Mt Gibson Wildlife Sanctuary

Ecohealth Report 2020

australian wildlife conservancy

Summary

Australian Wildlife Conservancy (AWC) has implemented an Ecological Health Monitoring Program to measure changes in the status and trend of conservation assets, and threats to those assets, across Mt Gibson Wildlife Sanctuary (Mt Gibson) including the feral predator-free fenced area (safe haven). Metrics from the program are reported in annual Ecohealth Reports and Scorecards.

This is the Ecohealth Report for 2020. Metrics in this report were calculated from data collected during surveys carried out between December 2019 and December 2020. The complete set of metrics and their values are summarised in the accompanying Ecohealth Scorecard. This report provides a description of the methodology and results of Ecohealth surveys conducted at Mt Gibson.

Mt Gibson is the location of an ambitious reintroduction program, with 10 species of regionally-extinct mammals planned for reintroduction to a 7,832 ha fenced feral predator-free area, and/ or outside the fenced area, by 2023. To date, eight mammal species have been reintroduced to the fenced area.

In 2020, translocations of seven of the eight species of locally-extinct mammals reintroduced to the fenced feral predator-free area on Mt Gibson met success criteria relevant to their stage of reintroduction.

- Red-tailed Phascogales were detected at a higher number of sites in 2020 than previous years
- Numbats were breeding and detected at a higher number of sites in 2020 than previous years
- Shark Bay Bandicoots were detected at a higher number of sites in 2020 than previous years, and to date there has been no sign of a bandicoot-specific virus in the population
- Greater Bilbies were breeding and detected at a higher number of sites in 2020 than previous years
- There were over 1,100 Woylies in the fenced area, well above the success criterion of 300 individuals
- Banded Hare-wallabies were breeding and detected at a higher number of sites in 2020 than previous years
- Greater Stick-nest Rats were detected at a higher number of sites in 2020 than previous years

Monitoring also focused on the activity of feral cats and foxes outside the fenced area, in a Before-After-Control-Impact design intended to measure the outcomes of aerial baiting on feral predator populations, ahead of planned reintroductions of Brushtail Possums and Western Quolls/ Chuditch. The results showed seasonal variation in activity in both treatment and comparison areas. There was a decline after baiting on the treatment area that persisted for several months, but a similar trend was observed in the comparison area.

Contents

Introduction 1
Mt Gibson Wildlife Sanctuary 1
Climate and weather summary 3
Methods 5
Indicators and metrics 5
Survey types and history 7
Survey design and methods 8
Safe Haven Camera Survey 8
Safe Haven Mammal Trapping Survey 9
Greater Stick-nest Rat Survey 10
BPCV1 Disease Monitoring 10
Feral Predator Camera Survey 12
Analysis methods 14
Safe Haven Camera Survey 14
Safe Haven Mammal Trapping Survey 14
Greater Stick-nest Rat Survey 14
Feral Predator Camera Survey 14
Fire Scar Analysis 14
Results 15
Biodiversity indicators 15
Reintroduced Mammals 15
Extant species 21
Threat indicators 22
Feral animals 22
Fire 22
Discussion 23
Acknowledgments 23
References 23

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Introduction

Australian Wildlife Conservancy (AWC) owns, manages, or works in partnerships across 30 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 the progress in meeting our mission and to improve conservation management. 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. 2018a). The program focuses on selected 'indicator' species, guilds, processes and threats, using metrics derived from data collected from a series of purpose-designed surveys.

The structure of the Ecohealth Program on each AWC property is as follows. Based on the guidance provided by AWC's over-arching program framework (above), Ecohealth monitoring plans are developed. These plans describe the conservation values or assets of each property, and threats to these assets; and detail the monitoring program that will be used to track the status and trend of selected indicators for each identified asset and threat. Annual survey plans are developed to implement the program and the outcomes of these surveys are presented in annual Ecohealth Reports and summary Ecohealth Scorecards.

This document, the Mt Gibson Ecohealth Report 2020, draws on surveys conducted in 2020 to calculate the values for metrics that reveal the status and trends of the Ecohealth indicators. The companion Ecohealth Scorecard presents the indicators and their metrics in a summary format.

Mt Gibson Wildlife Sanctuary

Mt Gibson Wildlife Sanctuary ('Mt Gibson') is a 132,500 ha property that lies within a transition zone between the eucalypt-dominated south-west and the mulga-dominated Eremaean Botanical Provinces (Figure 1; 29.60°S, 117.41°W).

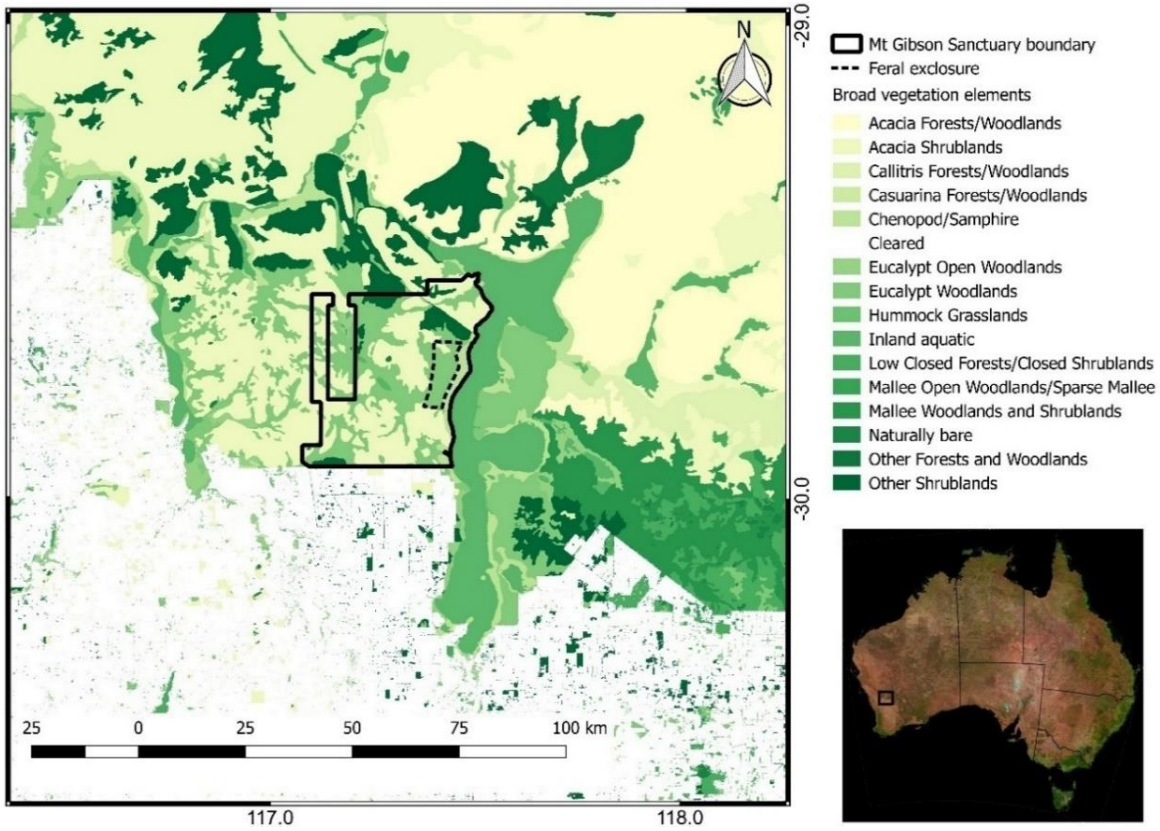


Figure 1. The location of Mt Gibson (solid black line) and the fenced area (dashed black line) in south-western Australia (colour inset), showing major vegetation elements in the area surrounding Mt Gibson. Source: National Vegetation Information System 2018.

Mt Gibson has a high diversity of habitats that previously supported a rich mammal fauna. At European settlement, Mt Gibson is likely to have sustained at least 33 species of terrestrial mammals (Baynes 2002). However, like much of semi-arid Australia, the area around Mt Gibson has lost a significant component of its mammal fauna, with three species globally extinct and another 13 extinct across most of their range. In total, 30 mammal species, 142 bird species, 62 reptile species and 6 amphibians are currently known or considered likely to occur at Mt Gibson. Two of the extant species present on Mt Gibson, Western Spiny-tailed Skink (*Egernia stokesii*) and Malleefowl (*Leipoa ocellata*) are listed as threatened nationally. Of the 700-800 plant species that occur on the sanctuary, 50 or more are of some level of conservation concern.

Mt Gibson is within the traditional lands of the Badimia people. Following European colonisation, and prior to AWC's acquisition of Mt Gibson in 2001, the property was run as a sheep (*Ovis aries*) station, and later as an Emu (*Dromaius novaehollandiae*) farm. AWC implements land management programs designed to maintain and restore the conservation values of the property. These programs include management of introduced predators and herbivores (i.e., eradicating feral goats (*Capra hircus*)), weeds and fire. Mt Gibson is an important part of the AWC estate because of its naturally occurring and diverse wildlife and for the conservation initiatives taking place on the sanctuary, notably the Mt Gibson Mammal Restoration Project. This project involves the reintroduction of 10 locally-extinct mammals, most to a 7,832 ha fenced area from which feral cats (*Felis catus*), foxes (*Vulpes vulpes*) and goats have been eradicated. To date eight species have been reintroduced into the safe haven (Table 1). In addition, AWC is undertaking research to inform the effective management of cats and foxes outside the fenced area, ahead of a proposed reintroduction of Brushtail Possums (*Trichosurus vulpecula*) and Western Quoll/ Chuditch (*Dasyurus geoffroii*).

Table 1. Species and number of individuals reintroduced to Mt Gibson's safe haven up to December 2020

Species	Number of individuals reintroduced
Woylie (*Bettongia penicillata*)	162
Greater Stick-nest Rat (*Leporillus conditor*)	95
Numbat (*Myrmecobius fasciatus*)	64
Greater Bilby (*Macrotis lagotis*)	56
Red-tailed Phascogale (*Phascogale calura*)	165
Shark Bay Bandicoot (*Perameles bougainville*)	64
Banded Hare-wallaby (*Lagostrophus fasciatus*)	119
Shark Bay Mouse (*Pseudomys fieldi*)	52

Nineteen different habitat types are present in the fenced area (Table 2), predominantly a mix of woodlands and shrublands (41% and 57% respectively).

Table 2. Vegetation types within 7,832 ha fenced area, Mt Gibson

Vegetation type	Area (ha)	Proportion (%)
Acacia ramulosa dunefields	691	8.8
Callitris columellaris woodland	343	4.4
Callitris columellaris York Gum (*Eucalyptus loxophleba*) woodland	1097	14.0
Deep granitic shrubland	1657	21.2
Eucalyptus clelandii woodland	196	2.5
Lithic/breakaway/granite outcrop vegetation	96	1.2
Mallee/shrubland	583	7.4
Mallee/woodland	497	6.3
Mixed shrubland (*Acacia/Allocasuarina/Melaleuca*)	220	2.8
Red soil shrubland	74	0.9
Saline herbfields and claypans	1	0.0
Salmon Gum woodland	406	5.2
Salmon Gum/York Gum woodland	52	0.7
Salt shrubland	45	0.6
Sandplain shrubland	535	6.8
Sandplain shrubland/mallee	134	1.7
Shallow granitic shrubland	571	7.3
York Gum woodland	626	8.0

Climate and weather summary

The climate of Mt Gibson is semi-arid, with an annual rainfall of 338 mm (range 153 – 539 mm), hot summers (mean maximum monthly temperature 37°C) and cool winters (mean minimum monthly temperature 6°C) (Figures 2 and 3). There is substantial variation in rainfall between years. In 2020, 308 mm of rainfall was recorded at Mt Gibson, below the long-term average, but an increase from 2019, when only 154 mm of rainfall was recorded (Figure 4).

