Curtin University

Survey for the Presence of Northern Quolls (*Dasyurus hallucatus*) within Eramurra Solar Salt Project Footprint

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REPORT INFORMATION

- Project Name: Survey for the Presence of Northern Quolls (*Dasyurus hallucatus*) within Eramurra Solar Salt Project Footprint
- Report Author(s): Mark Cowan, School of Molecular and Life Sciences, Curtin University
- Field Work undertaken by Mark Cowan, Billy McKee and Judy Dunlop
- Project Proponent(s): Leichhardt Salt Pty Ltd
- Report Date: 12th September 2024
- Animal Ethics Approval for this project was sought by and provided to Judy Dunlop: WAEC 24-05-23

BACKGROUND

A detailed fauna assessment of the proposed Eramurra Solar Salt Project footprint was conducted by Phoenix Environmental Services on behalf of Leichhardt Salt Pty Ltd. The assessment identified three areas as either confirmed or potential habitats for northern quolls. As a result, these areas became the focus of a comprehensive camera trapping program, led by Curtin University. The primary goal of the program was to confirm the presence of northern quolls, particularly within the critical habitat and its associated foraging and dispersal zone.

The study aimed to detect northern quolls and, if present, to estimate the number of individuals and assess their habitat usage. However, no northern quolls were detected in the areas identified as critical habitat or the associated dispersal and foraging habitat during the survey. Phoenix Environmental Services had previously identified northern quolls in Devils Creek, a drainage system outside the project area but adjacent to its eastern boundary. The current study confirmed their presence in specific locations within Devils Creek and assessed both the number of individuals and their general use of the environment.

In addition to northern quolls, this study also reports on the camera trap detection of other mammal species within the project footprint and adjacent areas and this includes feral cat, brush-tailed possum, red kangaroo and dingo/dog.

The camera placement and program duration were designed to answer questions about northern quoll presence, habitat utilisation, and individual numbers, particularly within the critical habitat and associated foraging/dispersal zones inside the project footprint, as initially reported by Phoenix Environmental Services.

The areas targeted in the camera trapping program were:

- An area identified as critical habitat, largely consisting of granitic outcropping, was determined based on the presence of northern quoll scat. This area formed the focal point for camera trap work and is situated within the proposed project footprint.
- A drainage channel intersects the southern boundary of the critical habitat and continues along its western margin, forming several small ephemeral pools. The

channel extends south of the critical habitat for approximately 1.75 km before narrowing into a shallow linear depression. A secondary channel, branching from the primary one, was also identified by Phoenix Environmental Services as potential dispersal/foraging habitat. However, ground surveys revealed that this secondary channel is little more than a damp substrate with slightly taller and greener, yet still sparse, vegetation. Consequently, camera trapping was focused on the primary drainage channel.

- Devils Creek runs along the eastern alignment of the project, but outside of the disturbance footprint. Baseline survey work by Phoenix Environmental Services identified the presence of northern quolls in this area but there was no attempt at determining the number of individuals. As the development of this project has excluded directly impacting this, the number of camera traps used here were fewer than those within the proposed development footprint.

A total of 20 camera traps were deployed across the identified areas for 153 days, from 16 February 2024 to 23 July 2024, amounting to 3,060 camera trap nights. The findings of this survey, including results on northern quolls and other mammal species, are detailed in this report.

METHODS

Based on a review of the spatial information from the Phoenix Environmental Services report, 20 Reconyx HP2X cameras were deployed on 16 February 2024 across three key areas identified as northern quoll habitats. Eight cameras were placed in the critical habitat (CH), seven in the dispersal/foraging habitat (DFH), and five in the section of Devils Creek (DC) adjacent to the proposed project footprint (Figure 1). Camera placement was designed to ensure comprehensive coverage within each target area.

Due to forecast severe weather along the Pilbara coast, the cameras were temporarily removed on 22 February and reinstated on 27 February. They were first serviced on 31 May, when battery checks were performed, data were collected, and olfactory lures were set up using universal bait and sardines. These lures were placed in vented PVC containers, positioned on stakes approximately 40 cm high, and placed 1.4 metres in front of each camera, the minimum focal distance for Reconyx cameras. The lures remained in place until the end of the survey on 23 July 2024. Images with and without lures are shown in Figure 2.

All cameras were set to capture three images in rapid succession with no delay between triggers. A balanced shutter speed (minimum 1/60th of a second) was used to ensure reasonable sharpness for moving animals and good flash penetration. Cameras were mounted on stakes and, where possible, oriented south with the PIR sensor positioned about 40 cm above the ground, angled slightly downward to maximise coverage. Cameras were strategically placed in locations that minimised obstructions, including vegetation; however, in some instances, dense ground cover led to a higher number of false detections.

Geographic coordinates for each camera location were recorded via GPS (Table 1), and photos were taken to document each camera's view of the environment (Appendix A). The distances between adjacent cameras varied depending on the location. In the relatively small critical

habitat area (7.5 hectares, largely defined by exposed rocky outcropping), camera spacing was relatively short, ranging from 88 to 150 metres, with an average of 128 metres. In the associated linear foraging/dispersal habitat, the average distance between cameras was 250 metres, while in the Devils Creek area, cameras were spaced at an average of 500 metres to ensure broader geographic coverage. The variability in camera spacing within habitats was designed to balance comprehensive geographic coverage with the strategic targeting of habitat features most suitable for northern quolls, such as vegetative cover, areas near water, and rocky outcrops.

