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COCKATOO ISLAND MULTI-USE SUPPLY BASE TARGETED FAUNA AND FLORA SURVEY

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EXECUTIVE SUMMARY

Targeted flora and fauna surveys on Cockatoo Island (located approximately 7 km off the Western Australian coast within the Buccaneer Archipelago) were required to support Crestlink Pty Ltd's (Crestlink) responses to submissions in relation to the Environmental Protection Authority's (EPA) assessment (Assessment on Referral Information) of the Cockatoo Island Multi-Use Supply Base project under Section 38 of the *Environmental Protection Act* 1986 (EP Act). There are potential impacts to flora and vegetation and terrestrial fauna resulting from the proposed clearing of up to 34.23 ha of vegetation within the development envelope. Specifically, Crestlink required targeted surveys for two significant fauna species, the northern masked owl (*Tyto novaehollandiae kimberli*) (Vulnerable (EPBC Act) and P1 (DBCA)) and the ghost bat (*Macroderma gigas*) (Vulnerable EPBC Act and DBCA); and two Priority plant species, the Priority 1 *Triodia* sp. Hidden Island (T. Handasyde TH 6109) and the Priority 2 *Solanum vansittartense*. Ecologia Environment (*ecologia*) was engaged by Crestlink to undertake the targeted surveys which were completed over a four-day period between 23 – 26 February 2025.

Targeted Flora Survey

Approximately 288 individuals of *Triodia* sp. Hidden Island (T. Handasyde TH 6109) (P1) were recorded from 13 points within the survey area. An additional 213 plants were recorded just outside of the survey area. *Solanum vansittartense* (P2) was not recorded within the survey area.

Targeted Fauna Survey

The ghost bat (*Macroderma gigas*) (Vulnerable EPBC Act and DBCA) was recorded at two ghost bat lure sites within the survey area. The northern masked owl (*Tyto novaehollandiae kimberli*) (Vulnerable (EPBC Act) and P1 (DBCA)) was not recorded in the current survey.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Targeted flora and fauna surveys on Cockatoo Island were required to support Crestlink Pty Ltd's (Crestlink) in relation to the Environmental Protection Authority's (EPA) assessment (Assessment on Referral Information) of the Cockatoo Island Multi-Use Supply Base project under Section 38 of the *Environmental Protection Act* 1986 (EP Act). Cockatoo Island is located approximately 7 km off the Western Australian coast within the Buccaneer Archipelago, approximately 130 km north of Derby, in the Kimberley region (Map 1). The project's development envelope covers an area of 52.66 ha and consists of land and marine elements. There are potential impacts to flora and vegetation and terrestrial fauna resulting from the proposed clearing of up to 34.23 ha of vegetation within the development envelope. Specifically, Crestlink required targeted surveys for two significant fauna species, the northern masked owl (*Tyto novaehollandiae kimberli*) (Vulnerable (EPBC Act) and P1 (DBCA)) and the ghost bat (*Macroderma gigas*) (Vulnerable EPBC Act and DBCA); and two Priority plant species, the Priority 1 (P1) *Triodia* sp. Hidden Island (T. Handasyde TH 6109) and the Priority 2 (P2) *Solanum vansittartense*.

1.2 SCOPE OF WORK

Targeted Flora Survey

Targeted searches for *Triodia* sp. Hidden Island (T. Handasyde TH 6109) (P1) and *Solanum vansittartense* (P2) will be conducted within the survey area along walked linear traverses spaced approximately 10 m apart. To comply with EPA Guidance, survey work should be conducted at a time that generally coincides with the flowering of the target species (February). Where target species are observed, the following parameters will be recorded: location using a GPS; species (a collection will be made and assigned a unique identifier in the field; number of individuals and their condition; whether plants are flowering or fruiting; and photograph of representative specimens.

Targeted Fauna Survey

Targeted surveys for the ghost bat and northern masked owl will be undertaken within the survey area at sites within suitable habitat for each species. In compliance with the *Technical Guidance - Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA, 2020)*, broadcast surveys will be conducted for the northern masked owl and lures will be deployed to target ghost bats. The surveys were conducted at a suitable survey time of year for both species (February), in suitable weather conditions (no heavy rain or wind). For each survey site, a habitat assessment was conducted, and the locations recorded using handheld GPS.

1.3 LEGISLATIVE AND REGULATORY FRAMEWORK

The Environmental Protection Authority's (EPA) environmental objectives for the factors *Flora and Vegetation* (EPA, 2016a) and *Terrestrial Fauna* (EPA, 2020) are to protect fauna, flora and vegetation so that biological diversity and ecological integrity are maintained. In this context, ecological integrity is the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements. The primary objective of this flora, vegetation and fauna assessment was to provide sufficient information to assess the impact of any proposed development on the fauna, flora, and vegetation of the survey area, thereby ensuring that the EPA's objectives can be met.

The survey was designed and undertaken to comply with the following guidance documents:

- Environmental Factor Guideline: Flora and Vegetation (EPA, 2016a).
- Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020).
- Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b).

1.4 TARGET SPECIES

***Triodia* sp. Hidden Island (T. Handasyde TH 6109) (P1)**

Triodia sp. Hidden Island (T. Handasyde TH 6109) is a large clumping hummock grass with lightly resinous foliage and a large open inflorescence of numerous spikelets. It was first recorded from Hidden Island in the northern Kimberley in 2009, where it was found on rocky limestone outcrops. It was subsequently recorded from Cockatoo Island during environmental surveys by GHD in 2014 (GHD, 2014) and 2017 (GHD, 2017) primarily from the eastern and western ends of the island.

