Fortescue Marsh Feral Cat Baiting Program

(Christmas Creek Water Management Scheme)

Year 4

Annual Report

November 2015

Department of
Parks and Wildlife

Prepared by

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Front cover Plate 1: Feral cat at camera trap C8; in the centre of Fortescue Marsh.

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The following permits were obtained to conduct this work:

- Capture and radio collaring of feral cats was conducted under Department of Parks and Wildlife Animal Ethics Committee permit AEC2013/07
- The Australian Pesticides and Veterinary Medicines Authority issued PER14102ver2 allowing the use of the feral cat bait *Eradicat*® on the Fortescue Marsh

Contents

Summary

Investigations into the use of the toxic *Eradicat*® cat bait to control the feral cat (*Felis catus)* is being undertaken at a number of locations in Western Australia under the Australian Pesticides and Veterinary Medicines Authority research permit PER14102ver2. The work being conducted on the Fortescue Marsh is being implemented in an adaptive framework to determine the most efficient and cost effective method to target feral cats in this environment.

Fortescue Metals Group (Fortescue) is aiming to reduce feral cat abundance on the Fortescue Marsh as part of the environmental conditions of the Environmental Protection and Biodiversity Conservation Act (EPBC Act). In doing so, this program aims to provide respite to the native fauna of this environment, in particular, the threatened species listed under the Act. This five-year program began in 2012 with monitoring of baiting efficacy through camera surveillance and radio-telemetry collars.

In 2015, *Eradicat*® baits were aerially distributed over a 896 km² area of the Fortescue Marsh in mid-July. Eighteen feral cats trapped within the treatment area were monitored with radio-collars and the probability of occupancy was assessed prior to, and following baiting using camera traps at 44 treatment and 24 control sites.

Eradicat® baiting of the Fortescue Marsh resulted in a 30% knock-down of radio-collared feral cats. This impact was supported by occupancy modelling using remote camera data, which also demonstrated a significant effect of baiting in the treatment cell when compared to a control. Random models detected decline in occupancy of approximately 20% and spatial models detected a decline of 15%. Models were run with previously collected camera data and methods which confirmed the significance of the baiting treatment in the four years of operation from 2012 to 2015, and also the value of remote cameras for occupancy modelling to be used as a method of monitoring baiting efficacy.

Survey efforts focussed on detecting EPBC listed species including the Bilby (*Macrotis lagotis*) , Mulgara (*Dasycercus cristicauda*) and Night Parrot (*Pezoporus occidentalis*) were successful in detecting Mulgara at one of the five sites targeted. The identification of this species is almost certainly *Dasycercus blythii* – the Brush-tailed Mulgara a species that is not listed as Threatened Fauna under the EPBC Act. No other individuals of these species were detected on cameras. Audio units programmed to specifically detect Night Parrots were setup at 14 sites. The data from these units has been analysed for other target bird species but the analysis for Night Parrots is to be conducted outside of this project. Due to unavailability of reference files this analysis is being performed by another contractor.

1 Background

The Department of Parks and Wildlife is implementing Fortescue Metals Group's Fortescue Marsh Baiting Plan (FMG, 2011) to satisfy Condition 16 of the EPBC Act approval 2010/5706, which is aimed at improving protection and long-term conservation of EPBC Act listed species in the Fortescue Marsh. The baiting program is meeting specific targets for Fortescue which include:

a) comprehensive landscape scale feral cat baiting program (across a minimum 150,000 ha (1,500 km²)) on the area proposed as conservation estate on the Fortescue Marsh;
b) a baiting program developed with expert advice, defining intensity and frequency of baiting in order to maximise the benefits of removal of feral cats to EPBC Act listed threatened and migratory species;
c) monitoring of feral cat populations and EPBC Act listed threatened and migratory species.

The Fortescue Marsh was covered by a number of pastoral leases. In July this year portions of the leases were relinquished and returned to the State as Unallocated Crown Land (UCL).

Until early this year, landscape scale baiting of feral cats using *Eradicat*® was in an experimental phase with this project covered under Experimental Permit issued by the Australian Pesticides and Veterinary Medicines Authority No. PER14102. The registration of *Eradicat*® will not alter the way in which the rest of this project is delivered.

This project was designed in an adaptive management framework, and with consideration of similar projects managed by the Department of Parks and Wildlife elsewhere in Western Australia in order to maximise learning outcomes.

The overall treatment cell encompasses an area of 1,240 km² (Figure 1) and is located at the eastern end of the study area, where the Marsh is at its widest. The baiting program commenced in 2012 with a total area of 838 km^2 baited with *Eradicat*®. This area was again baited in 2013, with an increased treatment site for 2014 and 2015 of 920 km² and 896 km² respectively.

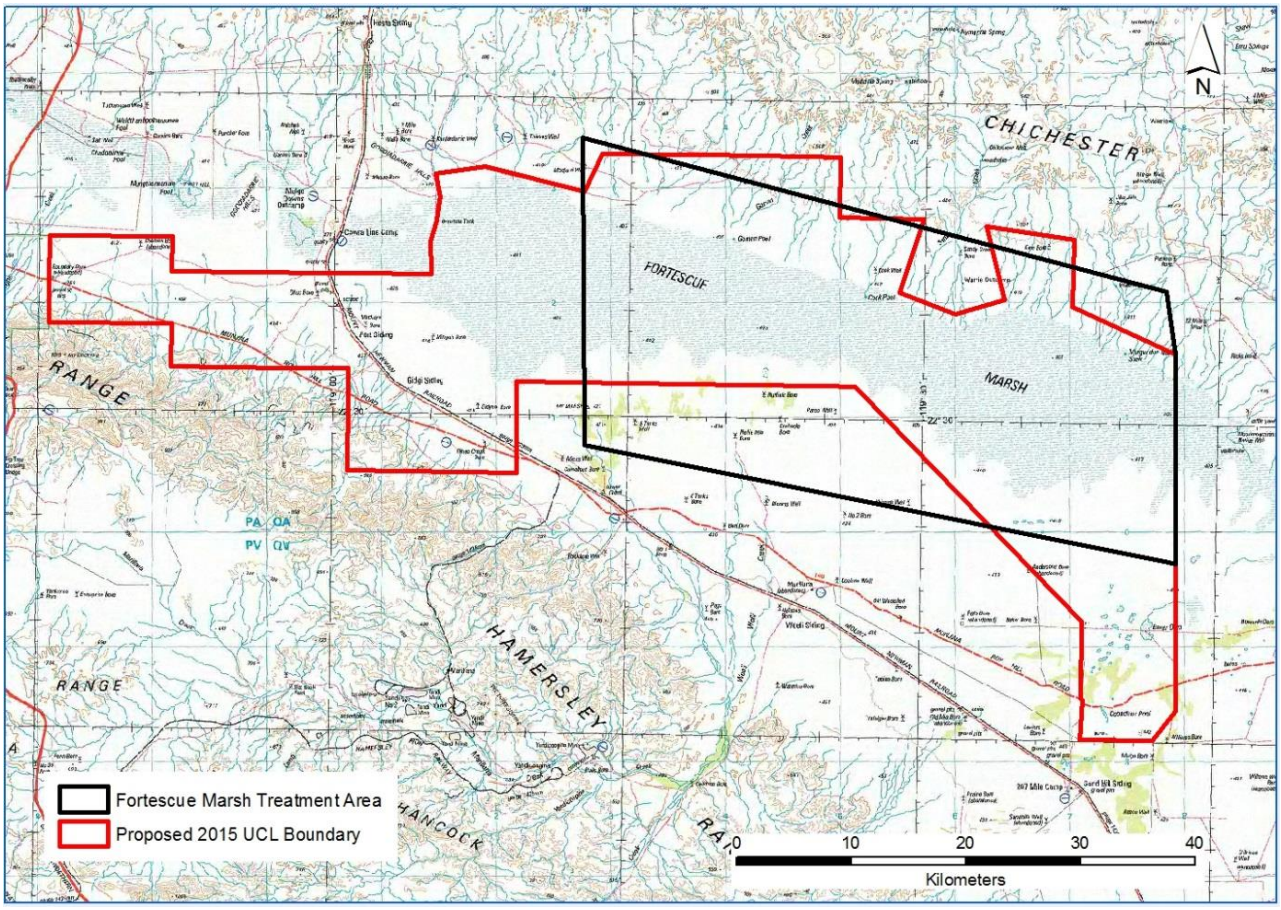


Figure 1. The treatment area boundary (black) with the proposed boundary of land that was relinquished from pastoral lease this year.

1.1 Site Description

The Fortescue Marsh is an extensive intermittent wetland situated at 22^0 26' 44" S, 119^0 26' 38" E, in the Pilbara region of Western Australia. It is located in the Pilbara Craton (Hamersley Basin) and has the form of a broad valley or small plain that lies between the Chichester and Hamersley Ranges. The Marsh occupies an area of approximately 1,000 km^2 when in flood (DEWHA 2008b) (Figure 2).

McKenzie *et al*. (2009) provide a succinct summary of the vegetation, climate and physiographic environment of the Pilbara as it relates to the biota. Climatic conditions in the Pilbara are influenced by tropical cyclone systems that predominately occur between January and March. The majority of rainfall received in the Pilbara is associated with these systems. The long-term average annual rainfall is 312 mm at Newman (Fortescue 2009). Temperatures are high, with summer maxima typically 35–40 °C and winter maxima 22–30 °C.

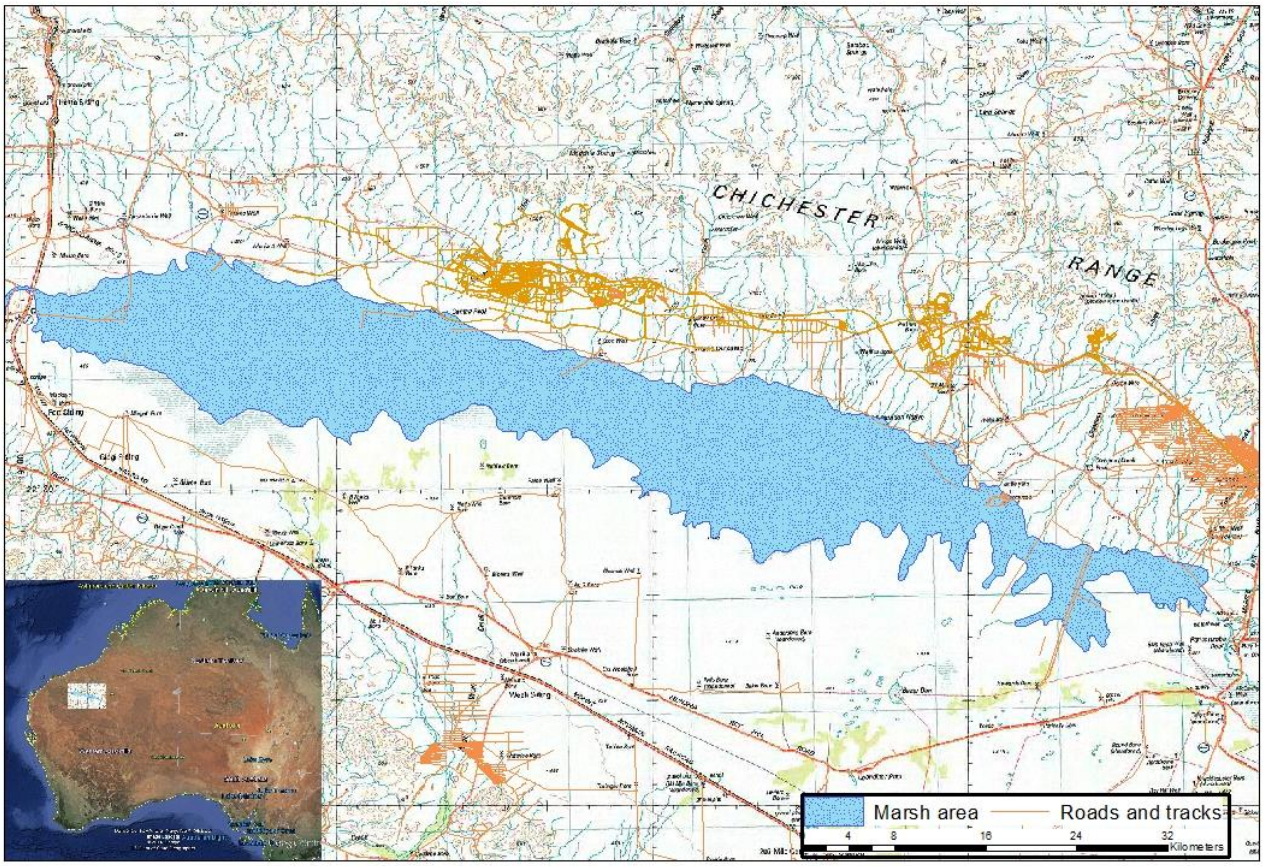


Figure 2. Location and regional setting of the Fortescue Marsh

Botanical surveys conducted for Fortescue's Cloud Break Iron Ore Project Public Environmental Review included descriptions of the fringing vegetation of the Marsh. Five distinct vegetation communities identified by Mattiske Consulting Services (2005) (cited in Fortescue 2009), have been used to describe the vegetation at each monitoring site. These include the following vegetation descriptions:

1. Low woodland to low open forest which occurs within the creek and drainage lines leading into the Marsh;
2. Hummock grassland of *Triodia angusta* with patches of *Acacia*;
3. Low halophytic shrubland of *Tecticornia auriculata* and *T. indica* with associated chenopods. This vegetation community adjoins the low woodland to low open forest;
4. Low halophytic shrubland of *T. auriculata*, *T. indica*, *T. halocnemoides* with patches of *Frankenia* species. This is the predominant vegetation community along the fringes of the Marsh; and
5. Hummock grassland of *Triodia angusta* with patches of *Acacia victoriae* over *Atriplex codonocarpa* and mixed chenopods and Poaceae species.

1.2 Planned Actions and Achievements

The Proposed Management Plan for Baiting Feral Cats on the Fortescue Marsh (Christmas Creek Water Management Scheme 2011) suggested an indicative works plan (Table 1) which was approved by the Commonwealth as part of Fortescue Metals Group's offset conditions. This plan has been the basis for the annual works program that has been adapted according to contemporary findings.

Table 1. Works program as per Algar *et al*. (2011) with timings and achievements for 2015

Activity	*Action*	*Completion Date*	*Achievement*
Planning	• Baiting approvals and Risk assessment. • Department of Parks and Wildlife invoice Fortescue for funding to support current years baiting program. • Evidence of Fortescue funding support for the plan provided to Department of Parks and Wildlife.	• 1 May • 1 Feb • 15 Feb	• Risk Assessments completed • Funds transferred • Liaison through email
Stakeholder liaison	• Consent and indemnity letters	• 1 May	• Completed
Monitoring and survey program	• Select and establish treatment and control sites. • Set up camera trap monitoring stations. • Complete cat trapping and radio-collaring. • Establish surveyed trapping grids for Northern Quoll and Mulgara. • Complete Northern Quoll radio-collar monitoring. • Service monitoring trap stations	• 13 – 22 May • 4 – 10 June • 5 – 22 May • Jun - Sept ('Native' - Mulgara and Bilby cameras) • Not applicable • 30 Jun – 5 July	• 44 and 24 cameras established as Treatment and Control Cells respectively • 20 feral cats captured, 18 collared • 15 cameras set at older plant communities, targeting fresh diggings • Cameras turned off and lures removed
Monitoring flights	• Conduct monitoring flights/ground traverses to locate and ensure all radio-collared animals are alive prior to bait delivery.	• 30 Jun	• 10/18 collars detected. 1 cat deceased.