Images were processed using Megadetector AI software (Vélez & Fieberg, 2022; Vélez et al., 2023), applying a threshold of 10% probability to differentiate between images with and without animals. Images flagged as false detections were also manually reviewed with FastStone Image Viewer (FastStone, 2023); any images containing animals were reclassified and moved to the folder containing positive animal imagery. False positives were not addressed at this stage, as they are identified during database entry.

Time sequences of images, typically indicative of the same individual, were extracted based on embedded EXIF data using the R statistical programming language (R Core Team, 2024). For each sequence where images were taken less than 10 seconds apart, the image with the highest probability of containing an animal was selected. This subset was then uploaded to the CPW Photo Warehouse database (Newkirk, 2016), where species, camera details, and timestamps were recorded. Identification details were subsequently applied to all images in the same time sequence and updated in the database.

The CPW Photo Warehouse database, an open-source MS Access tool, was utilised for managing and analysing the camera trap imagery. It supports metadata tracking, provides direct links to imagery, can be used to generate various reports and queries and can be directly exported for use in software specifically designed for camera trap data analysis (Cowan, 2017).

The total number of camera trap nights without lures was 2,000: 800 in the critical habitat, 700 in the foraging/dispersal habitat, and 500 in the Devils Creek area. The number of trap nights with lures was 1,060: 424 in the critical habitat, 371 in the foraging/dispersal habitat, and 265 in Devils Creek. Combined, this resulted in a total of 3,060 camera trap nights: 1,224 in the critical habitat, 1,071 in the foraging/dispersal habitat, and 765 in Devils Creek.

For reporting purposes, each species is considered independently detected once per 24-hour period on any given camera unless there were multiple individuals in the same image or, individuals could be distinguished. All additional detections of the same species on that camera within the same 24-hour period are disregarded for any analysis although the total number of detections is still recorded and reported.

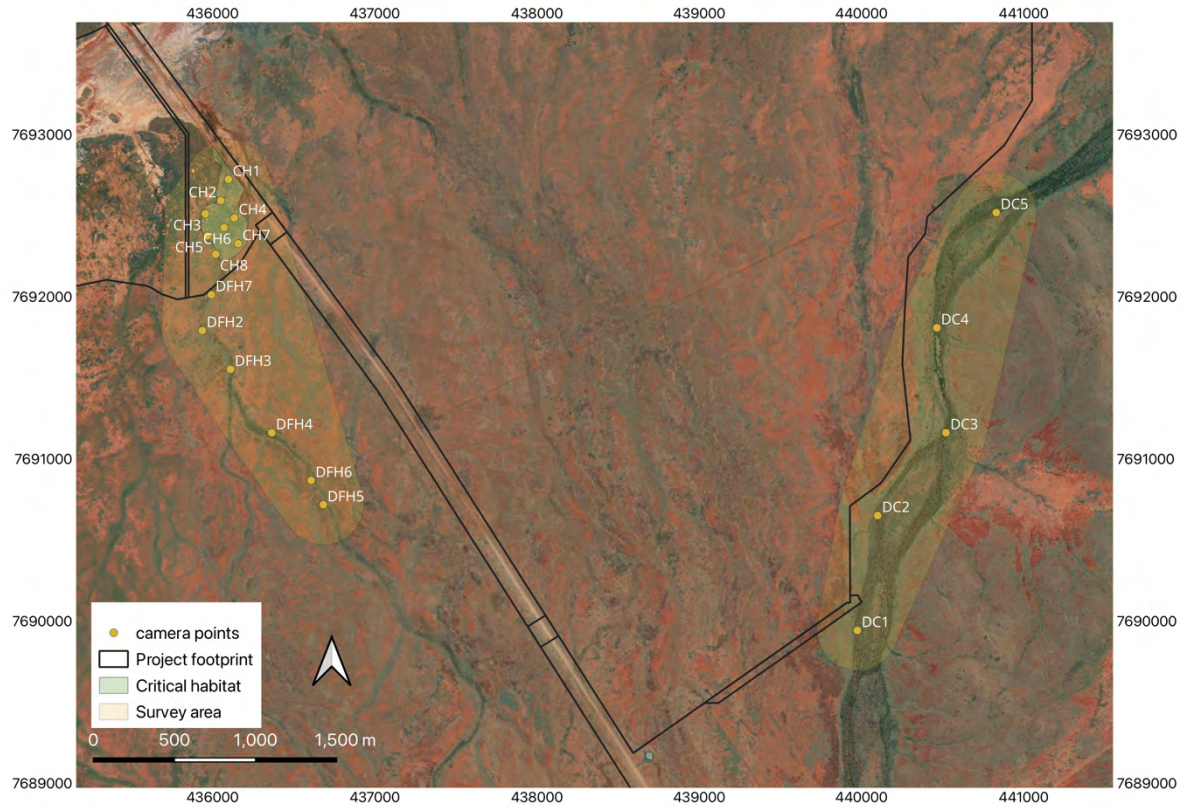

Figure 1 Camera placements in the different habitat type.

Table 1 Camera trap coordinates for all sites surveyed.