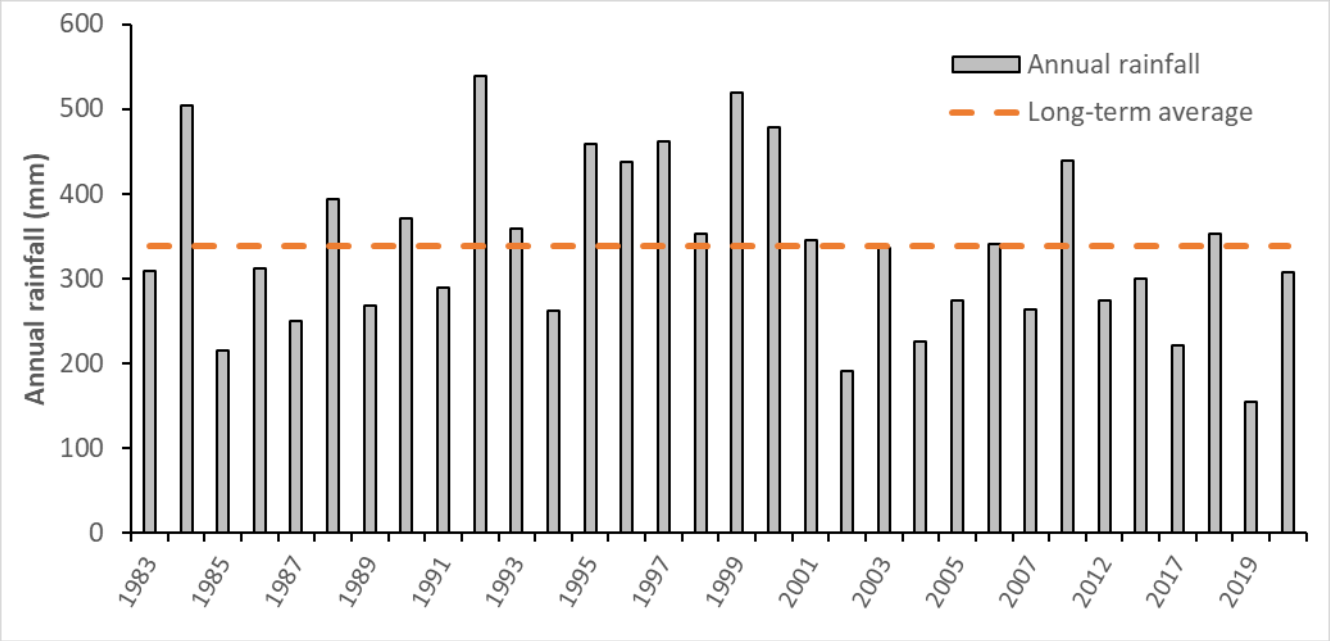


Figure 2. Annual rainfall Mt Gibson Sanctuary, 1983 - 2020 (BOM Station No. 10075)**.** Note: years with fewer than 350 days recorded have been deleted.

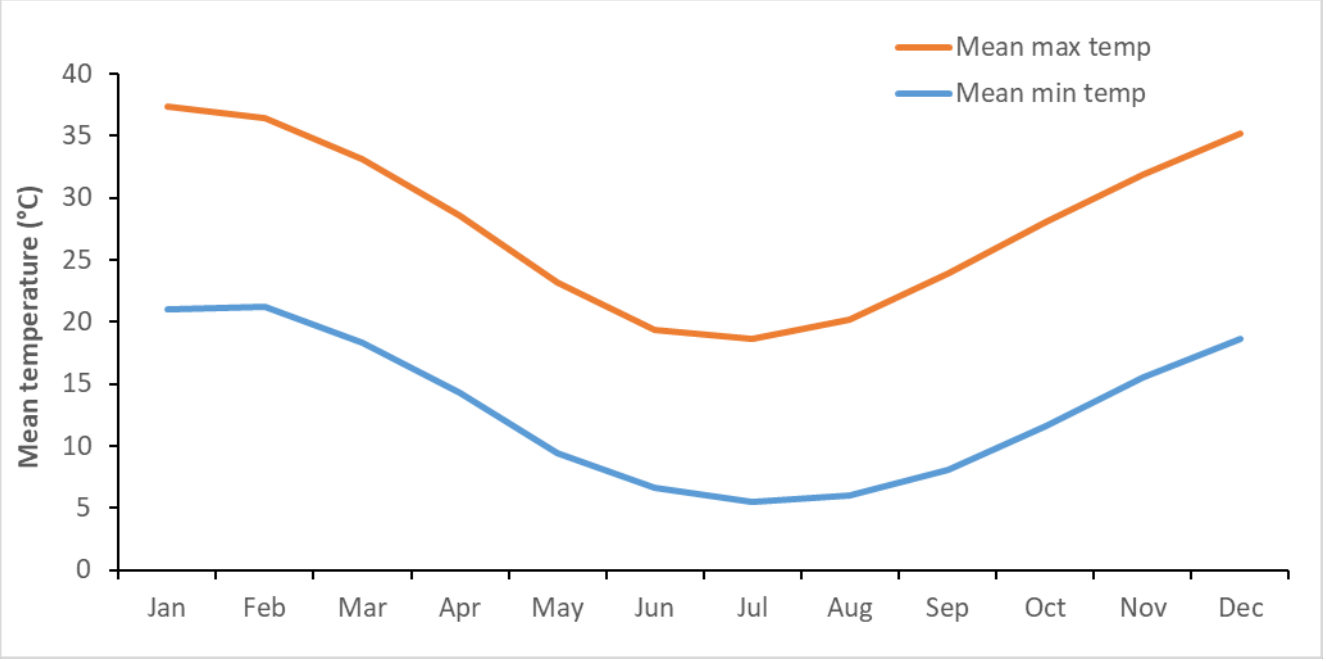


Figure 3. Mean minimum and maximum monthly temperatures recorded between 1975-2021 at Paynes Find Monitoring Station (BOM Station No. 007139). Paynes Find is 75 km north of Mt Gibson.

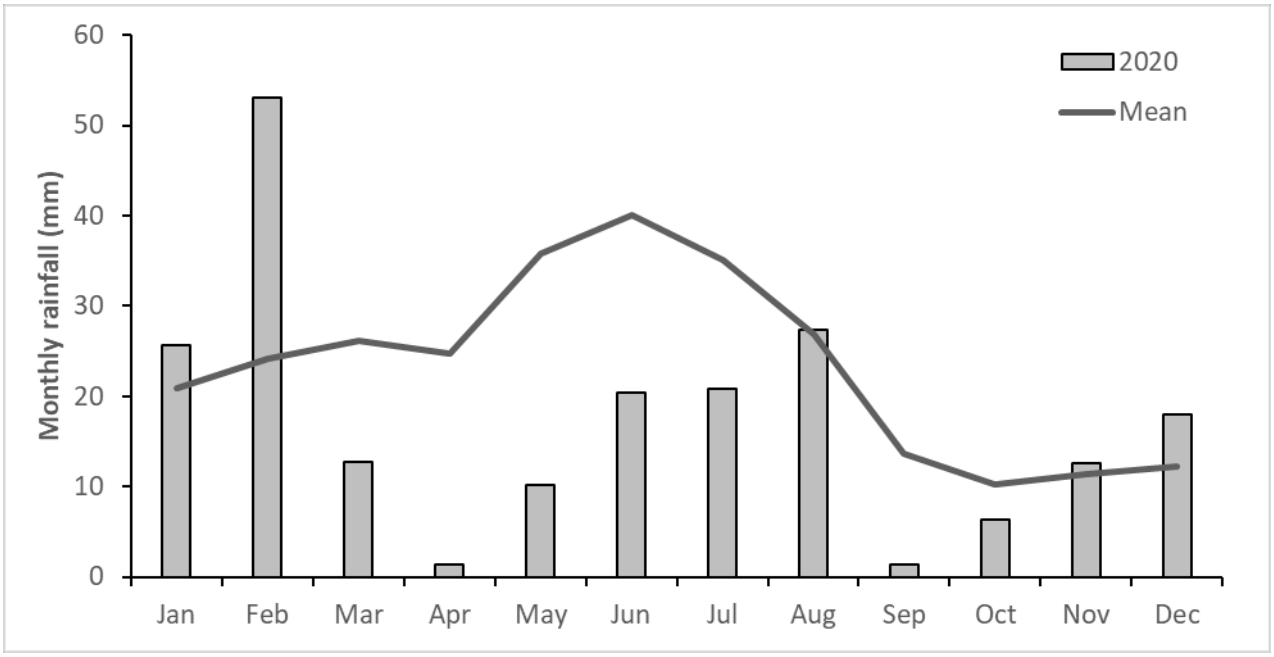


Figure 4. Monthly rainfall in 2020 compared with the mean recorded at Paynes Find Monitoring Station, 1919-2020 (BOM Station No. 007139).

Methods

Indicators and metrics

Mt Gibson's Ecohealth Monitoring Program has been designed to measure and report on the status and trends of species and threats on the sanctuary. The program focuses on selected biodiversity and threat indicators, using metrics derived from data collected through a series of purpose-designed surveys. A selection of species or guilds were chosen as biodiversity indicators which fit into one or more of the following categories: (1) declining and/or threatened species or guilds, (2) strong drivers of ecosystem function, or (3) are a member of the full range of taxa (to enable ongoing surveillance monitoring of a range of taxonomic groups to provide early warning of any unexpected declines).

In 2020, 8 of 17 biodiversity indictors are reported on; the rationale for their selection is recorded for each indicator in Table 3. Threat metrics are selected to ensure monitoring the status and trends of introduced weeds, predators and herbivores and changed fire regimes (where appropriate). In 2020, 4 threat metrics are reported on (Table 4).

Table 3. Biodiversity indicators for Ecohealth monitoring framework for Mt Gibson. Rationale for selection: T = threatened or declining; D = strong driver of ecosystem function; S = surveillance monitoring. Metric definitions: abundance = estimate of mean number of individuals across a set of sites; occupancy = proportion of sites where the species was detected; population estimate = estimate of number of individuals within the safe haven; activity = number of detections per day converted to the General Activity Index of Engeman (2005).

Indicator	Rationale			Survey method	Metric/s
	T	D	S		
Mammals					
Reintroduced mammals					
Red-tailed Phascogale	*			Red-tailed Phascogale Abundance Survey (in development); Safe Haven Camera Survey (for occupancy)	Abundance occupancy
Numbat	*			Numbat Distance Sampling Survey (in development); Safe Haven Camera Survey (for occupancy)	Population estimate occupancy
Shark Bay Bandicoot	*	*		Safe Haven Mammal Trapping Survey (for population estimate); Safe Haven Camera Survey (for occupancy) BPCV1 Disease Monitoring	Population estimate occupancy Proportion of animals with BCVP1
Greater Bilby	*	*		Safe Haven Camera Survey (for occupancy)	Occupancy
Woylie	*	*		Safe Haven Mammal Trapping Survey (for population estimate); Safe Haven Camera Survey (for occupancy)	Population estimate occupancy
Banded Hare-wallaby	*			Safe Haven Camera Survey (for occupancy)	Occupancy
Greater Stick-nest Rat	*			Greater Stick-nest Rat Survey	Abundance; occupancy
Shark Bay Mouse	*			Methods under development	TBD. Not surveyed 2020
Extant small-medium sized mammals					
Short-beaked echidna (*Tachyglossus aculeatus*)		*	*	Safe Haven Camera Survey	Occupancy

Indicator	Rationale			Survey method	Metric/s
Large herbivores					
Red Kangaroo (*Macropus rufus*)		*	*	Standard Camera Survey	Occupancy. Not surveyed 2020
Western Grey Kangaroo (*Macropus fuliginosus*)		*	*	Standard Camera Survey	Occupancy. Not surveyed 2020
Euro (*Macropus robustus*)		*	*	Standard Camera Survey	Occupancy. Not surveyed 2020
Large carnivores					
Dingo (*Canis dingo*)		*		Standard Camera Survey	Activity. Not surveyed 2020
Reptiles					
Small-medium reptiles					
Small-medium terrestrial reptile guild			*	Standard Trapping Survey	Occupancy. Not surveyed 2020
Other reptiles					
Varanus gouldii			*	Standard Camera Survey	Occupancy. Not surveyed 2020
Birds					
Diurnal birds			*	Standard Bird Survey	Occupancy. Not surveyed 2020
Malleefowl (*Leipoa ocellata*)	*			Mound Survey	Proportion of active mounds.