Activity	*Action*	*Completion Date*	*Achievement*
Bait delivery	• Bait preparation	• 15 & 16 July	• 42,000 baits delivered across 89,600 ha (896 km^2) over 1.5 days
Bird surveys	• Set up program and conduct surveys. • Service monitoring trap stations.	• 30 June – 5 Aug	• 14 Autonomous Recording Units (ARU) deployed
Monitoring flights	• Conduct monitoring flights/ground traverses to ensure the status of collared animal • Radio collar retrieval • Bird surveys	• 30 Aug • See above • 5 May – 1 Sept	• 10/17 collar located and retrieved. • See above • See bird list in Appendix 1
Complete Program	• Complete bird surveys • Complete camera survey	• 5 May – 1 Sept • 5 May – 1 Sept	• 11/14 ARUs recorded for whole survey, the other three only in part • 3,025 camera trap-nights
Program Evaluation	• Baiting efficacy results review • Activity and patterns of home range use • Review of monitoring data for radio-collared Northern Quolls and Mulgara	• Sept – Oct • Sept – Oct • Camera surveys instead May - Sept	• This report • This report • 1420 camera trap-nights
Reporting to FMG	• Report prepared on previous 12 months of activity and submitted to Fortescue	• This report	
Report to DotE	• Annual report of results from implementation of the plan and monitoring effectiveness submitted by Fortescue to Department of the Environment. • Annual monitoring results published on the web by Fortescue.	• This report • To be completed by Fortescue	

The previous year's operations resulted in the following recommendations being suggested for the 2015 program:

1) *An unusually high number (four) of feral cat mortalities occurred prior to baiting. At least two of these are most likely due to the trapping. One individual was predated by a bird of prey which is likely due to the cat's inability to recover sufficiently to escape an attack after having all four legs caught in the trap. In future, №1.5 leg-hold traps will be employed to minimise the impact of injury during trapping.*
2) *Establish a temporary weather station on the Marsh for the period just prior to baiting and for three weeks afterwards.*
3) *SoundID provides a unique and useful tool for the analysis of ARU recordings for bird calls. It was highly efficient at detecting the calls of fairy-wrens, even on poor quality recordings (i.e. with wind or other interference). However, the process can be time consuming, especially when only poor quality recordings are available for developing reference libraries. Future work should concentrate on acquiring better recordings of other potential monitoring targets (e.g. Night Parrot (Pezoporus occidentalis), Crested Bellbird (Oreoica gutturalis), Australasian Pipit (Anthus novaeseelandiae), Spinifexbird (Eremiornis carteri)), as well as augmenting existing reference libraries for other species. The process of developing an automated approach to ARU analysis has also informed the approach that future ARU surveys should use (i.e. ARU settings).*
4) *Further targeted camera surveys to be conducted for Mulgara and Bilby.*

2 Method

2.1 Timing

Field work for this project is based on the optimal time for baiting, that is, when feral cats are most likely to encounter and consume a bait. This has been determined as mid-winter to minimise the chance of rainfall and to reduce the loss of baits to reptiles. With this in mind, trapping and collaring of feral cats and establishing the camera surveillance grid needs to occur in autumn.

2.2 Study Area

In 2015, the study area has remained the same as per Tiller *et al*. (2012). High rainfall in late autumn resulted in the presence of surface water and a saturated water table from May and throughout the whole of winter. This limited access to many areas of the Marsh.

The design of a treatment cell (where *Eradicat*® baits would be distributed) and a control cell (where no baits are distributed) was again employed in 2015.

2.2.1 Treatment Cell

The designated area for baiting was determined in the first year of the study based on the understanding that variable water levels would impact on the actual area baited each year. The overall treatment cell encompasses an area of 1,240 km² and is located at the eastern end of the study area.

In 2015, late autumn rain severely limited staff from accessing many parts of the Marsh. The treatment cell from 2014 was maintained (with only a slight adjustment for a pastoral lease relinquishment) for the purposes of bait deployment with the area monitored reduced to 80% of the treatment area. The result was a treatment cell of 998 km² (Figure 3) with the understanding that the true area available for baiting would be less to allow for space taken by the surface water at the time of bait drop.

2.2.2 Control Cell

The control cell encompasses an area of 436 km² (Figure 3). Access to the area deemed as the control was also affected by the raised water table in May, requiring a reduced monitoring area to be used in 2015. Effectively only 80% of the cameras sites were able to be accessed.

The independence between the treatment and control cells was maintained with a buffer of a minimum of 5 km to separate treatment and control monitoring sites. This distance is estimated to be at least one average feral cat home range (D. Algar unpub. data).

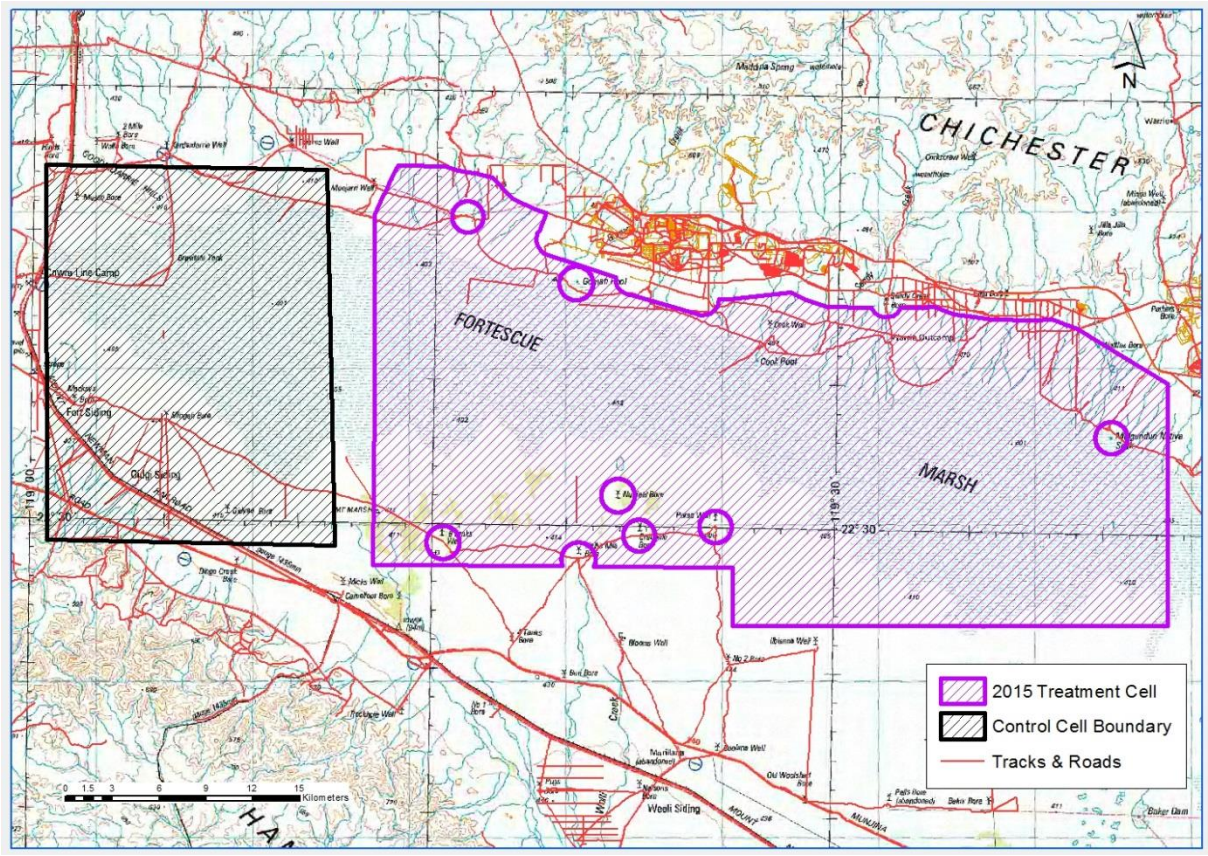


Figure 3. The survey area for 2015. Due to heavy rain in autumn only 80% of the survey area was able to be monitored. Bait exclusion areas around active water bores and wells are represented as circles.

2.3 Weather and Climatic Influences

There is limited access to accurate climatic data for the Marsh. The nearest weather station with regular information is the Cloudbreak gauge that is located within the mining footprint. Accurate data from the Christmas Creek weather station were also supplied by the Fortescue Environment team.

As per the *2014 Recommendation 2*, a portable weather station was installed in the centre of the treatment cell to collect climatic data for the duration that the *Eradicat*® baits would be active (Plate). Data were collected from 3/7/15 to 7/8/15.

Meteorological data for this study are focussed around the time of baiting to monitor for precipitation and relative humidity both of which, if at high enough levels, can impact on the effectiveness of bait uptake due to reduced palatability and toxicity of the *Eradicat*® baits.

Plate 2. A temporary weather station was erected in July in the centre of the treatment cell to gather data on climatic conditions during the baiting period. **Photo: S.Cowen**

2.4 Baits and Baiting

The feral cat bait (*Eradicat*®) used in the Fortescue Marsh baiting program is manufactured at the Department of Parks and Wildlife's Bait Manufacturing Facility at Harvey, Western Australia. The bait is similar to a chipolata sausage in appearance, approximately 20 g wet-weight, dried to 15 g, blanched and then frozen. This bait is composed of 70% kangaroo meat mince, 20% chicken fat and 10% digest and flavour enhancers (Patent No. AU 781829). Toxic feral cat baits are dosed at a rate of 4.5 mg of sodium fluoroacetate (compound 1080) per bait. All feral cat baits are sprayed during the sweating process with an ant deterrent compound (Coopex®) at a concentration of 12.5 g l^{-1} as per the manufacturer's instructions. This process is aimed at preventing bait degradation by ant attack and enhancing acceptance of baits to cats by limiting the physical presence of ants on and around the bait.

Baiting operations were conducted under an 'Experimental Permit' (Permit No. PER14102ver2) issued by the Australian Pesticides and Veterinary Medicines Authority and governed by the 'Code of Practice on the Use and Management of 1080' (Health Department, Western Australia) and associated '1080 Baiting Risk Assessment'.

Frozen baits were transported to the Munjina airstrip in the dedicated Western Shield bait truck. On the morning of 15 July, 50,000 baits were arranged on established bait racks at the Munjina airstrip such that they were in direct sunlight to thaw and 'sweat'. This process causes the oils and lipid-soluble digest material to exude from the surface of the bait making the bait more attractive to feral cats. A Beechcraft Baron B58 twin-engine aircraft (Thunderbird Aero Service, Western Australia) fitted with computerised, GPS-linked equipment was used to deploy the baits to ensure accurate application. A series of panel lights indicates to the bombardier when to release the baits, with a GPS-linked mechanism used to prevent the application of baits outside the programmed bait cell. The location of the aircraft was logged each time baits were released. Fifty baits per km^2 are distributed through a carousel to give an approximate 200 m long by 40 m wide bait swathe.

2.5 Feral Cats

As with previous years, a two-pronged approach to measuring baiting efficacy was implemented. Firstly, a measure of direct mortality was obtained from radio-collared cats, and secondly, site-occupancy indices of pre- and post-baiting were obtained through camera trapping.

Genetic analysis can assist with identifying the relationship of animals located in areas with significant human infrastructure to the feral cat population within the Marsh. Although beyond the scope of the annual program, samples were (and will continue to be) collected and analysed in the final year of the program.

2.5.1 Trapping and GPS/VHS Collaring

Feral cat trapping was conducted under ethics approval AEC2013/07. The trapping technique involved the use of padded leg-hold traps Victor 'Soft Catch'® traps №1.5 (Woodstream Corp., Lititz, Pa.; U.S.A.), the smaller trap was employed as per *2014 Recommendation 1*, with cat faeces and urine used as the attractant. Trap sets were parallel to tracks, along the verge, every 0.5 km. Open-ended trap sets were employed with two traps positioned lengthwise (adjoining springs touching) and vegetation/sticks used as a barrier along the trap sides. Analysis of the 2014 post-bait camera data assisted with determining the area for trapping. Three trap transects were established, one on the north of the Marsh, one in the middle and the west of the treatment cell and the third on the south side of the Marsh (Figure 4).

Trapped cats were sedated with an intramuscular injection of 4 mg/kg Zoletil 100® (Virbac, Milperra, Australia). All animals captured were sexed, weighed and had coat colour recorded. A broad estimation of age (either kitten, juvenile or adult) was registered using weight and signs of breeding as a proxy for age. Hair samples and an ear notch were collected for DNA analysis. A GPS/VHF radio-telemetry collar with mortality signal (ATS, Minnesota, USA) and remote download capabilities was fitted to each feral cat caught that had a weight over 1800 g. The collars were programmed to initially take three GPS fixes per day (0500, 1200 and 2000) up until 27 May to allow for collar battery longevity and to take into account at least four weeks of 24 fixes per day data being collected prior to baiting. From late May until the end of September the collars were programmed to take a location fix every 60 minutes and to go into mortality mode at 12 hours of inactivity. All cats were released at the site of capture.

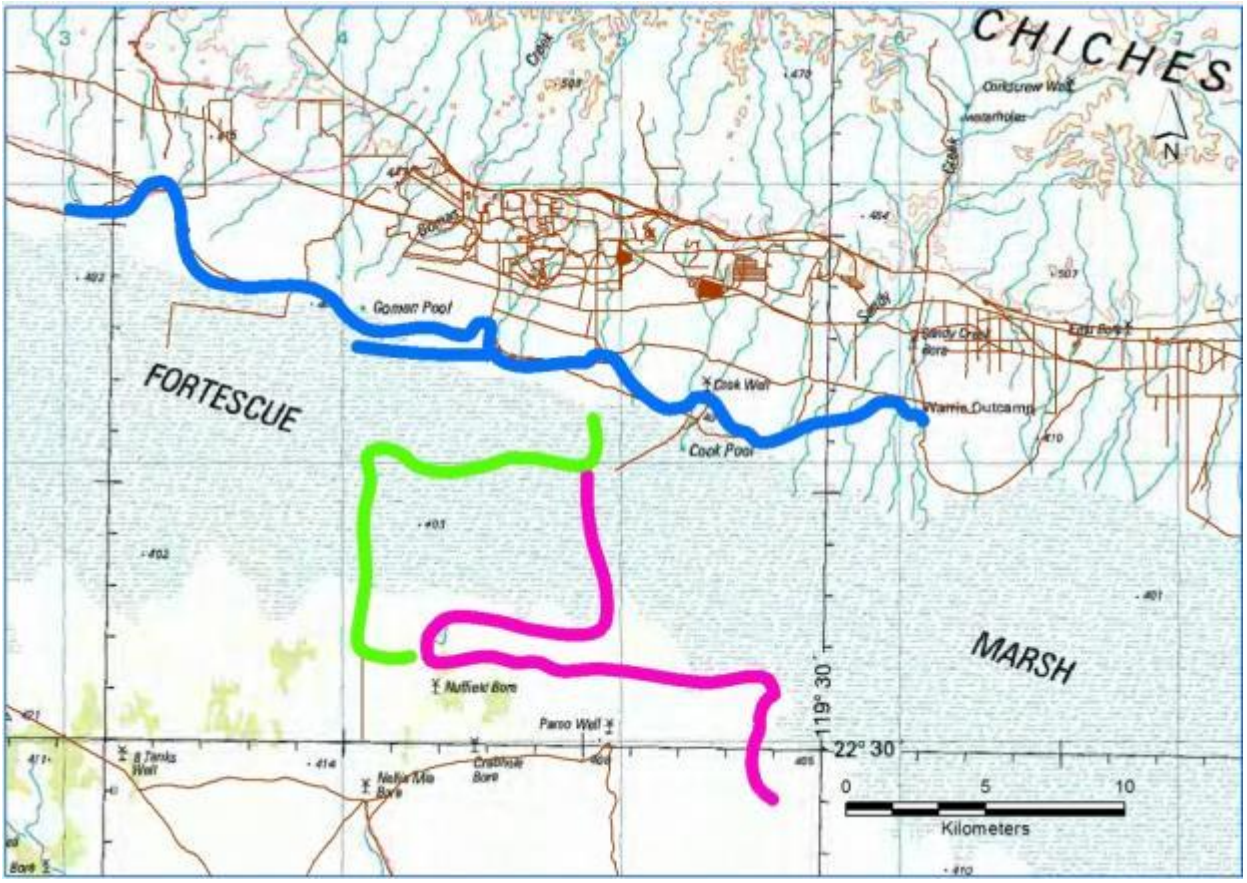


Figure 4. Three feral cat trapping transects were operated for nine nights in May, 2015

2.5.2 Monitoring and Recovery of Radio-collars

Monitoring of collars was scheduled as two helicopter flights. The first is conducted prior to baiting to ensure there are collared cats still on-site and the second several weeks after baiting to assist with collar retrieval. In between these flights, opportunistic locating of collars was attempted from the ground, during other scheduled works.