Location	Latitude	Longitude	Northing	Easting
CH1	-20.86453	116.38569	7692723	436097
CH2	-20.865712	116.385236	7692592	436050
CH3	-20.866454	116.384313	7692510	435955
CH5	-20.867675	116.384428	7692374	435967
CH8	-20.868704	116.384916	7692261	436018
CH7	-20.868124	116.38625	7692326	436157
CH6	-20.86722	116.385417	7692425	436070
CH4	-20.866678	116.386028	7692485	436133
DFH3	-20.875116	116.385772	7691551	436110
DFH2	-20.872959	116.384104	7691790	435936
DFH1	-20.871216	116.384292	7691983	435955
DFH7	-20.870956	116.384649	7692011	435992
DFH4	-20.878666	116.388199	7691160	436364
DFH6	-20.881329	116.390522	7690866	436607
DFH5	-20.882681	116.391236	7690716	436682
DC1	-20.889793	116.422873	7689941	439975
DC2	-20.883407	116.424098	7690649	440100

DC3	-20.878801	116.428162	7691160	440521
DC4	-20.872949	116.427646	7691807	440465
DC5	-20.866542	116.431188	7692518	440831

Figure 2 Example northern quoll (site DC1) and feral cat (site CH1) detections with and without olfactory lures. Responses of animals to olfactory lures was highly variable.

RESULTS

A summary of overall animal detections and camera performance throughout the sampling period, both with and without olfactory lures, is provided in Table 2 below. A total of 183,942 images were captured across all cameras, including 4,191 images with animals. Although the ratio of false detections to animal detections was high—due to environmental factors such as plant growth, rainfall, and debris blown in front of cameras—this did not significantly affect animal detection, as all but one camera remained operational throughout the deployment. The camera at CH2 experienced flooding four days after servicing and the deployment of lures on June 4th, due to a storm. This led to the memory card filling up and, consequently, this camera did not contribute further to the survey. Images from each camera view, both with and without olfactory lures, and the total number of images captured, are presented in Appendix A.

Table 2. Summary of all camera images from each site, showing the total number of images, those with animals (including birds, reptiles, and mammals), and those without animals (false detections).

Location Name	Camera ID	Total Images	Animals	False Detections
CH1	LH13	416	95	321
CH2	LH18	62256	125	62131
CH3	LH15	7764	34	7730
CH4	LH16	515	217	298
CH5	LH11	29956	132	29824
CH6	LH20	314	173	141
CH7	LH19	110	15	95
CH8	LH12	931	124	807
DC1	LH07	2049	1534	515
DC2	LH06	2038	176	1862
DC3	LH09	642	142	500
DC4	LH10	427	217	210
DC5	LH08	333	213	120
DFH1	LH04	49683	238	49445
DFH2	LH17	2791	215	2576
DFH3	LH14	9404	130	9274
DFH4	LH03	153	41	112
DFH5	LH01	184	96	88
DFH6	LH02	322	107	215
DFH7	LH05	13654	167	13487

Detections of all mammals are summarized in Table 3 and spatially represented for each of the five species in Figures 6 through 10.

All northern quoll detections occurred solely in Devils Creek, with all but one recorded at a single location, DC1 (Figure 6 and Table 3). These detections took place over a four-month period, from March 13 to July 13, spanning 14 nights at relatively regular intervals. The detections were consistent with previous records noted by Phoenix Environmental Services. During the first phase of the survey, it was not possible to determine the number of individuals due to the distance of the animals from the cameras. However, during the second phase, which incorporated olfactory lures, at least two individuals were identified at DC1 (Figure 3), distinguishable by variations in spot patterns and body sizes. It remains unclear whether the single individual detected at site DC5 was one of these two, as it did not approach the olfactory lure and was photographed while moving at a distance (Figure 4), making identification challenging.

Figure 3 Two individual northern quolls at site DC1 with the left image taken on the 3rd June 2024 and the right image on 4th June 2024.

Figure 4 A northern quoll image captured at site DC5. This was the only detection at this site and there was no interaction with the lure.

Feral cats were detected on 32 independent occasions (Table 3), with the highest frequency (15 occasions) in the critical habitat area. Four detections occurred in Devils Creek, and 13 in the dispersal/foraging habitat. Cats were detected on six cameras across both the critical habitat and foraging/dispersal areas, and on three cameras within Devils Creek (Figure 7), making them second only to red kangaroos in terms of spatial distribution during the study. Within the critical habitat and foraging/dispersal areas at least four individuals were identifiable.

Northern brush-tailed possums were detected on 41 independent occasions, but only on three cameras located in Devils Creek (Figure 8). The majority of these detections (37)

occurred at site DC1, the same location where most northern quoll detections were made. There were several images of a female with a juvenile on her back (Figure 5) and others that were clearly that of a male indicating at least three individuals in this system.

Figure 5 Female brush-tailed possum with juvenile at site DC1

Dingos/dogs were recorded exclusively within Devils Creek and were detected on every camera in this system (Figure 9).

The most widespread and frequently recorded species were red kangaroos, present in every habitat and at every camera location (Figure 10).

Overall, the highest number of detections occurred within the Devils Creek sampling area, with red kangaroos (64), dingoes/dogs (43), and brush-tailed possums (41) making up the majority of the records, in that order.

Table 3. Independent camera trap detections (single detection on a camera for a species in any 24hr period) for all mammal species over the entire survey at each site. Total number of detections for each species at each location are given in enclosed in brackets.

