



FLORA AND FAUNA ASSESSMENT

**Odin 2D and 3D seismic survey
Fitzroy Basin, Western Australia**

Report prepared for Bennett Resources

Report prepared by:



Low Ecological Services P/L

**PO Box 3130, Alice Springs NT
0871**

Ph: (08) 89 555 222

Fax: (08) 89 555 722

Email: lowecol@lowecol.com.au

Web: www.lowecol.com.au




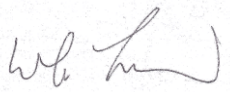
This page left intentionally blank

Front piece: Scenes around Petroleum Lease EP371: Spinifex plains, savannah woodlands with ephemeral swamps, bloodwood on sand dunes, Yellow spotted monitor (*Varanus panoptes*)

DISCLAIMER

This document has been prepared by Low Ecological Services (LES) for Bennett Resources in accordance with an agreement with Bennett Resources. LES has prepared this document to provide factual and technical information and reasonable solutions to identified risks. It does not constitute legal advice.

DOCUMENT CONTROL

Approvals	Name	Signature	Date
Prepared by:	Erin Westerhuis		14/01/2020
Approved by:	Bill Low		04/03/2020

REVISION DETAILS

Date	Author/Reviewer
10/01/2019	Erin Westerhuis
14/01/2019	Kristen Grant
16/01/2019	Tony Rudge
04/03/2020	Bill Low

This page left intentionally blank

Executive Summary

Low Ecological Services (LES) was commissioned by Bennett Resources (BR) to undertake a level 1 flora and fauna survey within Petroleum Exploration Lease EP371, located in the Kimberley Region of Western Australia. BR proposes to undertake 2D and 3D seismic surveys across a section of the lease. This is jointly referred to as the Odin project.

Approximately 40 people will be employed to undertake the seismic survey over a period of 2-3 months. The potential environmental impact is the disturbance of conservation significant species, environmental values and ecological function through clearing and grading of seismic lines. Additionally, potential exists for impacts on species important in local Aboriginal culture. Information provided by BR indicates that approximately 2800 hectares (ha) of seismic lines will be prepared through native vegetation across the Odin project area of 52000 ha. Of this, 25 % will be prepared using the “raised-blade” technique to reduce impacts on vegetation and soil. Preparation of seismic lines with raised-blade clearing involves setting the blade of a bulldozer above ground level and cutting off vegetation at the stem whilst leaving the root stock and topsoil intact (Department of Mines, Industry Regulation and Safety 2018). To avoid additional clearing and environmental disturbance:

- BR will use the existing cleared area at the Valhalla 2 Well for accommodating people employed on the seismic survey in a mobile camp.
- The existing Asgard road will be used in seismic surveys in the 2D area.
- Seismic equipment will be hand carried through the riparian area of Hardman Creek in the northern region of the 3D seismic area.

The scope of the assessment was to:

- Undertake a desktop assessment of threatened flora and fauna species and plant communities recorded within, or likely to occur within, the proposed project area (including any species listed under the *Environmental Protection and Biodiversity Conservation Act* (1999) or the *Western Australian Biodiversity Conservation Act* (2016)).
- Conduct a reconnaissance survey to verify desktop assessment of flora and fauna species present and habitat availability for conservation significant species within the project.
- Identify potential biodiversity and ecological impacts of the project.

A desktop assessment to identify threatened flora and fauna species and plant communities was conducted by LES using records from the *Environmental Protection and Biodiversity Conservation Act* (EPBC) Protected Matters Search Tool and the *Western Australian Biodiversity Act* (WABA) NatureMap tool, in addition to soil, vegetation and fire history. This assessment identified that the area was within the heritage listed *West Kimberley Region* (Department of Environment and Energy 2019) and was largely unmodified native vegetation (NatureMap 2019). A total of 35 protected matters comprised of 1 heritage listed place, 11 listed threatened species, 15 listed migratory species and 8 conservation priority species were identified as having the potential to occur within the project area (Table i). Of the

threatened and priority species, LES determined that Gouldian Finches, Greater Bilbies, Largetooth Sawfish and the Lakeland Downs Mouse are likely to be present in the project area.

A reconnaissance survey conducted in late November 2019 by two LES staff verified the results of the desktop survey and provided further information on the biodiversity values of the site. Plant communities throughout the survey area were diverse, with at least 11 broad community types observed. Some habitat degradation as a result of fire and cattle was observed, with highest cattle impacts noted in close proximity to water points. However, relatively intact vegetation was widespread and, importantly, previous exploration activities were not noticeable, suggesting the environment has recovered from similar impacts in the past.

No threatened or conservation significant species were identified during the reconnaissance survey, however unconfirmed signs of the Northern Quoll and Greater Bilby were observed. Based on available information for these species, including historical observations of Bilby burrows near the Asgard Well Site, habitat suitable for these and other conservation significant flora and fauna species exists within the survey area. Of note were the patches of mature spinifex, boab trees, large cathedral termite mounds and dune/ swale complexes- each with important habitat values which must be maintained during proposed activities. These can be mostly avoided by the careful planning and weaving of seismic lines (+/-20m) allowing the avoidance of trees and large termite mounds. Raised blade clearing or scraping reduces the impact of creating seismic lines and facilitates rehabilitation. While the impact of seismic surveys is likely to be low and occurring over a short term, the area over which the proposed seismic survey will occur is large and diverse. We therefore suggest that contractors working on this proposed project become familiar with the conservation significant species which may occur, and an induction booklet for this purpose is supplied as an appendix to this report.

Table i. Species with conservation significance recorded to be present (NatureMap) or have the potential to occur within the proposed project area (Protected Matters Search Tool). Species are arranged by taxonomy, with species within a class listed in order of conservation significance from critically endangered through to Priority 4 species. Further Information on these species is provided in the report. Species marked with an * are listed in more than one category.

Species	Common name	Conservation significance
	The West Kimberly	Listed Place
<i>Calidris ferruginea</i>	Curlew sandpiper	Critically endangered
<i>Erythrura gouldiae</i>	Gouldian finch	Endangered
<i>Malurus coronatus</i>	Purple Crowned Fairy-Wren	Endangered
<i>Pezoporus occidentalis</i>	Night Parrot	Endangered
<i>Polytelis alexandrae</i>	Princess parrot	Vulnerable
<i>Rostratula australis</i>	Australian Painted Snipe	Endangered
<i>Dasyurus hallucatus</i>	Northern Quoll	Endangered
<i>Macroderma gigas</i>	Ghost Bat	Vulnerable
<i>Macrotis lagotis</i>	Greater Bilby	Vulnerable
<i>Petrogale lateralis</i>	Black-footed rock wallaby (West Kimberly Race)	Vulnerable
<i>Pristis pristis</i>	Freshwater sawfish	Vulnerable
<i>Aristida polyclados</i>	Wiregrass	Priority 1
<i>Triodia pascoeana</i>	Spinifex	Priority 1
<i>Ctenotus uber</i>	Spotted Ctenotus	Priority 2
<i>Westraltrachia lievreana</i>	Le Lievre Ridge Land Snail	Priority 2
<i>Cayratia cardiophylla</i>	(Deciduous Climber)	Priority 2
<i>Goodenia byrnesii</i>	(Prostrate herb)	Priority 3
<i>Solanum leopoldense</i>	(Bush Tomato)	Priority 3
<i>Leggadina lakedownensis</i>	Lakeland Downs Mouse	Priority 4
<i>Apus pacificus</i>	Fork-tailed swift	Migratory Marine Bird
<i>Crocodylus porosus</i>	Salt-water Crocodile	Migratory Marine Species
<i>Pristis pristis</i>	Freshwater Sawfish	Migratory Marine Species*
<i>Cecropis daurica</i>	Red-rumped swallow	Migratory Terrestrial Species
<i>Cuculus opatus</i>	Oriental Cuckoo	Migratory Terrestrial Species
<i>Hirundo rustica</i>	Barn Swallow	Migratory Terrestrial Species
<i>Motacilla cinerea</i>	Grey Wagtail	Migratory Terrestrial Species
<i>Motacilla flava</i>	Yellow Wagtail	Migratory Terrestrial Species
<i>Actitis hypoleucos</i>	Common Sandpiper	Migratory Wetland Species
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Migratory Wetland Species
<i>Calidris ferruginea</i>	Curlew Sandpiper	Migratory Wetland Species*
<i>Callidris melanotos</i>	Pectoral Sandpiper	Migratory Wetland Species
<i>Charadrius veredus</i>	Oriental Plover	Migratory Wetland Species
<i>Glareola maldivarum</i>	Oriental Pratincole	Migratory Wetland Species
<i>Pandion haliaetus</i>	Osprey	Migratory Wetland Species

Contents

Executive Summary 5

1. Introduction 10

 1.1. Description of proposed activities and previous disturbance 10

 1.2. Report Scope and Objectives 10

2. Methods 12

 2.1. Desktop Assessment 12

 2.2. Reconnaissance Survey 12

 2.2.1. Conditions 12

 2.2.2. Flora and Vegetation Assessment 13

 2.2.3. Fauna Assessment 13

 2.3. Constraints and Limitations 14

3. Results 15

 3.1. Desktop Flora and Vegetation Assessment 15

 3.1.1. Site description and climate 15

 3.1.2. Bioregion 15

 3.1.3. Soil types 15

 3.1.4. Vegetation communities 16

 3.1.5. Conservation significant Flora 19

 3.1.6. Introduced species 20

 3.2. Reconnaissance Flora and Vegetation Survey 21

 3.2.1. Plant communities and species richness 21

 3.2.2. Introduced species 23

 3.2.3. Important bush foods 23

 3.3. Desktop Fauna Assessment 25

 3.3.1. Conservation significant fauna 25

 3.3.2. Description of threatened and priority fauna ecology and potential for occurrence in project area 26

 3.3.3. Non-conservation significant fauna 28

 3.3.4. Introduced fauna 29

- 3.4. Reconnaissance Fauna Survey 30
 - 3.4.1. Native Fauna Observations 30
 - 3.4.2. Non-native Fauna observations 32
- 4. Potential impacts 34
 - Vegetation..... 34
 - Soil Erosion and Compaction 35
 - Fauna..... 35
- 5. Conclusions 36
- 6. Recommendations 37
- 7. References 38
- 8. Appendices..... 40
 - A. Plant species recorded in desktop assessment 40
 - B. Plant Species observed in reconnaissance survey 42
 - C. Native fauna species recorded in desktop assessment 45
 - D. Native Fauna observed in reconnaissance survey 48
 - E. Habitat descriptions from site surveys 52
 - F. Induction booklet for seismic contractors 52
 - G. Examples of Bat Calls from Acoustic Analysis 53

1. Introduction

1.1. Description of proposed activities and previous disturbance

Bennett Resources (BR) intends to undertake 2D surveys along six seismic lines of varying lengths (124 km in total) and 3D seismic surveys across 52000 hectares (Figure 1) in the Odin project. To provide access for seismic survey teams, BR proposes that vegetation will be cleared and graded to a maximum width of 4.5 m along the entirety of the 2D seismic lines (approximately 56 hectares in total), excepting for where the northern most 2D seismic line runs along the Asgard well access track. This reduces the clearing within the 2D seismic project area from 124 km down to 105.78 km thereby reducing the clearing to 47 hectares. Within the proposed 3D seismic area, source and receiver lines will be cleared and graded at 250 m intervals running north-west to south-east and north-east to south-west respectively. Width of tracks for source and receiver lines in the 3D area will be between 3 m and 4.5 m. Previous seismic surveys across EP 371 were undertaken by Buru Energy Limited (Buru) in 2013. Three test wells; Asgard, Valhalla North and Valhalla 2 were ultimately developed in the north-west and south-east of the proposed seismic survey area. To reduce the total land disturbance required for this project, BR proposes to use the Valhalla 2 site for a mobile camp. The entirety of the proposed area is located on land which has been used for commercial rangeland cattle and sheep grazing operations since the 1880s.

1.2. Report Scope and Objectives

The objective of this assessment was to conduct a level 1 survey of flora and vegetation communities, and a level 1 survey of terrestrial fauna and fauna assemblage within the proposed exploration area. This included:

- A desktop assessment of protected matters and conservation significant species recorded within or likely to be within the proposed exploration area, including any species listed under the *Environmental Protection and Biodiversity Conservation Act (1999)* or the *Western Australian Biodiversity Conservation Act (2016)*
- Conduct a reconnaissance survey to verify desktop assessment of species present and vegetation associations/condition within the proposed exploration area
- Determine the local and regional significance of flora and vegetation recorded in the desktop assessment and confirmed in the reconnaissance survey.