GPS data obtained from collars were filtered to remove points from 1) the day of collar attachment until the day when 24 fixes started (27 May); 2) points after the day the collar was recorded motionless; 3) all points where the collar failed to collect a location (e.g. cat in sheltered

den site) and 4) inaccurate points where the Horizontal Dilution of Precision (HDOP) was greater than five.

Home range sizes were calculated using the minimum convex polygon (MCP) method, which creates a convex polygon around the smallest polygon that encompasses a specific proportion of the GPS locations for that animal (White and Garrot 1991). In this study 95% of points were used, where 5 % of data points furthest from the sample mean were removed. This was to reduce the impact of outliers on home range estimates. Only samples with a minimum of three weeks data (i.e. 504 data points) were used. Home range analysis was completed using the Animove for QGIS 1.4.2 Plugin in Quantum 2.8.1 Wien.

2.5.3 Site Occupancy using Remote Surveillance Cameras

An occupancy model using detection histories at camera sites across the Marsh was used to generate a probability of a particular site being occupied by a feral cat rather than just presence/absence. To determine the impact of the baiting program the camera grid was operating in both the treatment and control sites allowing the calculation of occupancy before and after baiting.

In 2015 site occupancy was determined using Bayesian occupancy models, with modelled random effects and spatial component. Bayesian modelling was chosen for occupancy modelling rather than conventional software (such as Presence) as Bayesian techniques offer the potential to model spatial autocorrelation and can utilise datasets where data may be incomplete. One of the assumptions of occupancy modelling is that an individual will not appear on more than one camera within the analysis period (ie. the pre or post-bait trapping session). Incorporating a spatial autocorrelation variable allows the model to compensate for any possible movements of cats between cameras. The model can also incorporate a random effects component which accounts for any unaccounted heterogeneity (e.g. habitat factors not included in the model).

The probability of detection is based on meeting four assumptions as detailed in MacKenzie *et al*. (2006): population closure; no un-modelled heterogeneity in occupancy; no un-modelled heterogeneity in detection and detection histories at each site are independent.

In 2015 two occupancy models were run in WinBUGS 1.4 (statistical software used for Bayesian analysis) to examine the impact of baiting on the feral cat populations. The first includes a random effects component (i.e. it assumes that detection probability is not constant) and the second model incorporates a spatial component to model the potential impact of an individual cat appearing on more than one camera. Both models were run with a burn in of 5,000 iterations before sampling for 5,000 iterations for both pre- and post-baiting data.

For the Fortescue cat baiting work, each year is treated as an independent event testing the impact of cat baiting. Therefore, comparison of baiting efficacy pre- and post-bait delivery in the year of treatment is the aim of occupancy modelling, rather than comparison between years. Comparisons between years do not give an accurate assessment of long-term cat baiting, as the system is not closed between years, and cats are able to migrate into the areas left unoccupied by individuals removed by baiting. However, with a sustained baiting effort, it can be expected that occupancy would decrease over time unless immigration or reinvasion rates are high.

During 4–9 June, the treatment and control camera-trap grids were established on 3 km^2 spacing. Twenty-four camera-trap survey sites were established as the control cell and 44 sites were

established as the treatment or baited cell (Figure 5). Survey sites in the control cells were located a minimum of 5 km (which at the time of project design was the estimated radius of the home range of a feral cat) from the boundary of the baited cell.

Cameras (HC600; Reconyx, Wisconsin, USA) were set horizontally, approximately 30 cm from the ground. Cameras were set on "Scrape" program which records five pictures per trigger, and picture interval is on 'RapidFire' which is two frames per second. There is no quiet period.

Lures for the camera-trap surveys are set at approximately 3 m from the camera. A 100 ml glass jar with holed sifter lid containing approximately 15 ml of an oil-based scented lure ('Catastrophic', Outfoxed, Victoria) was attached to a wooden stake approximately 30 cm from the ground. A 1.5 m long bamboo cane was joined to the wooden stake, with white turkey feathers connected to the cane approximately 30 cm above the scented lure and a strip of wired silver tinsel was taped to the top of the cane (Plate).

For the occupancy modelling, a capture event is considered within a 24 hour period from midday to midday with a presence/absence result recorded.

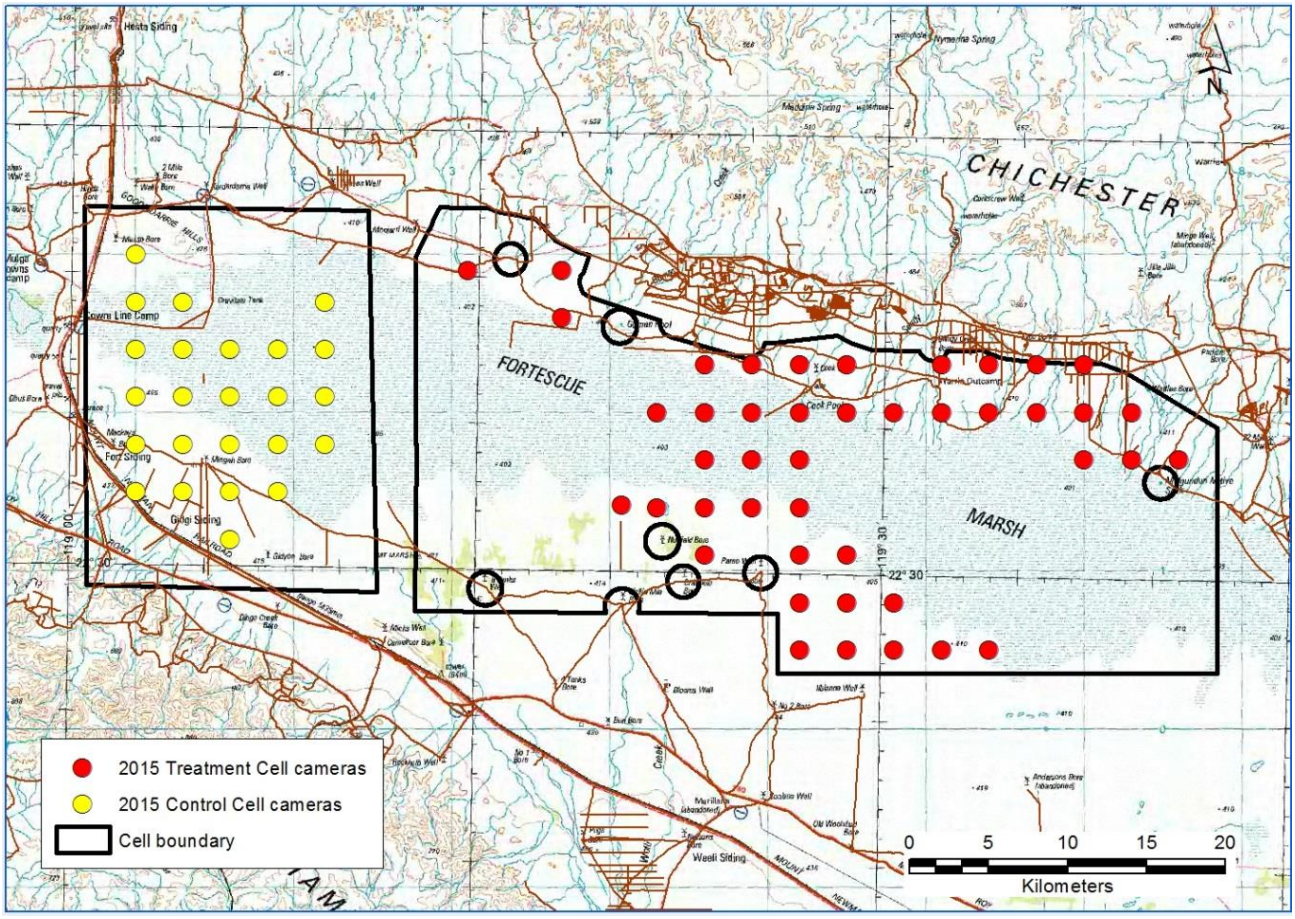


Figure 5. Remote surveillance camera grids for the control and treatment cells in 2015.

Plate 3. IFRP staff member Andrew Chapman sets a remote-camera trap in wet conditions on the north of the Marsh. **Photo: J.Pinder**

2.6 Non-target Species

2.6.1 Birds

Sites selected for bird surveys followed on from the method employed in previous years where Autonomous Recording Units (ARUs) (Song Meter SM2+, Wildlife Acoustics, Massachusetts, USA) were placed close to existing camera-trap survey locations. ARU sites were selected on the basis of habitat characteristics with the assumption that relationships with habitat diversity (i.e. species and structure) would be correlated for both cats and birds. Each camera-trap survey point was ranked on vegetation coverage, structure and type. Locations with high coverage of native vegetation (e.g. spinifex (*Triodia* spp.)) and structural diversity were given preference over locations with non-native species (e.g. buffel grass (*Cenchrus ciliaris*)), low coverage and low structural diversity (e.g. bare ground) (Figure 6).

Fourteen ARUs were set to record two, three hour periods each day from 1 July – 8 August. The first period started one hour prior to sunrise and the second would begin two hours prior to sunset thus incorporating one hour after dark and therefore the main time when Night Parrots (*Pezoporus occidentalis*) would be calling (Murphy 2015).

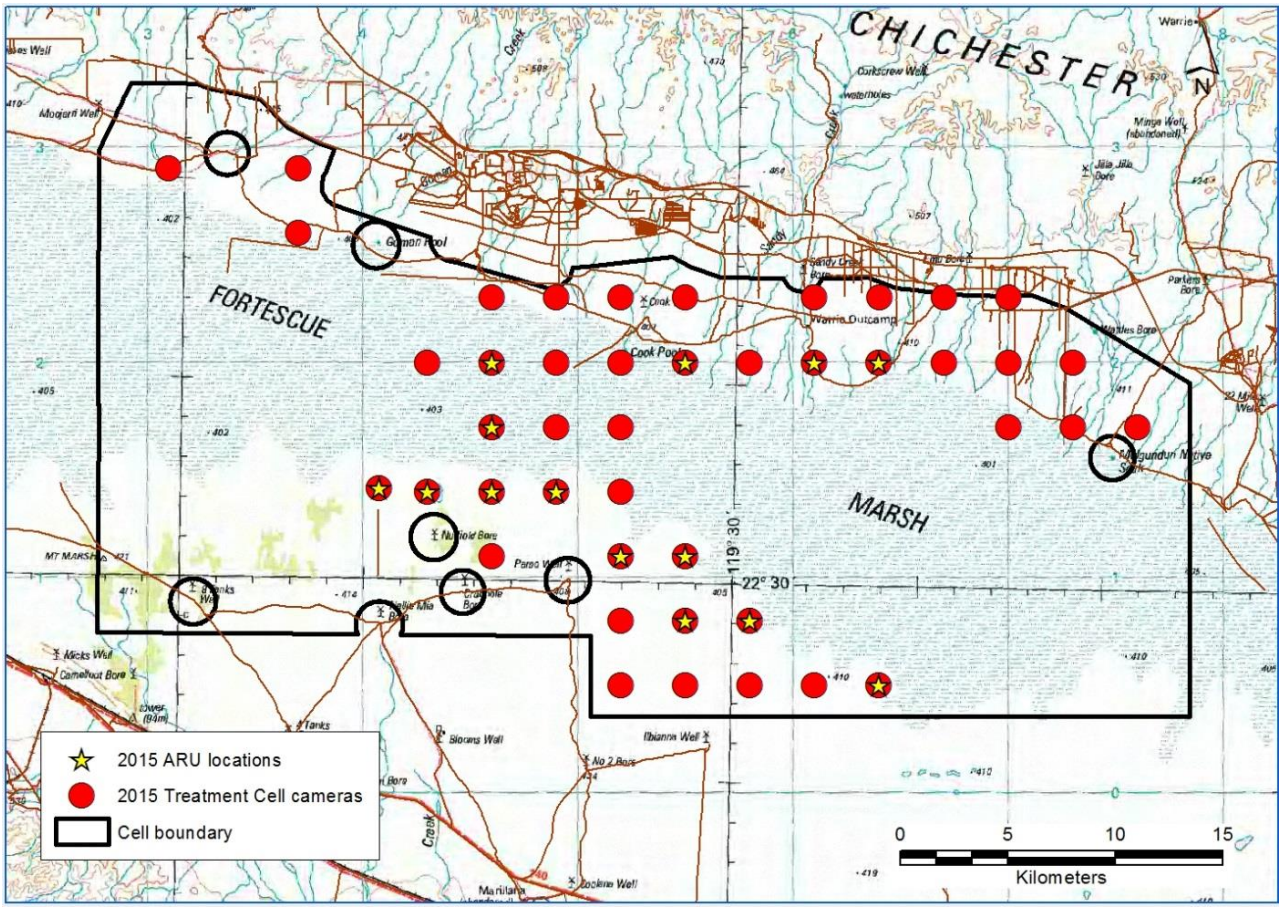


Figure 6. Autonomous Recording Unit (ARU) locations in relation to Treatment Cell cameras.

Analysis employed the use of sound recognition software SoundID (version 6.00.1) using the Recognition 1-D module in the 64bit beta version for the five targeted species. Bird species selected for analysis are those identified as potential monitoring targets in the Fortescue Marsh Baiting Plan (Algar *et al.* 2011).

SoundID requires good quality, 'clean' reference calls to develop a reference library to use in the analysis. In 2012, the IFRP field team recorded the calls of a number of species using a Marantz™ recording unit. Of these calls, only a few were of potential monitoring targets and of sufficient quality to use in a reference library. The development and testing of the reference libraries was time-consuming but now established and can be used to analyse future recordings as well as recordings from 2013.

In 2015, a fourth reference library for Crested Bellbird (*Oreoica guttaralis*) has been added, using calls recorded in the field this year. This was used along with the three reference libraries that were constructed in 2014 for Crested Pigeon (*Ocyphaps lophotes*), Variegated Fairy-wren (*Malurus lamberti*) and Red-capped Robin (*Petroica goodenovii*). Variegated Fairy-wren reference calls could also be used to recognise calls of White-winged Fairy-wren (*Malurus leucopterus*), which is also a potential monitoring target.

In addition to ARU recordings, species observed/heard directly during the course of the 2015 field work were noted as well as a number of species which were captured on camera-traps. These records are included in the bird species list for the area (Appendix 1).

2.6.2 EPBC Act Listed Mammals

The Northern Quoll (*Dasyurus hallucatus*), Greater Bilby (*Macrotis lagotis*) and Crest-tailed Mulgara (*Dasycercus cristicauda*) have been recorded in proximity to the survey area in the last twenty years (Davis et al 2005). In the first year of this program (2012), a search was conducted to within 5 km of the survey area for critical Northern Quoll habitat. No suitable habitat was found and no further effort has been made to detect this species, other than through incidental findings.

In 2014 camera-traps were used in an attempt to detect Bilby or Mulgara at several locations within the survey area. Photographs on the 'Mulgara cameras' were dominated by Spinifex Hopping-mice and did not include records of any of the target species. Nor did any of the photographs from the 'Bilby cameras'. As per *2014 Recommendation 4*, further reconnaissance surveys were conducted across the study area during the feral cat trapping work in 2015, with new locations identified and monitored for Bilby and Mulgara (Figure 7).