Location Name	Camera ID	**Cat**	**Dog**	**Northern Quoll**	**Brush-tailed Possum**	**Red Kangaroo**
CH1	LH13	3(11)				5(85)
CH2	LH18	4(27)				9(90)
CH3	LH15	1(3)				2(28)
CH4	LH16	1(3)				6(214)

Location Name	Camera ID	Cat	Dog	Northern Quoll	Brush-tailed Possum	Red Kangaroo
CH5	LH11					8(44)
CH6	LH20					8(107)
CH7	LH19	1(8)				4(7)
CH8	LH12	5(33)				12(88)
DC1	LH07		8(50)	13(120)	37(240)	25(818)
DC2	LH06	1(2)	5(42)		3(10)	12(122)
DC3	LH09		14(86)			8(50)
DC4	LH10	2(9)	12(49)			11(108)
DC5	LH08	1(5)	4(48)	1(3)	1(6)	8(86)
DFH1	LH04	1(5)				1(45)
DFH2	LH17	2(24)				7(182)
DFH3	LH14	2(27)				3(73)
DFH4	LH03					5(32)
DFH5	LH01	2(7)				7(89)
DFH6	LH02	4(60)				6(33)
DFH7	LH05	2(9)				4(49)
All sites		32(233)	43(274)	14(123)	41(256)	151(2322)

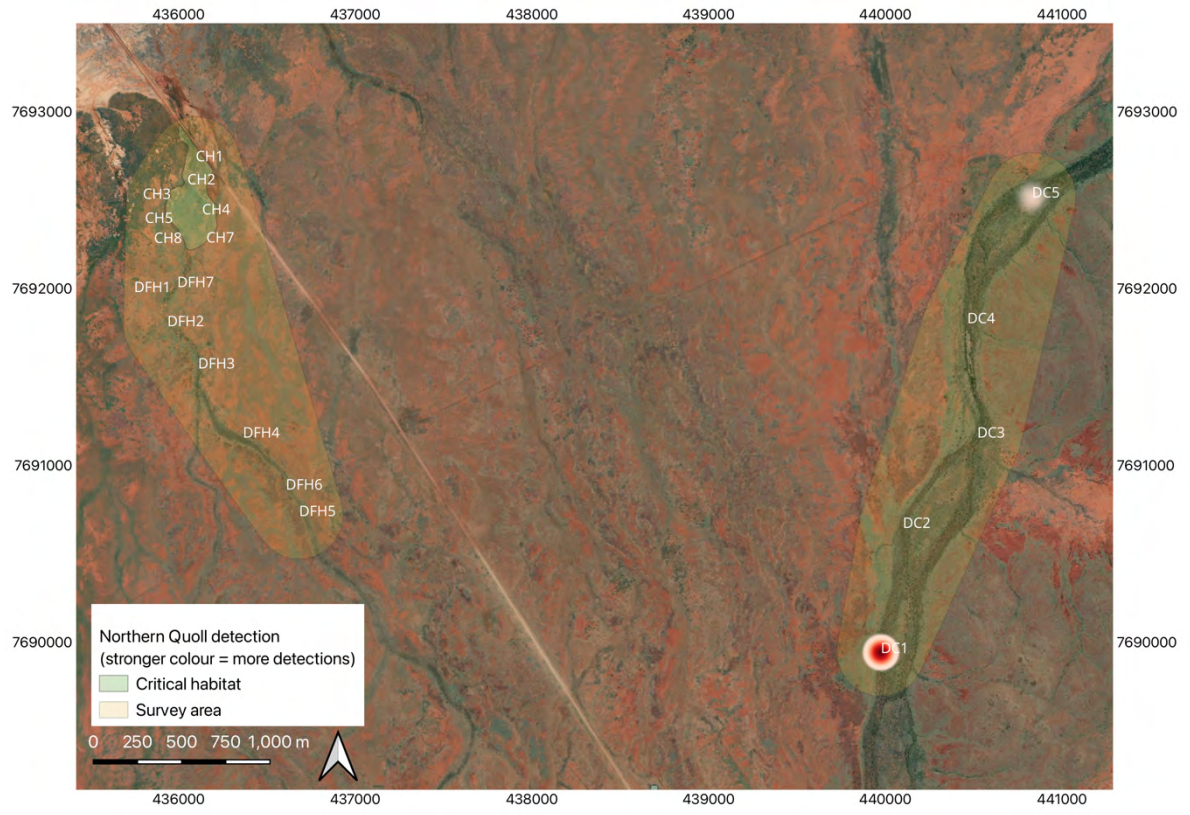

Figure 6 Northern quoll detections.