Table 4. Threat indicators for Ecohealth monitoring framework for Mt Gibson. Metric definitions: activity = number of detections per day converted to the General Activity Index of Engeman (2005).

Indicator	Rationale	Survey method	Metric/s
Problem animals			
Feral cat (*Felis catus*)	Threat to wildlife	Feral Predator Camera Survey	Activity (treatment area); activity (comparison area)
Fox (*Vulpes vulpes*)	Threat to wildlife	Feral Predator Camera Survey	Activity (treatment area); activity (comparison area)
Fire			
Fire	Key driver of vegetation dynamics, structure and composition, habitat attributes	Fire Scar Analysis	Area burnt (ha) planned Area burnt (ha) wildfire

Survey types and history

To report on the 9 Biodiversity and 4 Threat Indicators, AWC survey teams conduct a variety of surveys repeated on a schedule of 1-5 years. These include:

- Standard Trapping Survey
- Standard Camera Survey
- Standard Bird Survey
- Safe Haven Camera Survey
- Safe Haven Mammal Trapping Survey
- Numbat Distance Sampling Survey
- Greater Stick-nest Rat Abundance Survey
- BPCV1 Disease Monitoring
- Malleefowl Mound Survey
- Feral Predator Camera Survey

In addition to surveys, computations of sanctuary-wide ground-based data are conducted for:

- Fire Scar Analysis

Five surveys were completed at Mt Gibson in 2020: the Safe Haven Camera Survey, Safe Haven Mammal Trapping Survey, Greater Stick-nest Rat Abundance Survey, BPCV1 Disease Monitoring and Feral Predator Camera Survey (Table 5). The methodology is described and results of these surveys and computations are reported on in this document. A Standard Trapping Survey, Standard Camera Survey and Standard Bird Survey will be undertaken in 2022. Several surveys of reintroduced mammals were trialled in 2020 (Red-tailed Phascogale Abundance Survey, Numbat Distance Sampling Survey, and Banded Hare-wallaby Scat Plot Survey). These trial surveys will continue in 2021 and results be reported in future.

Table 5. Survey effort on Mt Gibson in 2020. 'TN' refers to trap nights.

Survey name	Effort in 2020	Description/comment	Survey history
Safe Haven Camera Survey	2,940 TN	70 sites throughout the safe haven, each with two lured infrared camera traps. Cameras are deployed at each site for three weeks. Sites stratified across the four broad habitat types (Callitris woodland, shrubland, woodlands and mixed vegetation mosaic).	2017 – 70 sites 2018 – 70 sites 2019 – 70 sites 2020 – 70 sites
Safe Haven Mammal Trapping Survey	1,440 TN	Live-trapping targeting Woylies and Shark Bay Bandicoots. 120 sites throughout the safe haven, with four cage traps each (n=480 traps), trapped for three nights.	2017 – 120 sites 2018 – 120 sites 2019 – 120 sites 2020 – 120 sites
Greater Stick-nest Rat Survey	363 TN	Five trapping grids of cage traps (n=125) pre-baited for seven days, trapped for three nights.	2020 – 5 sites
BPCV1 Disease Monitoring	50 TN	One site with 25 cage traps, trapped for two nights	2019 – 8 sites 2020 – 1 site
Feral Predator Camera Survey	39,960 camera trap nights	120 cameras permanently deployed to monitor cat and fox activity. 90 cameras were deployed for all of 2020 in treatment area; 30 cameras were deployed in May 2020 in comparison area.	2019 – 90 cameras 2020 – 90 cameras (treatment area); 30 cameras (comparison area)

Survey design and methods

Safe Haven Camera Survey

The Safe Haven Camera Survey is conducted annually to determine occupancy of five reintroduced mammals: the Red-tailed Phascogale, Numbat, Shark Bay Bandicoot, Greater Bilby and Woylie, and one extant indicator species, the Short-beaked Echidna. Seventy permanent monitoring sites (Figure 5) were selected based on their distribution across eight broad vegetation types: *Callitris*-York Gum woodland; Granite outcrop; Mallee; Mallee-woodland; Salmon Gum woodland; Shrubland; York Gum woodland and Other Eucalyptus woodland. Site locations were derived with a stratified sampling approach and the 'Random Points Inside Polygons' tool in QGIS (QGIS Development Team 2018). Sites were randomly distributed across the safe haven, stratified by vegetation type, with a mean distance among sites of 788 m and a minimum distance of 367 m between each site.

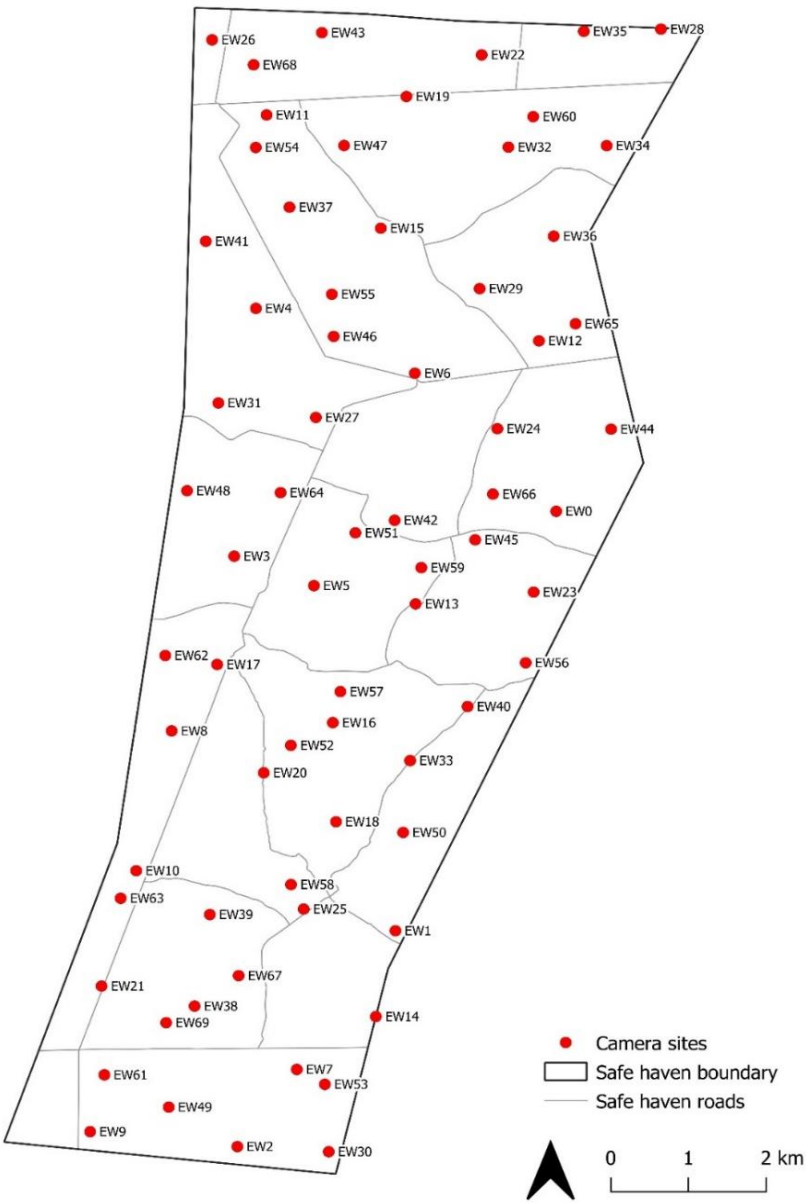


Figure 5. Camera monitoring sites for the Safe Haven Camera Survey

At each site, two Reconyx Hyperfire cameras (n=140) were deployed approximately 5 m apart. Cameras were attached to a star picket, facing downwards, one metre above the ground. A lure canister and a cork tile marked with a 50 x 50 mm grid (used as a scale reference) were positioned at the base of the star picket within the camera's field of view. At each site, one canister contained apple and Dairy Krave and the other contained a universal bait ball (peanut butter, sardines and oats).

The survey was conducted between January and March 2020. Cameras were deployed within each zone of the safe haven (north, middle and south) for a period of three weeks (Table 6).

Table 6. Survey timetable for 2020 safe haven-wide camera survey

Zone	Number of sites	Survey period
North safe haven	23 sites (46 cameras)	January (3 weeks)
Middle safe haven	22 sites (44 cameras)	Late January – Mid February (3 weeks)
South safe haven	25 sites (50 cameras)	Late February – March (3 weeks)

Safe Haven Mammal Trapping Survey

The annual Safe Haven Mammal Trapping Survey was designed primarily to obtain a population estimate for Woylies, however data are also collected for other small to medium-sized mammals. The safe haven was split into three sections (north, central and south) with 40 sites per section (Figure 6). All sites were 50 m from a road or track. Each site comprised four standard cage traps, one of which was fitted with a wooden excluder to reduce trap saturation by Woylies and increase trap success of other small-medium mammal species.

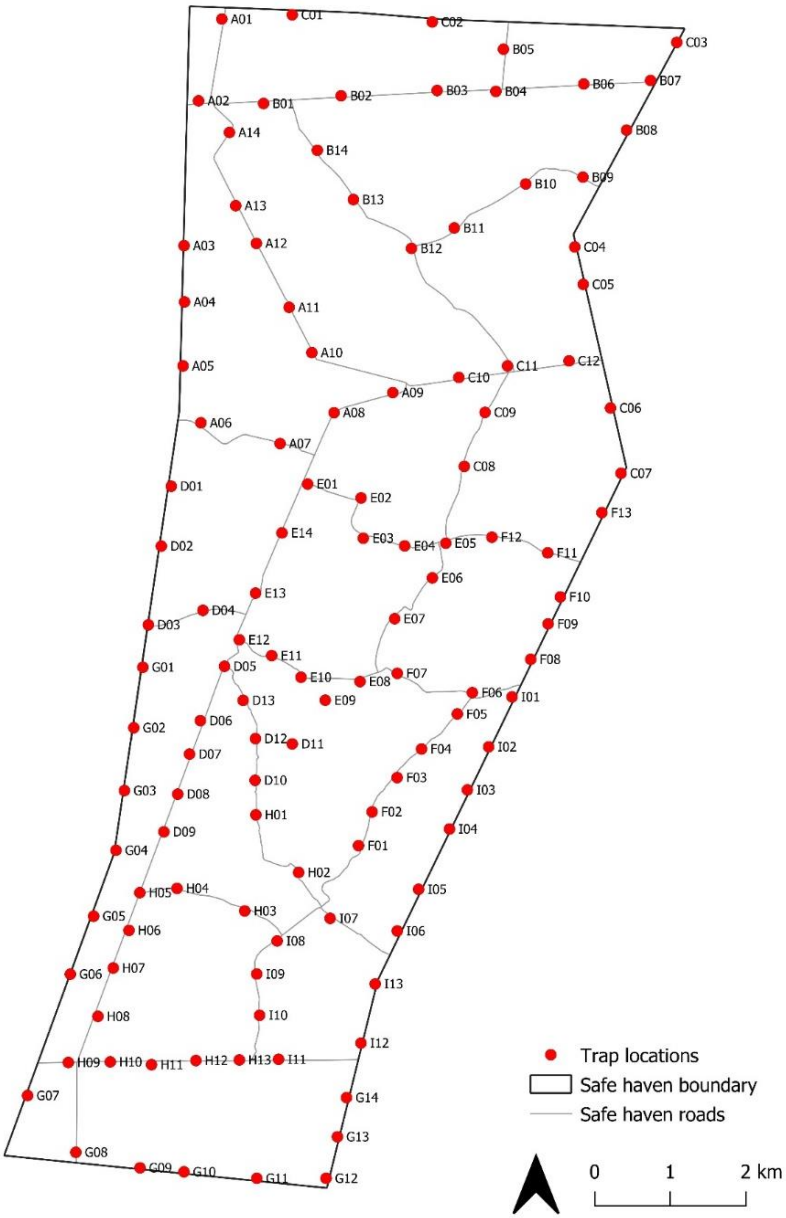


Figure 6. Trapping sites run during the Safe Haven Mammal Trapping Survey, July 2020

Four cage traps were deployed at each site. One trap per site had an excluder attached to prevent Woylies entering the trap (Figure 7). Each of the three sections of the safe haven was surveyed independently, for three consecutive nights. The survey was run for a total of nine nights. Traps were lured with universal bait

balls (peanut butter, sardines and oats). Traps were opened before sunset and checked and closed each morning, by three hours after dawn. In the northern Wheatbelt, sunrise in July is approximately 7:00am and sunset is approximately 5:30 pm.