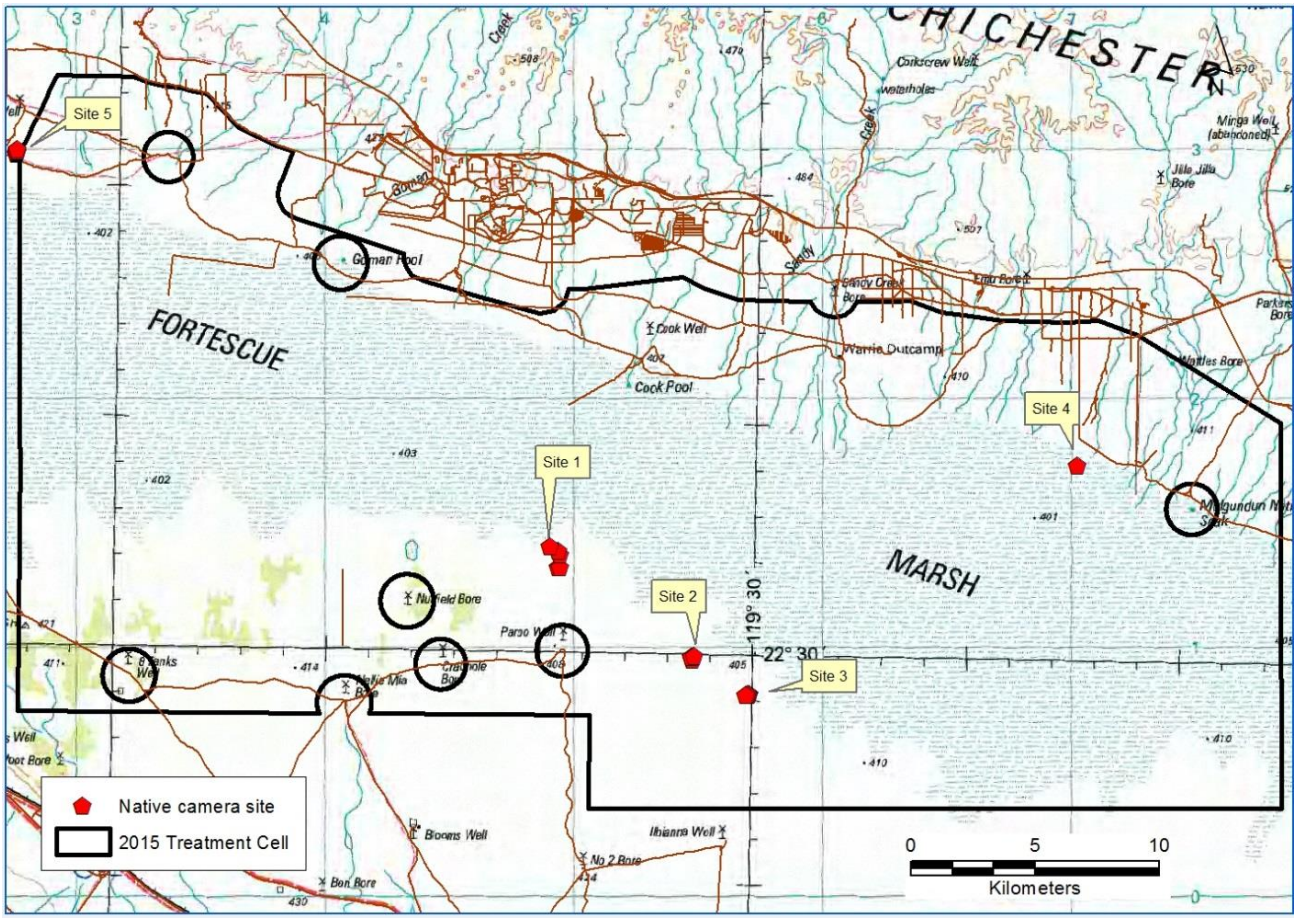


Figure 7. Location of Bilby/Mulgara-targeted cameras.

Five cameras (HC600; Reconyx, Wisconsin, USA) were deployed at Sites 1 and 2, targeting native species across a 2 ha area. Site 3 had four cameras and Site 4 was a single camera placed as a reconnaissance for Bilby activity amongst an area of burrows. All cameras were mounted on pegs approximately 15 cm above the ground, facing an area where there were diggings or an area where an animal might be funnelled by natural features. These were set 3 m from the target for the duration of the feral cat camera-trap survey. An additional five cameras were opportunistically deployed after the baiting at Site 5. These were located outside of the treatment area for a three week survey period. All cameras were set to the 'Scrape' program which records five pictures per trigger, and picture interval was on 'RapidFire' which is two frames per second with no quiet

period. No cameras were actively lured. A capture event is determined as the presence of an animal, on a single occasion at a camera trap with an independence interval of five minutes.

2.6.3 Incidental Records

Incidental records (sightings, scats, tracks, diggings and images obtained through non-targeted camera-trap surveys) of non-target native species, particularly listed threatened species, were also collected opportunistically during survey work.

Records were designated either as in the treatment and/or control cells or solely recorded in areas immediately adjacent to these cells (e.g. Kardardarrie Well or Cloudbreak Mine and camp).

3 Results

3.1 Weather and baiting

Areas of the Pilbara experienced a relatively dry summer in 2015, with no cyclone activity bringing the rains typical for this time of year. However, wet conditions began in autumn with over 116 mm being recorded in March at the Cloudbreak weather station and a further 135 mm recorded late in April (HSE; Fortescue, 2015). Even with this late rain, conditions on the Marsh were reasonable to start work in mid-May with access across most of the survey area. Cat trapping was undertaken and completed just prior to another rainstorm on 21 May that continued for a week, with rainfall accumulating to over 160 mm.

With little runoff, the water table on the Marsh rose close to the surface causing unperceived issues with access. By sight, the ground appeared firm but the water table had risen to be approximately 10 cm under the surface for most of the mapped Marsh area. This reduced access, resulting in a delay in setting cameras as well as reducing the number being able to be deployed and also put back the planned bait delivery timing. A reduced but still statistically adequate, camera monitoring array was implemented for both the treatment and control cells. This equated to 80% of the effort of 2014.

At the time of the bait delivery (15 & 16 July 15) most of the surface water had either evaporated or soaked in, resulting in the area baited being equating 896 km², which totalled as 42,000 baits.

The temporary weather station that was installed for the period of the baiting experienced a corruption in the data during download and was unable to be retrieved for analysis. The next nearest weather station was Cloudbreak; however, this station also experienced technical difficulties and did not record temperatures after May 2015. As a result, data have been used from both the Cloudbreak station and from the third nearest weather station, Christmas Creek camp offices.

Rainfall and relative humidity are factors that can affect the success of a baiting program due to their potential to impact on bait toxicity and palatability. There was no rainfall in the two weeks leading up to the baiting event, and minimal (<5 mm) precipitation on the sixth and ninth day post baiting (Figure 8). Apart from the two rainfall events, maximum relative humidity remained under 80% for the duration of the bait period.

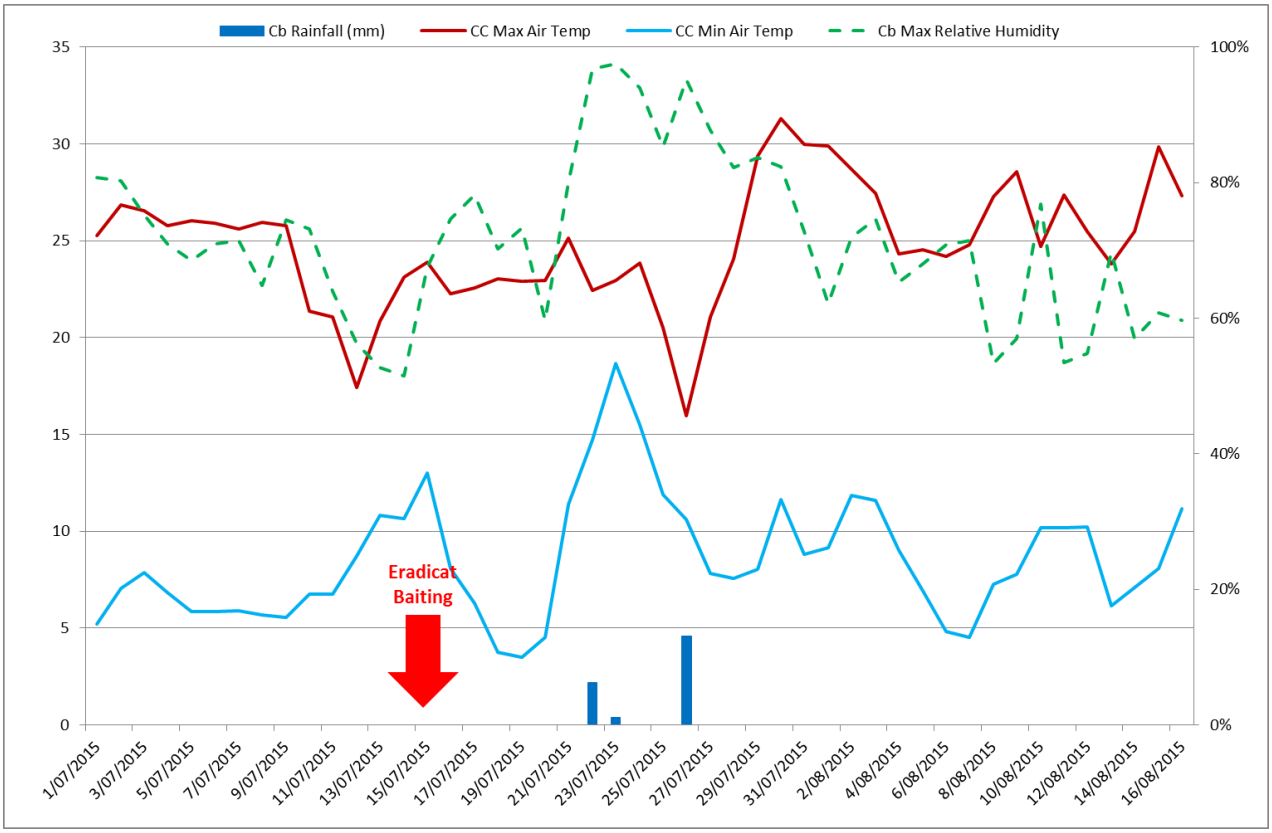


Figure 8. Climatic data for 15 days preceding baiting and 30 days post-baiting. Rainfall and Maximum Relative Humidity are sourced from the Cloudbreak (Cb) weather station but due to a technical malfunction, temperatures were inaccurate. Maximum and minimum temperatures are from the Christmas Creek (CC) weather station.

The area proposed for baiting in 2015 was 998 km², excluding the buffer areas around the active bore and well sites (Figure 3). This area was calculated with the knowledge that it would not all be baited due to the existing natural pools of water that were unlikely to have dried out by the end of June. The final area would be determined from the air at the time of baiting, when the staff in the bait plane had the best view of where baits would hit the ground rather than water. The total area baited was 896 km² (Figure 9).

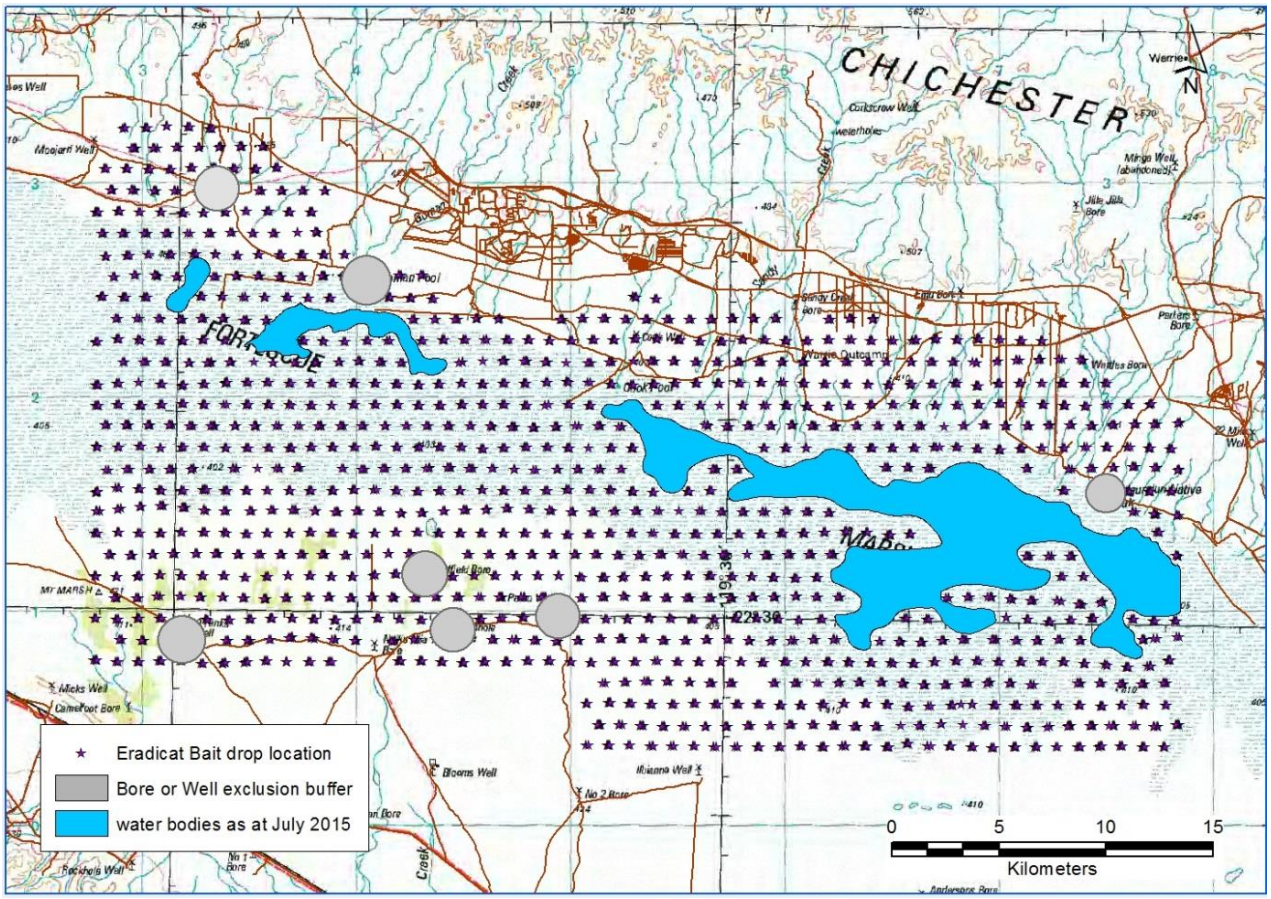


Figure 9. Distribution of baits on 15 &16 July. Bait exclusion areas are shown as blue (water bodies) and grey (bore buffer areas).

3.2 Feral Cats

3.2.1 Trapping and Radio-collaring

Twenty feral cats (twelve males and eight females) were captured over 943 trap-nights with a capture success rate of 2.12 % (Figure 10). Eighteen of the twenty feral cats were fitted with radio-collars. One sub-adult female (FMGf09) damaged her dew claw when trapped and was euthanized at the site of capture and another young male (FMGm10) was too small to be collared.

All cats captured appeared to be in reasonable health with one female possibly gravid. Bodyweight (mean ± SE) of the males was 3588 ±298 g and the females were 2509 ±201 g (Table 2). More than half the captures occurred on the north of the Marsh, with four being captured on the Marsh proper and the other five on the south of the Marsh (Figure 10).

During the trapping, Hillside Station conducted mustering which resulted in traps being closed prematurely on the north east of the trap lines. Cattle (*Bos taurus*) set-off a number of traps and there were two incidences of human interference, one of which resulted in a trap being damaged beyond repair.

Table 2. Capture records for feral cat on Fortescue Marsh, 13 - 22 May, 2015.