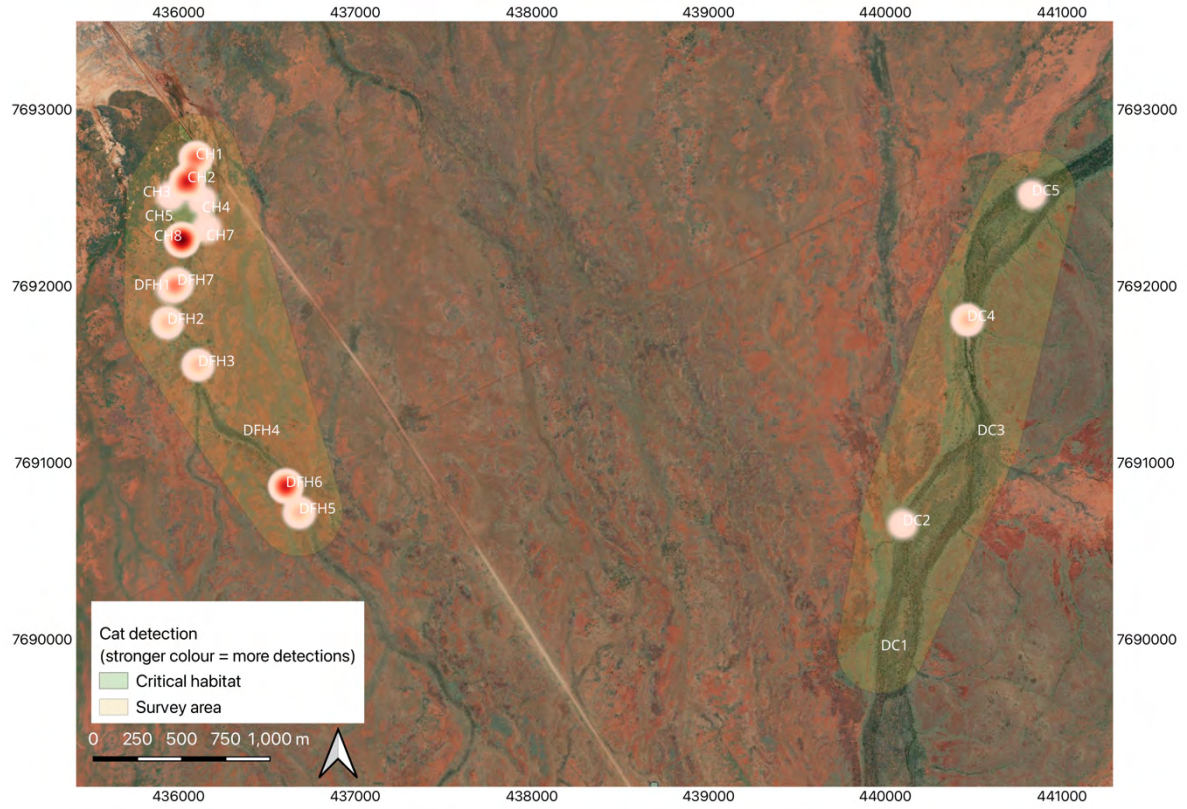

Figure 7 Feral cat detections.

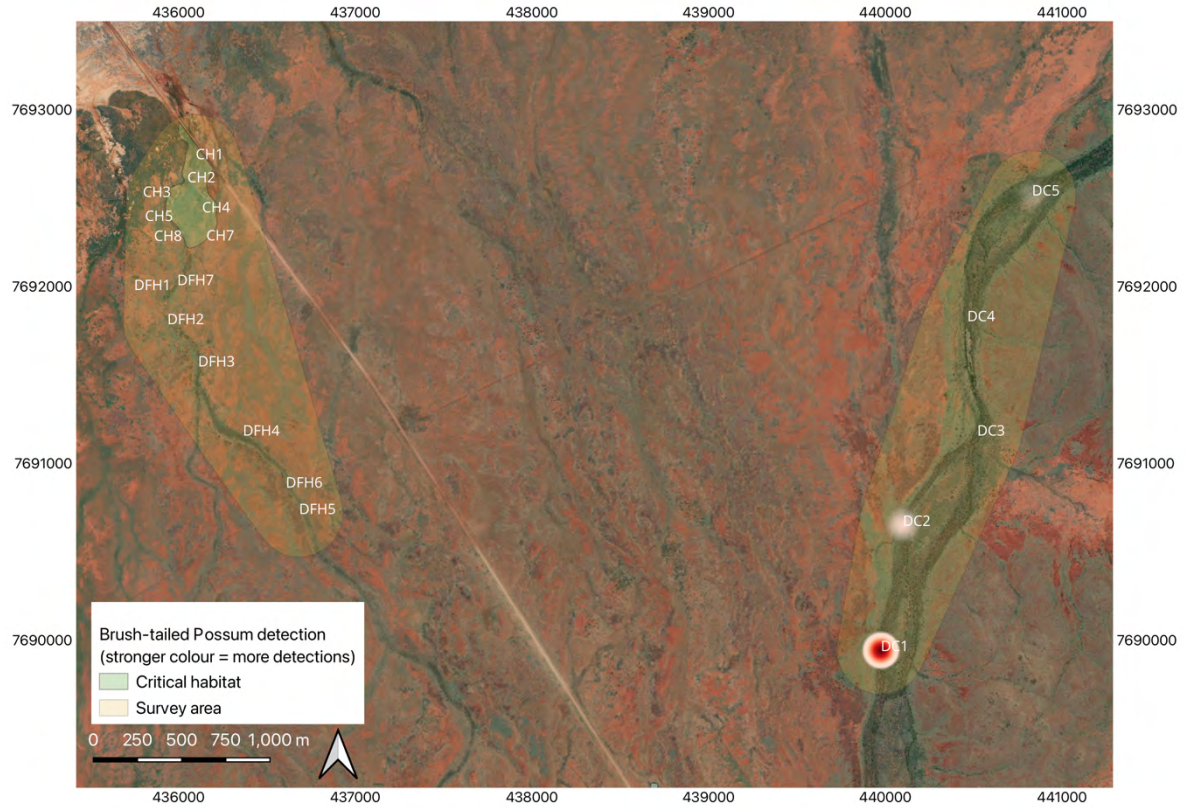

Figure 8 Brush-tailed possum detections.