All Ecohealth indicator species (new animals and recaptures from previous sessions) were processed with the following standard data collected: species identification; sex and reproductive status; microchip and DNA for new animals; weight and pes length.

Figure 7. Standard cage trap with wooden excluder

Greater Stick-nest Rat Survey

To evaluate the distribution of Greater Stick-nest Rats across the fenced area, a search was made for the relatively distinctive scat of Greater Stick-nest Rats within 2409 wood-piles that had been created during fence-line clearing and road-clearing at the time of the establishment of the fenced area at Mt Gibson.

To obtain an abundance estimate for the Greater Stick-nest Rat (*Leporillus conditor*) in 2020, a cage trap survey was run at five sites in the safe haven (Figure 8). Sites were selected based on the results of a 2019 safe-haven wide scat survey and camera detections from safe haven camera monitoring.

At each of the five sites, a five by five grid of cage traps, spaced 25 m apart, was established. Each trap had a wooden excluder attached to the front to minimise Woylie by-catch and interference (Figure 7). Each trap was pre-lured with apple coated in Dairy Krave and sweet potato for seven nights prior to the survey. Traps were opened for three consecutive nights. Traps were checked before dawn.

BPCV1 Disease Monitoring

Shark Bay Bandicoots were translocated from Bernier Island to Mt Gibson in 2018 and 2019 as part of AWC's Mt Gibson Mammal Restoration Project. A novel virus known as the Bandicoot papillomatosis and carcinomatosis syndrome or BPCV1 has been detected in individuals on Bernier Island. As stipulated by the Department of Biodiversity and Attractions (DBCA), disease monitoring in the Mt Gibson bandicoot population is undertaken every six months for three years post reintroduction.

BPCV1 Disease Monitoring was planned for April 2020. However, due to the high capture rate of Shark Bay Bandicoots during a trial Red-tailed Phascogale Abundance Survey in April, additional trapping was not required to complete the scheduled disease check. In September 2020, disease monitoring was undertaken at only one site (Figure 9) as a high number of Shark Bay Bandicoots were also trapped and checked for BPCV1 during the Safe Haven Mammal Trapping Survey in July 2020. This site was selected based on proximity to translocation release sites and previous captures of Bernier Island animals.

Shark Bay Bandicoot disease monitoring was undertaken using cage traps with wooden excluders fitted. The trapping grid comprised of five by five lines of traps, spaced 25 m apart. Traps were baited with universal bait balls (peanut butter, sardines and oats). Traps were wired open and pre-lured for seven nights, followed

by three trap nights. All Bandicoots captured were thoroughly inspected for signs of BPCV1. A DNA sample was collected from new animals, and standard morphometric measurements were taken.

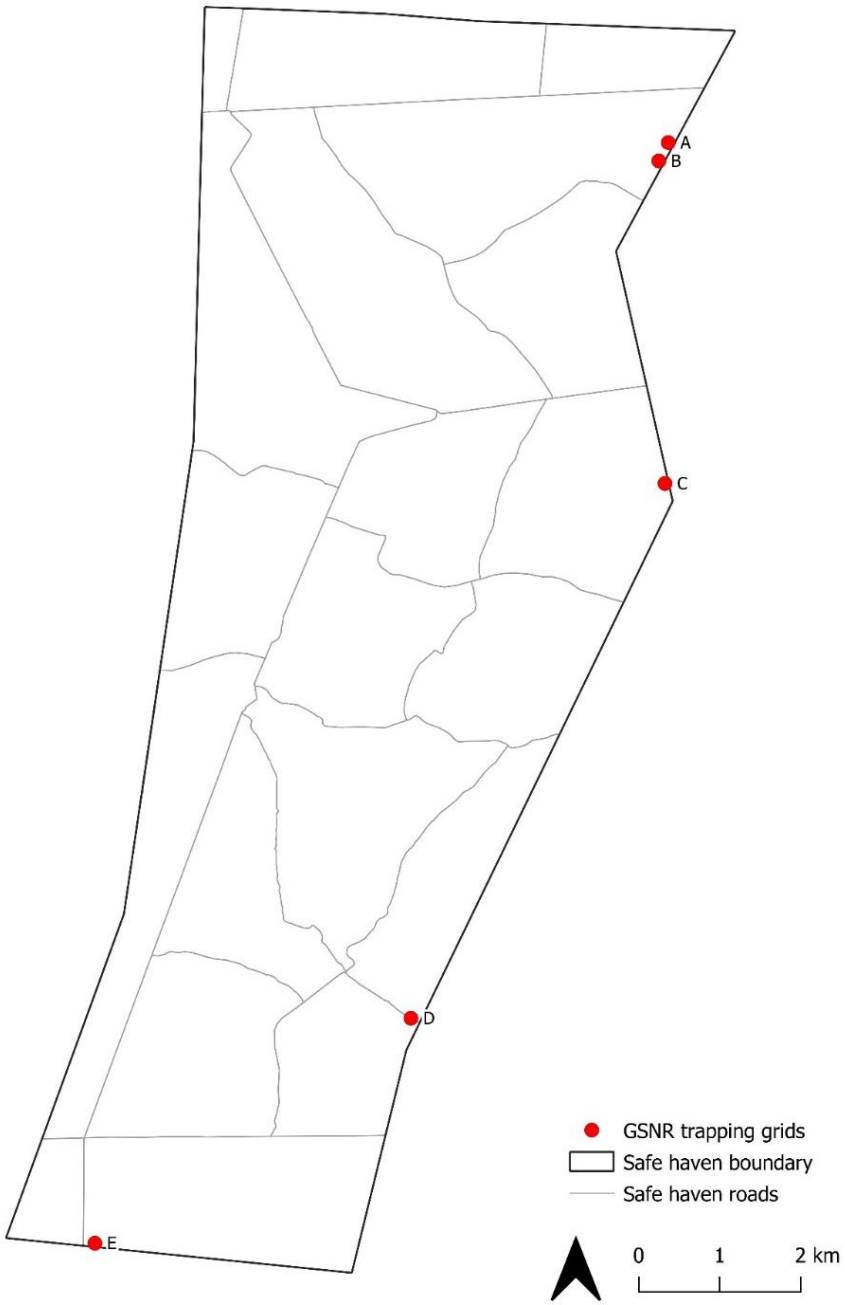


Figure 8. Greater Stick-nest Rat (GSNR) trapping sites within the Mt Gibson safe haven, 2020

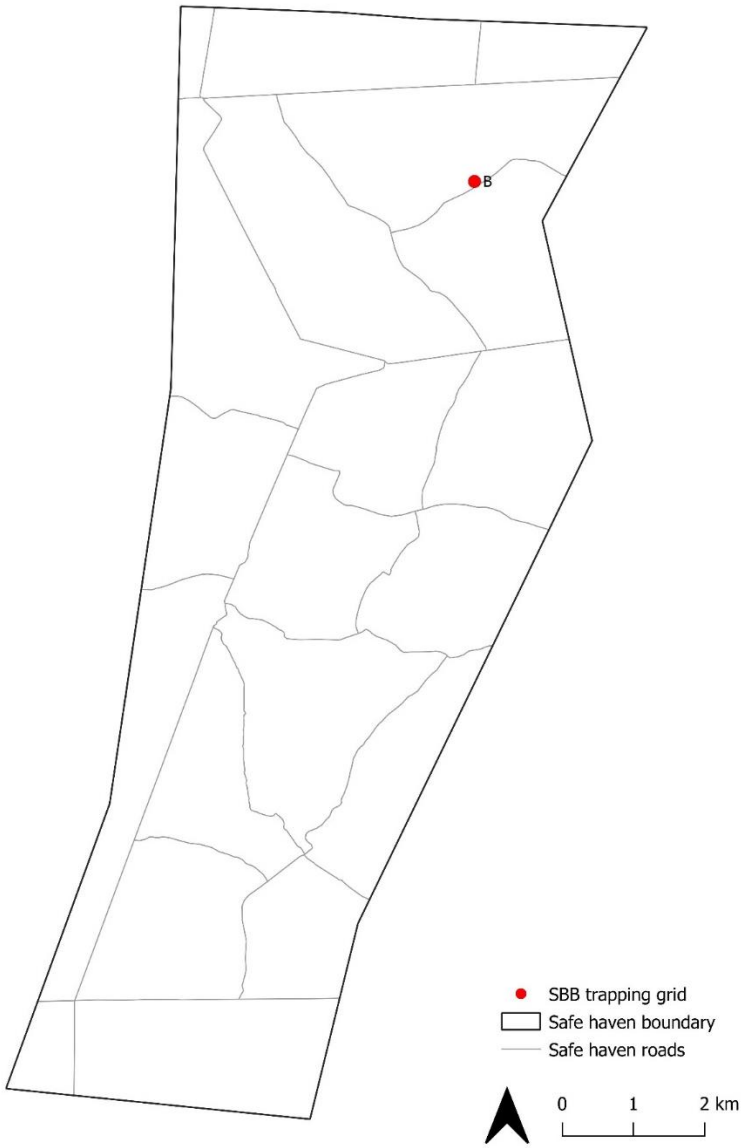


Figure 9. Trapping site for BPCV1 Disease Monitoring in Shark Bay Bandicoots (SBB) in September 2020

Feral Predator Camera Survey

Two large camera arrays were established to monitor cat and fox activity outside of the safe haven (Figure 10). One camera array (n=90) was established in a grid within the 20,000 ha 'treatment' area, which is subject to ongoing control efforts (baiting and trapping). The 90 cameras were deployed for the whole of 2020. The 'comparison' array (n=30) was established in a 3,000-ha area with no control efforts, between May-December 2020.

