report on the status and trends of species, ecological processes and threats on each of these properties (Kanowski et al. 2018). Data from the monitoring program are used to address the following broad questions relevant to our mission:

- 'are species persisting on a property?',
- 'are habitats being maintained?'
- 'are threats below ecologically-significant thresholds?'

For threatened and iconic species, including reintroduced species, AWC's monitoring program aims to obtain more detailed information related to their conservation management; for example, data on survival, recruitment, condition, distribution and/or population size.

The structure of the Ecohealth Program is as follows. AWC's Monitoring and Evaluation framework provides guidance on the development of the Ecohealth Monitoring Plans for each property managed by AWC: these plans describe the conservation values and assets of each property, the threats to these assets, and the monitoring program that will be used to track their status and trend, and to evaluate outcomes. Annual survey plans and schedules are developed to implement these plans. The outcomes of these surveys are presented in annual Ecohealth Reports and summary Ecohealth Scorecards.

This document is one of a series of annual Ecohealth Reports for Pungalina-Seven Emu Wildlife Sanctuary (referred to here as Pungalina-Seven Emu). The companion Ecohealth Scorecard presents the indicators and their metrics in a summary format.

Pungalina-Seven Emu

Pungalina-Seven Emu is located in the Gulf of Carpentaria within the traditional lands of the Garawa and Yanyuwa people and is 306,000ha in extent (Figure 1). Pungalina-Seven Emu protects areas of conservation significance including 3,000 km^2 of the Calvert and Robinson River catchments and 55 kilometres of coastline. Pungalina and Seven Emu are both pastoral leases. AWC owns the Pungalina lease, while the Seven Emu lease belongs to the Shadforth family, with a section managed by AWC in a long-term conservation arrangement. Pungalina was acquired by AWC in 2008 to protect the suite of ecosystems that extend from the ocean and its adjacent lowland plains to the top of the rugged sandstone plateau which dominates the Gulf region. Within this gradient lies a rich montage of habitats for flora and fauna including extensive savanna woodlands, significant areas of rocky escarpments and gorges, watercourses, springs and their associated riparian forests, and coastal scrubs (Figure 2).

AWC undertakes a prescribed burning program on Pungalina-Seven Emu. The overarching aim of AWC's fire management program is to re-establish ecologically appropriate fire regimes that promote the conservation of species, ecological communities and ecosystem processes (Webb et al. 2020). Fire management on Pungalina-Seven Emu in recent years has largely involved prescribed burning using ground-lit storm burns at appropriate times during the wet season, and early dry season burns, either ground-based or ignited by dropping incendiaries from helicopters (Webb et al. 2020).

To date, 352 species of native terrestrial vertebrates (39 mammal, 214 bird, 82 reptile, and 17 amphibian species) have been recorded on Pungalina-Seven-Emu. There are an additional 54 species found regionally that are considered 'likely' or 'very likely' to occur on the sanctuary. Ten species of fish are confirmed for waterways on Pungalina-Seven Emu, with a further 18 species of fish considered 'likely' or 'very likely' to occur. Flora surveys by AWC have resulted in the collection of 431 plant specimens from the Sanctuary to date, most of which have been formally identified in the Brisbane and Darwin herbaria.

There are 14 species of threatened vertebrate confirmed for the Sanctuary: one mammal, seven bird, and six reptile species. Of the seven threatened bird species, five are migratory shorebirds utilising the intertidal zone, and of the reptile species, three are marine turtles. The remaining six species are the Gouldian Finch (*Chloebia gouldiae*), Northern Crested Shriketit (*Falcunculus frontatus whitei*), Ghost Bat (*Macroderma gigas*), Merten's Water Monitor (*Varanus mertensi*), Yellow-spotted Monitor (*Varanus panoptes*) and Gulf Snapping Turtle (*Elseya lavarackorum*).

Figure 1. Location and regional context of Pungalina-Seven Emu.

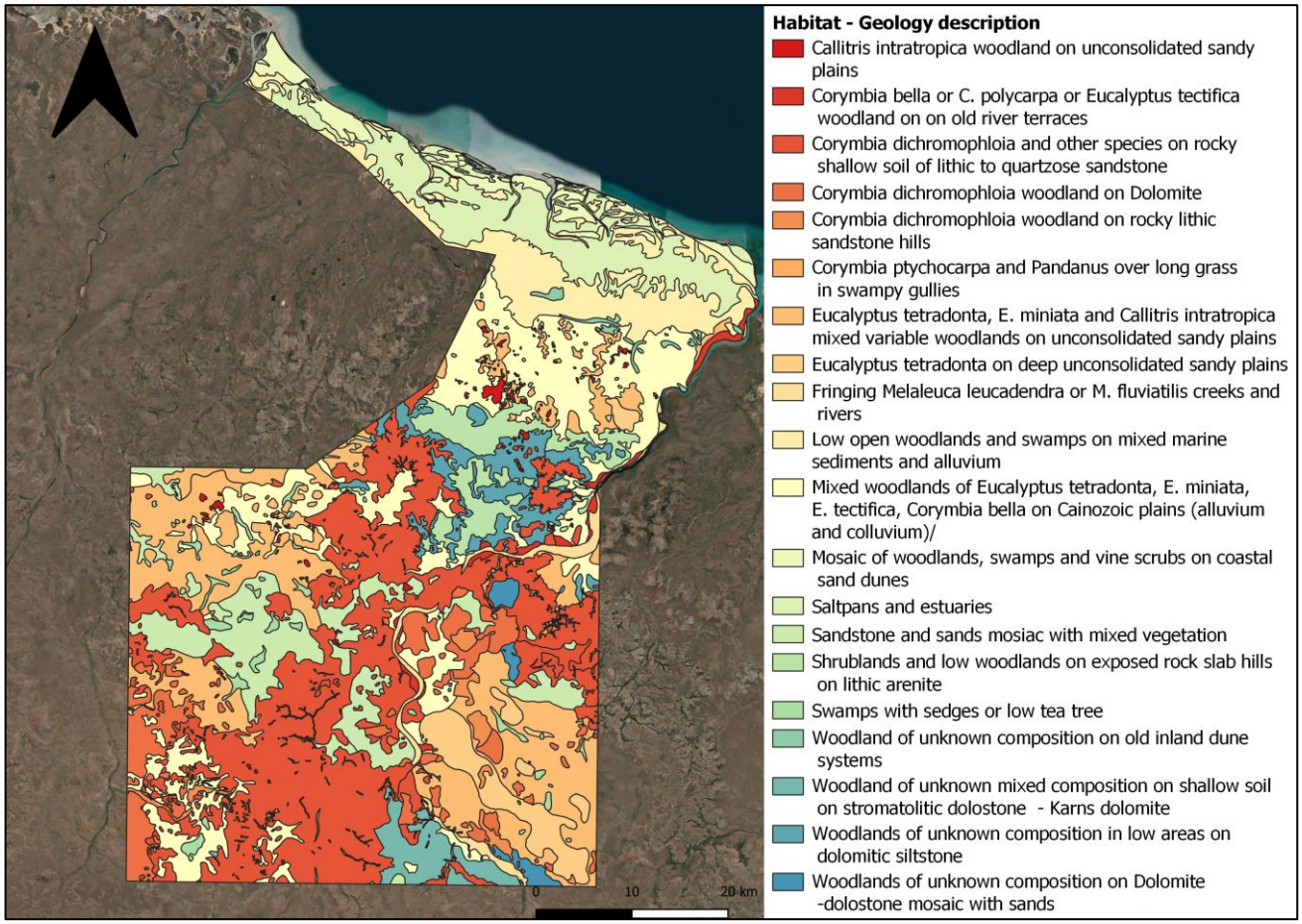

Figure 2. Extent and distribution of broad vegetation types of Pungalina-Seven Emu.

Climate and weather summary

Pungalina-Seven Emu is situated in Australia's monsoonal tropics. It has a warm temperature year-round and a highly seasonal rainfall pattern. Weather data reported are from Pungalina-Seven Emu (rainfall) and Borroloola Airport (temperature, weather station number 014723), the closest weather station for which long term temperature data exist (Bureau of Meteorology 2022). Pungalina-Seven Emu has received median annual rainfall of 1,049 mm (range between 733 mm to 1,877 mm) since recording began in 2010. Most of this rainfall occurs during the wet season between December to April (Figure 3). In 2021, total rainfall was 1,279 mm (Figure 4).