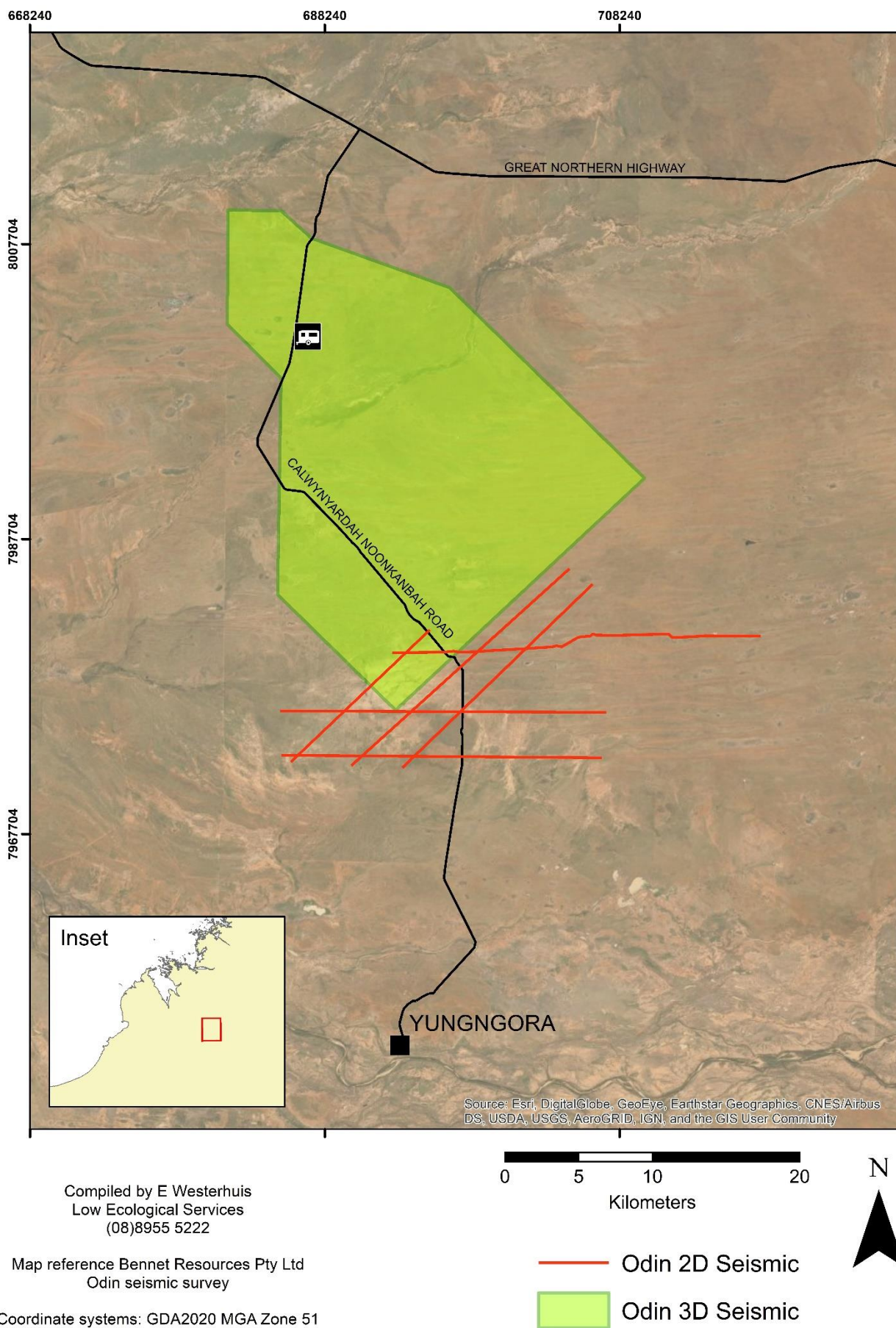


Figure 1 Location of the proposed activities and mobile camp at Valhalla Well 2 relative to roads and communities. Inset shows the location of the project in the Kimberly region of Western Australia.

2. Methods

The geographical position in addition to information provided from BR to LES regarding the extent and nature of the proposed exploration indicated that the activities would likely have a low impact on native fauna. From this it was determined that a *Level 1* Survey would be the most appropriate assessment for the project. LES undertook the survey following the recommended guidelines (Guidance No. 56 adapted from the Environmental Protection Authority (EPA) position statement No. 3). In accordance with these guidelines, LES survey consisted of both a desktop assessment of the area along with a low intensity reconnaissance field survey.

2.1. Desktop Assessment

A desktop assessment was undertaken to gather information on existing records of threatened flora and vegetation in the study area. The *Protected Matters Search Tool* (<https://www.environment.gov.au/epbc/protected-matters-search-tool>) and *Nature Map Search Tool* (<https://naturemap.dbca.wa.gov.au/>) were used to identify plant and animal species likely to occur in the proposed exploration area. These search tools were also used to identify threatened plants and animals likely to occur. Additional species may have conservation priority standing under the WA Biodiversity Conservation Act (2016). Species that are rare, threatened or conservation dependent are ranked Priority 4, whilst those that are data deficient are ranked from 1-3. Due to the remoteness of the region, few plant and animal observations have been directly recorded in the proposed area, therefore a buffer of 40 km surrounding the proposed exploration area was considered most appropriate for identifying all possible species likely to occur in the locality when undertaking the desktop assessment. Additional information was sourced from map-based datasets including the Australian Soil Atlas and the Western Australian Vegetation Extent Dataset to identify the major soil characteristics and vegetation communities of the proposed exploration area. LES staff also utilised information within a report commissioned by Buru Energy in 2012 for a previous 2D seismic survey in the petroleum exploration lease.

2.2. Reconnaissance Survey

2.2.1. Conditions

The reconnaissance survey was conducted from the 21st to the 25th of November 2019. The prevailing weather conditions at the time of the survey were hot and dry. Rainfall for the twelve months prior to the survey was below average (Figure 2). Early on the 25th November, widespread storms brought heavy rainfall over the project area and slightly cooler temperatures.

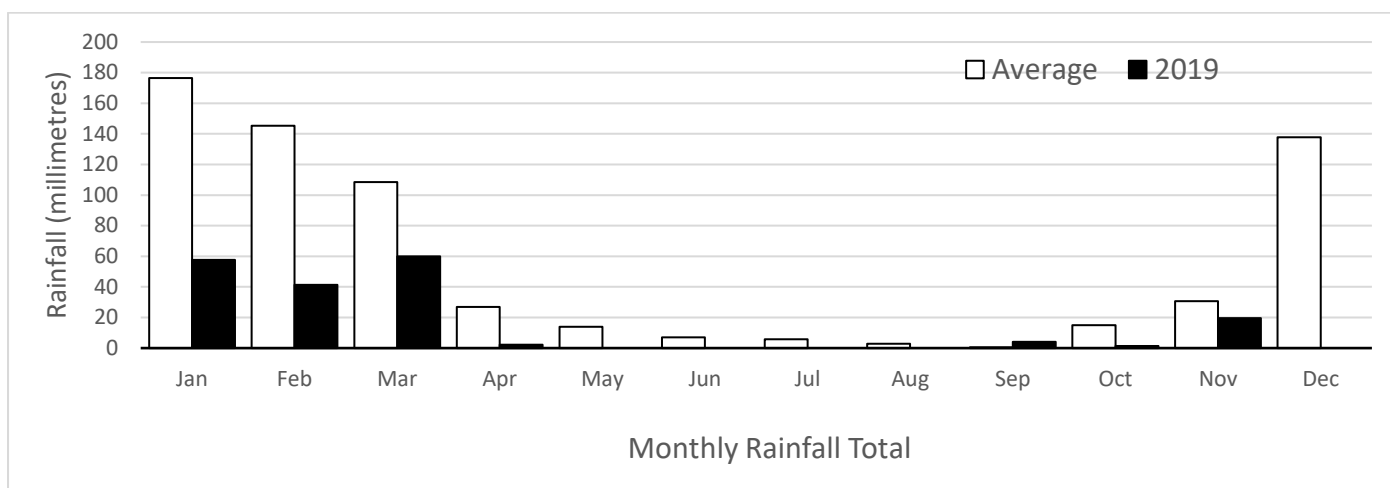


Figure 2 Comparison of rainfall prior to reconnaissance field survey relative to average rainfall (Fitzroy Crossing Weather Station, data accessed from Bureau of Meteorology 21/12/2019).

2.2.2. Flora and Vegetation Assessment

Habitat attributes were assessed in seventeen 50 x 50 m quadrats using the methods described in Clark (2009). These included photographs of the site, landform type, soil description, growth form, height, cover and species for upper, mid and ground level vegetation, vegetation condition and description of disturbance from animals and fire. A plant species list was also recorded, with samples collected and supplied to a botanist for identification where field ID was not possible.

During travel between sites (both by helicopter and car) the broad vegetation type was recorded according to dominant vegetation type, location and any other features such as large termite mounds, unusual vegetation structure, apparent fire history etc. These observations were used to ground-truth vegetation mapping of the project area.

2.2.3. Fauna Assessment

The reconnaissance fauna assessment consisted of bird surveys, acoustic bat surveys, motion activated camera surveys and track and scat searches.

- Targeted bird surveys were undertaken at each of the habitat assessment sites, with all birds seen and heard recorded. Any incidental observations made while travelling between sites was also recorded.
- To target insectivorous bats, two passive ultrasonic recorders (*Anabat- Titley Scientific*) were also deployed for four nights. Recorded calls were analysed by Erin Westerhuis using information in Milne (2002), McKenzie (2003) and McKenzie & Bullen (2012). Examples of species calls are provided in appendix G.
- Six motion activated trail cameras were deployed at sites representative of the broad habitat types present across the proposed project area for four nights to target cryptic and/or nocturnal animals (24 camera nights). A shallow water dish was placed in the cameras field of view as an attractant, and water was replenished daily.
- Twelve active track and scat searches were undertaken by one LES consultant and a Traditional Owner across an area of approximately 2 hectares over 20 minutes (Moseby et al 2009). Active searches occurred in

conjunction with habitat assessments. All primary and secondary signs of fauna were recorded and additional information such as species, observation type (animal, track, scat, burrow, digging etc.) was recorded and photos taken to assist in identification.

2.3. Constraints and Limitations

Possible survey constraints including those identified in the WA EPA's *Survey Guidelines* (2004) are described below (Table 2.1) as they relate to the Level 1 survey completed by LES staff. No active trapping (e.g. using pitfall traps, funnel traps, Elliott traps or cage traps) was undertaken as part of this assessment. While this is consistent with the requirements for a Level 1 survey (see EPA 2004), this report should not be treated as an exhaustive or conclusive account of the flora and fauna assemblage occurring in the proposed project area.

Table 2-1. Constraints and limitations relating to the Level 1 survey

Aspect	Constraint	Comment
Sources of information and availability of contextual information	Minor	Broad scale vegetation association mapping by Shepherd et al (2002) is readily available, however finer scaled mapping of vegetation in the region was not. Few flora and fauna observations have been directly recorded in the proposed project area, for this reason LES broadened the search in national and state databases to a 40 km radius around the project area.
Timing, weather and season	Minor	The survey was conducted in November 2019, conditions prior to the survey had been drier than average and during the survey were extremely hot and dry. Heavy rainfall occurred on the night prior to the fourth day in the field, and the increase in animal activity after rainfall was notable. It is likely this affected plant diversity recorded in the reconnaissance survey, particularly for annual species.
Access	No	The proposed area was completely accessible. LES staff surveyed the proposed area by vehicle for the first three days, on the last two days a helicopter was used to access more remote areas of the proposed project area.
Completeness and further work which might be needed	No	The survey is considered a complete Level One flora, vegetation and fauna survey as defined by guidelines provided by the WA EPA for proposed project in the Dampierland bioregion
Experience	No	The survey was completed by two experienced staff including an experienced ecologist and an environmental engineer. Plant samples not able to be identified in the field were sent to a botanist for expert identification.
Intensity	No	The survey effort satisfied the requirements of a Level One Survey according to Guidance Statement 56 (EPA, 2004).
Mapping reliability	No	Adequate satellite imagery was available of the area for desktop assessment mapping as well as mapping of survey sites. Flora, vegetation and fauna survey sites were reliably mapped and considered adequate in number and distance for the vegetation units within the study area.
Resources	No	EPBC and DEC search databases, WA Herbarium information and photographs, Florabase database, previous reports and other literature were used in preparation of the report.
Scope	No	The scope was clearly defined and achievable.

3. Results

3.1. Desktop Flora and Vegetation Assessment

3.1.1. Site description and climate

The climate of the proposed project area is semi-arid to dry-hot tropical. Average rainfall in the region is approximately 550 mm with 90% of rainfall occurring between November and February (Blina Station, Bureau of Meteorology 2019). Temperatures are highly variable, with mean temperatures ranging between 10 – 40 °C. The Odin project area is situated within the catchment for the Fitzroy River, with the St George Ranges to the south and the Oscar Range to the north-east, but the Odin project area features relatively flat topography across its entirety.

3.1.2. Bioregion

The proposed exploration area is located within the Fitzroy Basin subregion of the Dampierland Bioregion (Figure 3). The Interim Biogeographic Regionalisation of Australia (IBRA) provides a division of Australia in geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information (Thackway & Cresswell, 1995). The Dampierland bioregion covers approximately 844000 km² within Western Australia and is characterised by vegetation which is largely savanna woodland and pindan on Quaternary sandplain and extensive alluvial floodplains (Beard 1990). This area is part of the *Eremaean Botanical Province* and features largely intact pre-European vegetation and is primarily used for commercial grazing operations (Petheram and Kok 1983).

3.1.3. Soil types

Data acquired in the desktop survey indicated that most of the Odin project area features neutral red soils on relatively flat plains (Soil code *My58*, Figure 4). This area is likely to have irregularly spaced, elongated sand dunes with deep sands. The sand dunes are relatively stable with swamps in between dunes (Australian Soil Atlas). The other major soil unit is alluvial plains with laterite residuals: chief soils are gravelly neutral yellow earths often with stone and gravel on the soil surface. Small areas were identified as active flood-plains (*CC49*) with grey and brown clays, and a small portion of the 2D area potentially has areas of laterized sandstone (*My59*). The latter may contain soils with rock and laterite outcropping in elevated sites.