Identifier	Trap №	Capture Date	Sex	Weight (g)	Coat Colour	Age	VHF Freq
FMGm01	W04	14/05/2015	♂	2290	Tabby	Sub-adult	151.674
FMGm02	W10	15/05/2015	♂	3260	Tabby	Adult	151.614
FMGf03	S01	15/05/2015	♀	2920	Tabby	Adult	151.571
FMGf04	S08	15/05/2015	♀	2270	Tabby	Adult	151.133
FMGm05	SW09	16/05/2015	♂	5270	Tabby	Adult	151.652
FMGf06	M05	16/05/2015	♀	3150	Tabby	Adult	151.693
FMGm07	W20	16/05/2015	♂	4720	Ginger	Adult	151.292
FMGm08	W25	16/05/2015	♂	3970	Tabby	Adult	151.434
FMGf09	M03	17/05/2015	♀	1860	Ginger	Sub-adult	n/a
FMGf10	E06	18/05/2015	♀	1520	Tabby	Sub-adult	n/a
FMGm11	W15	18/05/2015	♂	2760	Tabby	Adult	151.353
FMGf12	SL23	18/05/2015	♀	2850	Tabby	Adult	151.273
FMGm13	SL28	18/05/2015	♂	3740	Tabby	Adult	151.151
FMGm14	W20	19/05/2015	♂	3240	Tabby	Adult	151.333
FMGm15	SL42	20/05/2015	♂	4900	Tabby	Adult	151.412
FMGm16	SL20	20/05/2015	♂	3820	Tabby	Adult	151.193
FMGm17	SW08	20/05/2015	♂	1871	Tabby	Sub-adult	151.473
FMGf18	M07	21/05/2015	♀	2720	Tabby	Adult	151.171
FMGf19	W09	21/05/2015	♀	2780	Tabby	Adult	151.452
FMGm20	S01	22/05/2015	♂	3210	Tabby	Adult	151.252

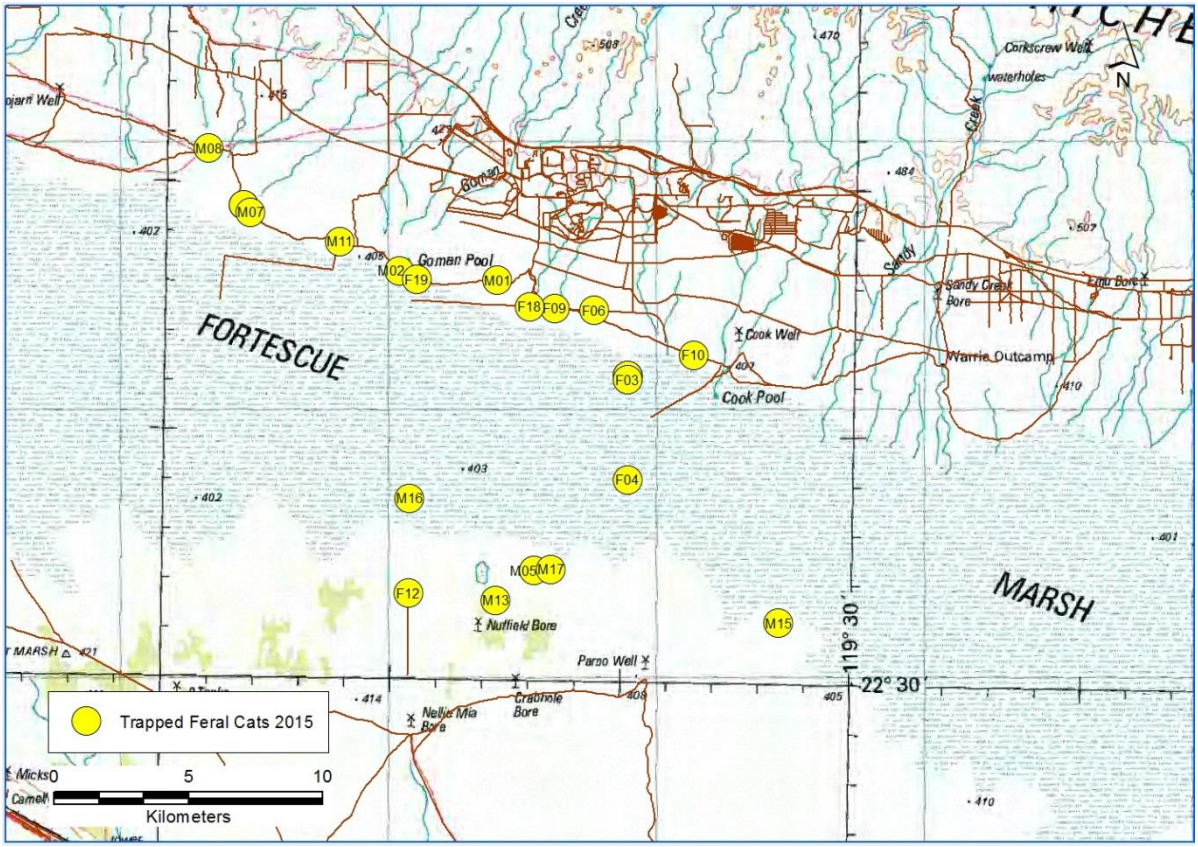


Figure 10. Location of the feral cat captures for 2015

Non-target captures (Table 3) were minimal with only two. A rabbit (*Oryctolagus cuniculus*) was euthanised and a crow was released with only a light abrasion to its left leg.

Table 3. Non-target captures for 13 - 22 May, 2015

Species	№ of Individuals	Trap Number
European rabbit (*Oryctolagus cuniculus*)	1	E06
Torresian crow (*Corvus orru*)	1	W22

3.2.2 Recovery, Monitoring of GPS/VHF Radio-collars and Bait Uptake

Eleven collars were recovered during the 2015 program. Three collared cats were determined as bait deaths, being stationary within two hours of passing through a bait drop location. Of the 18 cats collared, eleven were accounted for during the post-bait searches but one individual had died prematurely, evidently not long after being captured. Distances moved post-bait take ranged from 200 – 900 m. Three feral cats that had been captured on the north of the Marsh (FMGm07, FMGf06 and FMGf19) were determined to have spent less than half their time within the baited area (Figure 11). Calculations using their home range estimates showed - respectively - 37%, 19% and 37% of their time was within the area treated with *Eradicat*®.

FMGm11 was one of the bait deaths. Remarkably, this cat wandered over 130 km in a northwest direction and then came back a similar way to re-enter the treatment cell just four days prior to baiting (Figure 12). It then consumed a bait five days after the initial delivery of baits (Table 4).

Table 4. Feral cat radio-collar activity and recovery details, May – August 2015.

Identifier	Duration of filtered data	Total № fixes	Ave distance per day (m) ± sd	MCP95 (ha)	Cat Outcome
FMGm01	27 May - 18 July	1143	5508 ± 1053	2465	Died from bait
FMGm02	no data	n/a	n/a	n/a	unknown; not detected after collaring
FMGf03	27 May - 27 Aug	1999	4701 ± 1722	1292	Survived baiting; shot 27/8
FMGf04	27 May - 27 Aug	2148	6793 ± 2065	1910	Survived baiting; shot 27/8
FMGm05	27 May - 27 Aug	2155	10056 ± 3381	3367	Survived baiting; shot 27/8
FMGf06	27 May - 27 Aug	2083	4514 ±1669	1974	Survived baiting; not shot due to proximity to mining infrastructure
FMGm07	27 May - 27 Aug	2158	9612 ± 3278	3734	Survived baiting; shot 27/8
FMGm08	no data	n/a	n/a	n/a	unknown; last detected 30/6
FMGf09	no data	n/a	n/a	n/a	euthanised - 17/5
FMGf10	no data	n/a	n/a	n/a	not collared
FMGm11	27 May - 21 July	820*	8259 ± 4356	2450*	Died from bait
FMGf12	27 May - 27 Aug	2163	2925 ± 857	272	Survived baiting; shot 27/8
FMGm13	no data	n/a	n/a	n/a	unknown; not detected after collaring
FMGm14	no data	n/a	n/a	n/a	unknown; not detected after collaring
FMGm15	no data	n/a	n/a	n/a	unknown: last detected 28/6
FMGm16	no data	n/a	n/a	n/a	unknown; not detected after collaring
FMGm17	27 May - 16 July	1156	3951 ± 1399	851	Died from bait
FMGf18	no data	0	n/a	n/a	Died day of capture
FMGf19	27 May - 27 Aug	2135	4035 ± 1319	1076	Survived baiting; shot 27/8
FMGm20	no data	n/a	n/a	n/a	unknown; not detected after collaring

* excludes period when travelled >262 km outside bait cell (19 days)

Of the seven cats that survived baiting, six were shot and where possible, stomachs were sampled for a later diet analysis. The seventh cat was left alive due its close proximity to mining infrastructure; however a remote download from this cat's collar was obtained for home range analysis.

The average daily distances travelled by collared cats was consistent within sexes with females averaging 4.6 km/day (range: 2.9 – 7.0) and the males 7.5 km/day (range: 4.0 – 10.0).

All ten collars retrieved had collected sufficient GPS fixes (>504) to be analysed to establish home range size. Minimum convex polygons were run for 95% of GPS fixes (Table 4 and Figure 11). There was substantial overlap of individuals on the north of the Marsh with three individuals (one female and two males) having virtually 100% overlaps. The average (±SE) of the home ranges for males was 2,573.4 ha (±499) and females was 1,304.8 ha (±311).

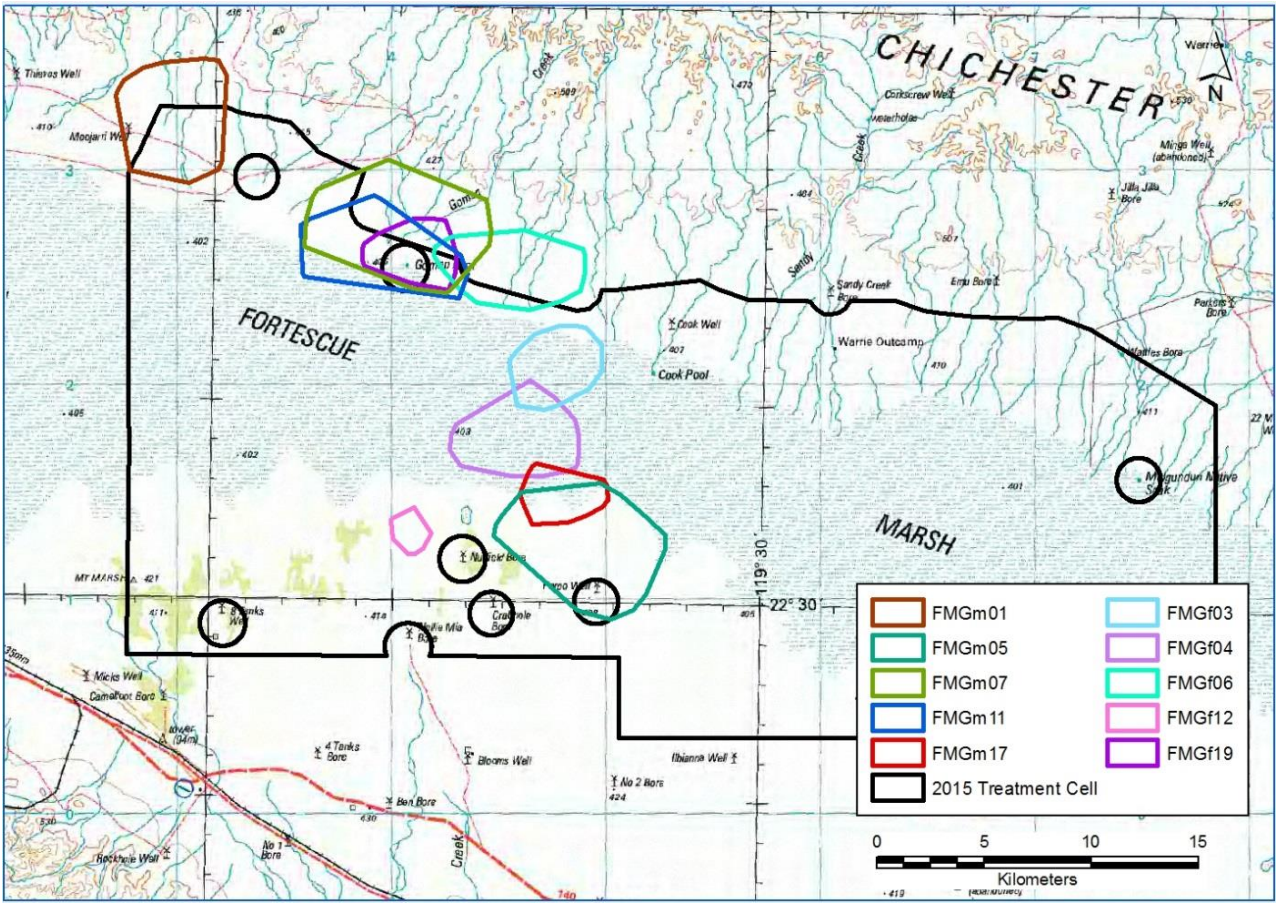


Figure 11. Feral cat home range as defined by 95% Minimum Convex Polygons showing the area of use by the collared feral cats.

Male FMGm11 (dark blue in Figure 11) travelled over 260 km over 19 days, making a trek north west along the Fortescue River, reaching the Roebourne-Wittenoom Road before turning around and making its way back to the Marsh. This sojourn has been excluded from the home range analysis but is shown separately in Figure 12.

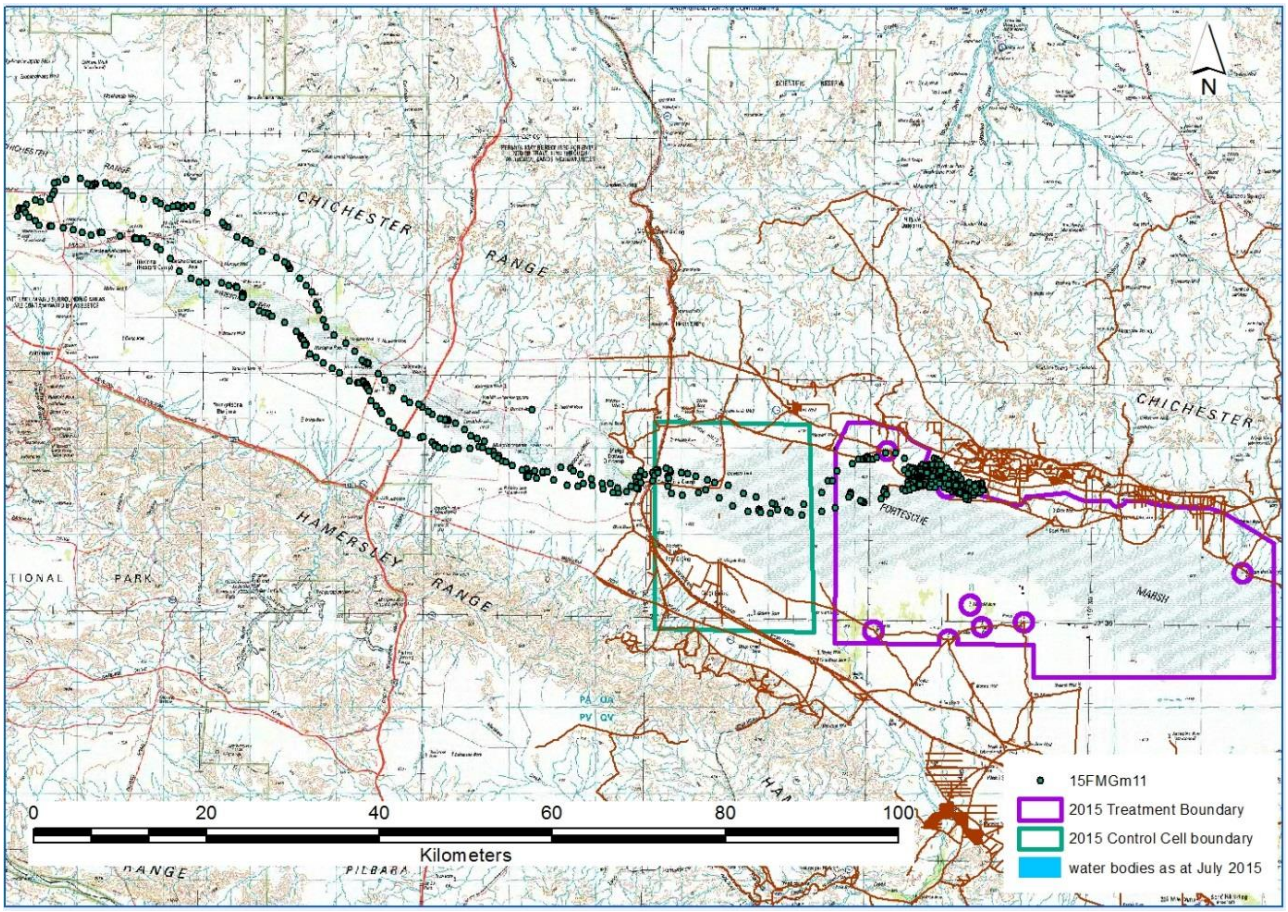


Figure 12. Individual FMGm11 covered over 260 km in 19 days, returning to his home range two days prior to the bait drop. This collar was in mortality five days after the first bait was dropped.