***Solanum vansittartense* (P2)**

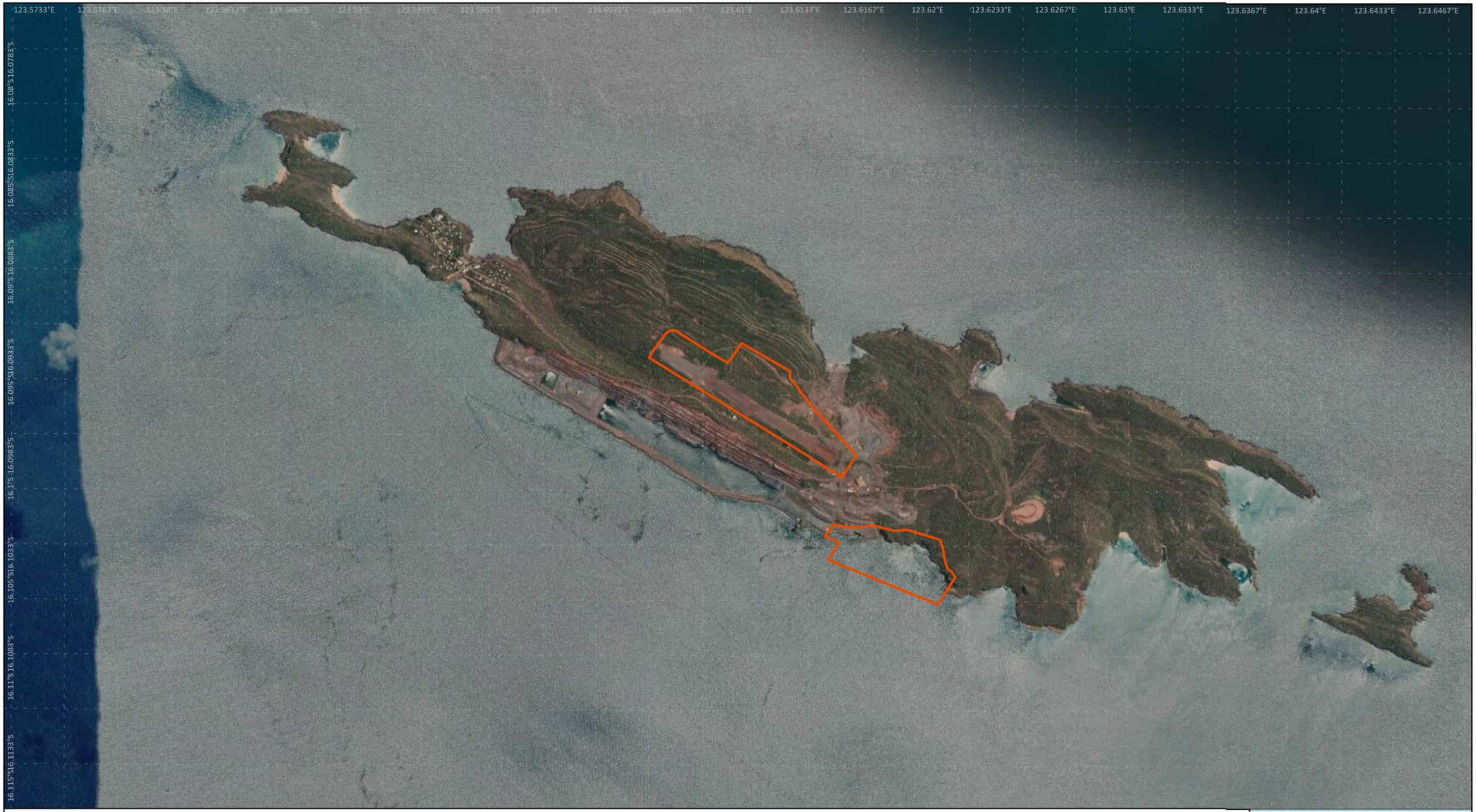
Solanum vansittartense is an erect dioecious shrub growing to approximately 3 m high. It is recorded exclusively from the Northern Kimberly region where it is typically associated with sand over sandstone (Wheeler, Rye, Kock, & Wilson, 1992). It was recorded from a single location at the western end of Cockatoo Island in 2008 but has not been recorded since then (GHD, 2017).

Ghost bat (*Macroderma gigas*) – Vulnerable EPBC Act & BC Act

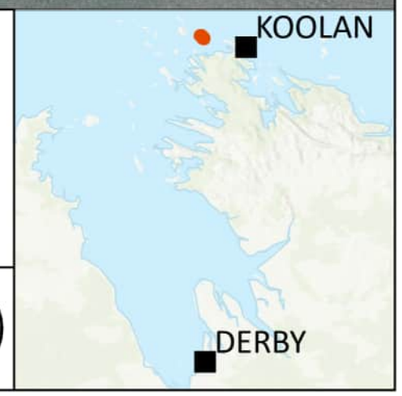
The ghost bat is the largest microchiropteran bat in Australia, with a head body length of 100-130mm. The species is creamy white in colour, with large ears and a prominent nose (Van Dyck & Strahan, 2008). Ghost bats roost in large and typically deep caves with complex internal systems. They prey on amphibians, reptiles, birds, small terrestrial mammals, insects and other bats (Van Dyck & Strahan, 2008). Ghost bats have a widespread distribution across northern Australia and are known to occur within the Buccaneer Archipelago. The species has previously been recorded on Cockatoo Island in August 2013 (GHD, 2017).

Masked owl (northern subspecies) (*Tyto novaehollandiae kimberli*) – Vulnerable EPBC Act & Priority 1 BC Act

The northern masked owl is a large species of owl (600-1000g), with a heart shaped disk, well feathered legs, a dark back and light body. The species closely resembles the more common barn owl, which is smaller and lighter in colour. The northern masked owl is uncommon and not well understood. This subspecies occurs in northern Queensland, the Northern Territory and the Kimberley in woodland habitat (Threatened Species Scientific Committee, 2015). The northern masked owl has previously been recorded on Cockatoo Island in February 2014 (GHD, 2014).