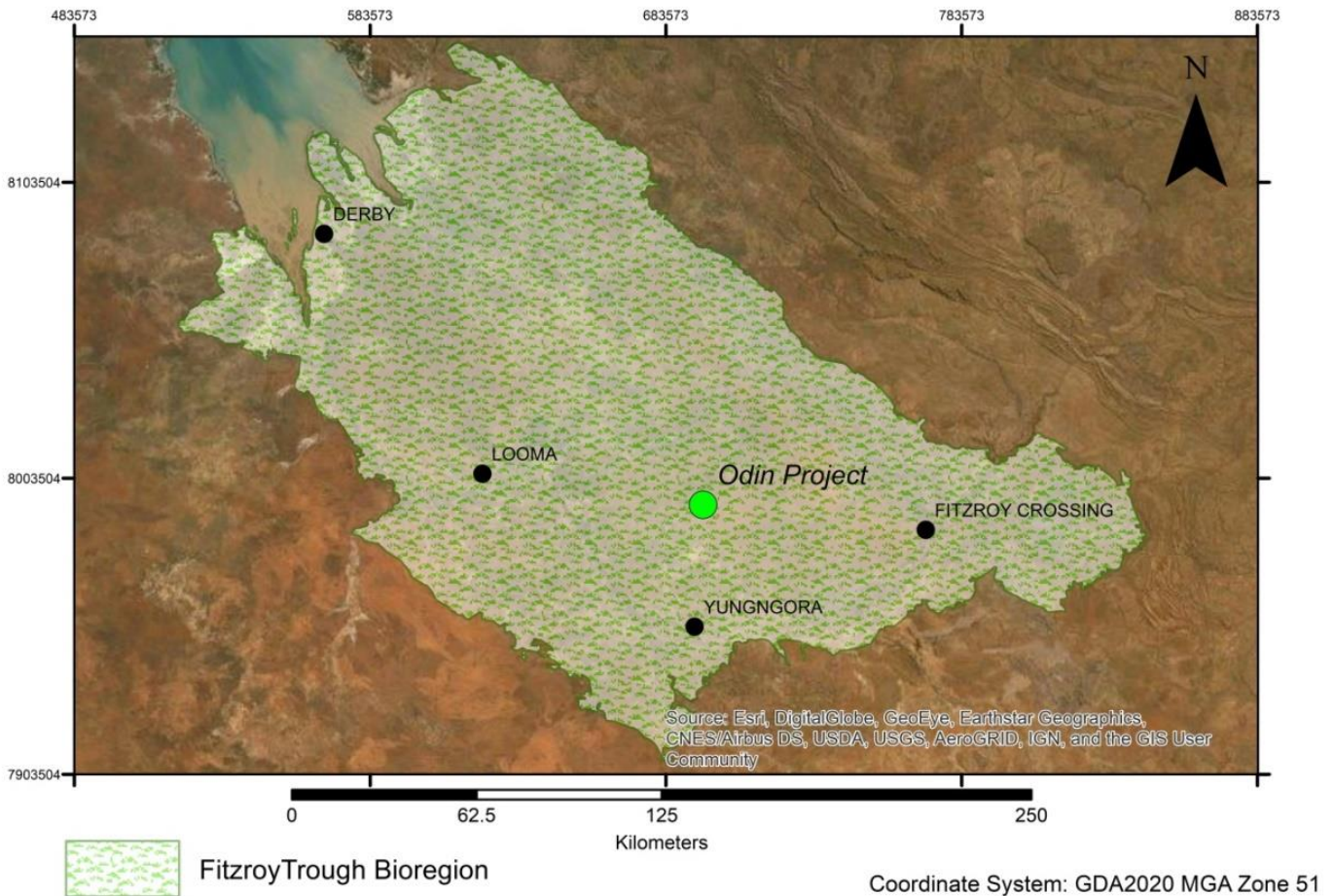


Figure 3 Location of the proposed project area and nearby townships within the Fitzroy Trough subregion.

3.1.4. Vegetation communities

Data from Shepherd et al (2002) indicated that the proposed project area contained five major vegetation units (Figure 5). In the northern section of the 3D area, vegetation type was primarily classified as pindan shrubland over spinifex on sandplain (Vegetation type 699). Patches of savanna woodland (Vegetation type 64) was also present in this area, with a mix of tree species over ribbon grass. A large area encompassing the lower half of the 3D area and eastern section of the 2D area was classified as shrublands and pindan on sand dunes (Vegetation type 700). In this vegetation community, *Acacia eriopoda* was reported as the dominant woody plant species, with scattered trees and an understorey of soft and curly spinifex. Across much of the 2D area and sections of the 3D area, the vegetation community was classed as a major vegetation mosaic with patches of *Adansonia gregorii* (Boab tree), *Bauhinia* and *Eucalyptus/Corymbia* over ribbon grass (Vegetation type 710). A small patch of open hummock grassland (Vegetation type 93) was reported to occur in the 2D area.

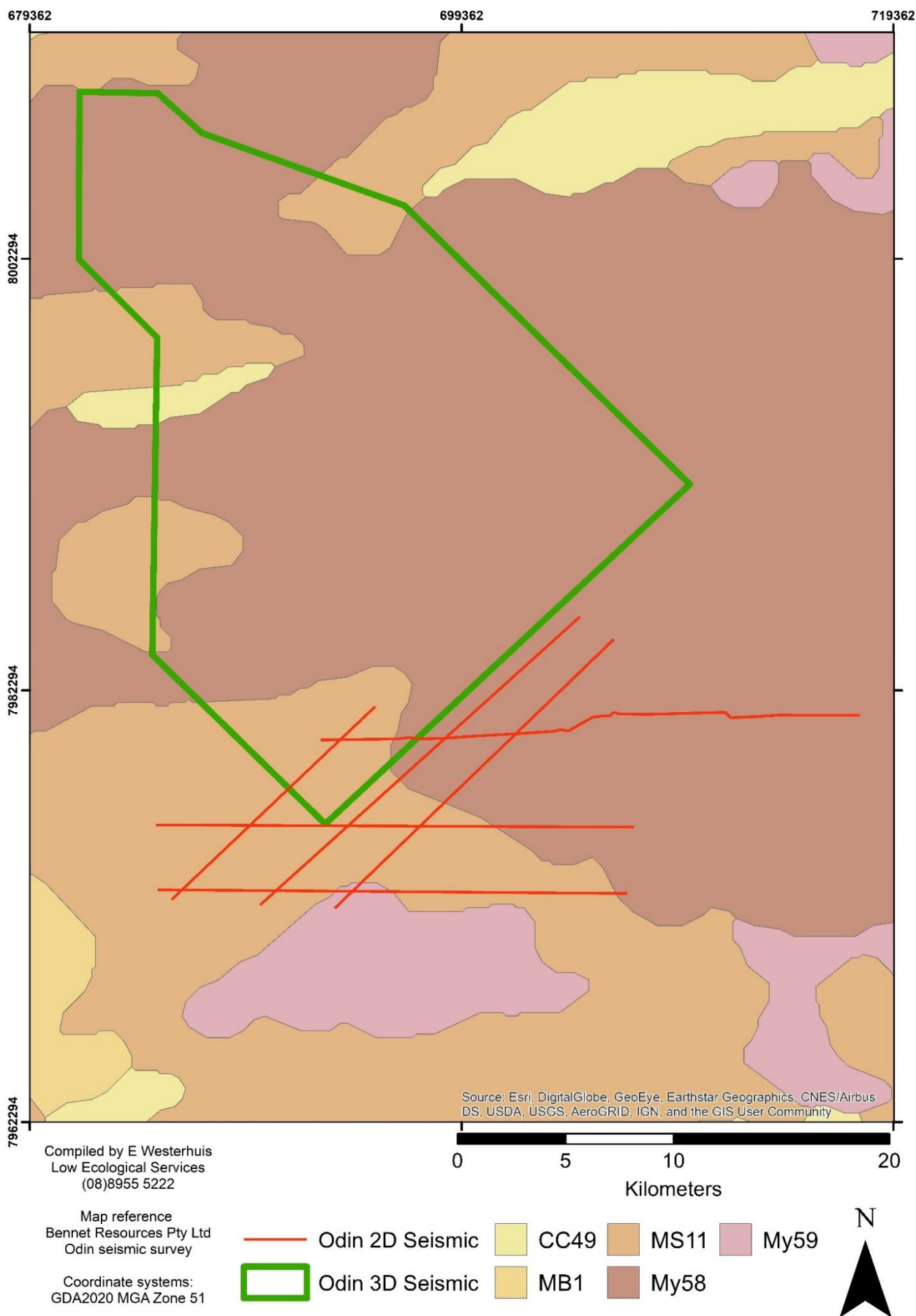


Figure 4 Soil map derived from the Australian Soil Atlas.

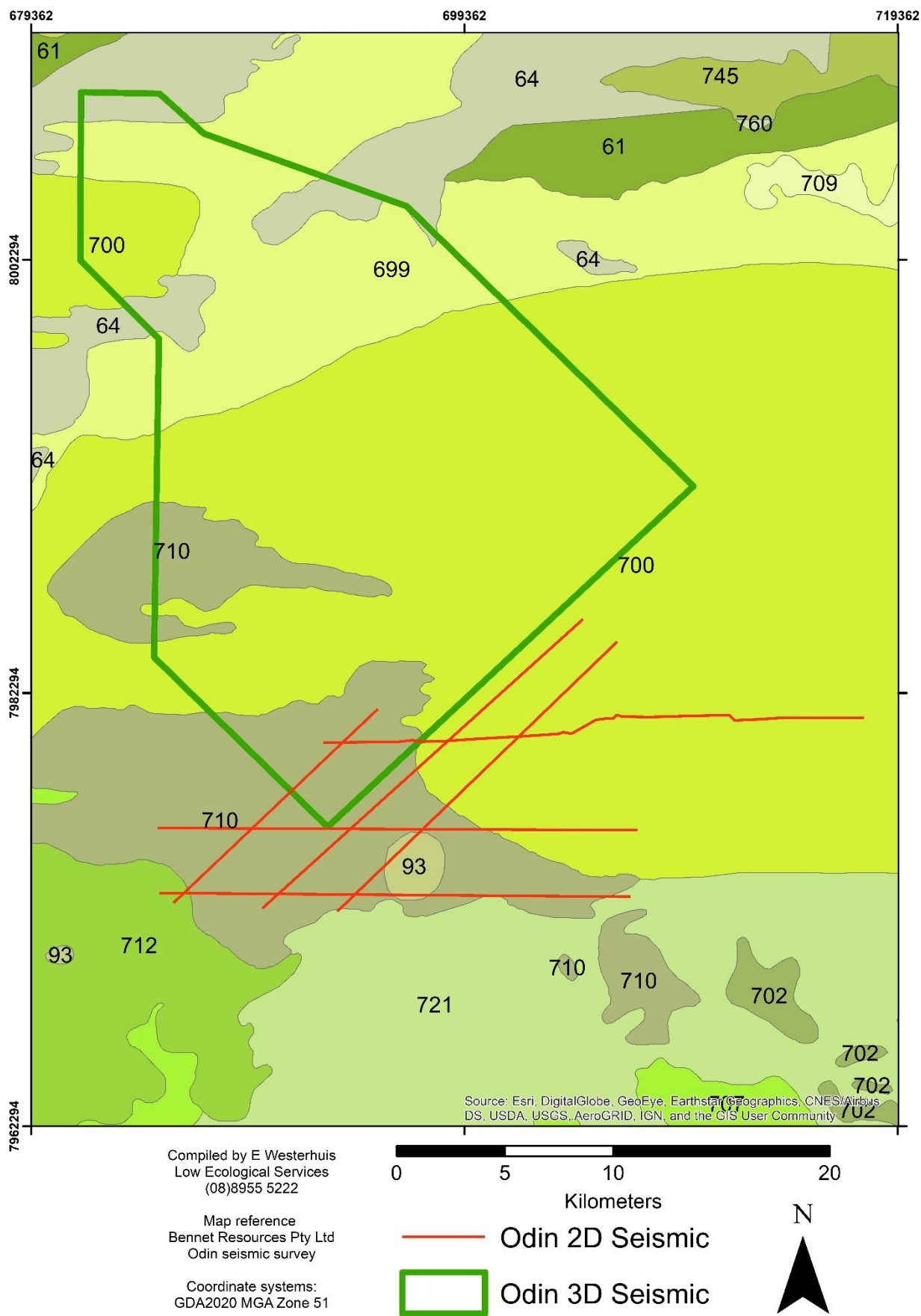
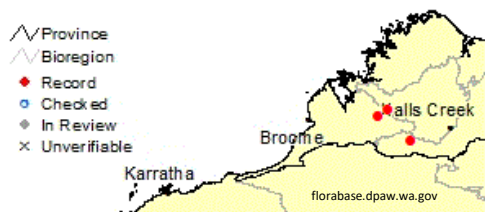


Figure 5 Vegetation communities from Shepherd et al. 2002. Vegetation types are numbered according to original classification in spatial dataset and described in preceding text.