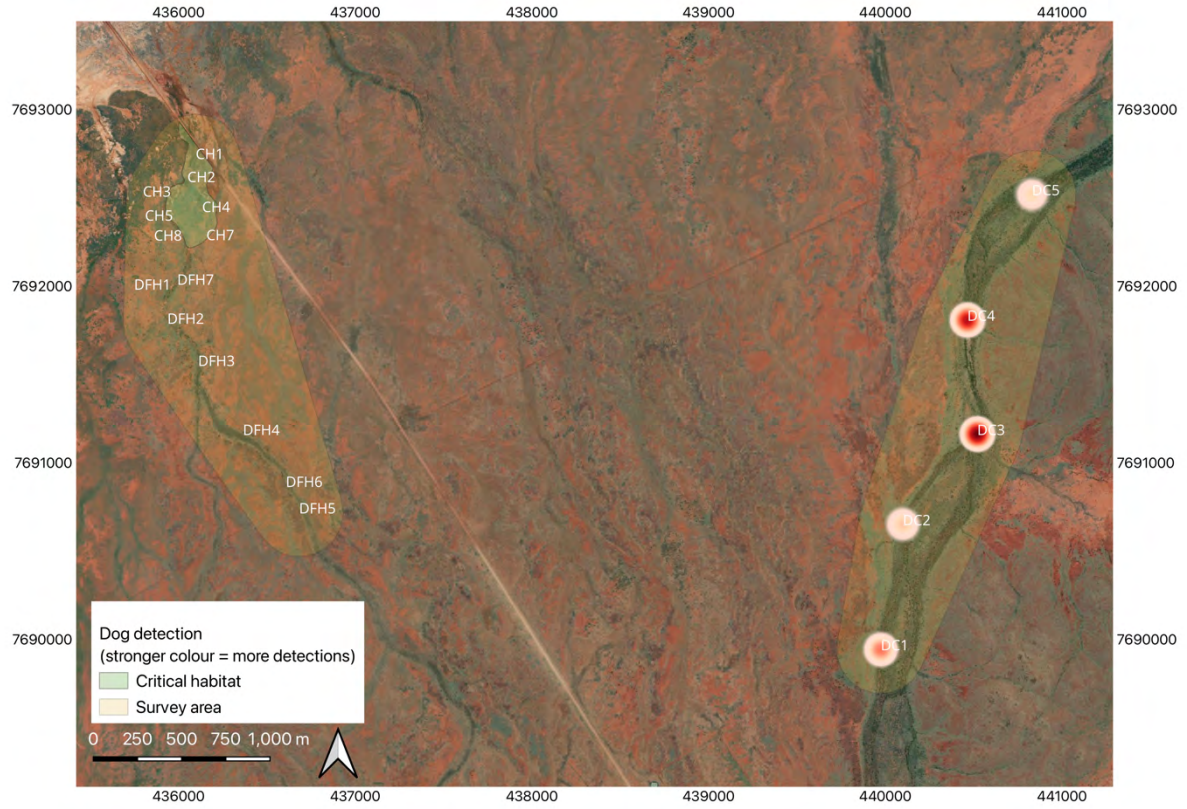

Figure 9 Dingo/dog detections

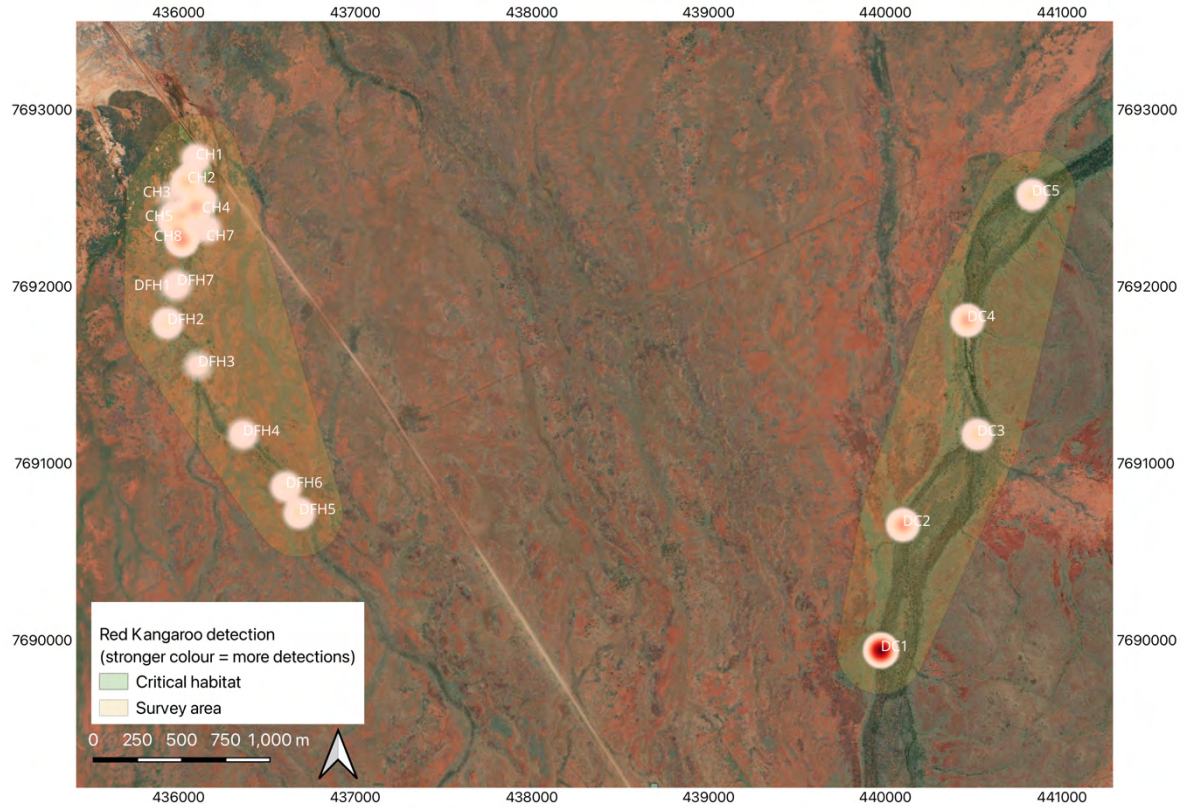

Figure 10 Red kangaroo detections.