Survey area



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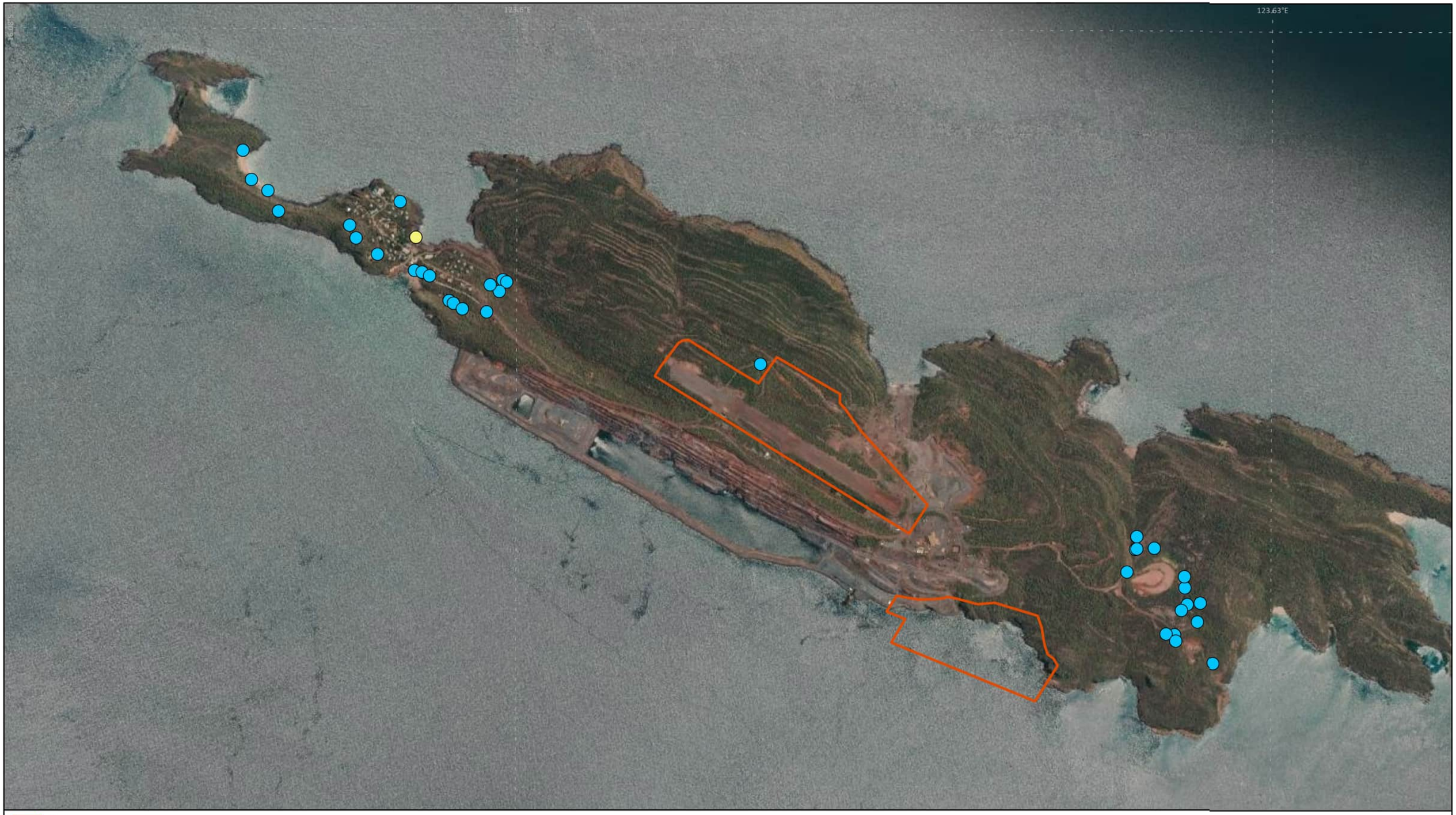
Project No.: 2036
Author: AC
Created Date: 6 March 2025
Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Scale: 1:20,000 @A3

Map 1: Location of survey area.

0 0.5 1 2
Kilometers



Survey area

Solanum vansittartense

Triodia sp. Hidden Island (T. Handasyde TH 6109)

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Project No.: 2036
Author: AC
Created Date: 28 February 2025
Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Scale: 1:15,000 @A3

Map 2: Existing records of *Triodia* sp. Hidden Island (T. Handasyde TH 6109) and *Solanum vansittartense* on Cockatoo Island..

Maxar

0 0.3 0.7 1.3
Kilometers

2 METHODOLOGY

2.1 TARGETED FLORA ASSESSMENT

2.1.1 Field Survey and Timing

The targeted flora assessment was conducted by one *ecologia* botanist (with assistance from Crestlink staff) over four days between 23 – 26 February 2025. The survey was completed in accordance with the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b). Both target species (*Triodia* sp. Hidden Island (T. Handasyde TH 6109) and *Solanum vansittartense*) have been recorded flowering in February (GHD, 2014; Western Australian Herbarium, 1998–), therefore the timing of this survey was appropriate.

2.1.2 Targeted Survey

Targeted searches were made along walked traverses in areas of potential suitable habitat within most of the survey area (Map 3). Traverses were undertaken at approximately 10 – 20 m spacings, depending on terrain and the density of vegetation. The traverses shown on Map 2 only include data from *ecologia* scientists, but additional traverses were also undertaken by Crestlink staff members which were not recorded. Some portions of the survey area could not be surveyed due to time and access constraints, including areas of very dense vegetation that were unlikely to support the target species.