3.1.5. Conservation significant Flora

Searches of federal and state databases showed five conservation significant flora were known to occur near or in the proposed project area. These are listed below in order of priority with a brief description of appearance and habitat.

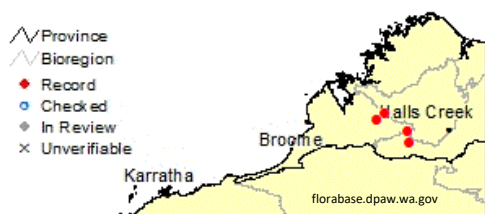
Aristida polyclados



Priority 1 – Known only from a few locations (generally five or less) which are potentially at risk.

Grass species found in the Gardner and Dampier bioregions, in Eucalyptus woodlands on sandy soils and alluvial sites (AusGrass 2019).

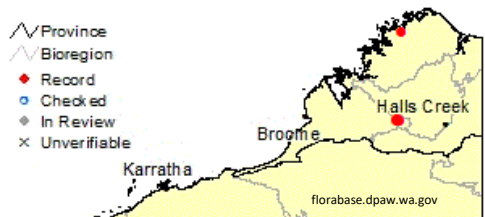
Triodia pascoeana



Priority 1 - Known only from a few locations (generally five or less) which are potentially at risk.

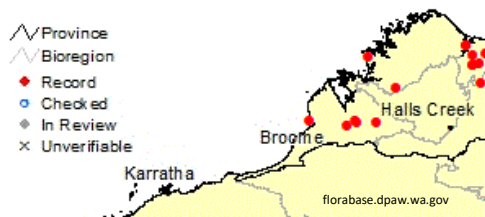
Spinifex species distinguished by its robust, non-resinous habit. Found in Limestone ranges and gorges; alluvial frontages and floodplains of major watercourses (Ausgrass 2019).

Cayratia cardiophylla



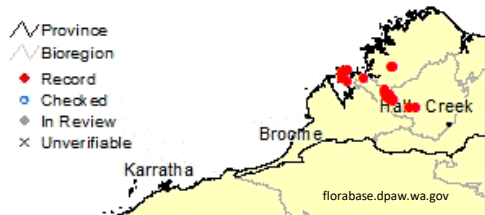
Priority 2 - Species that are known from one or a few locations, some of which are on lands managed primarily for nature conservation, e.g. national parks. Deciduous climber with green-white flowers from August to December. Found in limestone outcrops, seepage areas and amongst rocks (Florabase 2019).

Goodenia byrnesii



Priority 3 - Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under immediate threat. Prostrate to decumbent herb with stems to 30 cm. Yellow flowers in January and February. Found in sandy soils on creek lines (Florabase 2019).

Solanum leopoldense

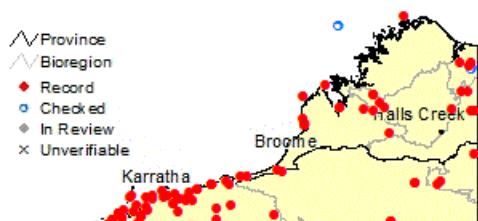


Priority 3- Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under immediate threat. Spreading shrub, 0.5-1 m high. Blue-purple flowers in May to August. Found in sandstone, rocky gullies & creek lines (Florabase 2019).

3.1.6. Introduced species

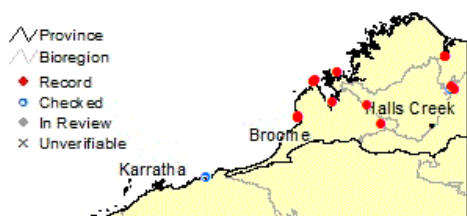
Searches of federal and state databases showed three listed weeds of national significance were known to occur near or in the proposed project area. These are listed below with a brief description of appearance and habitat.

Cenchrus ciliaris



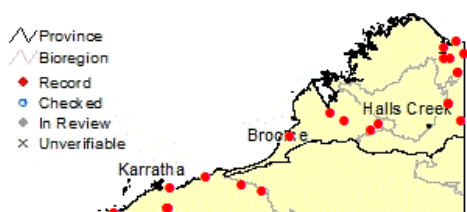
Tufted or sometimes stoloniferous perennial, grass-like or herb, 0.2-1.5 m high. Fl. purple, Feb to Oct. White, red or brown sand, stony red loam, black cracking clay (Florabase 2019). Native to southern Asia and Africa, introduced as a pastoral grass and for erosion control. Not a declared weed in Western Australia (DPIRD WA 2019) but implicated in increased fire frequency and intensity in addition to loss of biodiversity.

Jatropha gossypifolia



Species is an erect shrub with red-brown flowers in Jan to May. Is found in disturbed areas, often near rivers (Florabase 2019). Native to South America. Deliberately introduced to Australia as an ornamental plant. Poisonous to livestock, listed in Western Australia as a declared pest. ***If species is present, land managers must apply control to reduce numbers and prevent or contain spread to other areas.***

Parkinsonia aculeata



Spiny shrub or tree, to 8 m high. Fl. yellow, Mar or May to Dec. Sandy or clayey soils. Often along watercourses (Florabase 2019). Native to tropical America, introduced as an ornamental plant. Listed in Western Australia as a declared pest (C3) and as a Weed of National Significance. ***If species is present, land managers must apply control to reduce numbers and prevent or contain spread to other areas.***

3.2. Reconnaissance Flora and Vegetation Survey

3.2.1. Plant communities and species richness

97 plant species were recorded during the reconnaissance survey. Highest plant species richness was recorded in savannah low, open forest ($n = 18$). Detailed ground based habitat and vegetation attribute surveys were undertaken in 17 locations to provide fine scale measures of vegetation cover, plant diversity and potential for impact (Table 3.2-1, Figure 6). Each of the sites differed slightly in species composition and density, in addition to fire and grazing impacts. However some sites were broadly similar and it was determined that twelve vegetation units were present in the proposed area. This was confirmed from 93 observations on broad vegetation types/communities and their location/extent across the area which was recorded to ground truth existing vegetation mapping over the survey area.

Table 3.2-1 Plant communities observed during reconnaissance survey. Full results of plant community including dominant species in each type are provided in appendix B.

Site description and location details	
Savannah low, open forest	Site 1
Mixed eucalypt and acacia woodland	Site 2
Low open woodland over stony ground	Site 3
Riparian open forest	Site 4
Low open woodland with moderately dense pindan understory	Site 5
Low open spinifex grassland	Site 6
Low open woodland with moderately dense pindan understory	Site 7
Open boab woodland	Site 8
Low open woodland with box	Site 9
Recently burnt low open woodland	Site 10
Recently burnt open woodland	Site 11
Riparian open forest	Site 12
Recently burnt open woodland	Site 13
Low woodland on sand dune	Site 14
Riparian woodland	Site 15
Open boab woodland	Site 16
Low woodland in inter-dune swale	Site 17

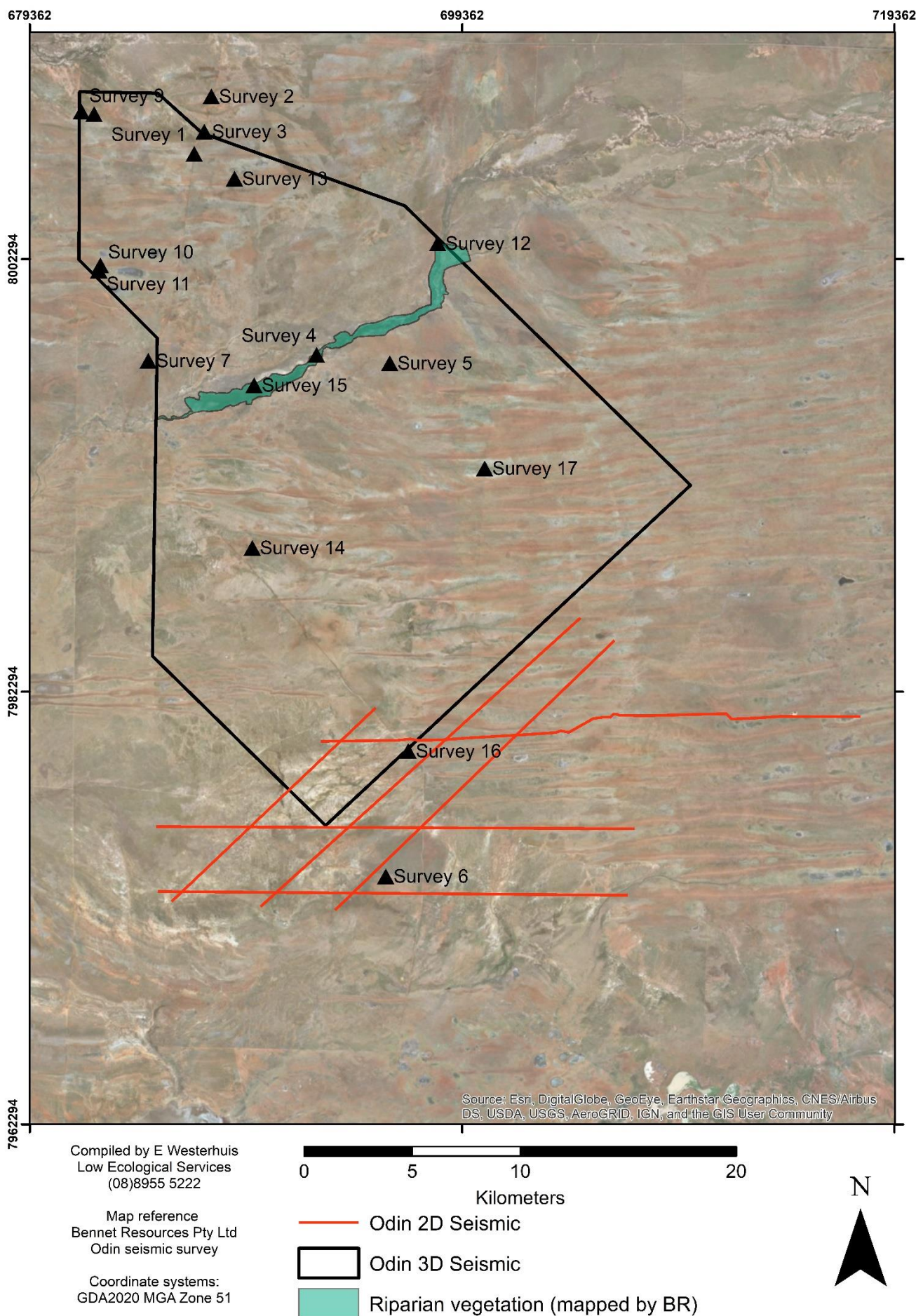


Figure 6 Location of full vegetation assessments and plant community assessments.

3.2.2. Introduced species

Two introduced plant species were recorded during the reconnaissance survey, and are described below.

***Calotropis procera* - Rubber Bush**

Rubber bush is a declared pest in Western Australia, but no specific action is required and no control category is assigned. LES consultants noted the plant to be widespread in the region, and was observed in the site along Hardmans Creek and along the roadside between Fitzroy Crossing and Yungngora. Seeds are primarily wind dispersed (DPIRD WA 2017).

***Cenchrus ciliaris* - Buffel Grass**

Buffel Grass is not a declared weed in Western Australia (DPIRD WA 2019) due to its value as a pasture grass but is implicated in increased fire frequency and intensity, in addition to loss of biodiversity. LES consultants observed buffel grass in patches along Hardmans Creek. Buffel grass seeds are dispersed by wind and water. Seeds may also become attached to livestock, clothing, machinery and other vehicles (Weeds of Australia 2019).

3.2.3. Important bush foods

During the reconnaissance survey, Traditional Owners Morrison Wulgarrie and Zecheriah Thirkell accompanied the LES consultants during field work and shared their knowledge on important bush foods. Three species which appeared to be particularly important are described below.

***Adansonia gregorii* - Boab Tree**

The boab is a large and distinctive tree species found only in the Kimberley region of Western Australia. During the reconnaissance survey it was noted to occur across much of the proposed project area in small patches. The large fruit, which ripens during the late dry season, is a favourite bush food, and the spongy wood acts as water storage which can be used in dry times (M. Wulgarrie pers. comms 22/11/2019).

***Carissa lanceolata* - Conker bush**

A spiny shrub with white flowers which occur after rain. The sweet berries are eaten fresh or dried (Z. Thirkell pers comms 25/11/2019), the wood is used for spear heads and the bark is used to prepare a bush medicine wash for skin and eye conditions (Latz 1995). This species was common across the project area, found in many different habitat types but was often the dominant understorey species in association with boabs or woodland.

***Cyperus bulbosus* – Bush Onion**

A grass-like sedge which grows in sandy soils associated with creeks, rivers, swamps and salt lakes. A very important food in times of drought, with the underground “onions” available in most months (Latz 1995). Suitable habitat occurs across much of the project area but a patch which was particularly well used by people in the Yungngora community was located in a low lying area near the existing road to Yungngora (Figure 6).