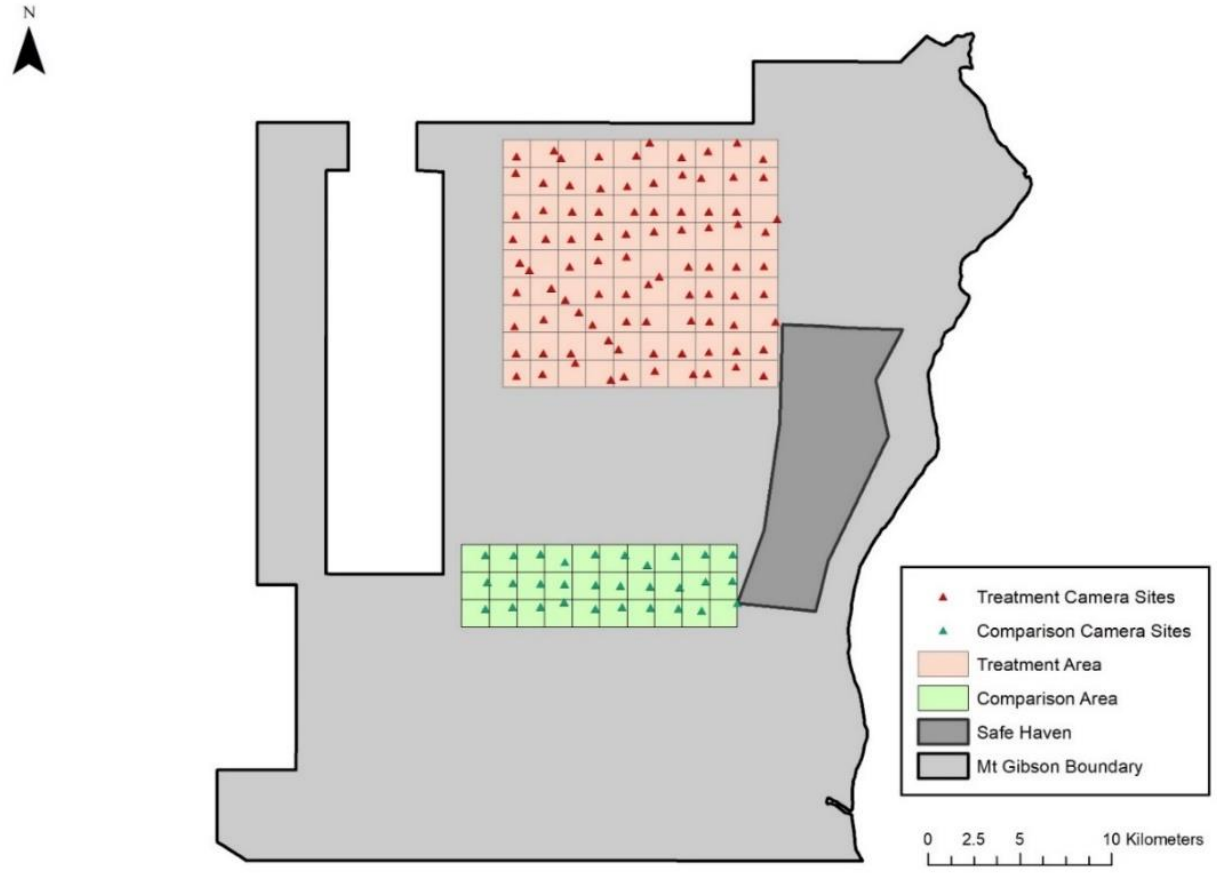


Figure 10. Camera arrays in treatment and comparison areas of the Feral Predator Camera Survey in 2020

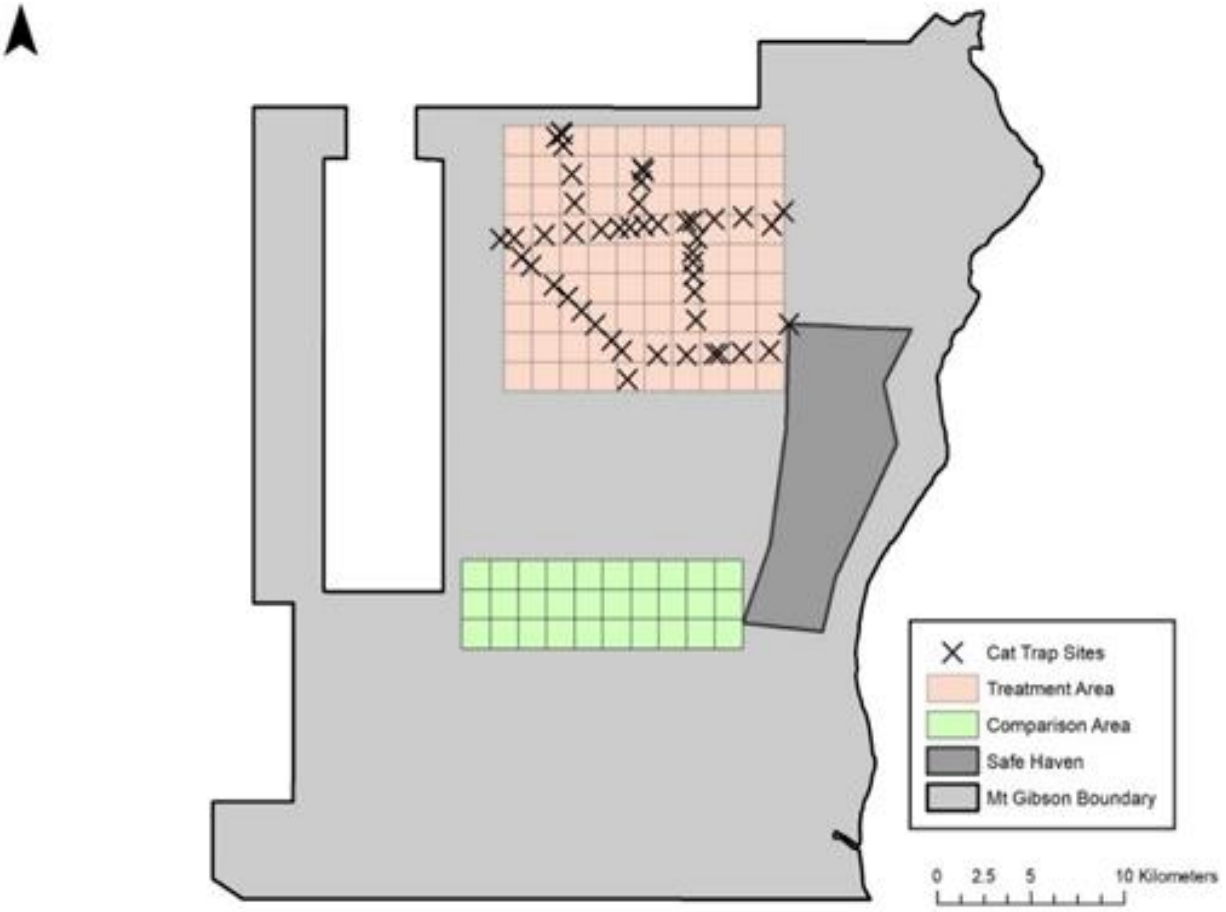


Figure 11. Locations of targeted cat traps deployed across the treatment area in June 2020

Cat and fox activity

Cameras in both the treatment and comparison area were positioned 50 cm above ground level, at the edge of a track or clearing. Treatment cameras were checked every five-six months and comparison cameras were checked every two months (due to shorter battery life of the camera model). After each camera check, images were processed and formatted for analysis, identifying all cat and fox detections.

Aerial baiting (Eradicat) took place within the treatment area in June 2020. A total of 10,000 baits were deployed. Baiting was undertaken in line with the Feral Cat Bait Prescription (Department of Biodiversity Conservation and Attractions 2018). This prescribes that flight transects be established 1 km apart, with Eradicat baits deployed at a rate of 50 baits/km² (Algar and Burrows 2004), at a speed of 160 kt and height of 500 ft above ground level. This allows 50 baits to spread across an approximate area of 200 m x 40 m (Algar et al. 2013). Buffer zones were established around sensitive areas (water bodies, gazetted roads and recreational areas) as per the 1080 Code of Practice DBCA and DPIRD 2018). Cat trapping was undertaken immediately after aerial baiting to maximise cat suppression (Lohr and Algar 2020). Forty-eight trap sites were selected in areas of known high cat activity within the treatment area, based on images from cameras set between November 2019 and February 2020; Figure 11.

No fox baiting was undertaken in the treatment area during 2020, as no foxes were detected on the treatment area camera grid.

Analysis methods

Safe Haven Camera Survey

Camera detections were used to calculate occupancy as the proportion of sites at which each species was detected.

Safe Haven Mammal Trapping Survey

Safe haven population estimates were generated for the Woylie and Shark Bay Bandicoot from the Safe Haven Mammal Trapping Survey, using Spatially Explicit Capture-Recapture (SECR) methods (Efford and Fewster 2013). Package SPACECAP (Gopalaswamy et al. 2012) was run within R software (R Core Team 2013). SPACECAP provides for the inclusion of a covariate to assess 'trap happiness'. Models with different configurations of detection function (half normal or exponential), with or without a covariate for trap response, and different home range probabilities were assessed by comparing convergence and Bayesian-p values (Gopalaswamy et al. 2012). Models that converged well and had a Bayesian-p value closest to 0.5 were considered the best model.

Greater Stick-nest Rat Survey

An abundance estimate of the number of individuals across survey sites was generated using Spatially Explicit Capture-Recapture methods (Efford and Fewster 2013), as described above for the Woylie and Shark Bay Bandicoot analyses.

Feral Predator Camera Survey

Images from the Feral Predator Camera Survey camera traps were processed using the Timelapse software (version 2.2.36; Greenberg 2020) to catalogue the number of detections for each species per site per day. A one-hour window of independence was applied for consecutive images of the same species. The General Index (developed by Engeman 2005) was used to quantify cat activity. As this was the first year of data collected, long term trends in activity cannot yet be described. Instead, the median activity index for the 12-month monitoring period has been used to describe cat activity in the treatment and comparison areas. Too few foxes were detected for General Activity Index analysis, as such, for 2020, occupancy was computed as the proportion of sites detected.

Fire Scar Analysis

No wildfires or prescribed fires occurred on Mt Gibson during 2020. For previous fires, fire scars were measured by walking the perimeter of the burned area using a handheld GPS unit with tracking function. The area of the scar in hectares was calculated using ArcMap 10 with Spatial Analyst (Environmental System Research Institute Inc., Redlands, CA, USA).

Results

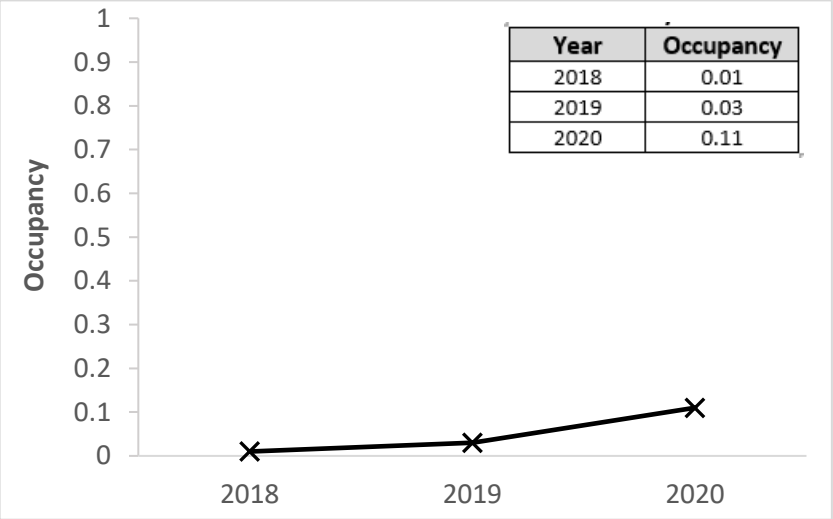
Biodiversity indicators

Reintroduced Mammals

Red-tailed Phascogale

A total of 165 Red-tailed Phascogales were translocated to Mt Gibson between 2017 and 2019. Due to their small size and semi-arboreal habits, this species is challenging to monitor. The success criteria developed for Red-tailed Phascogales species reflect these challenges, being limited to survival and recruitment in the period following release, and an increase in population size and an increase or maintenance of genetic diversity over the longer-term (5 years or more post-release) relate to (Ruykys et al. 2017c).

In 2020, the reintroduction Red-tailed Phascogales on Mt Gibson had been in progress for 3 years since the first release and 1 year since the final release of founders. There are no particular success criteria relating to this period of the reintroductoin, as criteria relating to population size and genetic diversity are intended for evaluation at 5 years post-release. Nevertheless, the Safe Haven Camera Survey has shown a substantial increase in the proportion of sites where Red-tailed Phascogales have been detected in the fenced area since 2018 (Figure 12). These results are consistent with dispersal through the fenced area and, presumably, growth in population size, suggesting the reintroduction of this species is on track to meet this longer-term success criterion.