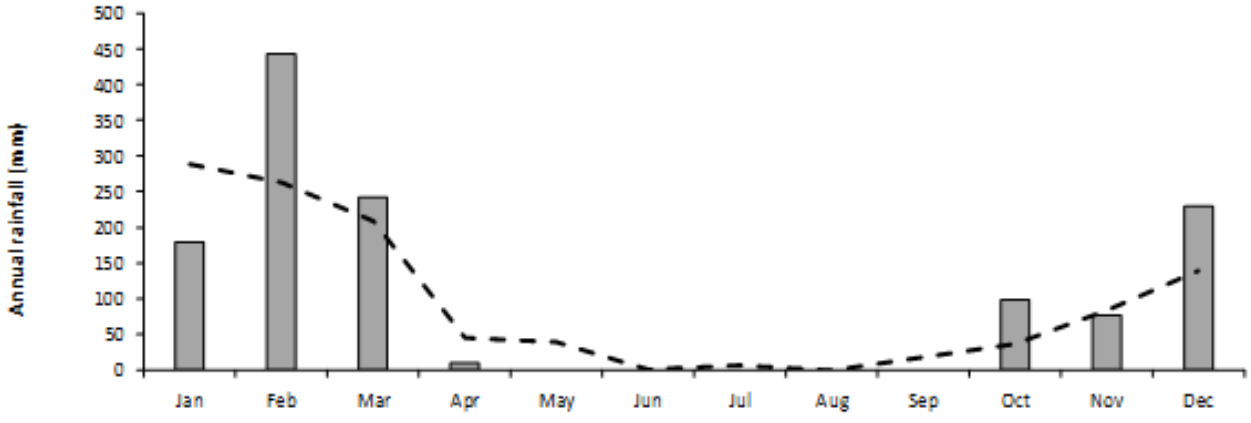

Figure 3. Monthly rainfall at Pungalina-Seven Emu in 2021. Dashed line = average monthly rainfall, 2010-21.

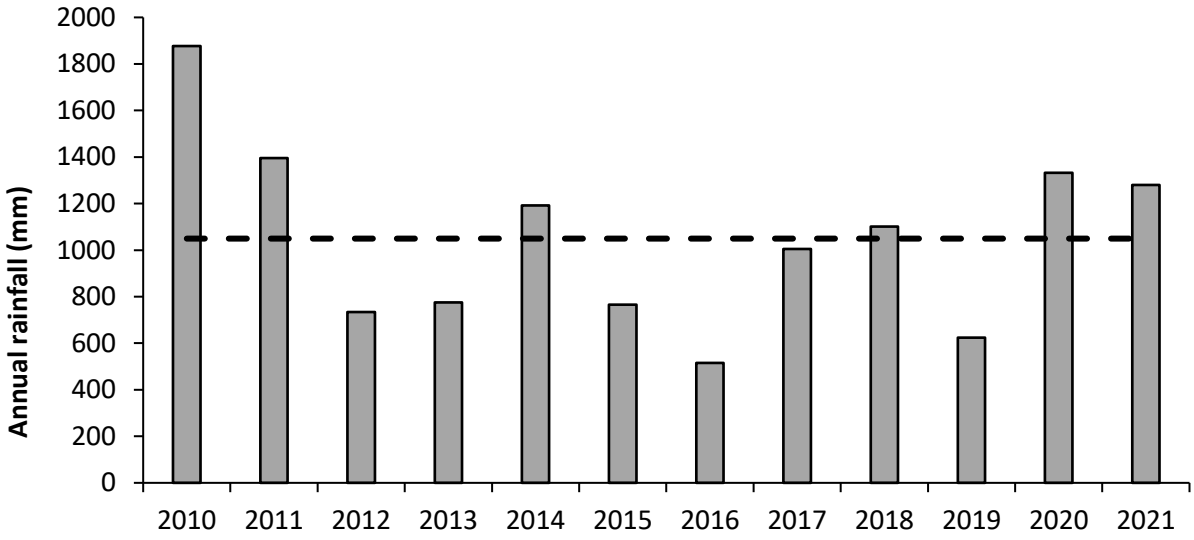

Figure 4. Annual rainfall at Pungalina-Seven Emu. Dashed line = average for 2010-21.

Historical temperature data are available from 1987. Historical monthly mean temperatures range from a minimum of 7.7 °C in July to a maximum of 41.4°C in December (Bureau of Meteorology 2022, data from Borroloola Airport).

Cyclones regularly impact the region and, in combination with low-pressure systems and monsoonal troughs, contribute substantially to its rainfall. Total annual rainfall is consequently highly variable, both in timing and magnitude, from year to year. During wet periods, ephemeral waterholes retain water, springs draining the dolomite formations discharge at a high rate, and water levels in the Calvert River are correspondingly high. In dry times, the ephemeral springs, waterholes and creeks dry up, and only major waterholes in the Calvert River and major tributaries remain (Zaar 2009).

Methods

Monitoring and evaluation framework

Pungalina-Seven Emu's Ecohealth Monitoring Program has been designed to measure and report on the status and trends of selected biodiversity and threat indicators on the property, using metrics derived from data collected through a series of purpose-designed surveys. Where possible, outcomes will be evaluated against performance criteria relevant to each species, guild or assemblage.

Key threatened and iconic species

The Ecohealth program is focused on species of high conservation value, including key threatened and 'iconic' species (e.g., regional endemics, species with high public profile and other species of conservation importance because of the role they play in an ecosystem, etc). For these species, AWC will aim to develop *Conservation Plans* to specify metrics to monitor outcomes for target species against nominated performance criteria.

Vertebrate assemblages and surveillance species

AWC's mission involves the conservation of all wildlife, not only threatened or reintroduced species. For this reason, AWC's monitoring program extends to surveillance monitoring of faunal assemblages (mammals, birds, reptiles, frogs). The monitoring program aims to address questions relevant to the conservation of assemblages.

At the most basic level, the program seeks to establish whether all species that are known to occur on the property are persisting on the property (i.e., 'are all species present?').

With increasing information, the monitoring program can address more detailed questions relating to conservation of assemblages, such as 'have species maintained their distributions or abundance?' However, the boom/ bust conditions of most Australian environments can lead to large variations in the numbers of individuals in a population and the habitats or sites occupied by a species – these variations may not necessarily be informative in relation to the conservation of a species at a property over the long term.

AWC is currently working on developing an evaluation framework for surveillance monitoring of faunal assemblages. At present, we will continue to present data on a range of metrics relating to indicator species and guilds.

Indicators and metrics

On Pungalina-Seven Emu, 25 biodiversity (species, guilds and ecological processes) indicators have been selected for monitoring (Table 1). Eleven of these indicators were reported on in 2021, including surveillance to monitor faunal assemblages.

Threat metrics are selected to monitor the status and trends of introduced predators and herbivores, and fire regimes. Five threat indicators have been selected for monitoring (Table 2). One of these threat metrics was reported on in 2021.

Table 1. Biodiversity indicators and metrics for Pungalina-Seven Emu.
Key threatened and iconic vertebrates

Indicator	Survey name	Survey method	Metric/s
Mammals			
Carpentarian Pseudantechinus, (*Pseudantechinus mimulus*)	Rocky Gorge Camera Survey	Camera trapping	Abundance, occupancy
Spectacled Hare-wallaby (*Lagorchestes conspicillatus*)	Spectacled Hare-wallaby Survey	Camera trapping	Abundance, occupancy
Ghost Bat (*Macroderma gigas*)	Ghost Bat Survey	Under development	Roost count (i.e., number of bats per roost).
Birds			
Eastern Purple-crowned Fairywren (*Malurus coronatus macgillivrayi*)	Playback Bird Survey	Playback – Under development	Occupancy
Reptiles			

Yellow Spotted Monitor (*Varanus panoptes*)	Varanid Camera Survey	Camera trapping	Abundance, occupancy
Merten's Monitor (*Varanus mertensi*)	Varanid Camera Survey	Camera trapping	Abundance, occupancy

Vertebrate assemblages and surveillance species

Indicator	Survey name	Survey method	Metric/s
Mammals			
Assemblage richness	All mammal surveys	Camera trapping, live trapping, harp trapping, observation	Number of species
Small-medium sized mammals			
Assemblage richness	Standard Trapping Fauna Survey, Standard Camera Survey, Rocky Gorge Camera Survey, Bandicoot Camera Survey, Spectacled Hare-wallaby Survey	Camera trapping, live trapping	Number of species
Small-medium mammals (trappable, excluding Rocky Gorge small-medium mammals)	Standard Trapping Fauna Survey, Standard Camera Survey	Camera trapping, live trapping	Richness, abundance
Rocky gorge small-medium mammals	Rocky Gorge Camera Survey	Camera trapping	Richness, abundance
Sandstone Pseudantechinus, (*Pseudantechinus bilarni*)	Rocky Gorge Camera Survey	Camera trapping	Abundance, occupancy
Northern Brown Bandicoot (*Isoodon macrourus*)	Bandicoot Camera Survey	Camera trapping	Abundance, occupancy
Rock Ringtail Possum (*Petropseudes dahli*)	Rocky Gorge Camera Survey	Camera trapping	Abundance, occupancy
Wilkin's Rock-wallaby (*Petrogale wilkinsi*)	Rocky Gorge Camera Survey	Camera trapping	Abundance, occupancy
Common Rock-rat (*Zyzomys argurus*)	Rocky Gorge Camera Survey	Camera trapping	Abundance, occupancy
Bats			
Microbats	Microbats Targeted Survey	Harp trapping	Richness
Large herbivores			
Large macropods	Standard Camera Survey	Camera trapping	Richness, abundance
Predators			
Dingo (*Canis dingo*)	Predator Camera Survey, Standard Camera Survey	Camera trapping	Abundance, occupancy
Birds			
Assemblage richness	Wetland Bird Survey, Playback surveys, Camera Trap Surveys (all), other incidental records	Playback surveys, observational, camera trapping	Number of species
Buff-sided Robin (*Poecilodryas cerviniventris*)	Playback Survey	Playback	Occupancy
Wetland birds	Wetland Bird Survey	Standard Bird Survey	Richness
Reptiles			
Assemblage richness	Standard Trapping Fauna Survey, Standard Camera	Camera trapping, live trapping	Number of species

Indicator	Survey name	Survey method	Metric/s
	Survey, Varanid Camera Survey		
Small-medium reptile guild			
Assemblage richness	Standard Trapping Fauna Survey, Standard Camera Survey	Camera trapping, live trapping	Number of species
Small-medium reptile guild (excl. varanids / snakes)	Standard Trapping Fauna Survey, Standard Camera Survey	Camera trapping, live trapping	Richness, abundance

Vegetation indicators and surveillance species

Ecological processes			
Wetland health	Wetland Condition Survey	Condition assessment	Wetland Assessment Score

Table 2. Threat indicators and metrics for Pungalina-Seven Emu.