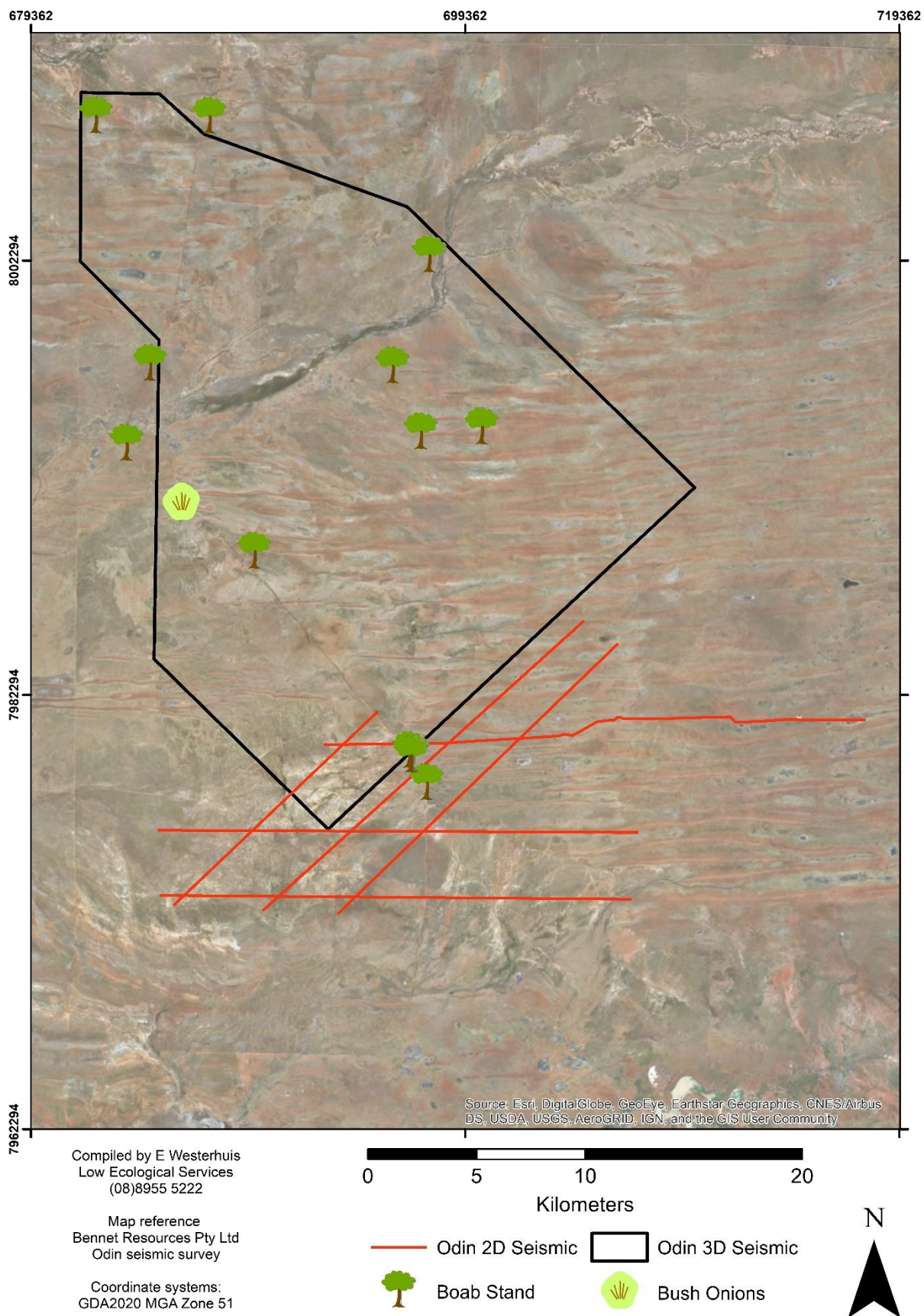


Figure 7 Observed locations of boabs and bush onions in the project area. Conker bush co-occurred with boabs in most sites, but was also present in many additional locations. See appendix B for more details.

3.3. Desktop Fauna Assessment

3.3.1. Conservation significant fauna

Searches of *NatureMap* and the *Protected Matters Search Tool* indicated that 27 fauna species of conservation significance either occurred, or had the potential to occur, within the proposed project area. These are listed below (Table 3.3-1) with further detail of the habitat requirements for threatened (EPBC) and priority species (WA) provided as context for likelihood of presence in the project area.

Table 3.3-1 Conservation significant fauna listed in order of conservation significance, then by class. Threatened and priority species are detailed further below. * Species are listed in multiple categories

Species or place	Common name	Conservation significance
<i>Calidris ferruginea</i>	Curlew sandpiper	Critically endangered
<i>Erythrura gouldiae</i>	Gouldian finch	Endangered
<i>Malurus coronatus</i>	Purple Crowned Fairy-Wren	Endangered
<i>Pezoporus occidentalis</i>	Night Parrot	Endangered
<i>Polytelis alexandrae</i>	Princess parrot	Vulnerable
<i>Rostratula australis</i>	Australian Painted Snipe	Endangered
<i>Dasyurus hallucatus</i>	Northern Quoll	Endangered
<i>Macroderma gigas</i>	Ghost Bat	Vulnerable
<i>Macrotis lagotis</i>	Greater Bilby	Vulnerable
<i>Petrogale lateralis</i>	Black-footed rock wallaby (West Kimberly Race)	Vulnerable
<i>Pristis pristis</i>	Large-tooth sawfish	Vulnerable
<i>Ctenopus uber johnsoni</i>	Spotted Ctenopus	Priority 2
<i>Westraltrachia lievreana</i>	Le Lievre Ridge Land Snail	Priority 2
<i>Leggadina lakedownensis</i>	Lakeland Downs Mouse	Priority 4
<i>Apus pacificus</i>	Fork-tailed swift	Migratory Marine Bird
<i>Crocodylus porosus</i>	Salt-water Crocodile	Migratory Marine Species
<i>Pristis pristis</i>	Large-tooth Sawfish	Migratory Marine Species*
<i>Cecropis daurica</i>	Red-rumped swallow	Migratory Terrestrial Species
<i>Cuculus opatus</i>	Oriental Cuckoo	Migratory Terrestrial Species
<i>Hirundo rustica</i>	Barn Swallow	Migratory Terrestrial Species
<i>Motacilla cinerea</i>	Grey Wagtail	Migratory Terrestrial Species
<i>Motacilla flava</i>	Yellow Wagtail	Migratory Terrestrial Species
<i>Actitis hypoleucos</i>	Common Sandpiper	Migratory Wetland Species
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Migratory Wetland Species
<i>Calidris ferruginea</i>	Curlew Sandpiper	Migratory Wetland Species*
<i>Callidris melanotos</i>	Pectoral Sandpiper	Migratory Wetland Species
<i>Charadrius veredus</i>	Oriental Plover	Migratory Wetland Species
<i>Glareola maldivarum</i>	Oriental Pratincole	Migratory Wetland Species
<i>Pandion haliaetus</i>	Osprey	Migratory Wetland Species

3.3.2. Description of threatened and priority fauna ecology and potential for occurrence in project area.

***Calidris ferruginea* – Curlew Sandpiper - Critically Endangered.**

The Curlew Sandpiper is a migratory wading bird. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. This species does not breed in Australia. They reach the northern shores of Australia in late August and early September (Threatened Species Committee 2016). ***Possible in project area during wet season***

***Erythrura gouldiae* – Gouldian Finch - Endangered**

Occupies tropical eucalypt woodlands and paperbark woodlands, usually with a grassy understorey and usually in the vicinity of water. Their diet is primarily grass seeds, particularly those of *Sorghum* species. Gouldian Finches require tree hollows for breeding. Small breeding populations have been recorded in the Dampierland sub-bioregion, in association with *Eucalyptus brevifolia* on rocky ridges. Grazing and changing fire regimes are thought to be the main threat to Gouldian Finches, as both can deplete the dry season seed resources that they rely on (Threatened Species Committee 2016). Previously recorded in the area, ***Likely in project area***.

***Malurus coronatus* – Purple Crowned Fairy-wren - Endangered**

The Purple-Crowned Fairy-wren usually occupies dense riparian woodland with an understorey of *Pandanus* or *Barringtonia* in the Kimberley region. It was previously recorded along the Fitzroy River in large numbers, however Purple-Crowned Fairy Wrens have not been observed in this location since the 1990s and this is likely a result of long-term degradation of riparian vegetation and the impacts of grazing livestock. ***Unlikely in project area***

***Rostratula australis* - Australian Painted Snipe - Endangered**

The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* or canegrass or *Melaleuca*. The Australian Painted Snipe sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber. ***Possible in project area during wet season***

***Pezoporus occidentalis* – Night Parrot - Endangered**

Cryptic, nocturnal, ground nesting parrot. Currently known from only a few small and disjunct populations in western Queensland and the Pilbara. Anecdotal records suggest that the species was previously widespread across the arid and semi-arid regions of Australia. Night Parrots characteristically roost and nest in clumps of dense vegetation, primarily old and large spinifex clumps (often >50 years unburnt), especially hummocks that are ring-forming. The

main threats to these species are unclear, though it is likely a combination of predation by feral animals, impacts of livestock and changing fire regimes. **Possible in project area**

***Polytelis alexandrae* – Princess Parrot - Vulnerable**

The princess parrot is a nomadic arid zone parrot species with a core range in the Sandy, Gibson, Tanami and Great Victoria Deserts. It forages on the ground and in shrubs, consuming a variety of plant species but usual foraging habitat is low inter-dune woodlands. Flocks congregate to breed in tree hollows in tree species such as *Eucalyptus camaldulensis* (river red gum), *E. gongylocarpa* (marble gum) and *Allocasuarina decasneana* (desert oak). As this species is highly nomadic, with movements and breeding unpredictable (though likely triggered by rainfall) the threatening processes are unclear. **Possible in project area**

***Dasyurus hallucatus* – Northern Quoll - Endangered**

The Northern Quoll is associated with a variety of habitats across northern Australia, but usually includes either rocky outcrops or diverse woodland with logs and hollows (EPBC referral guidelines 2016). The main threatening process affecting this species is habitat degradation, however feral animals such as cane toads, cats, pigs, wild dogs and cattle are believed to cause substantial direct and indirect mortality to quolls. **Possible in project area**

***Macroderma gigas* – Ghost Bat – Vulnerable**

The Ghost Bat depends on humid caves with mild and stable temperatures (Threatened Species Scientific Committee 2016). Ghost bats congregate in maternity caves during the breeding season, but disperse widely across the landscape outside of this time. The mean home range used for foraging is 61 hectares and individuals forage relatively close (< 5 km) to their roost site in caves. The main threat to this species is habitat loss and disturbance of breeding sites. **Unlikely in project area**

***Macrotis lagotis* – Greater Bilby - Vulnerable**

The Greater Bilby typically occupies either open grassland on uplands and hills, *Acacia aneura* (mulga) woodland/shrubland growing on ridges and rises, or hummock grassland on open plains and alluvial areas (Woinarski et al. 2014). The species is generally solitary and males and females differ considerably in the size of home ranges (males 316 hectares, females 18 hectares). Numerous active and inactive burrows are present in Greater Bilby home-ranges, with a new burrow constructed every few weeks (Moseby & O'Donnell 2003). The major threats to Bilby populations vary according to geography, however in the Kimberley Region the main threat is from introduced herbivores, particularly rabbits, and from large and intense fires (Bradley et al. 2015). Previously recorded within the project area (LES report 2012). **Likely in project area**

***Petrogale lateralis* – Black-footed Rock-Wallaby (West Kimberly Race) – Vulnerable**

Black-footed Rock-Wallabies typically occupy rocky outcrops, mountain ranges and require caves and rocky overhangs for shelter and protection from predators. The main threat to this species is predation by introduced predators and habitat degradation from introduced herbivores. **Unlikely in project area**

***Pristis pristis* – Largemouth sawfish – Vulnerable**

Largemouth Sawfish inhabit both freshwater and saltwater habitats and can live for 80 years. Generally, juvenile animals primarily occur in freshwater (including the upper reaches of inland creeks and rivers) while mature adults inhabit marine and estuarine environments. Individuals have been captured in water < 70 cm deep, and shallow pools in the dry season are potential habitat. Major threats to Largemouth Sawfish include fishing (commercial, recreational and indigenous) and habitat degradation. Inland freshwater habitats are thought to be most vulnerable and prone to disturbance from changes to water flow, water quality and the introduction of artificial barriers such as poorly constructed road crossings. Hardman Creek occurs in the project area and is a tributary of the Fitzroy River. This are both known location for Largemouth Sawfish, therefore this species is ***Likely in project area***.