Year	Occupancy
2018	0.01
2019	0.03
2020	0.11

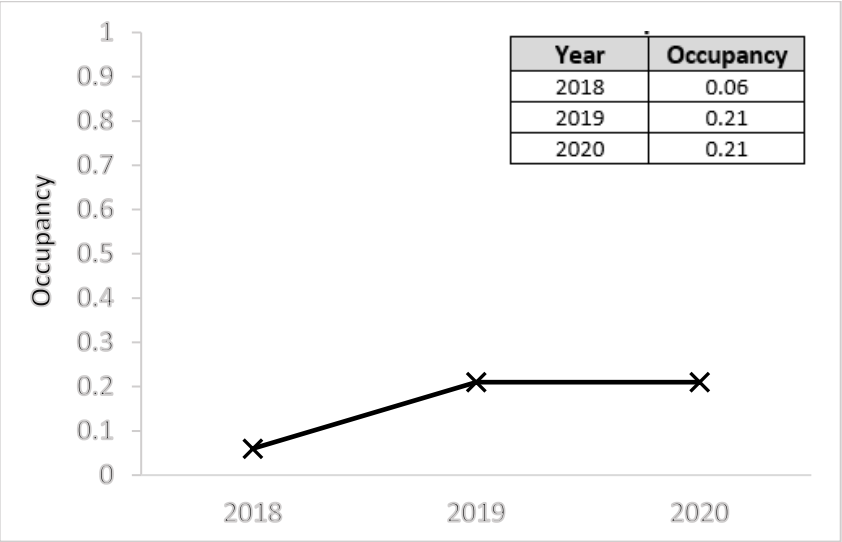
Figure 12. Proportion of sites Red-tailed Phascogales detected in annual camera survey, 2018-2020

Numbat

A total of 64 Numbats were translocated to Mt Gibson between 2016 and 2018. The success criteria developed for this species include survival and recruitment in the short-term (1 year post-release); breeding and dispersal (or population growth) through the fenced area in the mid-term (2 -5 years post-release); and a viable, genetically diverse population 5 years post-release (Ruykys et al. 2015a).

All short-term success criteria have been met.

In 2020, the relevant criteria were those relating to 2 years post-release: breeding and dispersal. Evidence of breeding was obtained by observations of sub-adult Numbats. The Safe Haven Camera Survey provides data on the occurrence of Numbats in the fenced area on Mt Gibson. The results of this survey show a substantial increase in the proportion of sites at which Numbats have been detected increased since 2018 (Figure 13). That is, the reintroduction of the Numbat is currently meeting relevant success criteria.



Year	Occupancy
2018	0.06
2019	0.21
2020	0.21

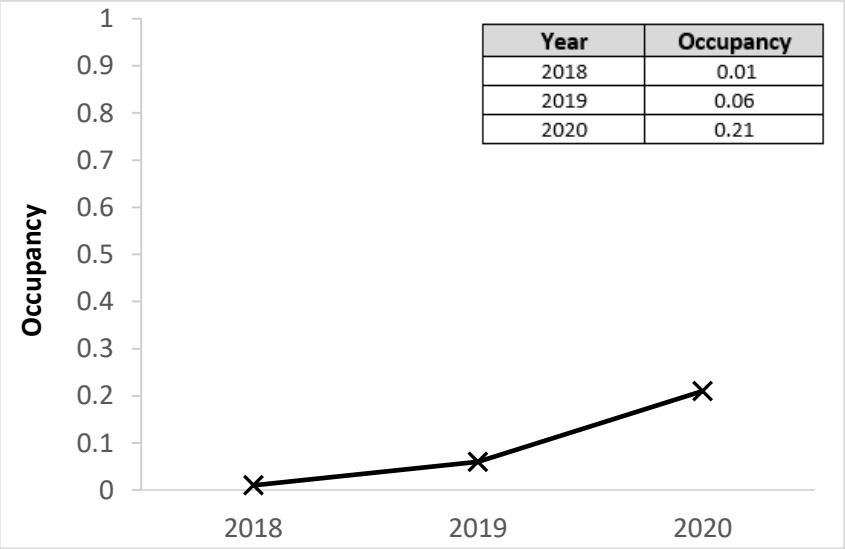
Figure 13. Proportion of sites the Numbat was detected in annual camera survey, 2018-2020

Shark Bay Bandicoot

A total of 64 Shark Bay Bandicoots (also known as Western Barred Bandicoots) were translocated to Mt Gibson between 2017 and 2019. The success criteria developed for this species include survival, maintenance of bodyweight and occupancy in the short-term (1 year post-release), breeding and dispersal through the fenced area in the mid-term (2 years post-release) and longer-term (to 5 years), and a viable, healthy genetically diverse population 5-10 years post-release (Smith et al. 2017). The health criteria relates to the incidence of BCPV1 relative to source populations.

All short-term success criteria have been met.

In 2020, the relevant criteria were those relating to 1-2 years post-release: breeding and dispersal. During trapping, there have captures of female bandicoots with pouch young as well as captures of Mt Gibson-born individuals, demonstrating that the population is successfully breeding. The Safe Haven Camera Survey provides data on the occurrence of Shark Bay Bandicoots in the fenced area on Mt Gibson. The results of this survey show a substantial increase in the proportion of sites at which bandicoots have been detected since 2018 (Figure 14). Reintroduction of this species is currently meeting relevant success criteria.



Year	Occupancy
2018	0.01
2019	0.06
2020	0.21

Figure 14. Proportion of sites Shark Bay Bandicoot detected, 2018-2020

Although estimates of population size are not required until 5 years post-release, a preliminary estimate of population size was obtained from SECR models of captures from 2020 trapping data (Figure 15). The estimate from this method was 116 individuals (95% CI 26 to 254). Note there is a clear artefact of trap location in density estimates presented in Figure 15: this suggests the analytical approach used to estimate population size may not be well-suited to these data, due for example to bandicoots having a small home

range size relative to the spacing of the trapping grid, and/ or due to a small number of captures as bandicoots are still establishing in the fenced area. Population estimates for the Shark Bay Bandicoot are expected to become more robust over time as the population increases in size and appropriate analytical methods are applied to the data.

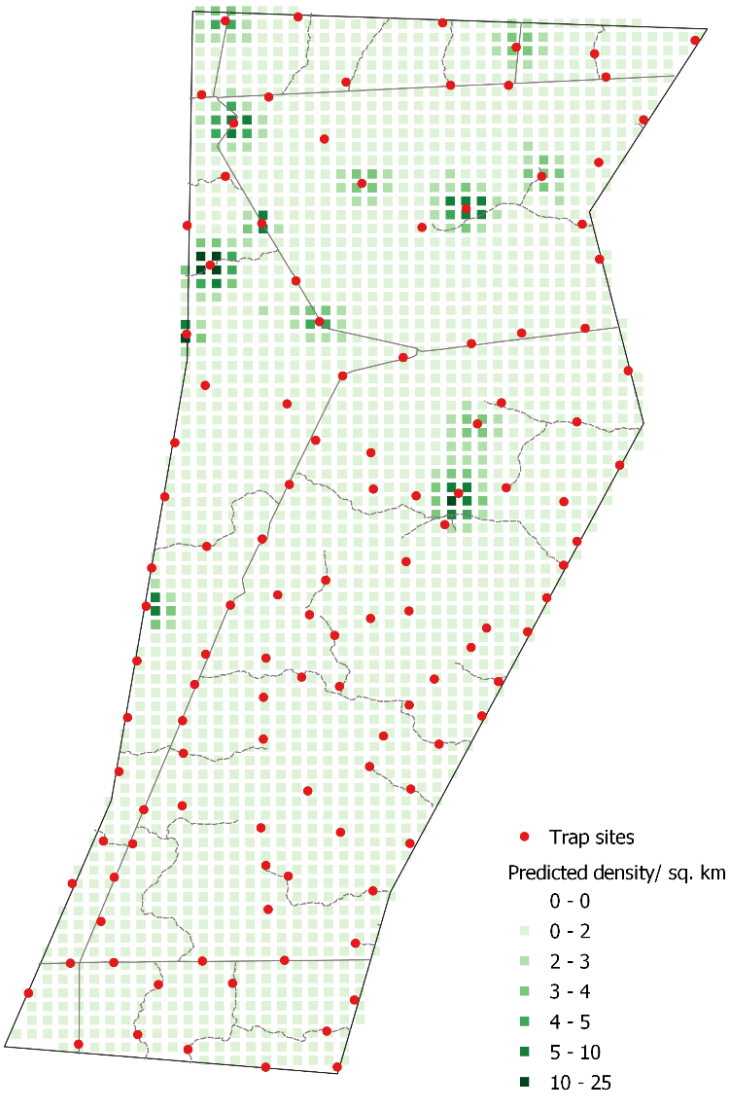


Figure 15. Preliminary modelled density of Shark Bay Bandicoots based on SECR analysis of 2020 trapping data on Mt Gibson. Pixel densities are estimated as the number of individuals per square kilometre. Note the SECR analysis has a number of assumptions that may not be met by the trapping data (see text).

An assessment of the incidence of disease in translocated Shark Bay Bandicoots is also not required until 5 years post-release (Smith et al. 2017). Nevertheless, a total of 51 bandicoots captured on Mt Gibson in 2020 were evaluated for clinical signs of BPCV1. Of these, 48 were in good condition with no clinical signs of BPCV1. Two of the remaining animals had possible symptoms of the disease (fur loss), the other had a scab - all three animals were swabbed for BPCV1, but all returned negative results. Similarly, all of the nine bandicoots swabbed in 2019 returned negative results for BPCV1. The assessments conducted to date have found no evidence of BPCV1 in the Shark Bay Bandicoot population established on Mt Gibson, and therefore the criteria in the Translocation Proposal around the prevalence of BPCV1 in the Mt Gibson bandicoot population has, so far, been met.

Greater Bilby

A total of 56 Greater Bilbies were translocated to Mt Gibson between 2016 and 2018. The success criteria developed for this species include survival in the short-term (1 year post-release), evidence of breeding/ recruitment and an increase in population size in the mid-term (2 -5 years post-release), and a viable, genetically diverse population long-term (Ruykys et al. 2016).

The short-term success criterion (survival) has been met.

In 2020, the relevant criteria were those relating to 2-5 years post-release: breeding/ recruitment and population size. There has been considerable evidence of breeding and recruitment, with captures of females with pouch young, and sub-adults. The Safe Haven Camera Survey has shown a substantial increase in the proportion of sites at which Bilbies have been detected since 2018 (Figure 16). This metric is presumably related to population size. The reintroduction of this species is currently meeting relevant success criteria.

In coming years, AWC will attempt to measure population size directly. On other AWC properties, spotlight surveys are used to estimate population size (e.g., Berry et al. 2019). On Mt Gibson, AWC commissioned the collection and analysis of scat DNA to estimate population size on part of the fenced area (Dziminski et al. 2020); whether this approach provides more robust data and/ or is more cost-effective than spotlighting on Mt Gibson is yet to be determined.

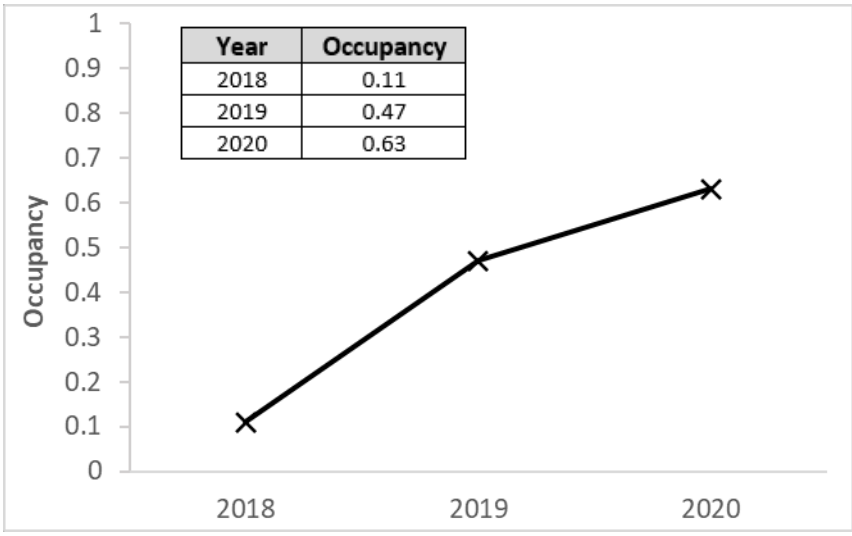


Figure 16. Proportion of sites Greater Bilby detected, 2018-2020

Woylie

A total of 162 Greater Bilbies were translocated to Mt Gibson between 2015 and 2018. The success criteria for this species were survival, breeding and recruitment in the short-term, and in the longer term, a population >300 individuals and an increase in genetic diversity relative to source populations (Ruykys et al. 2015b).