Analysis of temporal movements of collared cats in 2015 was conducted for nine individuals. The tenth cat (FMGm11) was excluded from this analysis due to the extraordinary movement in a three week travel period. In 2015, there was a return to bimodal peaks at sunset and sunrise for both males and females (Figure 13) with both sexes increasing in activity levels from previous years. There was also a shift in when the activity occurred for males with more severe extremes through a decrease in daytime movements and increase in night activities.

Average hourly activity for males in 2015 (n=4) continued to increase on previous years with a substantial increase in the range in this most recent year (Table 5).

Table 5. Annual hourly distance travelled (averages of collared feral cats 2013 - 2015)

	males			*females*		
	2013	2014	2015*	2013	2014	2015
Hourly Range (m)	231.92	340.32	550.52	223.10	196.92	325.73
Minimum distance (m)	65.67	161.29	76.98	67.20	55.30	36.78
Maximum distance (m)	297.59	501.61	627.49	290.30	252.22	362.52
Individuals	4	5	4	3	5	5

*Excludes FMGm11

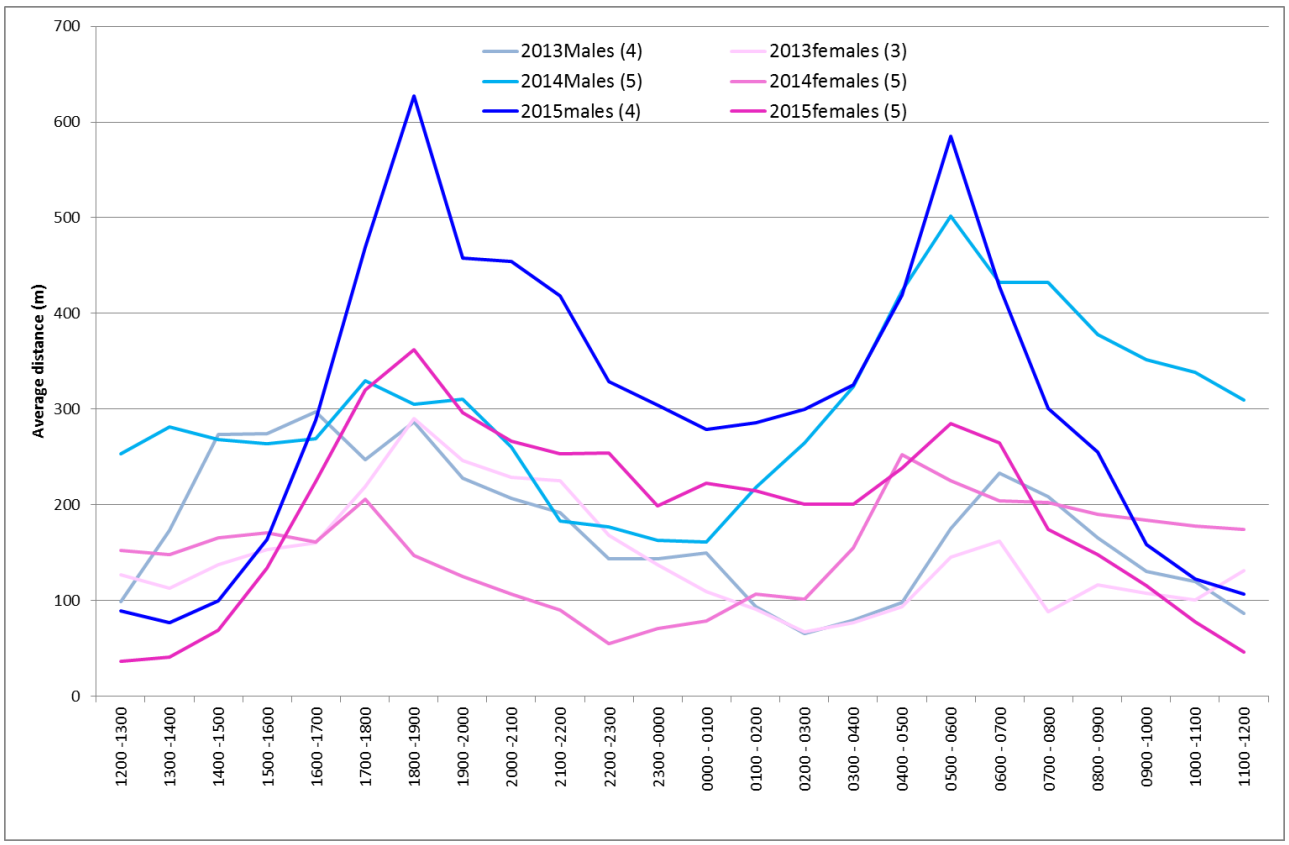


Figure 13. Average temporal movement pattern of male and female collared feral cats per survey period at Fortescue Marsh, 2013 - 2015

3.2.3 Site Occupancy

The camera surveys were conducted from 4 June to 1 September 2015. The 44 treatment and 24 control cell cameras were operational for approximately three weeks, before they were decommissioned ten days prior to baiting and for 20 days after baiting. Cameras and lures were then reinstated for another three weeks for the post-bait monitoring in August.

A total of 3,025 camera trap-nights (Table 6) were conducted, resulting in feral cats being recorded 25 out of 68 cameras sites (Figure 14).

Table 6. Camera trap-nights for survey areas.

	Pre-bait	Post-bait
Control (n=24)	576	480
Treatment (n=44)	1,064	905

Feral cat detections during the camera surveys showed a concentration (pre- and post-occurrences) in the centre and on the southern fringes of the Marsh (Figure 14).

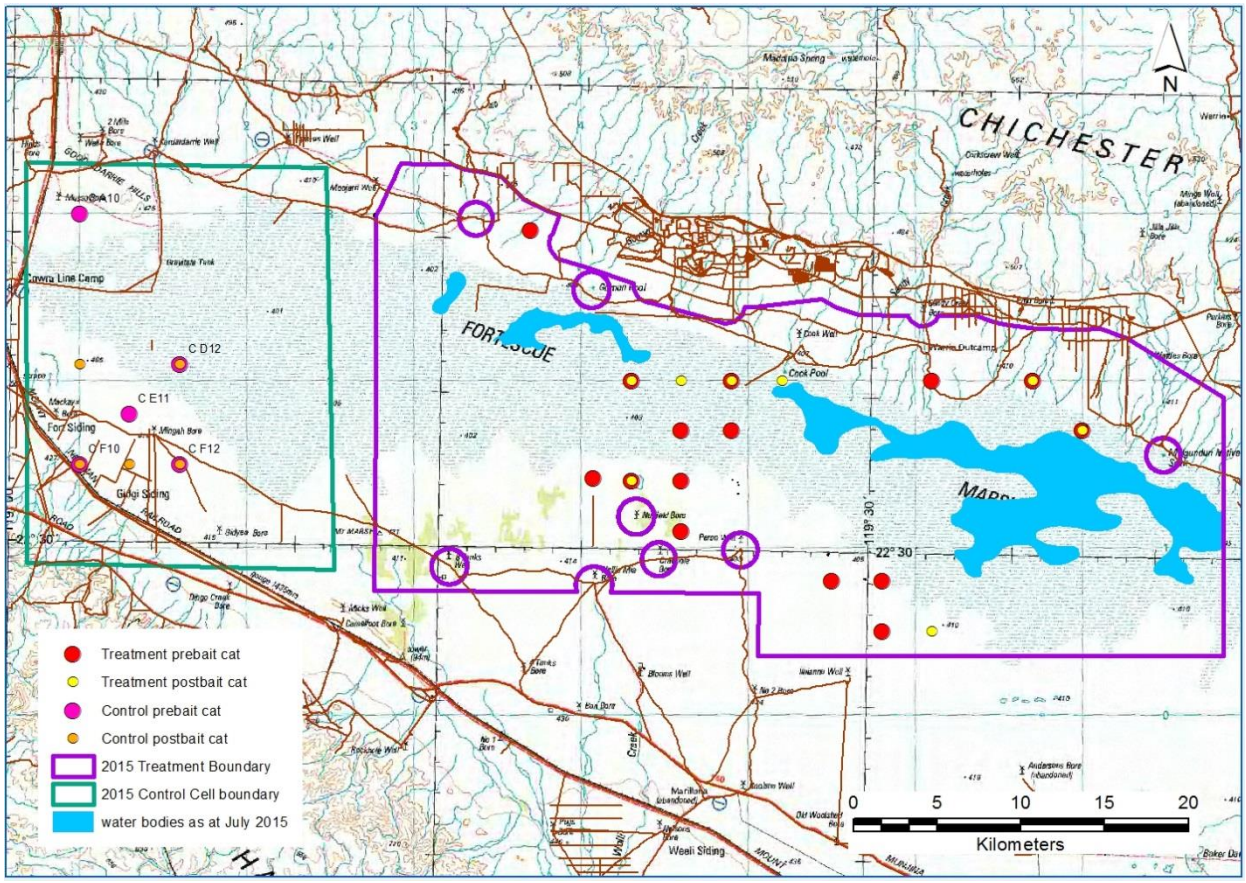


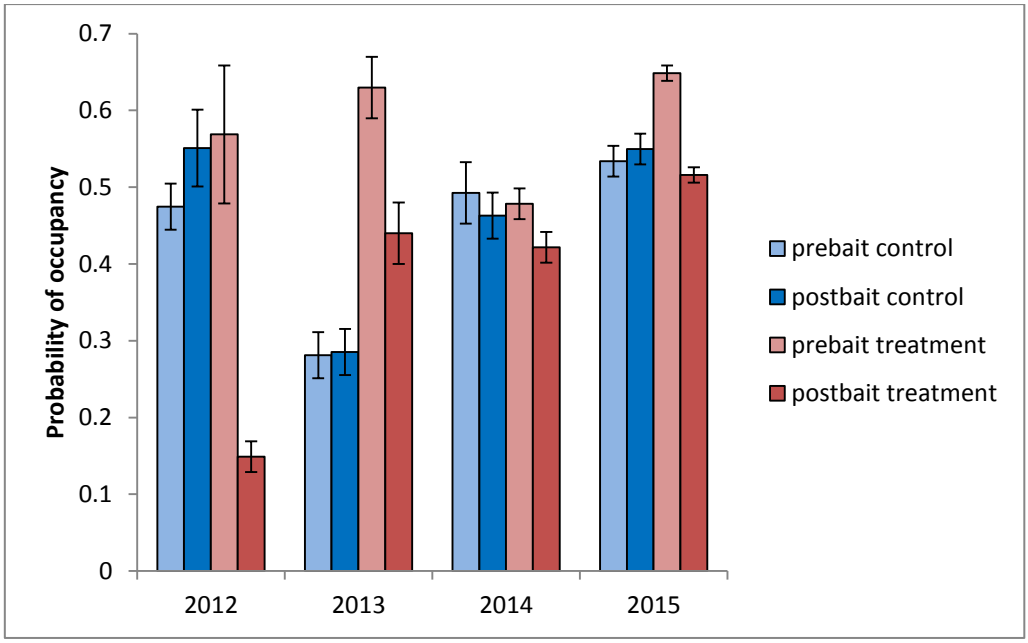
Figure 14. Location of feral cats recorded at camera-traps for both pre- and post-bait surveys for the control and treatment cells in 2015.

In 2015 both models (random effects and spatial component) showed no significant change pre and post baiting in occupancy on the control grid (t-test, $p>0.05$). However, both models showed a significant decrease post baiting for the treatment (t-test, $p<0.05$) (Table 7 and Figure 15a & 15b)

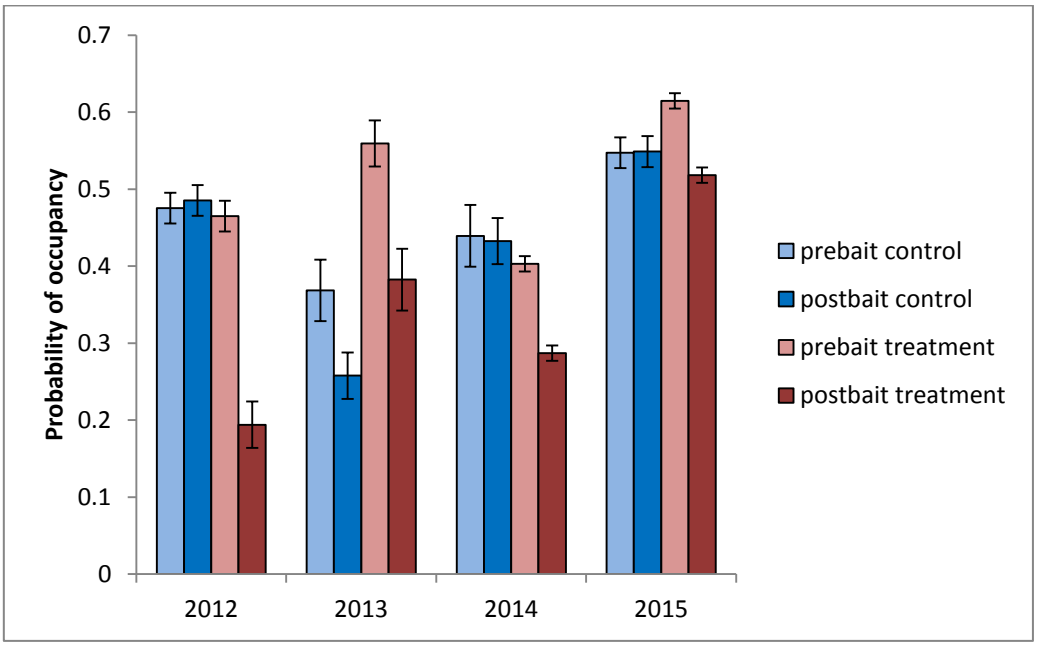
Table 7. Probability of occupancy ± SD (n) with no habitat covariates.

		Control		Treatment	
Model	**Year**	**Pre-bait (n)**	**Post-bait(n)**	**Pre-bait (n)**	**Post-bait(n)**
Random	2012	0.4747±0.1527 (29)	0.5511±0.2286 (29)	0.5687±0.6250 (49)	0.1491±0.1324 (49)
Random	2013	0.2813±0.1900 (31)	0.2845±0.1640 (31)	0.6298±.0190 (29)	0.4399±0.2335 (29)
Random	2014	0.4927±0.2042 (30)	0.4628±0.1891 (30)	0.4785±0.1283 (56)	0.4215±0.1642 (56)
Random	**2015**	**0.5340±0.0949 (24)**	**0.5497±0.1031 (24)**	**0.6487±0.0736 (44)**	**0.516±0.0.0812 (44)**
Spatial	2012	0.4853±0.1106 (29)	0.4852±0.0839 (29)	0.4649±0.1446 (49)	0.194±0.1696 (49)
Spatial	2013	0.3684±0.2383 (31)	0.2577±0.1670 (31)	0.5593±0.1836 (29)	0.3824±0.2030 (29)
Spatial	2014	0.4393±0.1958 (30)	0.4325±0.1898 (30)	0.4031±0.0831 (56)	0.287±0.0560 (56)
Spatial	**2015**	**0.5472±0.1028 (24)**	**0.5487±0.108 (24)**	**0.6147±0.0708 (44)**	**0.5181±0.0820 (44)**

The occupancy of control and treatment sites was calculated using both random effects and spatial models for pre- and post-baiting using data from all years of the baiting program (2012, 2013, 2014 and 2015). In 2012 and 2013 there was a significant decrease (10%) in the calculated occupancy post-baiting in the treatment site using the spatial model (t-test, $p<0.01$) while occupancy in the control site did not alter (t-test, $p>0.05$). A similar result was obtained modelling random effects when 2012 data was reanalysed with these models (t-test $p<0.01$ for treatment and $p>0.1$ for control). In 2014 both models showed a significant decrease in baited cell, with occupancy in the control site not changing (random effects: t-test, $p<0.05$ for treatment and $p>0.05$ for control; spatial effects: t-test, $p<0.01$ for treatment and $p>0.8$ for treatment). For both models in 2014 the decrease was larger in the treatment site.



a) modelled random effects



b) modelled spatial component

Figure 15. Site occupancy (mean ±SE) pre- and post-baiting for 2012, 2013, 2014 and 2015 with random effects (15a) and spatial component (15b).