***Leggadina lakedownensis* – Lakeland Downs Mouse - Priority 4* (WA)**

The ecology and habitat requirements of the Lakeland Downs Mouse is poorly understood however most observations of the species come from hummock or tussock grasslands in the dry tropics (intense short wet season followed by extended dry season). Observations from riparian vegetation on clay soils are also common (Kutt & Kemp 2005). It is nocturnal and shelters in burrows. Studies and biological surveys have found it to be sparsely distributed across the Kimberley and Pilbara regions of Western Australia (DCLM 2002) including several recorded observations from Liveringa Station approximately 10 km from the eastern boundary of the 3D seismic area. ***Likely in project area***

***Ctenotus uber johnsoni* – Spotted Skink – Priority 2* (WA)**

The ecology and habitat requirements of this sub-species is poorly understood, The *Ctenotus uber* group is known to prefer red soils and it is likely that the *johnsoni* subspecies is similar in its habitat preferences. It is endemic to a small geographical area near Balgo, which is the reason for being listed as a priority species. ***Unlikely in project area***

***Westraltrachia lievreana* – LeLievre Ridge Land-Snail – Priority 2* (WA)**

The LeLievre Ridge Land-Snail is one of 20 species of *Westraltrachia* occurring across the Kimberley Region, and was last recorded approximately 30 km from the survey area on the upper Hardmans Creek in 1984 (Solem 1984). Like many land snails, it is endemic to a small geographical area which is the reason for being listed as a priority species. The *Westraltrachia* genus is mostly associated with limestone, however they can be found in spinifex or scattered rocks and are not strictly associated with rocky outcrops. This genus differs from others found in the region by their habit of aestivating (dry-season hibernation) on the soil surface or in cracks and crevices rather than burrowing into soil. ***Unlikely in project area***

3.3.3. Non-conservation significant fauna

Searches of fauna records in a 40 km radius surrounding the project area indicated that a diversity of species were present. 152 Species of birds, one fish species, nine amphibians, nine invertebrates, 20 mammals and 53 reptiles had been previously recorded. These species are listed in appendix C.

3.3.4. Introduced fauna

Eight introduced species were reported as either present, or likely to occur in the proposed project area in state and commonwealth databases for the project area. These include: Dromedary Camels, Horses, Pigs, Dogs, Cats, Foxes, House Mice and Cane Toads. Feral cat density in the Kimberley region is estimated to be around 0.001 cats per hectare (ha). While this is considered a relatively low density, each individual cat is estimated to have a large home range between 397 (females) – 397 ha (males) (Mcgregor et al. 2015) and consume approximately thirty animals every day. To date Cane Toads have not invaded as far west as the project area, but their spread into this area seems probable in the future. The project area also occurs on two pastoral leases, therefore cattle are present as free-ranging herds in a rotational grazing system typical of the area. Average stocking density for the Kimberley Region is 13790 head per property, equivalent to 25 hectares per head (Agsurf 2016).

3.4. Reconnaissance Fauna Survey

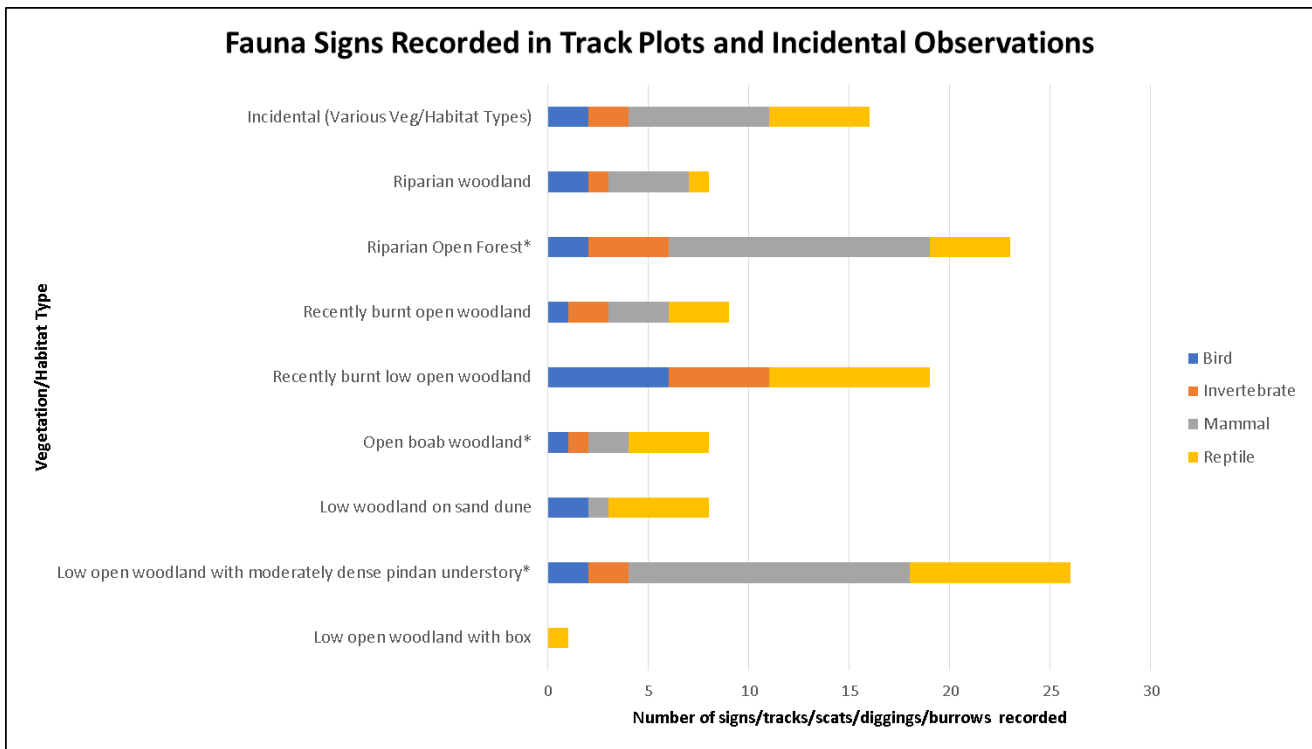
3.4.1. Native Fauna Observations

Despite high temperature throughout the reconnaissance survey, a diverse range of fauna was observed throughout the project area. Sixty bird, 11 mammals, 3 frogs and 5 reptile species were recorded during the survey. A full species list for each site in addition to incidental observations is provided in Appendix D. Due to the dry conditions and subsequent absence of natural water sources in the survey area, there were many birds visiting the cattle watering points (dams and troughs) within the survey area. However a high faunal diversity was also observed away from water, particularly in the riparian woodlands and savannah in the northern section of the project area and in the sand dune/swale complex throughout the eastern section of the project area. During the survey Boab trees and large termite mounds were observed to be very important habitats for reptiles, birds, and mammals, providing shelter from the sun/heat during extreme conditions (Figure 8).



Figure 8 Animals were frequently observed sheltering in the deep shade of boabs, or roosting in the hollows of large stems. Left red kangaroo, top right blue-tongue lizard, bottom right boobook owl.

Track based surveys were conducted at 12 sites throughout the survey area, and fauna/signs also recorded opportunistically during other activities. A range of animal tracks, scats, diggings, burrows, and remains were recorded. Samples were collected to assist with identification. A Traditional Owner accompanied LES consultants each day of the survey and assisted with identifying animal tracks, scats, diggings and burrows. A summary of recorded signs from track plot surveys are presented by vegetation/habitat type in Figure 9. The majority of the reptile and mammal observations in track plots were attributed to goannas and macropods respectively. Diggings identified as being Goanna (*Varanus* sp.) or smaller lizards were found to be widespread at many survey sites.



* These vegetation types include combined count from two track plot surveys. All other vegetation types are for a single track plot survey.
 Figure 9 Native Fauna signs recorded in track plot surveys and incidental observations of signs during other activities

There was an observation at site 10 (GPS co-ordinates -18.063° 124.726) with similar characteristics to that of a Greater Bilby (*Macrotis lagotis*) foraging excavation (**Error! Reference source not found.10**). Unlike the burrow and diggings of Sand Goannas (which were common in the area), generally the soil from Bilby excavations are spread around the hole (Triggs 2004). This could not be confirmed, as Bilby scats or tracks were not observed in the surrounding area, however Traditional Owners both confirmed Bilbies did occur across the project area, and a previous environmental report located a Bilby burrow near the Asgard Well (GPS co-ordinates -18.295856°, 124.906641).



Figure 10 Observation at site 10 with similar characteristics to that of a foraging Bilby excavation.

Native mammal scats were also collected during the reconnaissance survey, one of which may potentially be from the Northern Quoll (Figure 11) on account of the shape, size and strong odour. No white material characteristic of a reptile

scat was detected. While the habitat this scat was collected from (open boab woodland with spinifex understorey, survey site 16 GPS coordinates -18.264062°, 124.862762°) is not typical for a Northern Quoll, and the contents appeared to be predominantly invertebrates, there are few other possibilities given the size and shape of the scat.



Figure 11 Mammalian scat collected during the field survey. Potential Northern Quoll scat approximately 35 mm x 10 mm.

3.4.2. Non-native Fauna observations

As the project area is situated on two cattle stations, most observations of non-native fauna (or scats and tracks) were of livestock. However, tracks and scats of other non-native fauna were also observed.

Tracks and scats of feral cats were observed in several areas throughout the project area. Cat signs were found in savannah low open forest (Site 1), open Boab woodland (Site 8), riparian open forest (Site 12) and inter-dune swale on vehicle track (Figure 12). Cat tracks were observed following vehicle tracks and dry ephemeral creek beds, indicating that cats utilise these clear areas to move around in the landscape.

Camel Scats were observed at one location during the survey (coordinates -18.128394°, 124.866996°), and horse/donkey tracks observed at Site 5. Tracks and scats of a dogs and/or dingoes were also recorded at site 14 and coordinates -18.128394°, 124.866996°.

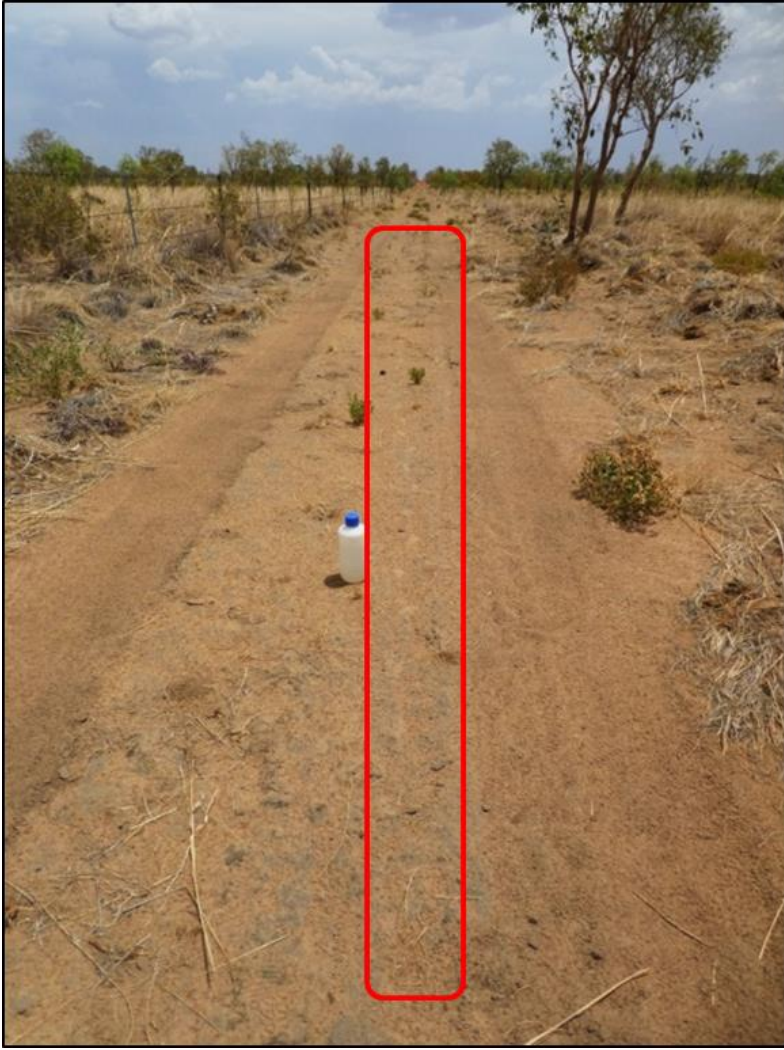


Figure 12 Cat tracks following vehicle track



Figure 13 Cat scats partially buried

4. Potential impacts

Based on information on the proposed activities available, LES considers the primary environmental impacts which may arise as a result of Bennett Resources activities in the project area are:

- Disturbance to or loss of native vegetation
- Soil compaction and erosion
- Disturbance to or loss of native fauna

These impacts are principally associated with the preparation of seismic lines. To allow trucks to access the seismic survey area, Bennett Resources proposes to prepare approximately 2800 hectares of tracks using bulldozers and graders. This is the main environmental impact of the project and has the potential to cause direct and indirect mortality to flora and fauna.

BR have prepared a detailed Environmental Risk Assessment Summary which addresses potential impacts including:

- Disturbance to native vegetation, flora and fauna species and habitat from seismic line preparation, generation of vibration and noise during seismic surveys and pollution;
- Soil compaction, rutting, erosion and alteration to drainage from seismic line preparation and vehicle access to seismic lines during surveys;
- Failure of native vegetation to recover following seismic line preparation;
- Introduction of weeds, plant diseases and feral fauna carried on machinery or camp equipment;
- Ignition of bushfires from seismic line clearing and vehicle access to seismic lines during surveys.

LES has identified additional factors which may impact vegetation, soil and fauna, and these are outlined below:

Vegetation

BR intend to use the “raised-blade clearing” for 25 % of the seismic line preparation (approximately 700 hectares), which removes the ground cover by pushing over vegetation but does not remove top soil or disturb the root zone of larger trees and shrubs. They also intend to avoid large trees through weaving of seismic lines and large termite mounds and hand-carry equipment through riparian vegetation. As a result, direct mortality of plants should only affect ground covers and small shrubs. Recent research indicates that vegetation cleared on seismic lines in the Kimberley recovers within 2-3 years without active remediation, however this is dependent on rainfall and fire frequency/intensity (Dawson et al. 2019). There is also potential risk of indirect effects to native vegetation from soil compaction, soil erosion and the spread of environmental weeds from vehicle access during the preparation of seismic lines and the seismic survey activities.