Indicator	Survey name/methods	Metric/s	Performance criteria
Pest animals			
Feral cats (*Felis catus)*	Cat Camera Survey	Abundance, occupancy	TBD
Feral Pigs (*Sus scrofa)*	Pig Survey	Abundance, occupancy	TBD
Feral Horses (*Equus caballus*)	Aerial Herbivore Survey	Abundance, occupancy	TBD
Feral cattle (*Bos taurus)*	Aerial Herbivore Survey	Abundance, occupancy	TBD
Fire			
Suite of ecologically relevant metrics, calculated for (i) all fire; and (ii) wildfire	Fire Scar Analysis/remote sensing	Extent (% of sanctuary) Distance to unburnt (km, mean)	Area burnt by late season wildfires.

Survey types and history

To report on the Biodiversity and Threat Indicators, our survey teams conduct a variety of surveys repeated on a schedule of 1-5 years, as required to obtain timely information on each indicator. These include:

For key threatened and iconic vertebrates, these include:

- Spectacled Hare-wallaby Survey
- Ghost Bat Survey
- Rocky Gorge Camera Survey
- Playback Bird Survey
- Varanid Camera Survey

For surveillance monitoring of assemblages, these include:

- Standard Trapping Fauna Survey
- Standard Camera Survey
- Rocky Gorge Camera Survey
- Bandicoot Camera Survey
- Microbats Targeted Survey
- Predator Camera Survey
- Playback Bird Survey
- Wetland Bird Survey

To monitor threats, a range of surveys are used, including:

- Aerial Herbivore Survey

- Pig Survey
- Cat Camera Survey
- Wetland Condition Assessment
- Fire Scar Analysis

Four of the ecological surveys were conducted at Pungalina-Seven Emu in 2021: Standard Trapping Survey, Standard Camera Survey, Rocky Gorge Camera Survey and Microbats Targeted Survey. Surveys reported upon in this Ecohealth Report are summarised in Table 3. The Fire Scar Analysis has been completed using satellite data from 2000 (eight years prior to acquisition) to 2021. The methodology is described and results of these surveys and computations are reported on in this document.

Table 3. Survey history and effort for Ecohealth surveys on Pungalina-Seven Emu presented in this report.

Survey name	Effort (2021)	Description/comment	Previous surveys
Standard Trapping Fauna Survey	3,420 trap nights	38 sites, each site with four bucket pitfalls, six funnel traps, 20 box traps*	2017: 48 sites, same number of traps per site (4,320 trap nights)
Standard Camera Survey	1,316 trap nights	47 sites, each site with 2 cameras, 35 sites associated with the Standard Trapping Fauna Survey Sites and 12 on coastal areas*	2017: 48 sites, two cameras per site (1,344 trap nights)
Rocky Gorge Camera Survey	484 trap nights	22 sites, each with two camera traps deployed for 11 nights.	2018: 20 sites, two cameras per site, deployed for 14 nights (560 trap nights).
Microbats Targeted Survey	16 trap nights	3 sites with harp traps set for 2 nights at Skeleton Creek and for 1 night at the other two sites.	2019: 1 site, traps set for 1 night (4 trap nights)
Spectacled Hare-wallaby Survey	0	43 cameras, left in situ 17 nights.	2020: 731 trap nights
Varanid Camera Survey	0	Ten sites with eight cameras deployed at each site for 7 nights.	2018: 560 trap nights

* Live trapping conducted for three consecutive nights per site. Camera traps deployed for a minimum of 14 nights per site.

Survey design and methods

Spectacled Hare-wallaby Survey

No Spectacled Hare-wallaby Survey was undertaken in 2021.

In 2020, forty-three sensor cameras were set along the edge of the Skeleton Creek track. The camera array was structured to determine: a) persistence at a known site (grid of nine cameras centred around previous detection); b) presence in the immediate vicinity of previous detection (21 cameras spaced 200 m apart in suitable habitat along Skeleton Creek track; and c) presence in suitable habitat further afield (10 cameras spaced 1 km apart on eastern Skeleton Creek track, plus three cameras 200 m apart in a southern habitat patch; Figure 5). Reconyx HP2W Whiteflash cameras were set at 70 cm height. A baitholder with bait (peanut butter, oats and vanilla) was placed 150 cm from the base of the tree on which the camera was set, with the baitholder raised 20 cm from the ground on a metal stake. Cameras were in place for 17 nights.

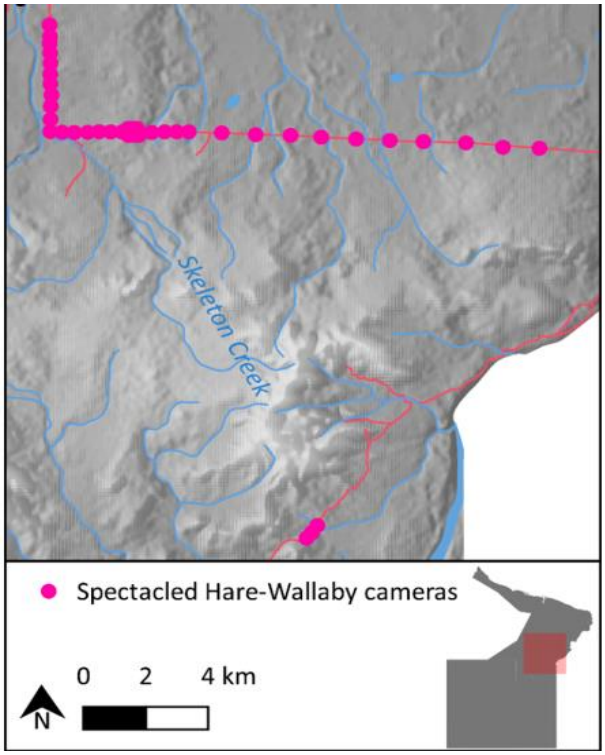

Figure 5. Spectacled Hare-wallaby camera locations.

Varanid Camera Survey

No Varanid Camera Survey was undertaken in 2021.

In 2018, in sandy, relatively open riparian areas, such as those along river and creek banks and fringing permanent wetlands, one Reconyx PC850 Whiteflash camera was set every 150 m, for up to 1,500 m sections. Ten sites were selected with eight cameras deployed at each site.

Cameras were set at an approximately 45° angle to the ground, with the camera aimed at a ground point ~1.3 – 2.0 m distant. Cameras were baited with one whole raw egg buried to 15 cm, one cracked open raw egg at the surface, a piece of raw beef and tinned tuna.

Cameras were deployed for a minimum of seven nights. If left in the field longer, data were used for seven nights and detections after that were retained as incidental records. Cameras were set at least five metres from and facing toward the water's edge, to ensure safety when deploying cameras in areas inhabited by estuarine crocodiles. Camera settings were: five photos per trigger, rapidfire, high sensitivity, no delay between photos.

Standard Trapping Fauna Survey

In June and July 2021, AWC completed Standard Trapping Fauna Surveys across Pungalina-Seven Emu at 38 sites (Figure 6). The number of sites was less than in 2017 because we did not use the sites at the Cycad Gorge area because it is a sacred site and we are currently seeking approval from the Traditional Owners. Additionally, the four northernmost sites (Fern Spring) were inaccessible due to wet conditions.

Each site encompasses a 1-ha survey area where a T-shaped drift fence, four bucket pitfalls, six funnel traps and 20 box traps (Figure 7). The live trapping array was used for three consecutive nights.