The short-term success criteria have been met.

In 2020, the population estimate for Woylies at Mt Gibson was 1,124 (95% CI 1,050 to 1,399) (Figure 17), well above the threshold for longer-term success.

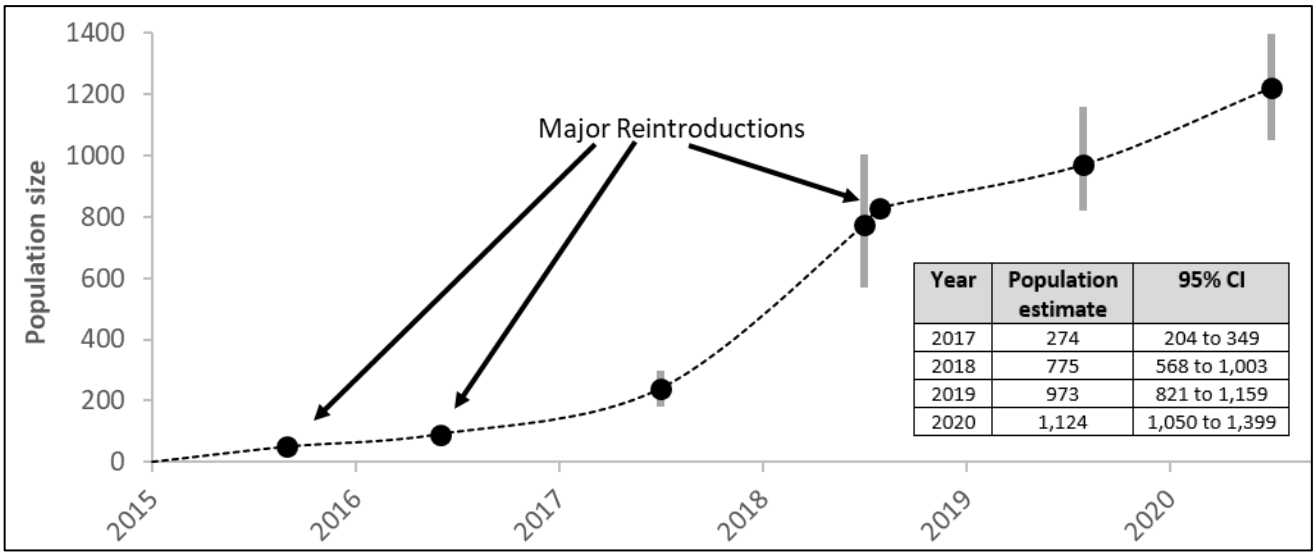


Figure 17. Population estimates of Woylies reintroduced to Mt Gibson (+/- SE).

Banded Hare-wallaby

A total of 119 Banded Hare-wallabies were translocated to Mt Gibson in 2017 and 2018. The short-term success criteria for this species were survival and maintenance of bodyweight, the mid-term (1-4 year) success criteria evidence of breeding and an increase in distribution / increase in population size, with the ultimate objective of establishing a viable, genetically diverse population (Ruykys et al. 2017b).

The short-term success criterion of survival was met; the criterion of maintenance of bodyweight was unable to be assessed, due to the difficulty in recapturing released animals.

In 2020, the relevant criteria were those relating to 2-4 years post-release: breeding and population size/ distribution. There is evidence of breeding from observations of sub-adults and female with pouch young. The Safe Haven Camera Survey has shown a gradual increase in the proportion of sites at which Banded Hare-wallabies have been detected since 2018 (Figure 18). This metric is presumably related to population size. Prior to 2020, most detections of Banded Hare-wallabies were in the northern third of the fenced area; however, in 2020, the species was detected in the southern third of the safe haven for the first time. Therefore, the reintroduction of this species is currently meeting relevant success criteria.

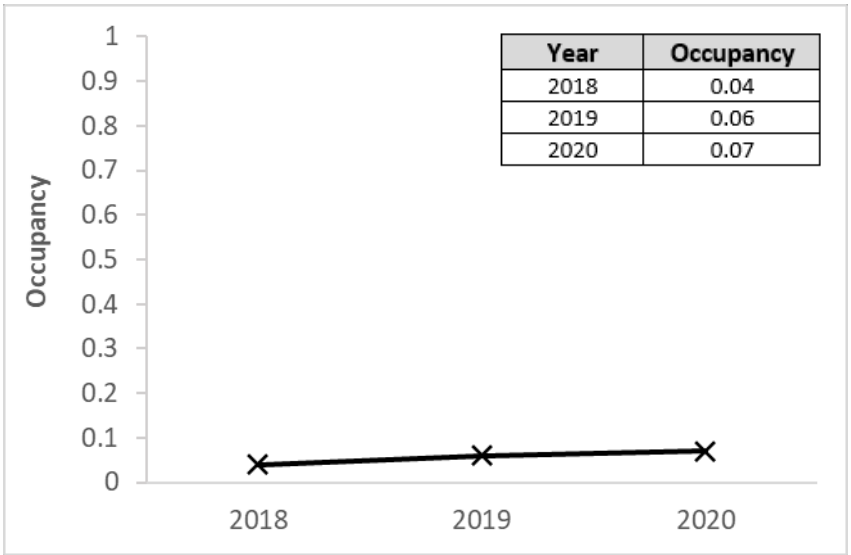


Figure 18. Proportion of sites Banded Hare-wallaby detected, 2018-2020

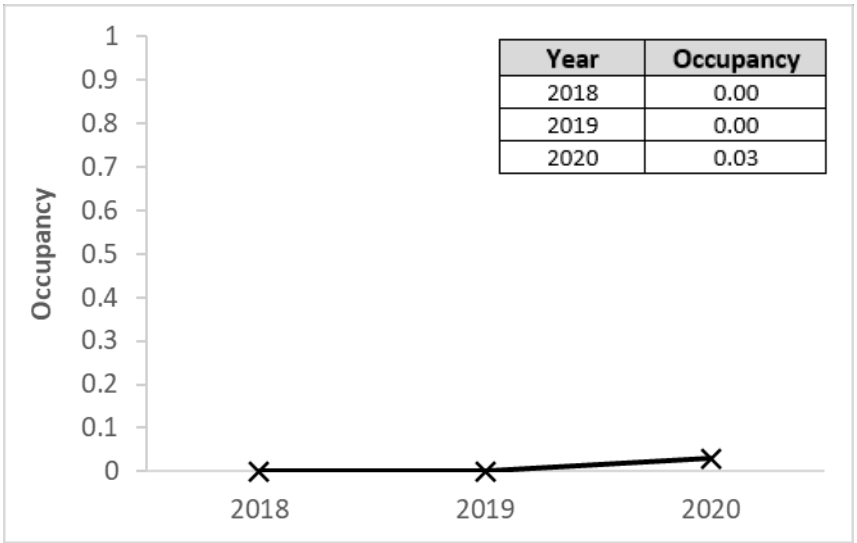
Greater Stick-nest Rat

A total of 95 Greater Stick-nest Rats were translocated to Mt Gibson between 2011 and 2019. The 2011 translocation was to a small breeding area, where animals were maintained until the main fenced area on Mt Gibson was completed. Animals were released from the breeding area in 2015; the population was supplemented with translocations in 2015, 2018 and 2019. The short-term success criterion for this species was survival, the mid-term (1-5 year) success criteria were evidence an increase in distribution and maintenance of abundance at 50% of monitoring sites; and the long-term objective was to establish a viable, genetically diverse population (Kanowski et al. 2018b).

The short-term success criterion (survival) was met.

In 2020, the relevant criteria were those relating to 1-5 years post-release: increase in distribution and maintenance of abundance. In 2020, Greater Stick-nest Rats were detected at two sites during the Safe Haven Camera Survey; the species had not previously been detected in this survey (Figure 19). In targeted camera surveys, there were 33 camera detections of Greater Stick-nest Rats at 10 sites in 2020; three of these sites have not had detections of the species previously previously. A search of over 2,400 wood-piles (mostly near the perimeter of the fenced area) detected the scat of Greater Stick-nest Rats in 69 locations (Figure 20). These results demonstrate an increase in the distribution of Greater Stick-nest Rats in the fenced area.

In targeted trapping, Greater Stick-nest Rats were captured at 2 of the 5 grids inside the fenced area, one of which was a new site for captures. Five individuals were captured at each site. The site abundance estimates for these 2 sites combined (14 ha in total) was 18 (95% CI 10 to 30; Figure 21).



Year	Occupancy
2018	0.00
2019	0.00
2020	0.03

Figure 19. Proportion of sites Greater Stick-nest Rats detected, 2018-2020

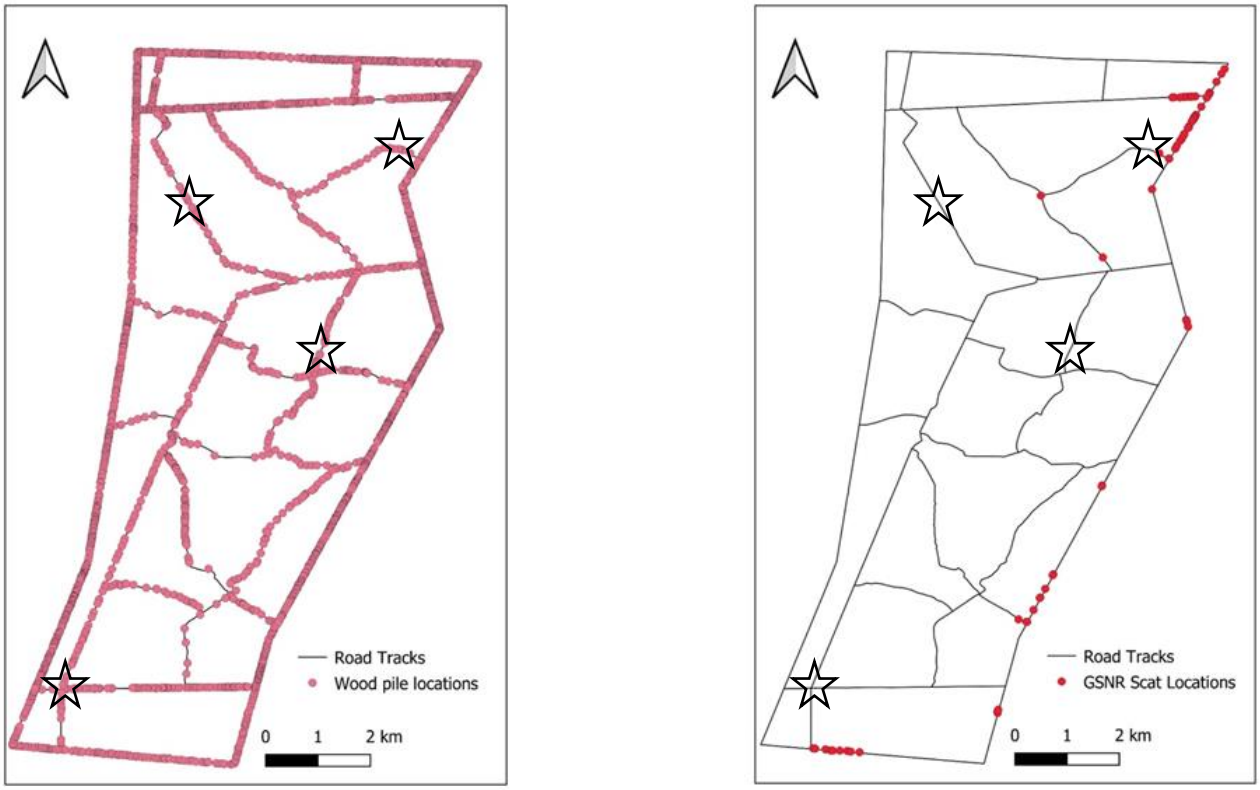


Figure 20. Location of the 2409 wood-piles survey searched for sign of Greater Stick-nest Rats at Mt Gibson (left); The location of 69 wood-piles where scat of Greater Stick-nest Rats was detected (right). Black stars show release locations.