Based on the desktop and reconnaissance survey, LES considers the riparian vegetation and sand dune/ swale plant communities to be most likely to be impacted by the preparation of seismic lines and access by heavy machinery during the seismic survey. Bennett Resources intends to carry recording equipment through some riparian vegetation (along

Hardman Creek) rather than clear vegetation for vehicle access which should offer some protection to this vegetation community.

Soil Erosion and Compaction

While raised-blade clearing for seismic surveys results in less impact to soil than other methods, this will not be possible for all areas of the proposed seismic survey. Areas with both dense *Triodia* or pindan *Acacia* will likely require a more intensive line preparation with As a result, some soil disturbance or compaction will occur. A large part of the proposed project area is situated on vegetation characterised by low sand dunes interspersed with swales. The orientation of seismic lines crossing sand dunes is likely to influence the erosion potential in this area, on soils which are prone to displacement from wind and run-off. Repeated access to seismic lines across the project area by heavy vehicles during seismic surveys is also likely to cause topsoil compaction and disturbance which could lead to erosion. With the project area situated on a commercial cattle grazing operation, cattle are likely to use seismic lines, especially where these lines are prepared in proximity to troughs and dams. This will increase the time for vegetation to recover post-survey.

Fauna

During seismic line preparation, it is likely that some small terrestrial fauna may attempt to hide in vegetation being cleared, rather than disperse. Similarly, crucial shelter may be destroyed such as logs and burrows, and as a result fauna may suffer direct injury or mortality. After clearing has occurred, the loss of ground cover may indirectly affect fauna by facilitating increased predation from feral and native predators (Dawson et al. 2018). Although cats appear to already be widely distributed across the project area, creation of additional clear pathways through the landscape may assist cats to move around more easily. Use of methods such as raised blade clearing to avoid creation of clear earth pathways, will reduce the likelihood that cats would utilise these to their benefit.

Fauna may also be injured by vehicles traversing seismic lines. Surveys in the last 10 years indicate that this has rarely been an issue, as seismic crew limits speed along cleared line to 40kph and operations are only carried out in the day time when fauna activity is reduced (T Rudge, Pers Comm). It is also worth noting that all potential impacts to vegetation are likely to have indirect effects on native fauna such as reduced food availability, loss of critical shelter and reduced ecological function in the short and long term.



Figure 14 The project area is situated in a region with extreme daily and annual climate variation. During the reconnaissance survey fauna were often observed sheltering from the heat of the day in mature spinifex (left), baobab trees (centre) and large termite mounds (right)

5. Conclusions

The methodology used for this Level 1 assessment adequately addresses the EPA Guidance for Assessment of Environmental Factors.

The desktop survey identified that 235 fauna species had been recorded in the vicinity of the project area (Nature map WA), with an additional 11 threatened and 15 listed migratory potentially occurring in the survey area. Of the threatened and priority species, LES determined that Gouldian Finches, Greater Bilbies, Largetooth Sawfish and the Lakeland Downs Mouse are likely to be present in the project area.

- Gouldian Finches have been observed near the project area, and savanna woodland with bunch grass (suitable foraging habitat for the species) was common across much of the northern section of the proposed project. The abundance of other granivorous bird species during the reconnaissance survey also points to abundant resources for Gouldian Finches in the survey area.
- Bilby burrows are very likely to occur in the project area. A Bilby burrow was observed by LES consultants in 2012, and two Traditional Owners who accompanied the LES staff during the current reconnaissance survey also confirmed Bilby burrows/diggings had been observed in dunes near the Asgard Well in 2013. The dune and swale habitat across much of the south eastern part of the project area (including 2D and 3D seismic surveys) provides appropriate habitat for Bilbies.
- Largetooth Sawfish are known from the Fitzroy River and associated tributaries such as Hardman Creek. It is possible that juvenile individuals may be present in waterholes in the early dry season.
- the Lakeland Downs Mouse have previously been observed near the study area, and suitable habitat for this species is present in the survey area.

Additionally, there is potential for the Night Parrot, Princess Parrot and Northern Quoll to be present in the survey area.

- While Night Parrots have not been recorded previously in the project area, vast areas of mature spinifex in the southern region of the proposed project provide suitable habitat for the Night Parrot. This species has recently been rediscovered in Western Australia, but is difficult to detect even with specialist acoustic recording and targeted surveys.
- Similarly, the Princess Parrot has not been recorded in the project area, but is highly nomadic and suitable vegetation and habitat for this species occurs across the south-eastern project area.
- A scat collected from the project area has been identified as potentially belonging to the Northern Quoll. The location and predominantly insectivorous components of the scat is atypical for Northern Quolls, however there is a possibility that the survey area could provide suitable habitat for Northern Quolls due to the presence of potential den sites in large boabs and termite mounds, and mesic riparian corridors.

6. Recommendations

To avoid impacts to these species, and to the biodiversity values of the project area in general, LES makes the following recommendations to complement Bennett Resources existing environmental risk mitigation measures:

- To reduce likelihood of erosion in sand dune habitat, wherever possible crossings of sand dunes should be orientated to reduce slope of crossing (i.e. cross on an angle rather than perpendicular to the dune).
- To reduce impacts to soil, tyre pressure should be reduced to spread weight of vehicles over as large an area as possible.
- Strict weed hygiene management practices, including vehicle wash or blow down should be implemented during the proposed operations when traversing areas of known weed infestations to prevent the introduction of weeds, spread of weeds in the area, and transport of weeds off site.
- Line clearing crews should be provided with a photo identification kit covering any flora of conservation significance which may occur in the survey area.
- Train line clearing crews to identify and avoid rubber bush (*Calotropis procera*), or clean down vehicles which have come into contact with seed as soon as possible.
- Train crews in identifying both threatened species and invasive species.
- Be aware of the characteristics of Greater Bilby burrows and Night Parrot roosts during seismic line preparation. Vehicles should detour around any known or suspected burrows/ roosts. The knowledge and experience of Traditional owners in identifying flora and fauna of conservation significance in their country is particularly valuable.
- Be alert for the presence of cane toads when transporting materials into the site from other locations, but also be aware of the similar appearance of some native frogs.
- All native wildlife including snakes, sawfish and crocodiles are protected and should not be interfered with.
- Where injury to fauna occurs, wildlife carers are located in Derby and Fitzroy Crossing and can provide advice and assistance for injured wildlife.

7. References

Agsurf data 2018, Commonwealth of Australia, Department of Agriculture, Retrieved from

<http://apps.daff.gov.au/agsurf/agsurf.asp>

Bradley, K., Lees, C., Lundie-Jenkins, G., Copley, P., Paltridge, R., Dziminski, M., Southgate, R., Nally, S., and Kemp, L. (2015). 2015 Greater Bilby Conservation Summit and Interim Conservation Plan (pp. 17-73); an initiative of the Save the Bilby Fund.

Bureau of Meteorology, 2012. Climate statistics for Australian locations - Fitzroy Crossing Aero. Available at: http://www.bom.gov.au/climate/averages/tables/cw_003093.shtml. [Accessed May 23, 2012].

Clarke, V. (2009a). Establishing vegetation quadrats. Standard Operating Procedure No. 6.1. Department of Environment and Conservation, Western Australia.

Commonwealth of Australia (2015), Sawfish and River Sharks Multispecies Issues Paper, <http://www.environment.gov.au/biodiversity/threatened/publications/recovery/sawfish-river-sharks-multispecies-recovery-plan>

Commonwealth of Australia (2016), EPBC Act referral guideline for the endangered northern quoll, <http://www.environment.gov.au/biodiversity/threatened/species/>

Dawson SJ, Adams PJ, Waddington KI, Moseby KE, & Fleming PA. (2019) Recovery of Pindan vegetation on seismic lines. *The Rangeland Journal* **41**, 393-403.

Dawson, SJ, Adams, PJ, Moseby, KE, Waddington, KI, Kobryn, HT, Bateman, PW, & Fleming, PA (2018). Peak hour in the bush: linear anthropogenic clearings funnel predator and prey species. *Austral ecology*, *43*(2), 159-171.

Department of Agriculture and Food and Department of Environment and Conservation (2012–). Pre-European Vegetation. Spatial dataset.

Department of Biodiversity, Conservation and Attractions. (2017). Fauna Profile - Black-footed Rock Wallabies *Petrogale lateralis*. Retrieved from <http://www.dbca.wa.gov.au>

Department of Environment and Conservation, 2012. FloraBase - the Western Australian Flora. Available at: <http://florabase.calm.wa.gov.au/> [Accessed March 23, 2012].

Department of Parks and Wildlife (2007–). NatureMap: Mapping Western Australia's Biodiversity. Department of Parks and wildlife. <http://naturemap.dpaw.wa.gov.au/>

Department of Sustainability, Environment, Water, Population and Communities, 2010. Protected matters search tool. Available at: <http://www.environment.gov.au/epbc/pmst/index.html>. [Accessed May 31, 2012].

Environmental Protection Authority and Department of Parks and Wildlife (2015). Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment (eds. K Freeman, G Stack, S Thomas and N Woolfrey). Perth, Western Australia. <http://www.epa.wa.gov.au/>

Kutt, A. S., and Kemp, J. E. (2005). *Distribution, habitat and conservation status of Leggadina lakedownensis (Rodentia: Muridae) in Queensland*. Australian Zoologist *33*, 258–264.

Mcgregor, H., Legge, S., Potts, J., Jones, M. and Johnson, C. (2015). Density and home range of feral cats in north-western Australia. *Wildlife Research*. 42.

Moseby, K.E & E. O'Donnell (2003). Reintroduction of the greater bilby, *Macrotis lagotis* (Reid) (*Marsupialia: Thylacomyidae*), to northern South Australia: survival, ecology and notes on reintroduction protocols. *Wildlife Research* *30*, 15-27.

Moseby, K.E., Nano, T., and Southgate, R. (2009). Tales in the Sand: A guide to identifying arid zone fauna using spoor and other sign. Ecological Horizons, South Australia.

Petheram, R.J., & Kok, B. 1983, Plants of the Kimberley Region of Western Australia. University of Western Australia Press. Nedlands, Western Australia.

Shepherd, D.P., Beeston, G.R. & Hopkins, A.J.M., 2002. Native vegetation in Western Australia: extent, type and status. Resource Management Technical Report no. 249, Perth, WA: Department of Agriculture and Food. Available at: http://www.agric.wa.gov.au/PC_92559.html?s=276204765 [Accessed June 6, 2011].

Solem, A., (1984). Camaenid Land Snails From Western And Central Australia (*Mollusca: Pulmonata: Camaenidae*) Iv Taxa From The Kimberley, *Westraultrachia* Iredale, 1933 And Related Genera. Records of the West Australian Museum Supplement no. 17.

Thackway, R., and Cresswell, I. (1995). 'An Interim Biogeographic Regionalisation for Australia: A Framework for Establishing the National System of Reserves. Ver. 4.0.' (Australian Nature Conservation Agency: Canberra)

Threatened Species Scientific Committee (2016). Conservation Advice Canberra: Department of the Environment. <http://www.environment.gov.au/biodiversity/threatened/species/>

Triggs, B. (2004) Tracks, scats and other traces: a field guide to Australian mammals. Oxford University Press South Melbourne, Victoria

Woinarski, J., Burbidge, A. & Harrison, P. (2014). The Action Plan for Australian Mammals 2012. (pp. 203-207). CSIRO Publishing.