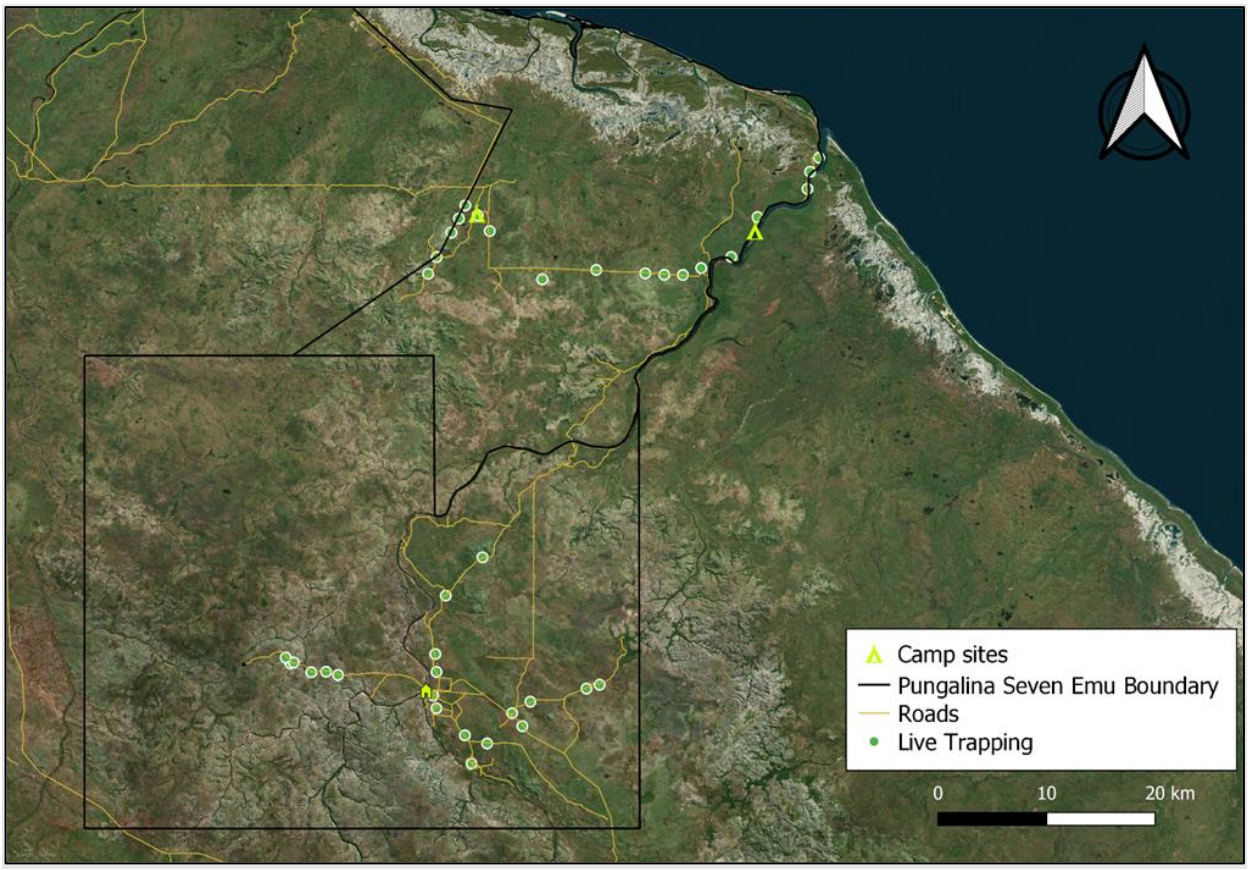

Figure 6. Standard Trapping Fauna Survey sites across the property.

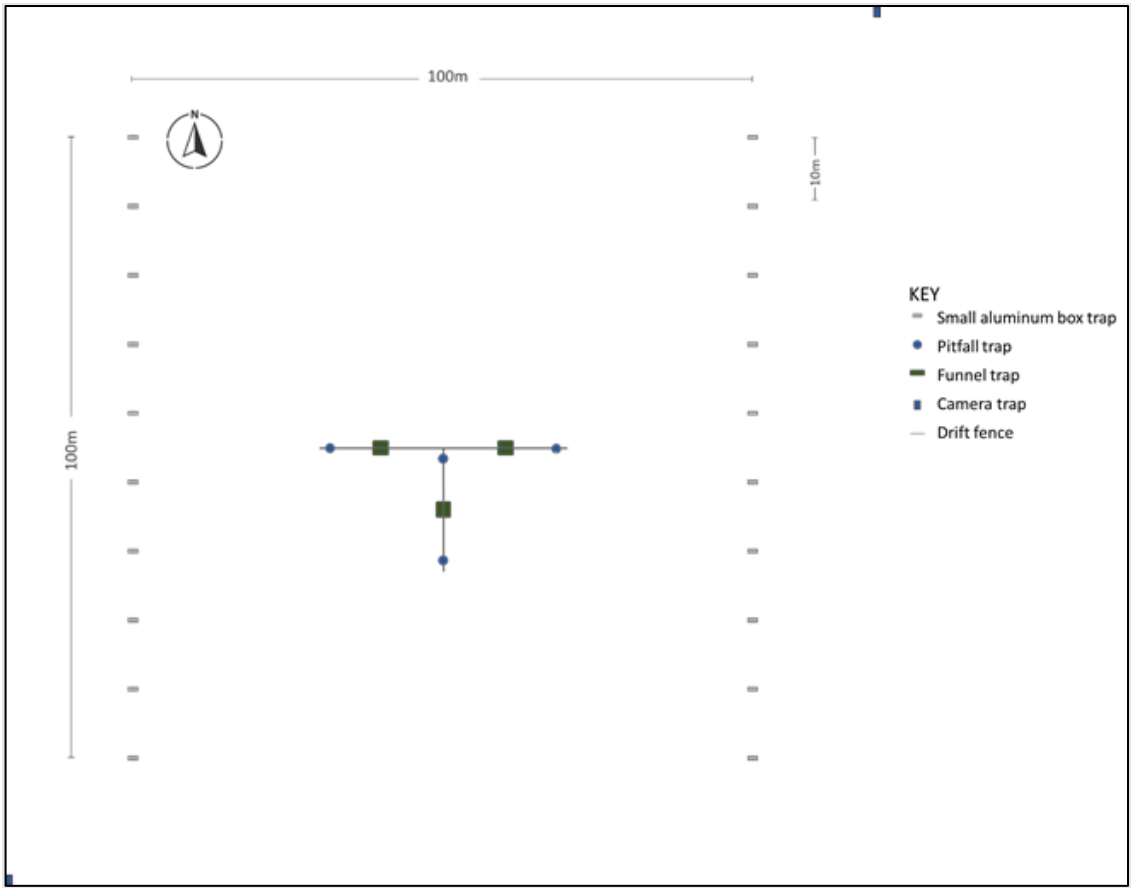

Figure 7. Set up of Standard Trapping Fauna Survey site at Pungalina-Seven Emu.

Standard Camera Survey

The Standard Camera Survey was conducted concurrently with the Standard Fauna Trapping Survey. Reconyx Hyperfire PC850 white flash camera traps were set at 47 sites comprising 12 sites in the Seven Emu coastal zone and 35 at the Standard Fauna Trapping Survey sites (see Figure 6 and Figure 9). Two cameras were placed at each site in the north-east and south-west corners of the 1 ha site (Figure 7) to detect macropods and feral animals. The cameras were left in place for a minimum of 14 nights.

Cameras were baited with a mixture of peanut butter, oats, vanilla and sardines, and attached to stable trees with bungee cords. Both cameras were set 70cm from the ground and angled to capture the bait container placed 150 cm away (Figure 8). The cameras were pre-set to the following customised settings: Motion pictures were turned on, three pictures per trigger, 'Rapidfire' picture interval, a 'NO DELAY' quiet period and 'high' sensitivity.

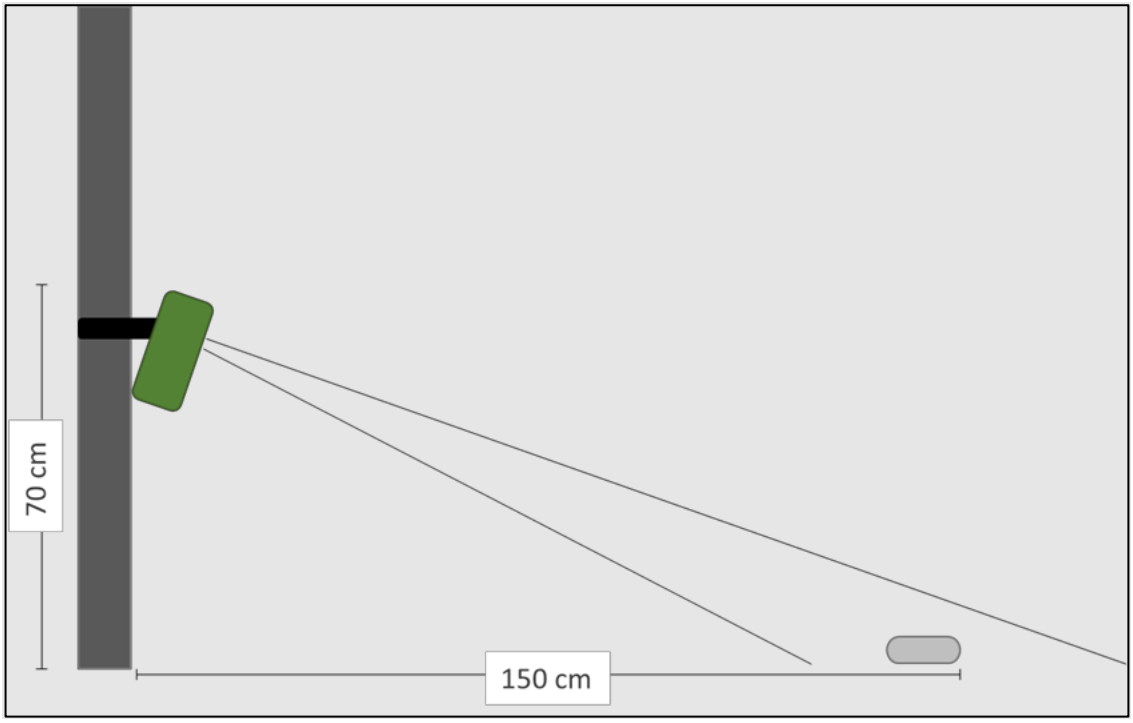

Figure 8. Configuration of camera traps for the Standard Camera Survey.