Where the target species were observed the following parameters were recorded: location (for individual or localised plants) or population boundary (for more extensive populations, time permitting); number of plants (count, for individual or localised plants) or estimated number of plants for more extensive populations; reproductive state; soils and landform.

2.1.3 Specimen Identification

Specimen identification was undertaken with reference to current taxonomic literature and herbarium reference specimens. Scientific names used in this report follow the species concepts currently adopted by the Western Australian Herbarium.

2.2 TARGETED FAUNA SURVEY

2.2.1 Field Survey and Timing

The targeted fauna assessment was conducted concurrently with the targeted flora survey. The survey was completed in accordance with the *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA, 2020). The survey was conducted during the optimal time of the year for both species, in suitable weather conditions (no heavy rain or wind), therefore the timing of the targeted surveys is considered appropriate.

2.2.2 Targeted Survey

Ghost bat lure

Each lure consists of one portable speaker, two camera traps, two infrared spotlights and a bat detector. Portable speakers were loaded with a micro-SD card containing a sequence of sound files containing 'squabble' calls of the ghost bat (*sensu* Hanrahan *et al.* 2023), with sound files played for a 2-minute period, followed by a 2-minute period of silence. Each camera trap was programmed to record 3-minute black and white video files at high resolution continuously upon start up. Infrared spotlights were set to turn on when ambient illumination levels drop below the threshold required for quality colour video recordings. A bat detector was placed on the star picket, below the portable speaker to maximise the chance of echolocation call detection if a ghost bat approached the speaker.

Each site was sampled for a single night, before the lure was relocated to a new location, ensuring that behavioural impacts associated with sampling over repeated nights are avoided. The distance at which ghost bats can hear the signals at night is unknown but assumed to be at least 100m (Kyle Armstrong, *pers. comm.*).

Ghost bats can be distinguished in infrared and thermal video recordings from other bat species and insects based on the observation of any combination of the following morphological and behavioural features that provide an empirical basis for the identification:

- flight pattern (four distinct behaviours classified as: 'circling' of the post containing the speaker; 'hover' in front of the speaker; 'long glide' towards the speaker; and 'drop in' whereby they would sometimes approach at c. 2 m above the speaker and then drop vertically towards it);
- body size relative to other objects in the frame;
- large ear size;
- lack of a tail;
- bright eyeshine of the reflected infrared light from their large eyes (infrared recordings only, though not always visible); and
- corroboration with concurrently recorded diagnostic echolocation calls.

All bats observed in videos are examined by single manual frame advancement to check for diagnostic features. The relatively high resolution and video frame rate provides a reasonable level of image quality.

Figure 1: Ghost bat lure layout.

Broadcast surveys

Broadcast surveys for the northern masked owl were undertaken at night, along roads at sites within suitable habitat 1 km apart. At each site, the survey consisted of:

- 5 minutes in silence with no spotlight, listening for calls and signs of moving birds
- 10 minutes of the recording playback, alternating between scanning the trees and surrounding area with and without a spotlight
- 5 minutes in silence, alternating between scanning the trees and surrounding area with and without a spotlight

The 10-minute playback recording consisted of 4% hisses, 4% chattering and 5% screeches (totalling of 1 minute and 20 seconds of calls) intermixed with silence. The audio file was stitched together with the volume automated using audio software 'Logic Pro'. The recording was broadcasted with a portable speaker with a maximum sound level of 90dBC and frequency range of 60Hz – 20kHz.

The methods used in this survey were consisted with the *Survey Protocol for masked owls in the NT Tyto novaehollandiae (north Australian mainland subspecies T. n. kimberli and Tiwi subspecies T. n. melvillensis) (Ward, 2010).*

2.3 ANIMAL ETHICS

The survey was conducted as per *ecologia*'s Animal Ethics Code of Practice, which conforms to Section 5 of the *Australian code of practice for the care and use of animals for scientific purposes* (National Health and Medical Research Council, 2004). In all cases, animals were identified in the field and not captured or collected during the survey.

123.6°E

Survey area

Inaccessible

Targeted flora traverse

Project No.: 2036
Author: AC
Created Date: 28 February 2025
Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Scale: 1:7,500 @A3

Map 3: Targeted flora survey effort.

Maxar

0 0.1 0.3 0.6

Kilometers

Survey area

Targeted ghost bat site

Ghost bat lure

Targeted northern masked owl site

Broadcast survey

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Project No.: 2036
Author: SP
Created Date: 04 March 2025
Coordinate System: GCS GDA 1994
Scale: 1:15,500 @A3

Map 4: Location of targeted fauna surveys.

Maxar

0 0.2 0.4 0.6 1
Kilometers

2.4 STUDY TEAM AND LICENCES

The personnel undertaking this assessment and project roles are listed in Table 1.

Table 1: Project staff and licences.

Project staff				
Name	**Qualification**	**Role**	Project role	Experience
Shaun Grein	B.App. Sc (Biol.); Grad. Dip. Nat. Resources; MBA	Managing Director/Senior Principal Scientist	Project management, QA	30+
Andrew Craigie	B.Sc. (Hons.) (Botany); PhD (Botany)	Principal Botanist and Taxonomist	Specimen identification, reporting	15+
Tim McCabe	B.Sc. Env. Biol, Dip Proj Mngment, Cert III Vert Pest Mngment	Principal Zoologist	Project management	15+
Sam Plant	B.Sc. WildlifeBiol. EnvSc.; MWildlifeHth; Cert II ConsLandMngment.	Zoologist	Field survey, reporting	5+
Amelia Shepherdson	B.Sc. (Botany)	Botanist	Field survey, specimen identification	2+
Licences				
Amelia Shepherdson	Flora Taking (Biological Assessment) Licence: FB62000723 (exp. 28/08/2025) Authorisation to Take or Disturb Threatened Species: TFL-2425-0045 (exp. 30/07/2027)			
Tim McCabe	Authorisation to Take or Disturb Threatened Species – Section 40 (TFA-2425-0193)			
Ecologia Environment	WAEC Ethics Approval (WAEC 24-07-37)			

2.5 LIMITATIONS AND CONSTRAINTS

An assessment of survey-specific issues and limitations is detailed in Table 2 for the flora and vegetation survey and Table 3 for the fauna survey. There were no significant limitations identified for either survey.