3.3 Non-target Species

3.3.1 Birds

Of the 14 ARUs deployed, two units only recorded for two days due to interference by cattle rubbing against the mounting posts and knocking the units to the ground. Another ARU only recorded for one day, resulting in total recordings of 816 hours.

All ARU recordings were analysed using SoundID. Presence/absence within the survey period at a particular location was recorded in binary form (Table 8). White-winged Fairy-wrens were recorded at 50% of locations, Crested Bellbirds at 29% of locations, Crested Pigeons were recorded at one location and no Red-capped Robins or Variegated Fairy-wrens were detected.

Eight of the 14 ARUs were located at sites where feral cats were also recorded.

Table 8. Results showing presumed occupancy of five bird species at 14 ARU locations in Fortescue Marsh, July 2015.

Location	Unit No	Crested Pigeon	White-winged Fairy-wren	Variegated Fairy-wren	Red-capped Robin	Crested Bellbird
C11	FMG1	0	0	0	0	0
C12	FMG2	0	0	0	0	1
E7	FMG17	0	0	0	0	1
E6	FMG18	0	1	0	0	1
F8	IFRP03	0	0	0	0	0
H12	IFRP04	0	0	0	0	0
E5	IFRP23	0	1	0	0	0
E4	IFRP24	1	1	0	0	1
G10	IFRP27	0	1	0	0	0
G9	IFRP28	0	0	0	0	0
F9	IFRP31	0	1	0	0	0
C9	IFRP32	0	1	0	0	0
D6	IFRP44	0	1	0	0	0
C6	IFRP45	0	0	0	0	0

3.3.2 Bilby and Mulgara

Five camera sites (20 cameras) covered approximately 4 ha. A total of 1,420 camera-nights were surveyed with Mulgara being detected at one site but there were no detections of Bilby. Presence/absence within the survey period at a particular location was recorded in binary form (Table 9). Sites 1 – 4 were located within the treatment cell and Site 5 was just to the west of this cell.

Table 9. All species (excluding birds) captured by non-lured Bilby/Mulgara targeted monitoring cameras

Common Name	*Scientific Name*	Site 1	Site 2	Site 3	Site 4	Site 5	Total sites
Feral Cat	*Felis catus*	1	1	1	1	0	4
Other small mammal	na	1	1	1	1	0	4
Hopping-mouse	*Notomys* spp.	1	1	1	0	0	3
Cattle	*Bos taurus*	0	0	0	1	1	2
Little Red Kaluta	*Dasykaluta rosamondae*	1	1	0	0	0	2
Native Mouse	*Pseudomys* spp.	1	0	1	0	0	2
Red Kangaroo	*Macropus rufus*	1	0	1	0	0	2
Short-beaked Echidna	*Tachyglossus aculeatus*	1	1	0	0	0	2
Yellow-spotted Monitor	*Varanus panoptes*	0	1	0	1	0	2
Dunnart	*Sminthopsis* spp.	1	0	0	0	0	1
European rabbit	*Oryctolagus cuniculus*	1	0	0	0	0	1
Mulgara	*Dasycercus* sp.	0	1	0	0	0	1
Ningaui	*Ningaui* spp.	1	0	0	0	0	1
Wild Dog	*Canis lupus familiaris*	0	0	1	0	0	1

	Site 1	Site 2	Site 3	Site 4	Site 5	Total
Number of trap-nights	500	420	336	79	85	1420

The Mulgara activity at Site 2 occurred eight times, on six different days between 21 June and 16 July. Although it is difficult to be absolutely certain, this species of Mulgara is most likely *D. blythi* (M. Cowan, Parks and Wildlife Kensington, pers. comm.) (Plate 4b). This is not an EPBC Act listed species.

(a)

(b)

Plate 4. a) The context of setting a camera trap at Site 2 and b) Photo of a Mulgara captured on a June morning.

The capturing of *Varanus panoptes* at two sites occurred consistently for the duration of the monitoring period (Table 10). Ongoing activity of this species throughout the winter months potentially impacts the effectiveness of baiting. The high event number for Varanid is likely attributed to the warmer weather experienced post-baiting in August.

Table 10. Capture events of species on the Bilby/Mulgara targeted cameras. An event is defined as at least a 5 minute interval between each image captured.

Common Name	Species	Total Events	
		Pre-bait	Post-bait
Yellow-spotted Monitor	*Varanus panoptes*	40	109
Hopping-mouse	*Notomys* sp.	29	16
Native Mouse	*Pseudomys* sp.	13	12
Little Red Kaluta	*Dasykaluta rosamondae*	7	11
Short-beaked Echidna	*Tachyglossus aculeatus*	2	6
Red Kangaroo	*Macropus rufus*	7	3
Mulgara	*Dasycercus* sp.	7	1
Dunnart	*Sminthopsis* sp.	1	0
Ningaui	*Ningaui* sp.	1	0
Feral Cat	*Felis catus*	38	17
Cattle	*Bos taurus*	7	3
Wild Dog	*Canis lupus familiaris*	1	0
European rabbit	*Oryctolagus cuniculus*	0	4

3.3.3 Incidental records

Birds seen and heard during the course of the field work are listed in Appendix 1. Additional species in 2015 were Banded Lapwing (*Vanellus tricolor*), Black-eared Cuckoo *(Chalcites osculans)*, Square-tailed Kite (*Lophoictinia isura*) and Flock Bronzewing (*Phaps histrionicus*).

In addition to the species captured by the Bilby/Mulgara targeted cameras, donkey (*Equus asinus)* and camel (*Camelus dromedarius*) are the only two additional non-target species to add to the overall species list for the Marsh.

Table 11. Percentage of cameras that captured non-target species during the feral cat surveys.

		Treatment Cameras		Control Cameras	
Common Name	**Scientific Name**	% pre-bait	% post-bait	% pre-bait	% post-bait
Camel *	*Camelus dromedarius*	0	2	0	0
Cattle *	*Bos taurus*	21	16	13	4
Donkey *	*Equus asinus*	4	0	0	0
dunnart	*Sminthopsis* sp.	7	2	0	0
European Rabbit *	*Oryctolagus cuniculus*	5	7	8	4
Feral Cat *	*Felis catus*	27	14	21	21
Little Red Kaluta	*Dasykaluta rosamondae*	7	4	4	0
other small mammal	n/a	21	23	38	29
Red Kangaroo	*Macropus rufus*	39	39	13	13
Short-beaked Echidna	*Tachyglossus aculeatus*	0	2	0	0
Spinifex Hopping-mouse	*Notomys alexis*	7	16	17	17
Wild Dog *	*Canis lupus familiaris*	5	0	0	4

* Introduced species

	Treatment Cameras		Control Cameras	
	pre-bait	post-bait	pre-bait	post-bait
№ of camera trap-nights	**1064**	**905**	**576**	**480**

4 Discussion

The weather conditions experienced in the Pilbara in the first half of this year were atypical resulting in a dry summer and heavy rainfall in late autumn. These conditions caused delays in the program and reduced the ability to monitor as much of the area that has been achieved in previous years. The delay in camera setup caused by heavy rain in May, rippled through the rest of the program with the baiting delayed in response to the late start. Despite these difficult conditions, approximately 80% of the area monitored in previous years was surveyed in 2015.

Captures of feral cats were consistent with previous years, with a 2.12% capture success rate. Over 50% of the captures were on the north side of the Marsh, and area that has been repeatedly trapped for the last few years. The high capture rate along this track would suggest a strong reinvasion rate in this area, resulting in naive individuals being caught each year.

The implementation of smaller leg-hold traps (from 3.0 to 1.5) to capture feral cats in 2015 appeared to be effective in reducing pre-bait deaths. Only one collared cat died the day it had been trapped. The other benefit to using the smaller traps was the reduction in non-target captures and the lower risk of injury if they are captured. A corvid was captured and was able to be released with only a minor graze on its right leg. A rabbit was also caught and euthanised on site.

All three collared cat deaths occurred within five days of baiting. Three millimetres of rain was recorded at Cloudbreak on the sixth day after baiting with a further 1 mm on the seventh day. These events are not significant enough to have impacted on the effectiveness of baiting although the late autumn rain occurred whilst the ground was still warm enough to support good vegetative growth. Field staff observed significant productivity in the Marsh (tracks, birds) while working in the area, which fits with the hypothesis that there was likely to be a boom in biomass giving feral cats an alternative source of food to the baits.

Activity periods for collared feral cats have shown both an increase in overall movement as well as a preference for night time endeavours. The home range analysis shows that although individuals were not travelling far, they must have been very active within their territory. FMGf12 had a relatively small home range of 272 ha yet she was, on average, travelling nearly 3,000 m per day. The area in which this individual roamed was the edge of the trap line and possibly her movements were suppressed by more dominant cats in the area or she was able to obtain all the resources she needed. Daily activity for male collared cats correlates with their body mass, but again home ranges appear to be limited by other factors such as resources.

Camera records of cats both pre- and post-baiting are concentrated in the centre of the Marsh where the true marsh is at its narrowest crossing from north to south. In terms of access for staff, this area has also been noted as the least likely to have pooled water and the highest evaporation rates. Although there has been only one noted event of a collared cat crossing the Marsh (2014), there are few barriers other than distance to prevent this occurrence.

Occupancy modelling using the remote camera data has again provided data to support the efficacy of baiting programs over large areas in successive years.

The analysis of camera data using occupancy models, with both spatial and random effects modelled, again found the effect of baiting on decreasing probability of site occupancy to be significant. Application of the same Bayesian models to previous years' data also supports the value of the camera-trap technique for detecting effects of baiting on the Fortescue Marsh. Both random effects and spatial models show a similar pattern in that the control site have minimal variation pre- and post-baiting (with the exception of the spatial model in 2013) and the treatment sites show a decline in occupancy post-baiting.

More than 50% of the camera sites chosen to monitor that also had ARUs, detected feral cats. The choice of these sites was based on vegetation structural complexity and diversity with the assumption that this might correlate for both the presence of birds and therefore cats. Overall, there was a decrease in the recordings of the target species in comparison to last year, with two of the species (Variegated Fairy-wren and Red-capped Robin) being absent from survey results. A new library reference for Crested Bellbirds was obtained in 2015, allowing for an analysis of this species. Its presence was detected at a third of the sites and is a good basis for future comparisons of this species over the years. This will be done for the final year of reporting.

Monitoring for EPBC Act listed species using remote cameras continued in 2015, building on the work started in 2014. A different approach to potential habitat was taken and paid off with the capture of Mulgara at one of the five survey sites. Several events were captured prior to baiting and one event post baiting.

4.1 Recommendations

1) Existing feral cat home range data to be examined prior to 2016 program to establish if bait delivery strategies can be refined to improve efficacy of delivery.
2) Continue the native species monitoring through un-lured camera trap detections.
3) Focus on collaring cats in the centre and south of the marsh to build on home range and habitat use data.

5 References

Algar D, Angus GJ, Williams MR, *et al*. (2007) Influence of bait type, weather and prey abundance on bait uptake by feral cats (*Felis catus*) on Peron Peninsula, Western Australia. *Conservation Science Western Australia* **6**(1), 109–149.

Algar D, & Burrows ND (2004) A review of Western Shield: feral cat control research. *Conservation Science Western Australia* **5(**2), 131–163.

Algar D, Comer S, Clausen L, Bozanich C and Grein S (2014) Moggies on the Marsh. *LANDSCOPE*, **30**(1), 19–22.

Algar D, Onus ML, & Hamilton NA (2013) Feral cat control as part of 'Rangeland Restoration' at Lorna Glen (Matuwa), Western Australia – the first seven years. *Conservation Science Western Australia* **8**(3), 367–381.

Algar D, Robertson H & Rummery C (2011) Proposed Management Plan for Baiting Feral Cats on the Fortescue Marsh (Christmas Creek Water Management Scheme), Dept of Environment and Conservation, WA, Prepared for Fortescue Metals Group. Available from:<http://www.fmgl.com.au/community/Environment/Environment_Library/default.aspx>

Bibby CJ, Burgess ND, Hill DA & Mustoe SH (2000) *Bird Census Techniques* (2nd Edition). Elsevier, London, UK.

Blyth J (1996) Night Parrot (*Pezoporus occidentalis*) Interim Recovery Plan for Western Australia 1996 to 1998 TSCU, WA CALM. Available from: <http://www.dec.wa.gov.au/pdf/plants_animals/threatened_species/irps/fauna/pez_occ_irp4.pdf> (Accessed 6/09/2013).

Boitani L, & Powell RA (2012) *Carnivore Ecology: A handbook of techniques*. Oxford University Press, London.

Bradshaw JWS (1992) *The Behaviour of the Domestic Cat*. C.A.B International UK.

Burbidge AA & McKenzie NL (1989) Patterns in the modern decline of Western Australia's vertebrate fauna: causes and conservation implications. *Biological Conservation* **50**, 143–198.

Burt JM (2001) Syrinx. Ithaca, New York: Bioacoustics Research Program, Cornell Laboratory of Ornithology. <http://www.syrinxpc.com>.

Carwardine J, Nicol S, van Leeuwen S, Walters B, Firn J, Reeson A et al. (2014) Priority Threat Management for Pilbara Species of Conservation Significance. CSIRO Ecosystems Sciences, Brisbane. 72 pp.

Clausen L, Speldewinde P, Cowen S, Pinder J, Bell L, Pridham J, Tiller C, Comer S & Algar D (2014) Fortescue Marsh Feral Cat Baiting Program (Christmas Creek Water Management Scheme) Year2, Annual Report. Department of Parks and Wildlife, WA. Report for Fortescue Metals Group.

Davis RA, Wilcox JA, Metcalf BM & Bamford MJ (2005) Fauna survey of proposed Iron Ore Mine, Cloudbreak. Prepared for Fortescue Metals Group by M.J. & A.R. Bamford

DEWHA (Department of the Environment, Heritage, Water and the Arts) (2008a) Threat Abatement Plan for Predation by Feral Cats, DEWHA, Canberra.

DEWHA (Department of the Environment, Heritage, Water and the Arts) (2008b) Australian Heritage Database. *Fortescue Marshes, Roy Hill, WA, Australia*. Department of the Environment, Heritage, Water and the Arts. Australian Federal Government.

DSEWPaC (Department Sustainability, Environment, Water, Population and Communities) (2011) Survey Guidelines for Australia's Threatened Mammals. DSEWPaC, Canberra.

EA (1999) *Threat Abatement Plan for Predation by Feral Cats*. Environment Australia, Biodiversity Group, Canberra, Australia.

EA (2001) *A Directory of Important Wetlands in Australia*, Third Edition. Environment Australia, Canberra.

Fischer J & Lindenmayer DB (2000) An assessment of the published results of animal relocations. *Biological Conservation* **96**(**1**), 1–11.

Fortescue (2009) Fortescue Marshes Management Plan. Fortescue Metals Group Limited.

Hurni H (1981) Daylength and breeding in the domestic cat. *Laboratory Animals* **15**, 229–233.

Johnston, M.J. (2012) Field assessment of the Curiosity® bait for management of Feral Cats after fire at Wilsons Promontory National Park: Black Saturday Victoria 2009 – Natural values fire recovery program. Department of Sustainability and Environment, Heidelberg, Victoria.

Johnston M, Bould L, O'Donoghue M, Holdsworth M, Marmion P, Bilney R, Reside AE, Caldwell D, Gaborov R and Gentles T (2014) Field Efficacy of the Curiosity® bait for management of a feral cat population at Roxby Downs, South Australia. Arthur Rylah Institute for Environmental Research Technical Report Series No. 253. Department of Environment and Primary Industries, Heidelberg, Victoria

MacKenzie DI, Nichols JD, Royle *et al.* (2006) *Occupancy Estimation and Modelling: Inferring Patterns and Dynamics of Species Occurrence.* Elsevier, New York.