Rocky Gorge Camera Survey

In June – July 2021, AWC deployed camera traps at 22 sites in rocky gorge/escarpment/outcrop areas (Figure 9). The ensemble of sites was based on the sites surveyed in 2018, minus the Cycad Gorge and Kfella Creek sites (8 sites). Nine sites were added – seven that have been used in the past and two new sites (to complete sampling of the 'Eastern Escarpment'). Camera traps from three standard trapping sites that are in rocky habitat were included in data from this survey.

At each site, two cameras were set up in appropriate habitat approximately 100 m apart. All camera traps were set at a height of 70 cm and attached to a tree with an elastic/bungy cord. Cameras were angled downward at a bait holder, placed 1.5 m from the camera. Where possible cameras were directed toward rock faces and bait holders placed at the base of these and secured with large rocks (Figure 10). One large bait ball consisting of rolled oats and peanut butter was placed within each bait holder.

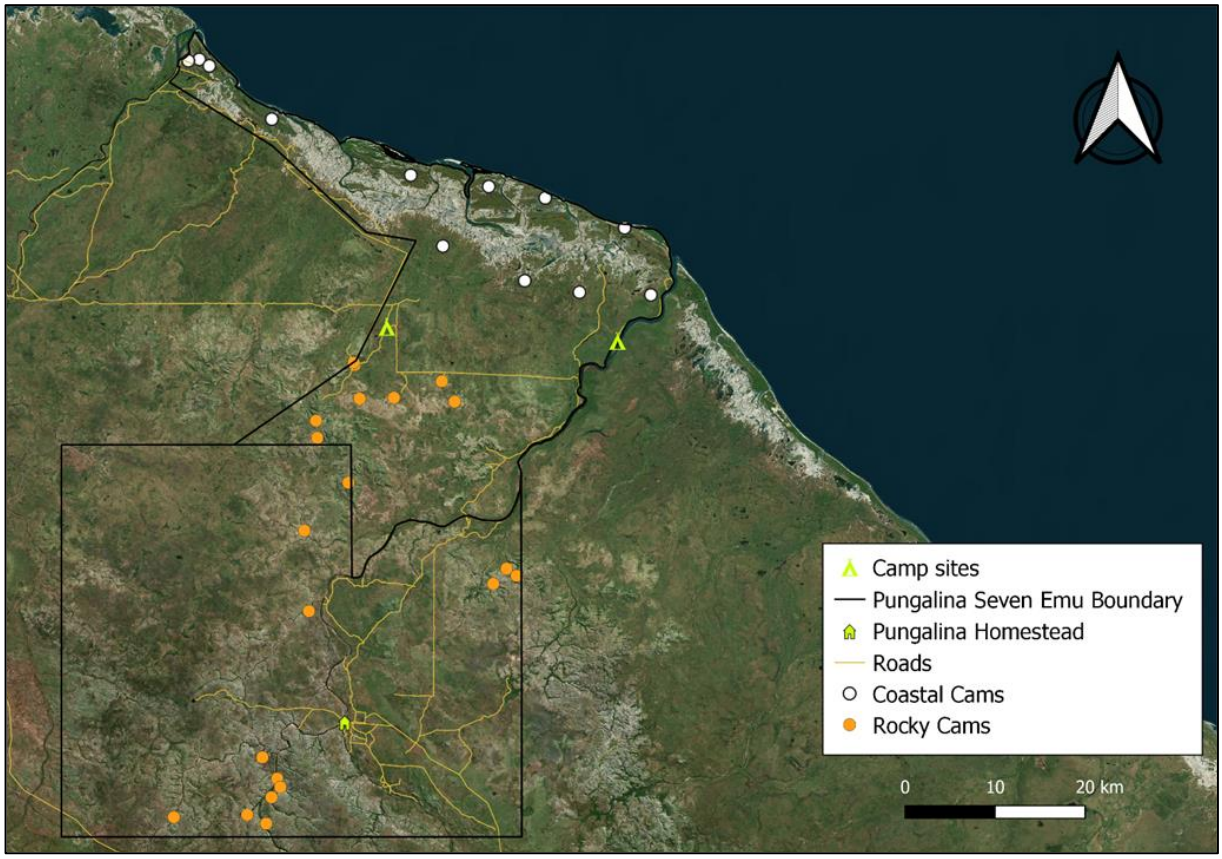

Figure 9. Location of Rocky Gorge Camera Survey sites and coastal camera sites. Coastal cameras formed part of the Standard Camera Survey (in addition to Standard Trapping Fauna Survey Sites).

Figure 10. Camera set up for Rocky Gorge Survey at Pungalina-Seven Emu.

Microbats Targeted Survey

Microbat trapping was undertaken using four three-bank harp traps (Faunatech Australia) at three sites over four nights (Figure 11) in conjunction with the Standard Trapping Fauna Survey. Harp traps are collapsible passive traps, using fine lightweight fishing line within a frame to capture microbats, usually when deployed in flyways or spaces in vegetation or near natural obstacles (Figure 12). Traps were set prior to sunset, tethered against wind and checked two hours later. Only staff trained to handle bats and vaccinated for Australian Bat Lyssavirus handled bats.

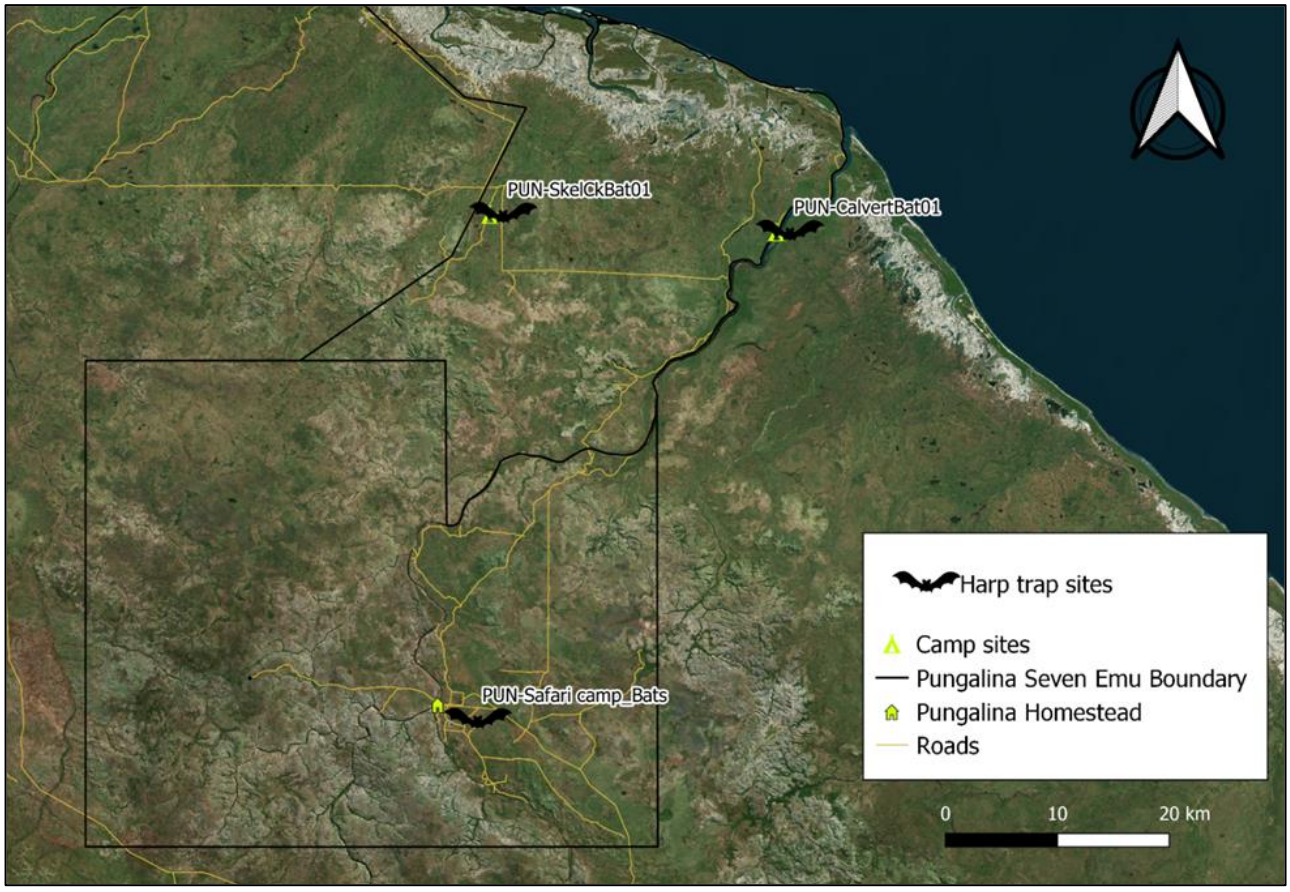

Figure 11. Location of traps for the Microbats Targeted Survey.