Table 2: Flora survey limitations.

Aspect	Assessment	Constraint
Availability of contextual information at a regional and local scale	Flora and vegetation survey data from previous surveys on Cockatoo Island were available prior to this survey. This information was adequate to provide appropriate contextual information for the survey.	Nil
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	The personnel undertaking field work and specimen identification were suitably qualified and have conducted numerous botanical surveys in Western Australia.	Nil
Proportion of flora recorded and/or collected, any identification issues	NA	Nil
Was the appropriate area fully surveyed (effort and extent)	The appropriate area was sufficiently surveyed.	Nil
Access restrictions within the survey area	Some parts of the survey area were inaccessible due to step terrain or very dense vegetation.	Minor
Survey timing, rainfall, season of survey	The survey was conducted during the known flowering period for both target species.	Nil
Disturbance that may have affected the results of survey such as fire, flood or clearing	No significant limitations identified.	Nil

Table 3: Fauna survey limitations.

Aspect	Comment	Constraint
Competency/experience of the consultant carrying out the survey.	The zoologist undertaking the fauna survey has more than five years of experience conducting terrestrial vertebrate fauna surveys in Western Australia.	Nil
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	The fauna survey focussed on significant fauna species that may have the potential to occur in the study area. The scope was well defined. Fauna and their habitats were surveyed using standardised and well-established techniques. Relevant databases were reviewed.	Nil
Proportion of fauna identified, recorded and/or collected.	The targeted fauna survey focussed on significant fauna species that may have the potential to occur in the study area.	Nil
Sources of information (previously available information as distinct from new data).	Database records, including significant fauna species, were available for the area and considered adequate to provide appropriate contextual information for the study.	Nil
The proportion of the task achieved and further work which might be needed.	Planned survey works were conducted and completed. No further work is required to complete the survey scope.	Nil
Timing/weather/season/cycle.	The survey was conducted during an appropriate time/season.	Nil
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	There were no natural or human interventions that constrained the survey of the study area.	Nil
Intensity (in retrospect was the intensity adequate).	Given the access to available information from the area, the survey intensity was considered adequate and is appropriate for a targeted fauna assessment.	Nil
Completeness (e.g. was relevant area fully surveyed).	The targeted fauna survey was considered complete. The representative sites were sampled across the entirety of the survey area and the majority of the survey area was traversed concurrently with the flora surveys.	Nil
Resources (e.g. degree of expertise available in animal identification to taxon level).	Resources were adequate to carry out the survey and survey participants were competent in the identification of species and likelihood of occurrence.	Nil
Remoteness and/or access problems.	Most of the survey area was accessible at the time of the survey. Remoteness is not considered to be a significant constraint. The targeted fauna sites were able to be placed in the first-choice locations (suitable habitat) without any access issues.	Nil
Availability of contextual (e.g. biogeographic) information on the region.	The data available was adequate for the level of survey work undertaken during this assessment.	Nil
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	Sampling methods are considered adequate for target species.	Nil

3 RESULTS AND DISCUSSION

3.1 TARGETED FLORA ASSESSMENT

Triodia sp. Hidden Island (T. Handasyde TH 6109) (P1)

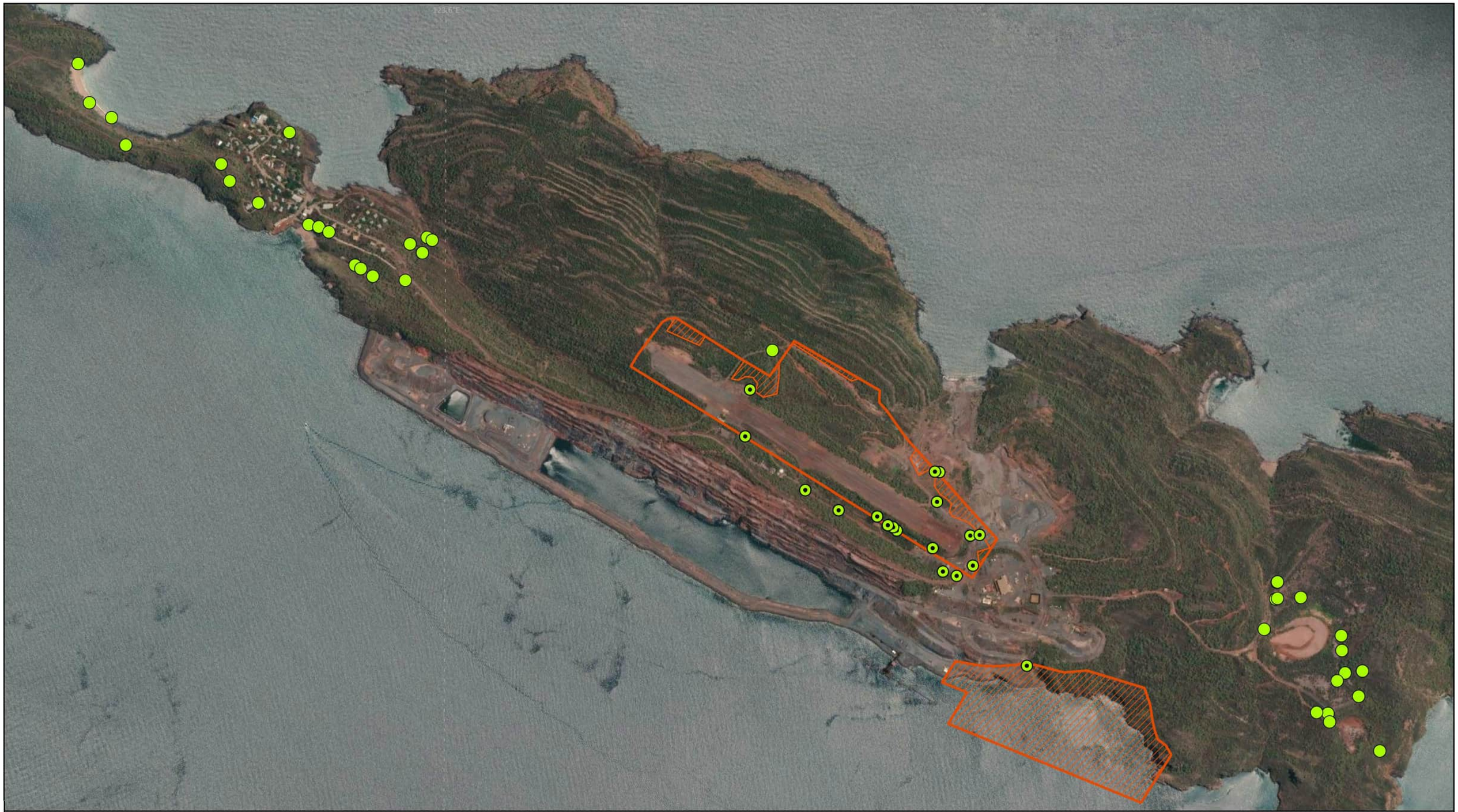
Approximately 288 individuals of *Triodia* sp. Hidden Island (T. Handasyde TH 6109) were recorded from 13 points within the survey area. An additional 213 plants were recorded just outside of the survey area (Map 5). Plants were recorded from a variety of landforms, but primarily from rocky slopes within areas mapped by GHD as *Eucalyptus* open woodlands (*Eucalyptus miniata*, *Corymbia cadophora*, *Brachychiton diversifolius* open low woodland over *Triodia bynoei* hummock grassland) (GHD, 2014).