Mattiske Consulting Services (2005) Flora and vegetation on the Cloud Break and White Knight Leases. Report for the Fortescue Metals Group.

McCarthy MA & Possingham HP (2007) Active adaptive management for conservation. *Conservation Biology* **21**, 956–963.

McKenzie NL, Burbidge AA, Baynes A, *et al*. (2007) Analysis of the factors implicated in the recent decline of Australia's mammal fauna. *Journal of Biogeography* **34**, 597–611.

McKenzie NL, van Leeuwen S, & Pinder AM (2009) Introduction to the Pilbara Biodiversity Survey, 2002 - 2007. *Records of the Western Australian Museum* **Supplement No. 78**, 3–89.

Meek P., Ballard G., Claridge A., Kays R., Moseby K., O'Brien T., O'Connell A., Sanderson J., Swann D., Tobler M., Townsend S., (2014) Recommended guiding principles for reporting on camera trapping research. Biodiversity and Conservation **Vol 23, Issue 9** 2321-2343

Morton SR (1990) The impact of European settlement on the vertebrate animals of arid Australia: a conceptual model. *Proceedings of the Ecological Society of Australia* **16**, 201–213.

Murphy S and the Night Parrot Recovery Team (2015) Shining a light: the research unlocking the secrets of the mysterious Night Parrot. *Australian birdlife* Sept 2015, 30-35.

O'Brien TG, Kinnaird MF & Wibisono HT (2011) Estimation of species richness of large vertebrates using camera traps: an example from an Indonesian rainforest. In *Camera Traps in Animal Ecology: Methods and Analyses* (eds. AF O'Connell *et al*.) pp 233–252. Springer.

Risbey DA, Calver M, Short J, *et al*. (2000) The impact of cats and foxes on the small vertebrate fauna of Heirisson Prong, Western Australia. II. A field experiment. *Wildlife Research* **27**, 223–235.

Rodgers AR, Carr AP, Beyer HL, Smith L, and Kie JG (2010) HRT: Home Range Tools for ArcGIS. http://flash.lakeheadu.ca/~arodgers/hre/

Short J, Turner B, Risbey DA, *et al*. (1997) Control of feral cats for nature conservation II. Population reduction by poisoning. *Wildlife Research* **24**, 703–714.

Tiller C, Comer S, Speldewinde P, Cowen S & Algar D (2012) Fortescue Marsh Feral Cat Baiting Program (Christmas Creek Water Management Scheme) Year 1, Annual Report, Department of Conservation and Environment, WA. Report for Fortescue Metals Group. http://www.fmgl.com.au/community/Environment/Environment_Library/

Tiller C, Speldewinde P, Cowen S, Clausen L, Bell L, Pinder J, Pridham J, Comer S & Algar D (2013) Fortescue Marsh Feral Cat Baiting Program (Christmas Creek Water Management Scheme) Year2, Annual Report. Department of Parks and Wildlife, WA. Report for Fortescue Metals

Group. Available from: http://www.fmgl.com.au/community/Environment/Environment_Library

White, G.C. & Garrot, R.A. (1990) *Analysis of Wildlife Radio-tracking Data*. Academic Press.

Woolley PA, Haslem A & Westerman M (2013) Past and present distribution of Dasycercus: towards a better understanding of the identity of specimens in cave deposits and the conservation status of the currently recognised species *D. blythi* and *D. cristicauda* (Marsupialia : Dasyuridae). *Australian Journal of Zoology* **61**, 281-290. Doi:10.1071/ZO13034

6 Appendices

6.1 Appendix 1 –Birds recorded on Fortescue Marsh

Species	Scientific Name	DPaW Schedule	Calls Recorded	2012		2013			2014		2015	
				On Cameras	Sightings	On Cameras	On ARUs	Sightings	On Cameras	Sightings	On Cameras	Sightings
Australasian Grebe	*Tachybaptus novaehollandiae*							A		A		A
Australasian Pipit	*Anthus novaeseelandiae*			Y	Y	Y	Y	Y	Y	Y	Y	Y
Australian Bustard	*Ardeotis australis*	P4		Y	Y	Y		Y	Y	Y	Y	Y
Australian Darter	*Anhinga novaehollandiae*				A			B				
Australian Hobby	*Falco longipennis*				Y			B		B		B
Australian Magpie	*Gymnorhina tibicen*			Y	B					A		
Australian Owlet-nightjar	*Aegotheles cristatus*					Y				B		
Australian Pelican	*Pelecanus conspicillatus*				A					B		B
Australian Pratincole	*Stiltia isabella*				B		Y	B		B		B
Australian Ringneck	*Barnardius zonarius*		Y		B		Y	B		Y		Y
Australian Shelduck	*Tadorna tadornoides*		Y		A			B		B		Y
Australian White Ibis	*Threskiornis molucca*									B		
Banded Lapwing	*Vanellus tricolor*											B
Black Falcon	*Falco subniger*				C			B		A		
Black Honeyeater	*Sugomel niger*		Y		B		Y	B		B	Y	Y
Black Kite	*Milvus migrans*				B			B		B		B
Black Swan	*Cygnus atratrus*									B		B
Black-breasted Buzzard	*Hamirostra melanosternon*				B			Y		B		
Black-chinned Honeyeater	*Melithreptus gularis*							?B				
Black-eared Cuckoo	*Chalcites osculans*											B
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		Y		Y			B		Y		Y

Species	Scientific Name	DPaW Schedule	Calls Recorded	2012		2013			2014		2015	
				On Cameras	Sightings	On Cameras	On ARUs	Sightings	On Cameras	Sightings	On Cameras	Sightings
Black-faced Woodswallow	*Artamus cinereus*		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Black-fronted Dotterel	*Elseyornis melanops*				C			B		B		B
Black-shouldered Kite	*Elanus axillaris*				C			B		Y		B
Black-tailed Native-hen	*Tribonyx ventralis*							B				
Black-winged Stilt	*Himantopus himantopus*				A					B		
Blue-winged Kookaburra	*Dacelo leachii*				A					?A		B
Bourke's Parrot	*Neopsephotus bourkii*			Y				Y		Y		B
Brown Falcon	*Falco berigora*			Y	Y			Y		Y		Y
Brown Goshawk	*Accipiter fasciatus*			Y	Y	Y		Y		B		B
Brown Honeyeater	*Lichmera indistincta*		Y		B			Y		B		Y
Brown Quail	*Coturnix ypsilophora*			Y	B	Y				B		C
Brown Songlark	*Cincloramphus cruralis*			Y	Y	Y	Y	Y	Y	Y	Y	Y
Budgerigar	*Melopsittacus undulatus*		Y	Y	Y		Y	Y		Y		Y
Buff-banded Rail	*Gallirallus philippensis*								Y			
Caspian Tern	*Hydroprogne caspia*									B		B
Chestnut-breasted Quail-thrush	*Cinclosoma castaneothorax*							B		B	Y	B
Chestnut-rumped Thornbill	*Acanthiza uropygialis*						Y	B		B		B
Cockatiel	*Nymphicus hollandicus*		Y	Y	Y		Y	B		Y		Y
Collared Sparrowhawk	*Accipiter cirrocephalus*			Y	B			B	Y			B
Common Bronzewing	*Phaps chalcoptera*			Y	Y	Y		B	Y	Y	Y	B
Crested Bellbird	*Oreoica gutturalis*		Y	Y	Y		Y	Y	Y	Y	Y	Y
Crested Pigeon	*Ocyphaps lophotes*		Y	Y	Y		Y	Y	Y	Y	Y	Y
Crimson Chat	*Epthianura tricolor*		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Diamond Dove	*Geopelia cuneata*		Y	Y	Y	Y		Y		Y	Y	Y
Eastern Barn Owl	*Tyto javanica*							B				B
Eastern Great Egret	*Ardea modesta*	3*			C					B		B

Species	Scientific Name	DPaW Schedule	Calls Recorded	2012		2013			2014		2015	
				On Cameras	Sightings	On Cameras	On ARUs	Sightings	On Cameras	Sightings	On Cameras	Sightings
Elegant Parrot	*Neophema elegans*							B		B		
Emu	*Dromaius novahollandiae*				B	Y		B	Y		Y	
Fairy Martin	*Petrochelidon ariel*				C							Y
Flock Bronzewing	*Phaps histrionicus*											
Galah	*Eolophus roseicapillus*		Y	Y	Y	Y		Y	Y	Y	Y	Y
Great Cormorant	*Phalacrocorax carbo*									B		
Grey Butcherbird	*Cracticus torquatus*							B	Y	B	Y	Y
Grey Falcon	*Falco hypoleucos*	1								B		B
Grey Honeyeater	*Conopophila whitei*				?B			?B				
Grey Teal	*Anas gracilis*				A			B		B		B
Grey-crowned Babbler	*Pomatostomus temporalis*		Y		Y		Y	B		B		B
Grey-headed Honeyeater	*Lichenostomus keartlandi*				A			B		A		
Ground Cuckoo-shrike	*Coracina maxima*			Y	C					A		
Gull-billed Tern	*Gelochelidon nilotica*									B		B
Hooded Robin	*Melanodryas cucullata*			Y	B			B		B		B
Horsfield's Bronze-cuckoo	*Chalcites basalis*						Y	B			Y	B
Horsfield's Bushlark	*Mirafra javanica*			Y	Y		Y	Y	Y	Y	Y	Y
Inland Dotterel	*Charadrius australis*			Y	Y						Y	C
Inland Thornbill	*Acanthiza apicalis*							B				
Little Black Cormorant	*Phalacrocorax sulcirostris*				A					B		B
Little Button-quail	*Turnix velox*			Y	Y	Y		Y	Y	Y		B
Little Corella	*Cacatua sanguinea*				Y			B		B	Y	Y
Little Crow	*Corvus bennetti*			?	B			B				
Little Eagle	*Hieraaetus morphnoides*				B					B	Y	
Magpie-Lark	*Grallina cyanoleuca*		Y	Y	Y		Y	Y	Y	A	Y	Y
Masked Woodswallow	*Artamus personatus*		Y		Y		Y	Y		B		Y

Species	Scientific Name	DPaW Schedule	Calls Recorded	2012		2013			2014		2015	
				On Cameras	Sightings	On Cameras	On ARUs	Sightings	On Cameras	Sightings	On Cameras	Sightings
Mistletoebird	*Dicaeum hirundinaceum*							B				
Nankeen Kestrel	*Falco cenchroides*			Y	Y	Y		Y	Y	Y	Y	Y
Orange Chat	*Epthianura aurifrons*				C			B	Y	B	Y	Y
Oriental Plover	*Charadrius veredus*	3*			B							
Pacific Black Duck	*Anas superciliosa*				A							B
Painted Finch	*Emblema pictum*									A		
Pallid Cuckoo	*Cacomantis pallidus*							A		Y	Y	Y
Peaceful Dove	*Geopelia striata*		Y		A							
Peregrine Falcon	*Falco peregrinus*									B		B
Pied Butcherbird	*Cracticus nigrogularis*		Y	Y	Y		Y	Y	Y	B		Y
Pied Honeyeater	*Certhionyx variegatus*		Y		?B		Y	B				Y
Pink-eared Duck	*Malacorhynchus membranaceus*							B				
Plumed Whistling-duck	*Dendrocygna eytoni*				A			B				B
Rainbow Bee-eater	*Merops ornatus*	3*	Y		B			Y		B		Y
Red-backed Kingfisher	*Todiramphus pyrrhopygius*				Y			B		Y		Y
Red-browed Pardalote	*Pardalotus rubricatus*				B			B		A		Y
Red-capped Plover	*Charadrius ruficapillus*				C							B
Red-capped Robin	*Petroica goodenovii*		Y	Y	Y			B				B
Red-kneed Dotterel	*Erythrogonys cinctus*							B				
Red-necked Stint	*Calidris ruficollis*	3*			C					B		
Redthroat	*Pyrrholaemus brunneus*		Y		B			B				B
Royal Spoonbill	*Platalea regia*				A					B		
Rufous Songlark	*Cincloramphus mathewsi*			Y	Y			B		B	Y	Y
Rufous Whistler	*Pachycephala rufiventris*		Y		Y		Y	B		Y	Y	Y
Sacred Kingfisher	*Todiramphus sanctus*				A							
Singing Honeyeater	*Lichenostomus virescens*		Y	Y	Y	Y	Y	Y		Y		Y

Species	Scientific Name	DPaW Schedule	Calls Recorded	2012		2013			2014		2015	
				On Cameras	Sightings	On Cameras	On ARUs	Sightings	On Cameras	Sightings	On Cameras	Sightings
Slaty-backed Thornbill	*Acanthiza robustirostris*		Y		Y			Y		B		Y
Southern Boobook	*Ninox novaeseelandiae*			Y	A							
Spinifex Pigeon	*Geophaps plumifera*							B		A		A
Spinifexbird	*Eremiornis carteri*		Y		Y		Y	Y		B		B
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*		Y		Y		Y	Y		Y	Y	Y
Spotted Harrier	*Circus assimilis*				Y			Y	Y	Y		Y
Spotted Nightjar	*Eurostopodus argus*				A				Y	B	Y	
Square-tailed Kite	*Lophoictinia isura*											B
Straw-necked Ibis	*Threskiornis spinicollis*		Y		Y			B	Y	B	Y	Y
Striated Grasswren	*Amytornis striatus*	P4								A		
Stubble Quail	*Coturnix pectoralis*			Y					Y	B		
Swamp Harrier	*Circus approximans*			?						B		
Tawny Frogmouth	*Podargus strigoides*			Y	B							
Torresian Crow	*Corvus orru*		Y	Y	Y	Y	Y	Y	Y	B	Y	Y
Tree Martin	*Petrochelidon nigricans*							B				B
Variegated Fairy-wren	*Malurus lamberti*		Y		Y		Y	Y	Y	B		B
Wedge-tailed Eagle	*Aquila audax*			Y	B			Y	Y	Y		B
Weebill	*Smicrornis brevirostris*		Y		Y			Y		A		
Welcome Swallow	*Hirundo neoxena*											B
Western Bowerbird	*Ptilonorhynchus guttatus*			Y		Y		B			Y	B
Western Gerygone	*Gerygone fusca*							B		Y		
Whiskered Tern	*Chlidonias hybrida*									?B		
Whistling Kite	*Haliastur sphenurus*		Y	Y	Y			Y	Y	Y		B
White-bellied Sea-eagle	*Haliaeetus leucogaster*	3*			A					B		B
White-browed Babbler	*Pomatostomus superciliosus*			Y	C			B		Y		
White-faced Heron	*Egretta novaehollandiae*				C			B	Y	B		B

Species	Scientific Name	DPaW Schedule	Calls Recorded	2012		2013			2014		2015	
				On Cameras	Sightings	On Cameras	On ARUs	Sightings	On Cameras	Sightings	On Cameras	Sightings
White-fronted Honeyeater	*Purnella albifrons*						Y	C				
White-necked Heron	*Ardea pacifica*				A			B	Y	B		B
White-plumed Honeyeater	*Lichenostomus penicillatus*		Y		B		Y	Y		Y		Y
White-winged Fairy-wren	*Malurus leucopterus*		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
White-winged Triller	*Lalage sueurii*				Y			B		B		B
Willie Wagtail	*Rhipidura leucophrys*		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Yellow-billed Spoonbill	*Platalea flavipes*				A					B		
Yellow-throated Miner	*Manorina flavigula*		Y	Y	Y			Y		Y	Y	Y
Zebra Finch	*Taeniopygia guttata*		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Totals	**37**	**43**	**95**	**20**	**30**	**92**	**32**	**99**	**34**	**93**

Codes

A	Adjacent to either B or C but presumed that species may use study area (N.B. B or C overrides A in table)
B	Baited cell only
C	Control only
Y	Both B and C
?	Possible sighting (not definite)
1	Conservation Code: Included under Schedule 1 of WA Wildlife Conservation Act (1950) (updated November 2012)
3	Conservation Code: Included under Schedule 3 of WA Wildlife Conservation Act (1950) (updated November 2012)
*	Conservation Code: Included under EPBC Migratory Species List (JAMBA/CAMBA/Bonn Convention)
P4	Conservation Code: Priority 4 under WA Wildlife Conservation Act (1950)