Figure 12. Harp traps set at Skeleton Creek campsite.

Analysis methods

Most Ecohealth metrics are common across the indicator species for Pungalina-Seven Emu. Unless noted otherwise, the metrics are calculated as set out in Table 4 below.

Table 4. Metrics and associated calculations for Pungalina-Seven Emu.

Indicator	Metric	Survey data sources	Description	Analysis summary/calculation
Assemblage richness	Number of species	All surveys and incidental records	A measure of intactness for the whole sanctuary	The number of species detected on the sanctuary within the last 2-4 years is compared to the number of species listed as 'confirmed', 'very likely' or 'likely' on the sanctuary species list.
Various	Abundance	Standard Trapping Fauna Survey Standard Camera Survey Rocky Gorge Camera Survey Microbats Targeted Survey	A measure of activity, either number of detections per 100 trap nights, or per site Where, 'number of detections' is captures for live trapping data; and independent 'visits' for camera traps. In a sequence of images of a single species, a single	**Per 100 trap nights:** <u>For individual species:</u> Calculate the average over all survey sites of: ((No. individuals of that species recorded at survey site/ total number of trap night at survey site) x 100) <u>For guilds:</u> Calculate the average of: ((Total no. individuals of the guild recorded at each survey site/

Indicator	Metric	Survey data sources	Description	Analysis summary/calculation
			camera 'visit' is defined as occurring when there is at least a 5 min period between the species' first capture and subsequent image, unless otherwise stated.	total number of trap night at each survey site) x 100) **Per site** For guilds: Calculate the average over all survey sites of: (No. individuals of that guild recorded at survey site/ total number nights)
Mammals, reptiles, birds	Occupancy	Standard Trapping Fauna Survey Standard Camera Survey Rocky Gorge Camera Survey Microbats Targeted Survey	A measure of distribution; the proportion of sites where the species was recorded using a particular technique	For individual species: (Number of sites at which the species was recorded/ number of sites surveyed) [x 100 if reporting as a %] For guilds: (Number of sites at which any species within the relevant guild was recorded/ number of sites surveyed) [x 100 if reporting as a %]
Mammals, reptiles, birds	Richness	Standard Trapping Fauna Survey Standard Camera Survey Rocky Gorge Camera Survey Microbats Targeted Survey	A measure of diversity; average number of species per site	Average of number of species recorded at each site Calculate the average over all survey sites of: (No. species of that guild recorded at survey site/ total number nights)

Camera Surveys: Standard Camera Survey and Rocky Gorge Camera Survey

Camera data were downloaded and categorised as "animal present" or "animal absent" using the Artificial Intelligence (AI) software (Microsoft Azure and Postman). Once categorised, images with animals present were uploaded into the program 'Timelapse' (Greenberg et al. 2019) and animals were identified to species level where possible. A file containing all species captures was exported from Timelapse.

Abundance, occupancy and richness were calculated as per the above table.

Fire Scar Analysis

Fire scar data were derived from Landsat satellite imagery, and in later years supplemented by Sentinel-2 satellite imagery. 'Hotspot' data from the North Australian Fire Information (NAFI) website were used to help identify the month of the fire when the Landsat satellite imagery interval extended across two months. Each scar was attributed by year, month and season. Fire scars detected from January to July (inclusive) were attributed as 'Early', whereas those detected August to December were attributed as 'Late'. For each year, unburnt areas were created by erasing the recorded fires from the entire boundary area. The maps and statistics for the analyses were created using ArcGIS (Environmental System Research Institute Inc., Redlands, CA, USA) with Spatial Analyst, and were semi-automated using Python scripting. Graphs were produced using Microsoft Excel. Detailed methods are provided in Webb et al. (2020).

Results

Key threatened and iconic vertebrates

Carpentarian Pseudantechinus

During the 2021 Rocky Gorge Camera Survey the Carpentarian Pseudantechinus (*Pseudantechinus mimulus*) was recorded at 22.7% of sites with an abundance of 3.03 ± 1.62 (detections per 100 camera trap nights). During the 2018 Rocky Gorge Camera Survey this species was detected at 26% of sites with an abundance of 1.9 ± 0.9 (detections per 100 camera trap nights).

Spectacled Hare-wallaby

No survey was conducted in 2021. There were no detections of the Spectacled Hare-wallaby (*Lagorchestes conspicillatus*) during the 2020 survey.

Eastern Purple Crowned Fairy-wren

No survey was conducted in 2021, Playback Bird Surveys are under development.

In 2018, Eastern Purple-crowned Fairywrens (*Malurus coronatus macgillivrayi*) were present at all riparian sites surveyed and species abundance was 2.2 ± 0.6 individuals per site (Nelson et al. 2021).

Varanids – Yellow Spotted Monitor; Mertens Monitor

No survey was conducted in 2021. The targeted Varanid Camera Survey in 2018 generated low numbers of detections. Only one species was detected, Merten's Water Monitor, which was present at 30% of sites, at a low average abundance of 1.7 ± 1.1 individuals per 100TN. No Yellow-spotted monitors were detected at any sites. This species, however, has very rarely been detected with any survey method in the past; only one record exists (from 2016) in the sanctuary's fauna database.

Vertebrate assemblages and surveillance species

Mammals

At Pungalina-Seven Emu, 33 mammal species were recorded since 2017 from 57 known or likely to occur. Missing species comprised mostly species from the bat community (17) and Long-tailed Planigale (P*lanigale ingram*i), Long-haired Rat (*Rattus villosissimus*), Central Pebble-mouse (*Pseudomys johnsoni*), Savanna Glider (*Petaurus ariel*), Spectacle Hare-wallaby (*Lagorchestes conspicillatus leichardt*i), Antilopine Wallaroo (*Macropus antilopinus*), and Red Kangaroo (*Macropus rufus*).

Small-medium sized mammals

During the 2021 surveys 13 species of small-medium mammals were detected, three more species than in 2017 when the Standard Trapping Fauna Survey and the Standard Camera Survey were undertaken. The three species recorded in 2021 but not in 2017 were Northern Short-tailed Mouse (*Leggadina lakedownensis*), Grassland Melomys (*Melomys burtoni*), and Pale Field-rat (*Rattus tunneyi*).

During the Standard Trapping Fauna Survey in 2021 the richness (0.5 ± 0.11) of small-medium mammals recorded was lower compared to the results from the previous Standard Trapping Fauna Survey in 2017 (richness 0.6). However, it is important to note that the actual number of species recorded in 2021 was higher than in 2017 (7 vs 5). The Stripe-faced Dunnart (*Sminthopsis macroura*) and the Northern Short-tailed Mouse) were not recorded in the Standard Trapping Survey in 2017 but were recorded in 2021. A complete list of species captured during the 2021 Standard Trapping Fauna Survey is provided in Appendix 1.

During the Standard Camera Survey in 2021 richness (0.82) recorded for small-medium sized mammals were similar to the results of the previous Standard Camera Survey from 2017 when small and medium mammals were detected on 44% of sites with cameras detecting less than one species per site. A complete list of species detected during the 2021 Standard Camera Survey is provided in Appendix 2.

During the 2021 Rocky Gorge Camera Survey, the Rocky-gorge small-medium mammal richness was 1.45 ± 0.18, and abundance was 27.27 ± 0.95, similar values to those recorded during the last survey period in

2017. The most abundant mammal was the Common Rock-rat (*Zyzomys argurus*; 21.21 detections per 100 camera trap nights) which also had the greatest occupancy (recorded at 86% of sites). The Rock Ringtail Possum (*Petropseudes dahli*) was recorded at almost 10% of sites. A complete list of species detected during the Rocky Gorge Camera Survey is provided in Appendix 3.

Detailed metrics for the surveillance species detected during the 2021 surveys can be found on Table 5.

Table 5. Abundance and occupancy for surveillance species recorded during the 2021 surveys at Pungalina-Seven Emu.

Indicator	Survey name	Metric	Value 2018	Value 2021
Sandstone Pseudantechinus	Rocky Gorge Camera Survey	Abundance Occupancy	1.1 ± 0.8 13%	0 0%
Northern Brown Bandicoot	Standard Camera Survey	Abundance Occupancy	NA	5.8±2.4 19%
Wilkin's Rock-wallaby	Rocky Gorge Camera Survey	Abundance Occupancy	2.3 ± 1.3 26%	2.8±1.9 23%
Common Rock-rat	Rocky Gorge Camera Survey	Abundance Occupancy	27.6 ± 4.7 83%	21.2±3.6 86%
Rock Ringtail Possum	Rocky Gorge Camera Survey	Abundance Occupancy	0.2 ± 0.2 4%	0.6±0.4 9%

In 2021 the occupancy for the Common Rock-rat and Rock Ringtail Possum was higher than the last survey period in 2018. Results for abundance were variable, the Common Rock-rat was found to have lower abundance in 2021 than in 2018, however, the opposite was found for the Rock Ringtail Possum and Wilkin's Rock-wallaby. Sandstone Pseudantechinus was not recorded in 2021. Data from 2018 is not available for Northern Brown Bandicoot therefore comparisons are not possible.