There is currently no available information on how to distinguish *Triodia* sp. Hidden Island (T. Handasyde TH 6109) from closely related species. Based on examination of reference collections and label information at the Western Australian Herbarium, communication with WA herbarium staff, and photographs provided in technical reports for Cockatoo Island (GHD, 2014, 2017), *Triodia* sp. Hidden Island (T. Handasyde TH 6109) is a large clumping hummock grass with lightly resinous foliage and a large open inflorescence of numerous spikelets. The glumes are papery with a short bristle or awn. The spikelets are up to approximately 6 mm long including the lemma awns. The lemmas have 3 awns, with the central awns slightly longer than the laterals. The lemma body has long dense straight hairs in the lower half obscuring the surface and much shorter dense hairs in the upper half.

The *Triodia* specimens collected during this survey and identified as *Triodia* sp. Hidden Island (T. Handasyde TH 6109) (Figure 2) were consistent with the reference specimen of *Triodia* sp. Hidden Island (T. Handasyde TH 6109) at the Western Australian Herbarium, and had the following features: foliage non-resinous or lightly resinous; leaf sheaths mostly glabrous but often long-ciliate on the margins; orifice with soft hairs to ca. 5 mm long; inflorescence an open panicle, consisting of numerous spikelets; spikelets ca. 5 – 6 mm long including the awns, with ca. 3-5 florets all terminating at about the same level; glumes papery, mostly glabrous in the lower half and with very short scabrous hairs in the upper half, with a short awn or bristle to ca. 1-1.5 mm long; lowest lemmas ca. 6 mm long including the awns and callus, 3-lobed, central awn ca. 2.5-3 mm long, lateral awns slightly shorter ca. ca 1.5 mm long, body with moderately dense hairs over the entire surface, with straight hairs in the lower half obscuring the surface and much shorter somewhat scabrid hairs in the upper half; palea with soft appressed hairs on the body and densely ciliate on keels. They were distinct from *Triodia bynoei*, a commonly recorded species on the island, which typically has longer lemma awns (mid-lobe and awn 4.5–10 mm long) and sparse short hairs on the lemma body (Lazarides, 1997).

Solanum vansittartense (P2)

One plant recorded from the survey area as potentially being *Solanum vansittartense* (P2) was later identified as the similar but more common and widespread species *Solanum dioicum* for the following reasons: fruiting pedicels ca. 25 mm long (<15 mm long in *S. vansittartense*) (Barrett, 2012; Wheeler et al., 1992); fruiting calyx with prickles to ca. 9 mm long (10-14 mm long in *S. vansittartense*) (Wheeler et al., 1992). No other *Solanum* species were observed during the survey. *Solanum vansittartense* (P2) was therefore not recorded within the survey area.



Survey area
Inaccessible
Triodia sp. Hidden Island (ecologia record)
Triodia sp. Hidden Island (existing GHD record)

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Project No.: 2036
Author: AC
Created Date: 28 February 2025
Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Scale: 1:11,195 @A3

Maxar

Map 5: Records of *Triodia* sp. Hidden Island (T. Handasyde TH 6109) within the survey area..

0 0.3 0.5 1
Kilometers

Figure 2: Photographs of *Triodia* sp. Hidden Island (T. Handasyde TH 6109) from the survey area.

Top. Plants growing *in situ* within the survey area; bottom left: spikelets; bottom right: inflorescence.

3.2 TARGETED FAUNA ASESSMENT

Ghost bat (*Macroderma gigas*) - Vulnerable EPBC Act & BC Act

The ghost bat was historically distributed across much of Australia but now has a has a patchy but widespread distribution restricted to northern Australia (Threatened Species Scientific Committee, 2016). Following European settlement, the distribution of this species contracted northward with arid zone populations undergoing the greatest contractions (Threatened Species Scientific Committee, 2016). Ghost bat populations are highly structured and are considered to be genetically distinct at both local and regional scales (Threatened Species Scientific Committee, 2016).