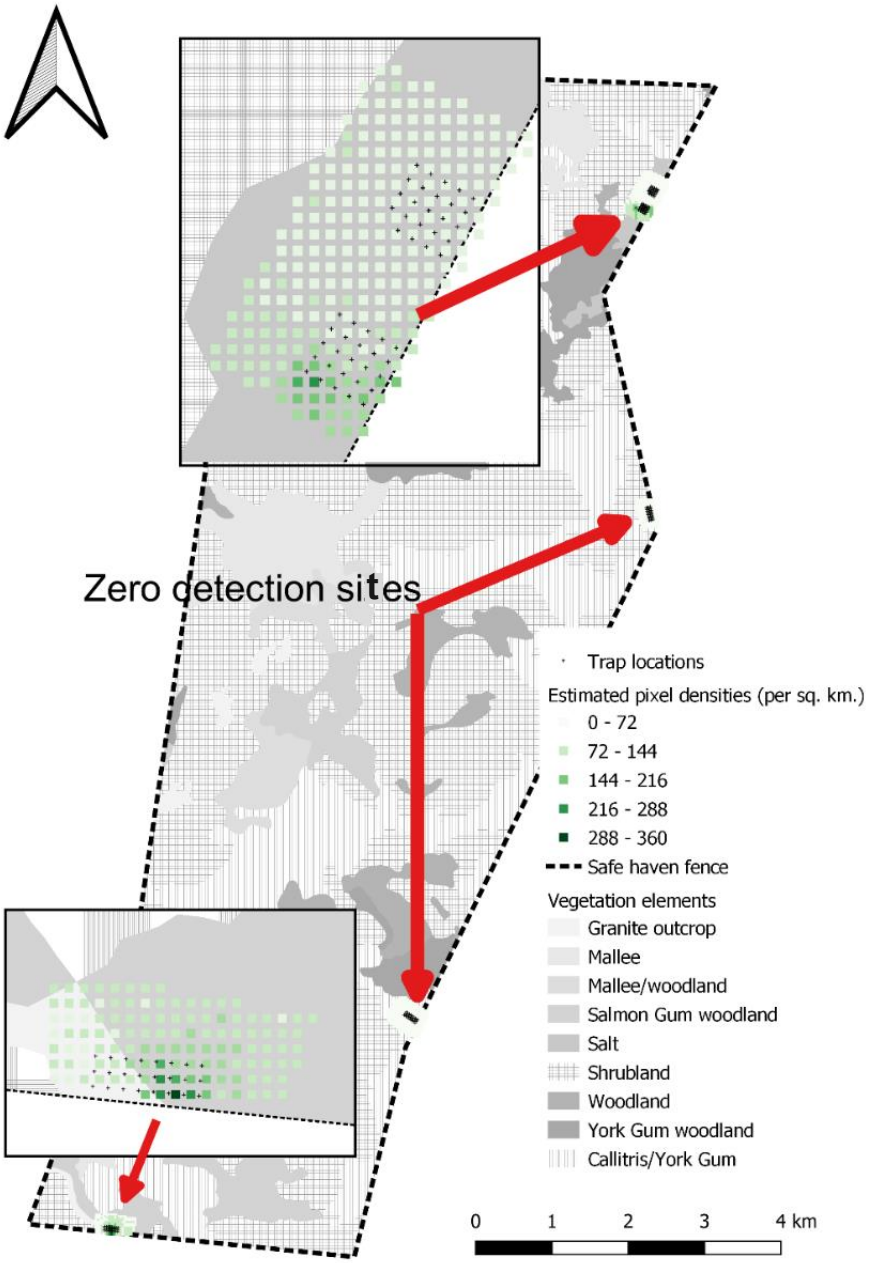


Figure 21. Preliminary predicted site abundance estimates for Greater Stick-nest Rat at five targeted trapping sites

Shark Bay Mouse

A total of 52 Shark Bay Mice were translocated to Mt Gibson in 2017 and 2018; planned follow-up translocations have yet to be conducted. Success criteria for this species were an increase in distribution and evidence of breeding if possible, with the ultimate objective of establishing a viable, genetically diverse population (Ruykys et al. 2017a).

Apart from records obtained immediately after translocations, there has been no subsequent evidence of Shark Bay Mice on Mt Gibson. The success criterion for reintroductions conducted to date have not been met, although the translocation is not yet complete.

Extant species

Short-beaked Echidna

The occupancy of Short-beaked Echidna in the fenced area varied markedly from 2018 to 2019 to 2020; (Figure 22). Given the longevity and slow reproductive rate of Echidnas, these trends are more likely to be an artefact of the surveys or the behaviour of Echidnas, rather than a signal of changes in the population of Echidnas on Mt Gibson.

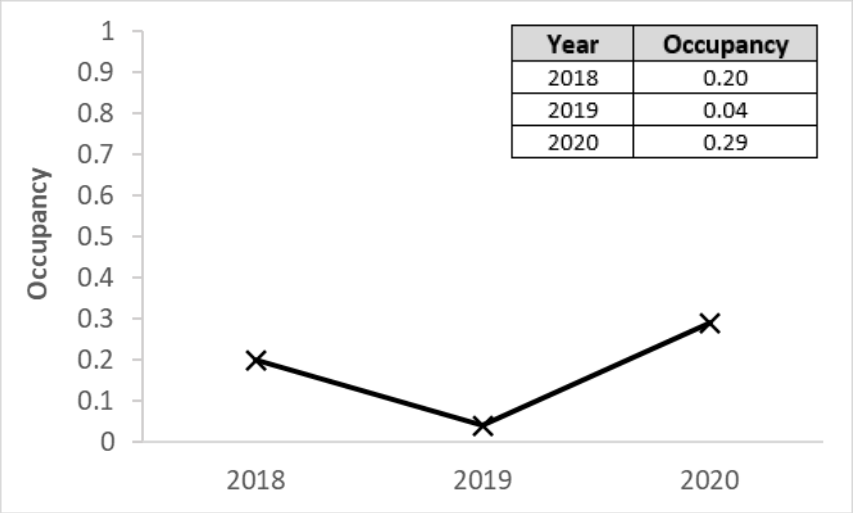


Figure 22. Proportion of sites Short-beaked Echidna detected, 2018-2020

Threat indicators

Feral animals

Cat

The initial results of the cat-baiting program were equivocal. The activity indexes suggested there was a sharp decline in cat activity after baiting in June which persisted to August, after which activity began to increase (Figure 23). In the comparison area, cat activity also declined from May to June, with stable activity to September, after which activity increased as on the treatment site. Additional data will be required to better understand and interpret the relationship between baiting and cat activity. The results reported in the scorecard are the median General Activity Indices for the 12-month monitoring period.

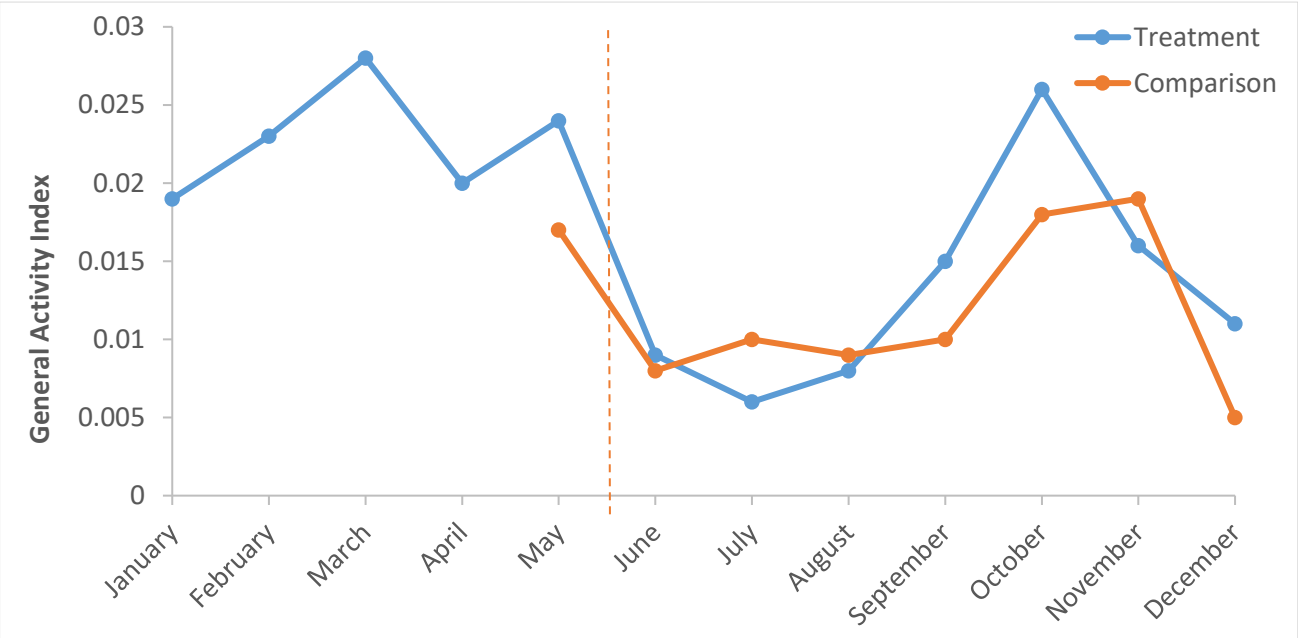


Figure 23. Monthly general activity estimates for cat activity in the treatment and comparison areas during 2020. The comparison cameras were deployed in May 2020. The red dashed line represents when aerial baiting took place.

Foxes

During the Feral Predator Camera Survey in 2020, only two fox detections occurred, one in each array (occupancy: 0.01 treatment area; and 0.03 comparison area).

Fire

No planned or unplanned fires occurred on Mt Gibson in 2020.

Discussion

The results of this monitoring program show that seven of the eight species of mammals reintroduced to Mt Gibson are meeting success criteria relevant to the stages of translocation, with increases in occupancy (increase in distribution across the fenced area). The Woylie population continued to increase and has reached the point where the population may be harvested to help establish or supplement reintroductions at other sites. These results demonstrate the effectiveness of the fenced area on Mt Gibson in protecting threatened species from feral predators and large herbivores. The remaining species, Shark Bay Mouse, has not been detected for several years. This species is only part way through its proposed reintroduction.

The Feral Predator Camera Survey provided data on the activity of feral cats and foxes outside the fence at Mt Gibson and their response to a baiting program. The first year of data reported here showed a decline in cat activity after baiting on the treatment area, but a similar decline was also observed on the comparison area, so the results may be seasonal rather than an effect of baiting. This work will continue to inform the planned reintroduction of Brushtail Possums and Chuditch outside of the fenced area in coming years.

Acknowledgments

We acknowledge and pay respect to all First Nations people and their country, the land on which we live, learn and work. We acknowledge and pay respect to the Badimia people – the traditional owners of the country on which Mt Gibson falls, and respectfully acknowledge their connection to native wildlife, waters, country and culture.

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

Thank-you to the entire South-West Science and Operations teams for their hard work at Mt Gibson that has made the running and collection of data from all our surveys possible.

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