Microbats

The 2021 Microbats Targeted Survey captured 12 individual bats from five species across 3 sites, with a species richness of 1.3 ± 0.7 species per site. Table 6 shows the list of species recorded and the site where they were recorded. The Northern Long-eared Bat (*Nyctophilus arnhemensis*) was the most common species recorded (five individuals at two sites), followed by the Pygmy Long-eared Bat (*Nyctophilus walkeri;* three individuals at one site).

The previous Microbat Targeted Survey was carried out in 2019 at one site, with only one species detected, the Gould's Wattled Bat (*Chalinolobus gouldii*). The results are therefore not comparable between surveys.

Table 6. Microbat species recorded during the Microbat Targeted Survey at Pungalina-Seven Emu in 2021.

Scientific name	Common name	Site and number of bats recorded
Rhinonicteris aurantia	Orange Leaf-nosed Bat	Calvert River: 1 Skeleton Creek: 1
Chalinolobus nigrogriseus	Hoary Wattled Bat	Skeleton Creek: 1
Nyctophilus arnhemensis	Northern Long-eared Bat	Calvert River: 2 Skeleton Creek: 3
Nyctophilus daedalus	Pallid Long-eared Bat	Calvert River: 1
Nyctophilus walkeri	Pygmy Long-eared Bat	Skeleton Creek: 3

Macropods

During the Standard Camera Survey in 2021 the Agile Wallaby (*Macropus agilis*) and the Northern Nailtail Wallaby (*Onychogalea unguifera*) were detected. Metrics for the macropod guild are shown in Table 7. The occupancy and richness of macropods was similar between 2017 and 2021. In 2021 the higher abundance is driven by the higher numbers of Agile Wallaby recorded.

Table 7. Metrics for macropods recorded during the 2021 Standard Camera Survey.

Indicator	Metric	Value 2017	Value 2021
Macropods	Abundance Richness	0.3 0.1 ± 0.05	3.9±0.04 0.27±0.07

Birds

Ninety-three bird species were recorded since 2018 from 228 known or likely to occur. Missing species include 14 not confirmed and species that are irregular and or seasonal visitors.

Reptiles

Forty reptile species were recorded since 2020, from 106 species known or likely to occur. Missing species included 24 snakes, geckos and skinks that are highly likely or likely to be on the sanctuary but have not been recorded.

During the 2021 Standard Trapping Fauna Survey the abundance and species richness of small-medium reptiles were similar to the values recorded in 2017 (Table 8). In 2021, 34 species in this assemblage were recorded, from 79 known or likely to occur. Missing species included 20 not confirmed for the Sanctuary, snake species, geckos and skinks.

Table 8. Metrics for small-medium reptiles captured during the 2021 Standard Trapping Fauna Survey.

Indicator	Metric	Value 2017	Value 2021
Small-medium reptiles	Abundance Richness	6.0 ± 0.7 3.3 ± 0.2	5.0 ±0.5 2.8 ±0.3

Threat indicators

Fire

Active fire management began in 2009. On average, all key fire metrics on Pungalina-Seven Emu have improved since implementation of active fire management in 2009. Fire management has reduced distances to unburnt vegetation from within fire scars and reduced the extent of late dry season wildfires.

Table 9. Fire metrics for Pungalina-Seven Emu for 2021.

Metric	**Baseline** average	**AWC** average	**2021 result**	**Trend** (AWC vs baseline)	**Trend** (2021 vs baseline)
Area burnt by early dry season (EDS) fire (%)	5	14	9	↑	↑
Area burnt by late dry season (LDS) fire (%)	21	9	26	↓	↑
Cumulative extent burnt by LDS fire in past 3 years (%)	58	20	39	↓	↓
Mean distance to unburnt vegetation (km)	1.5	0.8	1.2	↓	↓
Mean distance to vegetation unburnt by LDS fire for 3 or more years (km)	2.5	0.8	1.1	↓	↓

Notes:

Baseline values for metrics are the average for the years immediately prior to acquisition of Pungalina-Seven Emu by AWC: i.e., 2002-2008, for annual metrics, and 2002-2008, for 3-year metrics.

AWC management values for metrics are the average for the years following acquisition of Pungalina-Seven Emu by AWC: i.e., 2009 onwards, for annual metrics, and 2011-2021 onwards, for 3-year metrics.

Trend: change in metric compared with baseline, considering (i) average across AWC management; (ii) current year. Change in magnitude shown by arrows: increase ↑, no change ↔, reduction ↓).

Inferred consequences for ecological health depicted by colour: improving in green (e.g., ↑ or ↓, depending on the metric); deteriorating in red (e.g., ↑ or ↓); no change, or if the change cannot be interpreted in terms of ecological health, in black. (↔, ↑ or ↓).

Discussion

This latest assessment of Pungalina-Seven Emu's Ecohealth indicates the sanctuary is maintaining its high levels of diversity with respect to the fauna community. Our Standard Trapping Fauna Survey, across 38 sites and 3,420 trap nights, showed that the abundance of the vulnerable small-medium mammal assemblage is slightly higher than in 2017. Two species, the Stripe-faced Dunnart and the Northern Short-tailed Mouse, were detected in 2021 and not previously in 2017. These represent positive signs given these species are vulnerable to predation by feral cats.

Prior year surveys for threatened and iconic vertebrates generated mixed results. The surveys demonstrated a positive status for the Eastern Purple-crowned Fairy Wrens which were detected at all riparian sites and at moderate abundances. In contrast, surveys for the Spectacled Hare-wallaby generated nil detections. Similarly, only one species of varanid was detected, Merten's Water Monitor, and its numbers were low. Future surveys for these species will provide greater insight into their status on Pungalina-Seven Emu, including whether additional targeted surveys are required to detect those species that are difficult to survey, e.g. the Yellow Spotted Monitor.

Sensor camera surveys were used to survey larger mammals (e.g. macropods) and were undertaken across 47 sites, with a coastal array added to standard live trapping sites. This survey showed that the abundance of macropods was higher in 2021 and richness was equivalent to 2017. The higher abundance was driven primarily by an increase in Agile Wallabies, potentially reflecting a modified approach to fire management by current sanctuary managers which combines early dry season fires with storm burning (late dry season/early wet season fires) and creates a mosaic of vegetation classes and age across the property.

Escarpment country and rocky gorges were also surveyed in 2021 because of the unique wildlife that inhabits these landscapes. We surveyed 22 sites in 2021 using sensor cameras and recorded 16 native species, as well as three invasive species (cats, pigs, cane toads). The escarpment country specialists were the most abundant mammals, with Common Rock-rat, Wilkin's Rock Wallaby and, Carpentaria Pseudantechinus recorded at over 20% of sites. Rock Ringtail Possums were also regularly recorded (9% of sites). The introduced species were recorded less frequently than the native fauna although further investigation is required to assess their impact on native wildlife.

The most significant tool Pungalina-Seven Emu land managers use to protect biodiversity is fire management. Due to the establishment of the current fire mosaic patterns (vegetation age) across the sanctuary, the risk of large-scale, destructive late wild season fires has been significantly reduced on Pungalina-Seven Emu over the 14 years of management. Since active fire management began in 2009, the extent and frequency of wild late dry season fires have been substantially reduced. Fire management has also reduced distances to unburnt vegetation from within fire scars (1.5 km before AWC management vs 1.2 km in 2021). There are now well-established mosaics that are maintained with appropriate fire management strategies including early dry season and wet season prescribed fires. This fire management is based on broad ecosystems, past disturbance (fire, cyclones, floods), weed infestations, past and present cattle management, and infrastructure protection which not only reduces the likelihood of large-scale wildfire, but also aims to reduce cat predation (e.g., leaving as much cover as possible) and weed infestation for many species.

Acknowledgments

AWC acknowledges the Yanyuwa and Garawa people, the Traditional Custodians, of Yanyuwa and Garawa Country on which Pungalina-Seven Emu Wildlife Sanctuary resides. We also acknowledge their continuing connection to land, culture and community. We pay our respects to Yanyuwa and Garawa Elders past present and emerging.

AWC's Ecohealth Program is only possible because of the generosity of AWC's supporters.

For their assistance in conducting Ecohealth surveys at Pungalina-Seven Emu in 2021, we particularly thank Bryn Pickering, Greg Waddell, Peter Newbery, Alan Catteral and Margie Haines.

The North-east Science team is grateful for the assistance from the Pungalina-Seven Emu Sanctuary Managers, Gavin and Kerri Enever, during the 2021 surveys and for the information provided for this Ecohealth report.