Ghost bats are known to move between a number of caves seasonally or as dictated by weather conditions (Hutson, Mickleburgh, & Racey, 2001) and disperse widely when not breeding but concentrate in a relatively few roost sites when breeding (Threatened Species Scientific Committee, 2016).

The ghost bat is the largest microchiropteran bat in Australia, is strictly carnivorous and captures its prey mainly on the ground before returning to an established feeding site to devour its catch. The diet of this species includes amphibians, reptiles, birds, small terrestrial mammals, insects and other bats (Van Dyck & Strahan, 2008). Unlike other microchiropteran bat species, the ghost bat does not continuously call whilst in flight and instead uses its eyes and ears to scan for prey (Van Dyck & Strahan, 2008). Females reach reproductive maturity between two and three years of age (Hoyle, Pople, & Toop, 2001).

Occurrence within the study area

The ghost bat was recorded during the current survey at both ghost bat lures deployed in the study area (Map 6, Figure 3). Ghost bats have previously been recorded by GHD on Cockatoo Island in August 2013, approximately 500 metres west of the current survey area (GHD, 2017). All ghost bat records from the current survey were reviewed and confirmed by bat specialised Dr. Kyle Armstrong (Appendix B).

Masked owl (northern subspecies) (*Tyto novaehollandiae kimberli*) – Vulnerable EPBC Act & Priority 1 DBCA

The northern masked owl is distributed across northern Australia, from the Kimberley in Western Australia across the top end of the Northern Territory and into western Queensland (Garnett, Szabo, & Dutson, 2011). It is generally found in sub-coastal woodland habitats or along watercourses further inland. The distribution of the northern masked owl is very imperfectly known due to remarkably few records across its broad range (Woinarski & Ward, 2006). The wooded habitat in which this subspecies occurs provides the large, hollow-bearing trees required for roosting and breeding. Masked owls have also been known to roost and occasionally nest in caves.

Occurrence within the study area

The northern masked owl was not recorded in the study area or anywhere else on Cockatoo Island in the current survey. The species has previously been recorded by GHD on Cockatoo Island in February 2014, approximately 1400 metres east of the airstrip in woodland habitat (GHD, 2014).

Figure 3: Screenshots of ghost bat lure footage recorded in the survey area.
Top image: GB01; Bottom image: GB02.

123.6°E
123.6042°E
123.6083°E
123.6125°E
123.6167°E
123.6208°E
123.625°E
16.0917°S
16.0958°S
16.1°S
16.1042°S

Survey area

Ghost bat

Project No.: 2036
Author: SP
Created Date: 04 March 2025
Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Scale: 1:7,500 @A3

Map 6: Records of ghost bat *(Macroderma gigas)* within the survey area.

Maxar

0 0.08 0.2 0.3 0.5
Kilometers

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5 APPENDICES

Appendix A Fauna habitat assessments

MO01

Date	24/02/2025		
Site type	Masked owl playback survey		
Coordinate	-16.09275181, 123.60615555		
Habitat type	Woodland (open)		
Habitat type (other)	NA		
Habitat description	Eucalypt woodland (open) over mixed Acacia tall shrubland over open Triodia hummock grassland and Ipomoea vineland.		
Habitat condition	Good		
Suitability for significant species	No		
Evidence of significant species	Foraging masked owl		
Disturbance	Weeds/Construction materials/ Roads		
Time since fire	No evidence		
Leaf litter cover	> 40 with layering		
Woody debris	10 – 40		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	No		
Landform	Hill	**Landform (other)**	NA
Slope	Negligible	**Aspect**	NA
Soil colour	Reddish brown	**Soil texture**	Loamy sand
Bare soil	< 10	**Drainage**	NA
Rock type	Mixed	**Rock size**	Mixed
Rock abundance	10 – 30		
Upper stratum	Tall woodland		
Middle stratum	Tall shrubland		
Lower stratum	Open hummock grassland		

MO02

Date	25/02/2025		
Site type	Masked owl playback survey		
Coordinate	-16.10181414, 123.61729357		
Habitat type	Woodland (open)		
Habitat type (other)	NA		
Habitat description	Eucalypt woodland (open) over mixed Acacia tall shrubland over openmixed tussock and Triodia hummock grassland with dense Ipomoea vineland.		
Habitat condition	Poor		
Suitability for significant species	No		
Evidence of significant species	Foraging masked owl		
Disturbance	Weeds/Construction materials/ Roads		
Time since fire	No evidence		
Leaf litter cover	10 – 40		
Woody debris	10 – 40		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	No		
Landform	Hill	**Landform (other)**	NA
Slope	Steep	**Aspect**	South
Soil colour	Reddish brown	**Soil texture**	Clay loam
Bare soil	10 – 30	**Drainage**	Drainage line
Rock type	Mixed	**Rock size**	Mixed
Rock abundance	30 – 70		
Upper stratum	Tall woodland		
Middle stratum	Tall shrubland		
Lower stratum	Tussock grass land / sedgeland / herbland		

GB01

Date	24/02/2025		
Site type	Ghost bat lure site		
Coordinate	-16.0983132, 123.61410581		
Habitat type	Hummock Grassland		
Habitat type (other)	NA		
Habitat description	Triodia hummock grassland with scattered Eucalyptus woodland, over mixed Acacia shrubland with scattered tussocks.		
Habitat condition	Good		
Suitability for significant species	No		
Evidence of significant species	Foraging ghost bat		
Disturbance	Airstrip/ windrow		
Time since fire	No evidence		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Hill	**Landform (other)**	NA
Slope	Gentle	**Aspect**	North
Soil colour	Reddish brown	**Soil texture**	Loamy sand
Bare soil	30 – 70	**Drainage**	NA
Rock type	Mixed	**Rock size**	Mixed
Rock abundance	< 10		
Upper stratum	Scattered trees		
Middle stratum	Scattered shrubs		
Lower stratum	Mid-dense hummock grassland		