Comparisons were made between mammal species detections before and after the deployment of olfactory lures, with an assessment focusing on both detection rates per 100 camera trap nights and the proportion of cameras (sites) at which each species was detected. The inclusion of olfactory lures increased the detection rate for all mammal species except the red kangaroo (Figure 11). The proportion of cameras detecting each species appeared unaffected by the olfactory lures, except for feral cats and northern quolls (Figure 12). In the case of feral cats, the observed variation could also be influenced by the extended camera deployment period rather than the lures alone. Although the number of sites where northern quolls were detected increased from one to two, this increase was not directly attributable to the olfactory lures, as there was only a single sighting at the second location, and this did not involve any interaction or investigation of the lure.

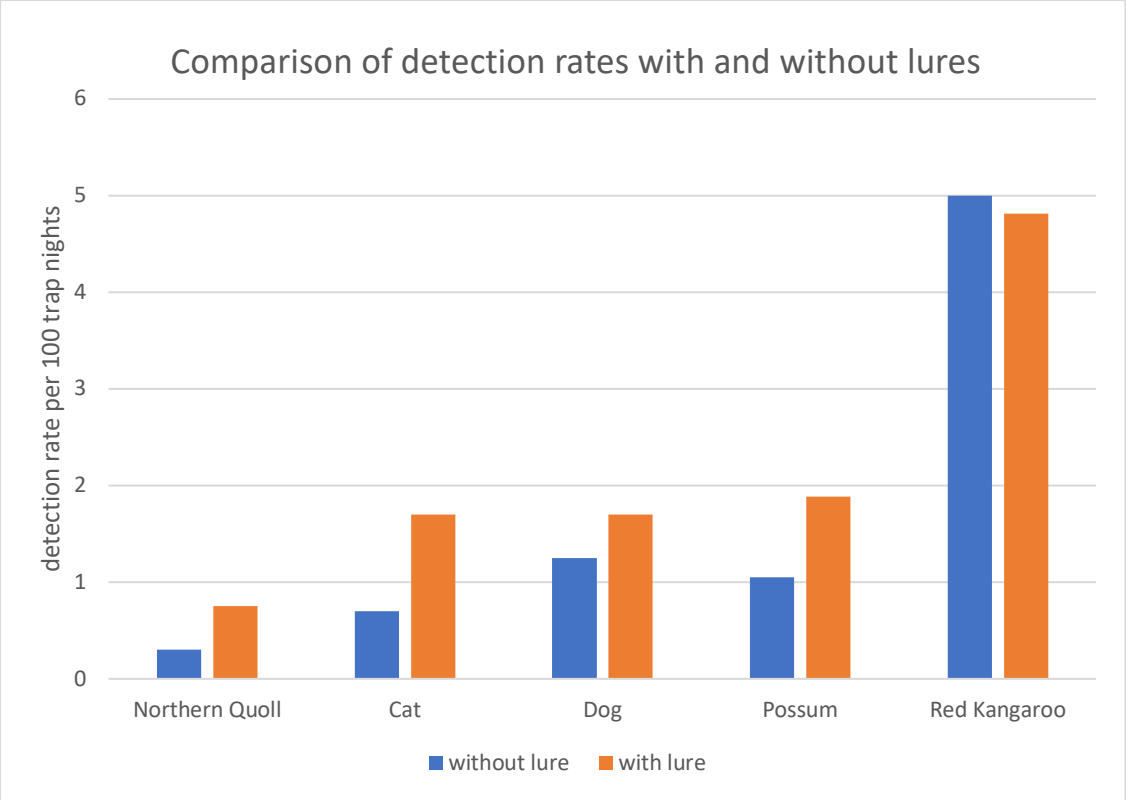

Figure 11 Detection rates per 100 camera traps nights pre and post olfactory lure deployment.