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Appendices

Appendix 1. Species captured during the Standard Trapping Fauna Survey

Class	Family	Scientific name	Common name
Mammalia	Dasyuridae	*Planigale maculata*	Common Planigale
Mammalia	Dasyuridae	*Sminthopsis macroura*	Stripe-faced Dunnart
Mammalia	Muridae	*Leggadina lakedownensis*	Northern Short-tailed Mouse
Mammalia	Muridae	*Mus musculus*	House Mouse
Mammalia	Muridae	*Pseudomys delicatulus*	Delicate Mouse, Molinipi
Mammalia	Muridae	*Pseudomys nanus*	Western Chestnut Mouse
Mammalia	Muridae	*Pseudomys* sp.	N.A
Mammalia	Muridae	*Zyzomys argurus*	Common Rock-rat
Reptilia	Agamidae	*Chelosania brunnea*	Chameleon Dragon
Reptilia	Agamidae	*Chlamydosaurus kingii*	Frilled Lizard
Reptilia	Agamidae	*Diporiphora magna*	Yellow-sided Two-lined Dragon
Reptilia	Agamidae	*Lophognathus horneri*	Horner's Dragon
Reptilia	Colubridae	*Pseudonaja nuchalis*	Northern Brown Snake
Reptilia	Diplodactylidae	*Amalosia rhombifer*	Zigzag Velvet Gecko
Reptilia	Diplodactylidae	*Rhynchoedura sexapora*	Northern Beaked Gecko
Reptilia	Elapidae	*Demansia quaesitor*	Sombre Whipsnake
Reptilia	Elapidae	*Demansia sp.*	N.A
Reptilia	Elapidae	*Demansia vestigiata*	Lesser Black Whipsnake
Reptilia	Gekkonidae	*Heteronotia binoei*	Bynoe's Prickly Gecko
Reptilia	Gekkonidae	*Strophurus ciliaris*	Spiny-tailed Gecko
Reptilia	Scincidae	*Carlia amax*	Bauxite Rainbow-skink
Reptilia	Scincidae	*Carlia munda*	Shaded-litter Rainbow-skink
Reptilia	Scincidae	*Carlia* sp.	N.A
Reptilia	Scincidae	*Cryptoblepharus pannosus*	Ragged Snake-eyed Skink
Reptilia	Scincidae	*Ctenotus astictus*	Arnhem Striped Ctenotus
Reptilia	Scincidae	*Ctenotus decaneurus*	Ten-lined Ctenotus
Reptilia	Scincidae	*Ctenotus inornatus*	Bar-shouldered Ctenotus
Reptilia	Scincidae	*Ctenotus pulchellus*	Red-sided Ctenotus
Reptilia	Scincidae	*Ctenotus robustus*	Robust Ctenotus
Reptilia	Scincidae	*Ctenotus saxatilis*	Stony-soil Ctenotus
Reptilia	Scincidae	*Ctenotus sp.*	N.A
Reptilia	Scincidae	*Ctenotus spaldingi*	Straight-browed Ctenotus
Reptilia	Scincidae	*Lerista orientalis*	North-eastern Orange-tailed Slider
Reptilia	Scincidae	*Menetia greyii*	Common Dwarf Skink
Reptilia	Scincidae	*Menetia maini*	Northern Dwarf Skink
Reptilia	Scincidae	*Morethia ruficauda*	Lined Firetail Skink
Reptilia	Scincidae	*Morethia storri*	Top End Firetail Skink
Reptilia	Scincidae	*Notoscincus ornatus*	Ornate Soil-crevice Skink
Reptilia	Scincidae	*Proablepharus tenuis*	Northern Soil-crevice Skink
Reptilia	Typhlopidae	*Anilios ligatus*	Robust Blind Snake

Class	Family	Scientific name	Common name
Reptilia	Varanidae	*Varanus baritji*	Black-spotted Spiny-tailed Monitor
Reptilia	Varanidae	*Varanus tristis*	Black-headed Monitor
Amphibia	Bufonidae	*Rhinella marina*	Cane Toad
Amphibia	Hylidae	*Litoria caerulea*	Green Tree Frog
Amphibia	Hylidae	*Litoria nasuta*	Rocket Frog
Amphibia	Hylidae	*Litoria rubella*	Desert Tree Frog
Amphibia	Limnodynastidae	*Notaden melanoscaphus*	Northern Spadefoot Toad
Amphibia	Myobatrachidae	*Uperoleia lithomoda*	Stonemason Toadlet
Amphibia	Myobatrachidae	*Uperoleia sp.*	N.A
Amphibia	Myobatrachidae	*Platyplectrum ornatum*	Ornate Burrowing Frog

Appendix 2. Species captured during the Standard Camera Survey

Class	Family	Scientific name	Common name
Mammalia	Canidae	*Canis dingo*	Dingo
Mammalia	Dasyuridae	N.A	Small mammal
Mammalia	Peramelidae	*Isoodon macrourus*	Northern Brown Bandicoot
Mammalia	Muridae	*Leggadina lakedownensis*	Northern Short-tailed Mouse
Mammalia	Macropodidae	N.A	Macropod
Mammalia	Macropodidae	*Macropus agilis*	Agile Wallaby
Mammalia	Muridae	*Melomys burtoni*	Grassland Melomys
Mammalia	Muridae	N.A	Rodent
Mammalia	Macropodidae	*Onychogalea unguifera*	Northern Nailtail Wallaby
Mammalia	Muridae	*Pseudomys delicatulus*	Delicate Mouse
Mammalia	Muridae	*Pseudomys nanus*	Western Chestnut Mouse
Mammalia	Muridae	*Rattus sp*	
Mammalia	N.A	N.A.	Small mammal
Mammalia	Muridae	*Zyzomys argurus*	Common Rock-rat
Mammalia	Bovidae	*Bos taurus*	Cattle
Mammalia	Equidae	*Equus asinus*	Donkey
Mammalia	Felidae	*Felis catus*	Cat
Mammalia	Suidae	*Sus scrofa*	Pig
Aves	Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar
Aves	Burhinidae	*Burhinus grallarius*	Bush Stone-curlew
Aves	Cuculidae	*Cacomantis pallidus*	Pallid Cuckoo
Aves	Cuculidae	*Centropus phasianinus*	Pheasant Coucal
Aves	Ptilonorhynchidae	*Chlamydera nuchalis*	Great Bowerbird
Aves	Corvidae	*Corvus orru*	Torresian Crow
Aves	Phasianidae	*Coturnix ypsilophora*	Brown Quail
Aves	Artamidae	*Cracticus nigrogularis*	Pied Butcherbird
Aves	Alcedinidae	*Dacelo leachii*	Blue-winged Kookaburra
Aves	Columbidae	*Geopelia humeralis*	Bar-shouldered Dove
Aves	Columbidae	*Geopelia placida*	Peaceful Dove
Aves	Artamidae	*Gymnorhina tibicen*	Australian Magpie
Aves	Maluridae	*Malurus coronatus macgillivrayi*	Eastern Purple-crowned Fairywren
Aves	Petroicidae	*Microeca fascinans*	Jacky Winter
Aves	Estrildidae	*Neochmia phaeton*	Crimson Finch
Aves	Ardeidae	*Nycticorax caledonicus*	Nankeen Night-Heron
Aves	Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler
Aves	Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail
Aves	Turnicidae	*Turnix pyrrhothorax*	Red-chested Buttonquail
Amphibia	Bufonidae	*Rhinella marina*	Cane Toad
Reptilia	Varanidae	*Varanus panoptes*	Yellow-spotted Monitor

Appendix 3. Species captured during the Rocky Gorge Camera Survey

Class	Family	Scientific name	Common name
Mammalia	Canidae	*Canis dingo*	Dingo
Mammalia	Dasyuridae	N.A	N.A
Mammalia	Muridae	*Hydromys chrysogaster*	Water-rat
Mammalia	Macropodidae	*Macropus robustus*	Common Wallaroo
Mammalia	Macropodidae	*Petrogale wilkinsi*	Wilkin's Rock-wallaby
Mammalia	Pseudocheiridae	*Petropseudes dahli*	Rock Ringtail Possum
Mammalia	Muridae	*Pseudantechinus mimulus*	Carpentarian Antechinus
Mammalia	N.A	N.A	N.A
Mammalia	Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna
Mammalia	Muridae	*Zyzomys argurus*	Common Rock-rat
Mammalia	Felidae	*Felis catus*	Cat
Mammalia	Suidae	*Sus scrofa*	Pig
Aves	Otididae	*Ardeotis australis*	Australian Bustard
Aves	Ptilonorhynchidae	*Chlamydera nuchalis*	Great Bowerbird
Aves	Pachycephalidae	*Colluricincla harmonica*	Grey Shrikethrush
Aves	Pachycephalidae	*Colluricincla woodwardi*	Sandstone Shrikethrush
Aves	Corvidae	*Corvus orru*	Torresian Crow
Aves	Artamidae	*Cracticus nigrogularis*	Pied Butcherbird
Aves	Columbidae	*Geopelia cuneata*	Diamond Dove
Aves	Columbidae	*Geopelia placida*	Peaceful Dove
Aves	Columbidae	*Geophaps plumifera*	Spinifex Pigeon
Aves	Meliphagidae	*Philemon argenticeps*	Silver-crowned Friarbird
Reptilia	Elapidae	*Demansia papuensis*	Greater Black Whipsnake
Reptilia	Varanidae	*Varanus acanthurus*	Ridge-tailed Monitor
Amphibia	Bufonidae	*Rhinella marina*	Cane Toad

Document history

Text and analyses

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