GB02

Date	25/02/2025
Site type	Ghost bat lure site
Coordinate	-16.09319583, 123.60877022
Habitat type	Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
Habitat type (other)	NA
Habitat description	Rocky outcrop/cliff supporting scattered low Eucalypts over scattered low shubland over open Triodia hummock grassland.
Habitat condition	Poor
Suitability for significant species	No
Evidence of significant species	Foraging and potential caves (no access) ghost bats
Disturbance	Mining haul tracks, artificial drainage line
Time since fire	No evidence
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	10 – 30
Large trees	No
Tree hollows	No
Landform	Outcrop
Landform (other)	NA
Slope	Steep
Aspect	South
Soil colour	Reddish brown
Soil texture	Loamy sand
Bare soil	< 10
Drainage	Drainage line
Rock type	Banded ironstone
Rock size	Boulders (> 265 mm)
Rock abundance	> 70
Upper stratum	Scattered trees
Middle stratum	Low open shrubland
Lower stratum	Open hummock grassland

Appendix B Specialised Zoological report

Specialised Zoological
ABN 92 265 437 422

Dr Kyle Armstrong
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Claudia Elliott
Ecologia Environment Pty Ltd
463 Scarborough Beach Road, Osborne Park, Western Australia 6017.

5 March 2025

Validation of acoustic lure recordings from Cockatoo Island

Dear Claudia,

Thank you for sending me the validation set of infrared video and ultrasonic bat detector recordings (from acoustic lure sites) from your recent field survey for bats on Cockatoo Island. I am pleased to provide my opinion on whether the recordings contain evidence of visitation by the Ghost Bat.

I observed an individual Ghost Bat circling the broadcast speaker and bat detector on each of the three videos provided. The identification of this species was unambiguous. I made my identification based on my previous experience with this apparatus from several projects in the Pilbara, Kimberley and Northern Territory; and on the basis of several qualitative characters—both behavioural and of their appearance (**Table 1**; **Figure 1**). Note that it is not possible to estimate the size of the island population from these observations—it just confirms their presence in the study area.

I did not observe any echolocation calls of the Ghost Bat in the bat detector recordings. Note that the detection of echolocation calls, which are not broadcast by the track we load onto the portable speaker, are a good way to validate the visitation of a Ghost Bat, even when it is obvious that the bat circling the speaker is indeed that species (Ruykys et al. 2024). Social calls are ignored in the analysis of bat detector recordings associated with acoustic lures because it is not straightforward or reliable to separate social calls from visiting individuals and the lure recording. Echolocation calls of the Ghost Bat have a distinct structure and frequency content, and the species can be identified unambiguously from them by an experienced analyst, especially away from cave entrances.

Sincerely,

Dr Kyle Armstrong
Zoologist

Figure 1. Cropped example of a single frame from video GB02-A_VD_00024.MP4 that shows the characters consistent with the identification of a Ghost Bat.

References

Ruykys L., Hanrahan N. and Stokeld D. (2024) Northern Territory guidelines for surveying for the ghost bat at the landscape scale. Technical Report 05/2024, Department of Environment, Parks and Water Security, Palmerston, Northern Territory and Charles Darwin University, Brinkin, Northern Territory.

Table 1. Observations from the infrared video and ultrasonic bat detector recordings sent for validation.

Filename	Bat species identified	Period	Behaviour	Appearance
Video				
GB01-A_VD_00033.MP4	Ghost Bat *Macroderma gigas*	19:31:58 – 19:32:26	circling	large, pale, broad wings, large ears, no tail
GB01-A_VD_00046.MP4	Ghost Bat *Macroderma gigas*	20:11:34 – 20:11:40	circling	large, pale, broad wings, large ears, no tail
GB02-A_VD_00024.MP4	Ghost Bat *Macroderma gigas* t	19:28:58 – 19:29:30	'drop in' flight, circling	large, pale, broad wings, large ears, no tail
Bat detector				
SM4-08_20250224_193049.wav	acoustic lure social calls only, no echolocation calls of Ghost Bats	.	.	.
SM4-08_20250224_193054.wav	acoustic lure social calls only, no echolocation calls of Ghost Bats	.	.	.
SM4-08_20250224_193058.wav	acoustic lure social calls only, no echolocation calls of Ghost Bats	.	.	.
SM4-08_20250224_193102.wav	acoustic lure social calls only, no echolocation calls of Ghost Bats	.	.	.
SM4-08_20250224_193106.wav	acoustic lure social calls only, no echolocation calls of Ghost Bats	.	.	.
SM4-08_20250224_193110.wav	acoustic lure social calls only, no echolocation calls of Ghost Bats	.	.	.
SM4-08_20250224_193114.wav	acoustic lure social calls only, no echolocation calls of Ghost Bats	.	.	.
SM4-08_20250224_193118.wav	acoustic lure social calls only, no echolocation calls of Ghost Bats	.	.	.
SM4-08_20250225_192558.wav	*Taphozous georgianus*	.	.	.
SM4-08_20250225_192602.wav	*Taphozous georgianus*	.	.	.
SM4-08_20250225_192715.wav	*Taphozous georgianus*	.	.	.
SM4-08_20250225_192725.wav	*Taphozous georgianus*	.	.	.
SM4-08_20250225_192730.wav	*Taphozous georgianus*	.	.	.
SM4-08_20250225_192734.wav	*Taphozous georgianus*	.	.	.