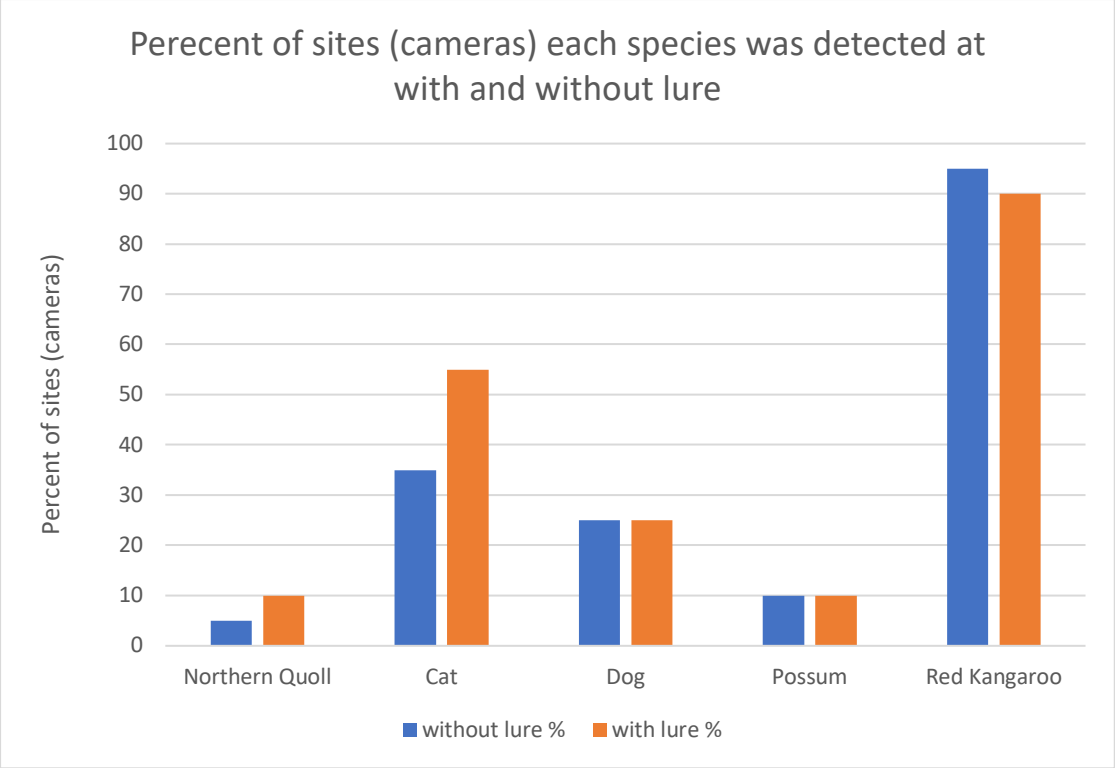

Figure 12 Percent of cameras each species was detected on pre and post olfactory lure deployment.

DISCUSSION AND CONCLUSIONS

This intensive camera trap program, which operated continuously for over five months and accumulated 3,060 camera trap nights, detected five mammal species. Of these, all but two species, feral cats and red kangaroos, were confined to Devils Creek, outside the proposed project footprint. The use of olfactory lures increased detection rates for most species except red kangaroos; however, this did not significantly alter the spatial detection patterns for the majority of species. The overall conclusions about species distributions would have remained largely consistent, whether or not olfactory lures were used, with the exception of feral cats. For these predators, extended camera deployment likely contributed to their increased detection rates, as their interaction with the lures was minimal and they were generally more focused on the cameras themselves or simply moving through the detection zones. These results suggest that extending camera deployment time can be as effective as using lures for detecting species presence at specific sites. Additionally, the imagery indicates that species' curiosity about cameras often influences detection rates as much as, if not more than, their interest in olfactory lures. Almost all species seem to have an innate awareness of their surroundings and recognise and investigate new or unusual objects, particularly in the early stages of deployment.

The high-density deployments of camera traps within the identified critical habitat and dispersal/foraging areas aimed to detect northern quolls if they were present. Despite the extensive camera coverage, duration, and the use of olfactory lures, northern quolls were not detected within either of these areas and were only intermittently detected in Devils Creek, at two locations both outside the project's footprint. Most of these detections were at a single

location and appear to be from at least two individuals This finding suggests that the area of Devils Creek adjacent to the project area may function as a movement corridor and potential foraging area but is unlikely to constitute primary habitat as there is a notable lack of extensive or suitable cover for daily refuge in this part of the creek line.

Determining what size area would constitute critical habitat for northern quolls, particularly for small and isolated areas like a rock pile, is challenging due to uncertainties about whether individuals, if present, are transient or resident. The area mapped as critical habitat for this project, based on a single scat, covers approximately 7.5 hectares and is geographically isolated within a grassy plain, at least five kilometres from any other potential northern quoll habitat. Numerous studies of northern quoll home ranges in the Pilbara show that females typically require at least 13 hectares, but often exceed 35 hectares, while males use areas generally over 100 hectares (Henderson, 2015; Cowan et al., 2020; Hernandez-Santin et al., 2020; Moore et al., 2021; Cowan et al., 2022). Additionally, GPS-tracking data reveal that northern quolls prefer rugged, topographically complex areas rather than the subdued relief of plains (Cowan et al., 2022), which make up the vast majority of the proposed project area. Given their extensive foraging behaviour and the larger areas they typically use, if northern quolls were present in either the critical habitat or associated foraging/dispersal habitat, they would have been detected by this intensive camera trapping program. The consistent detection of feral cats, whose prey would be more abundant than the predator itself, further supports the conclusion that northern quolls were not present.

Although northern quolls from nearby populations, such as those near Devils Creek, could conceivably traverse the area, the lack of a clear pathway and the shallow, exposed drainage tracts suggest such occurrences would be rare, if they occur at all. Additionally, the small size and limited rock complexity of the area would provide inadequate thermal protection under extreme Pilbara conditions, further reducing its suitability for northern quolls.

In summary, the absence of northern quoll detections within the critical and foraging/dispersal habitats of the Eramurra Solar Salt Project footprint, despite intensive monitoring efforts, indicates that the area does not currently support northern quolls or fulfill their habitat needs. The small, isolated rock formation does not align with what is generally understood about the habitat requirements outlined in the literature and is unlikely to be important for northern quolls. While the only species detected in this area were feral cats and red kangaroos, even in the absence of feral cats, the nature of this environment, as outlined, makes it extremely unlikely northern quolls would reside in this area. We have found no evidence to suggest the area is either visited or utilised in any other way by northern quolls.

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Appendix A

Camera Orientation	Camera Orientation With Olfactory Lures
 *CH1-416 images, 95 animal detections*	
 *CH2-62,256 images, 125 animal detections*	
 *CH3-7,764 images, 34 animal detections*	

CH4-515 images, 217 animal detections

CH5-29,956 images, 132 animal detections

CH6-314 images, 173 animal detections

CH7-110 images, 15 animal detections

CH8-931 images, 124 animal detections

DFH1-49,683 images, 238 animal detections

DFH2- 2,791 images, 215 animal detections

DFH3-9,404 images, 130 animal detections

DFH4-153 images, 41 animal detections

DFH5-184 images, 96 animal detections

DFH6-322 images, 107 animal detections

DFH7-13,654 images, 167 animal detections

DC1-2,049 images, 1,534 animal detections

DC2-2,038 images, 176 animal detections

DC3-642 images, 142 animal detections

DC4-427 images, 217 animal detections

DC5-333 images, 213 animal detections