8. Appendices

A. Plant species recorded in desktop assessment

Table 8-1 Plant species identified as occurring in a 40 km radius around the project area

Species	Species
<i>Acacia acradenia</i>	<i>Gomphrena brachystylis</i> subsp. <i>pindanensis</i>
<i>Acacia ancistrocarpa</i>	<i>Gomphrena canescens</i> subsp. <i>canescens</i>
<i>Acacia bivenosa</i>	<i>Gomphrena leptoclada</i> subsp. <i>leptoclada</i>
<i>Acacia eriopoda</i>	<i>Goodenia armitiana</i>
<i>Acacia minniritchi</i>	<i>Goodenia byrnesii</i>
<i>Acacia monticola</i>	<i>Goodenia lamprosperma</i>
<i>Acacia papyrocarpa</i>	<i>Goodenia</i> sp. Dampier Peninsula
<i>Acacia synchronicia</i>	<i>Gossypium australe</i>
<i>Acalypha pubiflora</i> subsp. <i>australiana</i>	<i>Gyrocarpus americanus</i>
<i>Achyranthes aspera</i>	<i>Hakea arborescens</i>
<i>Ammannia multiflora</i>	<i>Heliotropium geocharis</i>
<i>Aristida hygrometrica</i>	<i>Heliotropium tanythrix</i>
<i>Aristida ingrata</i>	<i>Hibiscus apodus</i>
<i>Aristida latifolia</i>	<i>Hibiscus austrinus</i> var. <i>austrinus</i>
<i>Aristida polyclados</i>	<i>Indigofera linifolia</i>
<i>Atalaya hemiglaucula</i>	<i>Ipomoea polymorpha</i>
<i>Bergia pedicellaris</i>	<i>Iseilema vaginiflorum</i>
<i>Bidens subalternans</i> var. <i>simulans</i>	<i>Josephinia papillosa</i>
<i>Boerhavia</i> sp.	<i>Josephinia</i> sp. Northern (T.E.H. Aplin 6360)
<i>Cajanus marmoratus</i>	<i>Lophostemon grandiflorus</i> subsp. <i>riparius</i>
<i>Cajanus pubescens</i>	<i>Melaleuca alsophila</i>
<i>Calandrinia strophiolata</i>	<i>Melaleuca nervosa</i>
<i>Capparis umbonata</i>	<i>Murdannia graminea</i>
<i>Cardiospermum halicacabum</i> var. <i>halicacabum</i>	<i>Neptunia dimorphantha</i>
<i>Cassipoupa filiformis</i>	<i>Panicum seminudum</i> var. <i>cairnsianum</i>
<i>Centipeda minima</i> subsp. <i>macrocephala</i>	<i>Phyllanthus exilis</i>
<i>Chrysopogon fallax</i>	<i>Pluchea tetranthera</i>
<i>Chrysopogon latifolius</i>	<i>Polycarpaea corymbosa</i>
<i>Cleome viscosa</i>	<i>Pseudochaetochloa australiensis</i>
<i>Corchorus aestuans</i>	<i>Pterocaulon sphacelatum</i>
<i>Corchorus olitorius</i>	<i>Ptilotus lanatus</i>
<i>Corymbia dichromophloia</i>	<i>Ptilotus polystachyus</i>
<i>Corymbia flavescens</i>	<i>Rotala diandra</i>
<i>Corymbia greeniana</i>	<i>Rotala mexicana</i>
<i>Corymbia zygophylla</i>	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>
<i>Crotalaria brevis</i>	<i>Senna barclayana</i>
<i>Crotalaria medicaginea</i> var. <i>neglecta</i>	<i>Senna glutinosa</i> subsp. <i>x luerssenii</i>
<i>Cymbopogon ambiguus</i>	<i>Sesbania cannabina</i>
<i>Dichanthium fecundum</i>	<i>Solanum dioicum</i>
<i>Dichanthium sericeum</i> subsp. <i>polystachyum</i>	<i>Solanum lucani</i>

Species	Species
<i>Dichrostachys spicata</i>	<i>Swainsona campylantha</i>
<i>Dinebra neesii</i>	<i>Tephrosia rosea</i> var. <i>clementii</i>
<i>Dolichandrone occidentalis</i>	<i>Tinospora smilacina</i>
<i>Drosera derbyensis</i>	<i>Trianthema oxycalyptrum</i> var. <i>oxycalyptrum</i>
<i>Enneapogon purpurascens</i>	<i>Trianthema portulacastrum</i>
<i>Eriachne glauca</i> var. <i>glauca</i>	<i>Trichodesma zeylanicum</i>
<i>Eriachne obtusa</i>	<i>Triodia bitextura</i>
<i>Eucalyptus chlorophylla</i>	<i>Triodia caelestialis</i>
<i>Eulalia aurea</i>	<i>Triodia intermedia</i>
<i>Euphorbia biconvexa</i>	<i>Triodia pascoeana</i>
<i>Euphorbia cinerea</i>	<i>Triodia wiseana</i>
<i>Ficus aculeata</i> var. <i>indecora</i> Ranji	<i>Triumfetta micracantha</i>
<i>Fimbristylis solidifolia</i>	<i>Zornia albiflora</i>
<i>Flueggea virosa</i> subsp. <i>melanthesoides</i>	

B. Plant Species observed in reconnaissance survey

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	I*
<i>Acacia ancistrocarpa</i>	X		X	X		X												
<i>Acacia bivenosa</i>									X									
<i>Acacia colei</i>	X		X							X								
<i>Acacia elachantha</i>																		X
<i>Acacia eriopoda</i>																		X
<i>Acacia hemignosta</i>			X								X							
<i>Acacia holeraceae</i>				X									X		X			
<i>Acacia platycarpa</i>									X									
<i>Acacia pyrifolia</i>						X												
<i>Acacia synchronicia</i>																		X
<i>Acacia tumida</i>																		
<i>Adansonia gregorii</i>		X			X		X	X				X				X		
<i>Aerva javanica</i>																		X
<i>Alstonia linearis</i>																		X
<i>Amyema villiflora</i>																		X
<i>Aristida contorta</i>														X				
<i>Aristida hygrometrica</i>	X	X	X					X				X						
<i>Aristida latifolia</i>	X			X										X				
<i>Atalaya hemiglauca</i>								X				X		X				
<i>Bauhinia cunninghamii</i>				X	X		X			X			X	X	X			
<i>Bergia henshalli</i>																		X
<i>Bothriochloa bladhii</i>																		X
<i>Bulbostylis sp.</i>																		X
<i>Cajanus pubescens</i>																		X
<i>Cajanus marmeratus</i>																		X
<i>Calotropis procera</i>														X				
<i>Carissa lanceolata</i>	X		X	X		X	X					X	X	X		X		
<i>Cenchrus basedowii</i>											X							
<i>Chrysopogon fallax</i>		X	X															X
<i>Chrysopogon latifolius</i>						X	X	X										
<i>Corchorus sidoides ssp sidoides</i>	X				X								X					
<i>Corymbia bella</i>				X								X			X			
<i>Corymbia cadophora</i>									X									
<i>Corymbia grandifolia</i>		X																
<i>Corymbia opaca</i>	X	X	X		X		X						X					
<i>Corymbia zygophylla</i>																		X
<i>Cucumis argenteus</i>									X									
<i>Cullen pustulatum</i>																		X
<i>Cymbopogon ambiguus</i>						X												
<i>Cyperus blakeanus</i>																		X
<i>Cyperus haspan subsp. juncoides</i>																		X
<i>Dicanthium fecundum</i>																		X
<i>Dolichandrone occidentalis</i>									X					X				
<i>Eragrostis eriopoda</i>	X	X							X									

Bennett Resources –Odin 2D and 3D Seismic Survey – Flora and Fauna impact assessment

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	I*
<i>Eriachne obtusa</i>	X	X		X		X												
<i>Erythrophleum chlorostachys</i>	X									X			X	X				X
<i>Eucalyptus camaldulensis subsp. obtusa</i>											X							
<i>Eucalyptus intertexta</i>				X			X				X				X			
<i>Eucalyptus miniata</i>																		X
<i>Eucalyptus chlorophylla</i>																		X
<i>Eulalia aurea</i>																		X
<i>Euphorbia biconvexa</i>							X											X
<i>Ficus coronulata</i>				X														X
<i>Fluggia virosa ssp melanthesoides</i>																		X
<i>Gomphrena canescens</i>																		X
<i>Goodenia armitiana</i>	X						X											
<i>Grevillea agrifolia</i>																		X
<i>Grevillea pyramidalis</i>					X									X				
<i>Grevillea refracta</i>																		X
<i>Grevillea striata</i>	X						X		X									
<i>Grevillea wickhamii</i>		X			X													
<i>Gyrocarpus americanus</i>							X			X		X		X				X
<i>Hakea aborescens</i>	X															X		
<i>Hakea macrocarpa</i>		X	X							X			X	X				
<i>Heliotropium ovalifolium</i>																		X
<i>Hibiscus austrinus</i>								X							X			
<i>Hibiscus leptocadus</i>								X										
<i>Iseilema vaginiflorum</i>										X					X			
<i>Jasminium didymum</i>	X			X				X				X						
<i>Malvaceae sp</i>	X					X												
<i>Melaleuca lasiandra</i>																		X
<i>Melaleuca nervosa</i>				X														
<i>Neptunia dimorphantha</i>																		X
<i>Panicum semidium</i>																		X
<i>Pluchea tetranthera</i>				X		X		X	X			X						
<i>Psydrax attenuata var. tenella</i>			X					X										
<i>Pterocaulon sphacelatum</i>	X			X			X											
<i>Ptilotus exaltus</i>		X																
<i>Santalum lanceolatum</i>			X							X		X						
<i>Schima nervosum</i>				X		X												
<i>Senna venusta</i>		X																
<i>Sesbania formosa</i>					X													
<i>Solanum lucani</i>																		X
<i>Sorghum stipoides</i>	X			X							X							
<i>Streptoglossa decurrens</i>								X										
<i>Tephrosia rosea</i>							X											
<i>Tephrosia sp</i>							X		X									
<i>Tephrosia virens</i>							X		X									
<i>Terminalia platyphylla</i>				X								X						

Bennett Resources –Odin 2D and 3D Seismic Survey – Flora and Fauna impact assessment

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	I*
<i>Themeda triandera</i>									X									
<i>Tinospora smilacina</i>				X								X						
<i>Trichodesma zeylanicum</i>								X										
<i>Triodia intermedia</i>	X	X	X		X			X	X	X				X				
<i>Triodia pungens</i>																	X	
<i>Vachellia farnesiana</i>			X														X	
<i>Ventilago viminalis</i>									X									

C. Native fauna species recorded in desktop assessment

Table 8-2 Bird Species Recorded in Nature Map for Coordinates 124° 55' 33" E, 18° 09' 56" S; with a 40km buffer. Conservation status of species as: T -Rare or likely to become extinct, X - Presumed extinct, IA - Protected under international agreement, 1 -Priority 1, 2 -Priority 2, 3 -Priority 3 and 4 -Priority 4.

Species	Common Name	Cons. Stat	Species	Common Name	Cons. Stat
Accipiter cirrocephalus	Collared Sparrowhawk		Geopelia striata	Zebra Dove	
Accipiter fasciatus	Brown Goshawk		Geophaps plumifera	Spinifex Pigeon	
Actitis hypoleucos	Common Sandpiper	IA	Gerygone olivacea	White-throated Gerygone	
Aegotheles cristatus	Australian Owlet-nightjar		Grallina cyanoleuca	Magpie-lark	
Anas castanea	Chestnut Teal		Grus rubicunda	Brolga	
Anas gracilis	Grey Teal		Haliastur sphenurus	Whistling Kite	
Anas superciliosa	Pacific Black Duck		Hamirostra isura	Square-tailed Kite	
Anhinga novaehollandiae	Australasian Darter		Hamirostra melanosternon	Black-breasted Buzzard	
Anseranas semipalmata	Magpie Goose, Pied Goose		Heteromunia pectoralis	Pictorella Mannikin	
Anthus australis	Australian Pipit		Hieraaetus morphnoides	Little Eagle	
Aprosmictus erythropterus	Red-winged Parrot		Himantopus himantopus	Black-winged Stilt	
Apus pacificus	Fork-tailed Swift	IA	Lalage tricolor	White-winged Triller	
Aquila audax	Wedge-tailed Eagle		Lichmera indistincta	Brown Honeyeater	
Ardea ibis	Cattle Egret		Limosa limosa	Black-tailed Godwit	IA
Ardea intermedia	Intermediate Egret		Malacorhynchus membranaceus	Pink-eared Duck	
Ardea modesta	Great egret		Malurus lamberti	Variegated Fairy-wren	
Ardea novaehollandiae	White-faced Heron		Malurus leucopterus	White-winged Fairy-wren	
Ardea pacifica	White-necked Heron		Malurus melanocephalus	Red-backed Fairy-wren	
Ardeotis australis	Australian Bustard		Manorina flavigula	Yellow-throated Miner	
Artamus cinereus	Black-faced Woodswallow		Melanodryas cucullata	Hooded Robin	
Artamus leucorhynchus	White-breasted Woodswallow		Melithreptus albobularis	White-throated Honeyeater	
Artamus minor	Little Woodswallow		Melithreptus gularis	Black-chinned Honeyeater	
Artamus personatus	Masked Woodswallow		Melithreptus gularis	Black-chinned Honeyeater	
Artamus superciliosus	White-browed Woodswallow		Melopsittacus undulatus	Budgerigar	
Aythya australis	Hardhead		Merops ornatus	Rainbow Bee-eater	
Burhinus grallarius	Bush Stone-curlew		Microcarbo melanoleucos	Little Pied Cormorant	
Cacatua galerita	Sulphur-crested Cockatoo		Microeca fascinans	Jacky Winter	
Cacatua roseicapilla	Galah		Milvus migrans	Black Kite	
Cacatua sanguinea	Little Corella		Mirafra javanica	Horsfield's Bushlark	
Cacomantis pallidus	Pallid Cuckoo		Myiagra inquieta	Restless Flycatcher	
Cacomantis variolosus	Brush Cuckoo		Neochmia phaeton	Crimson Finch	
Calidris acuminata	Sharp-tailed Sandpiper	IA	Neochmia ruficauda	Star Finch	
Calyptorhynchus banksii	Red-tailed Black-Cockatoo		Nettapus pulchellus	Green Pygmy-geese	
Centropus phasianinus	Pheasant Coucal		Nycticorax caledonicus	Rufous Night Heron	
Certhionyx variegatus	Pied Honeyeater		Nymphicus hollandicus	Cockatiel	
Chenonetta jubata	Australian Wood Duck		Ocyphaps lophotes	Crested Pigeon	
Chrysococcyx basalis	Horsfield's Bronze Cuckoo		Oriolus sagittatus	Olive-backed Oriole	
Chrysococcyx osculans	Black-eared Cuckoo		Pachycephala rufiventris	Rufous Whistler	
Circus assimilis	Spotted Harrier		Pardalotus rubricatus	Red-browed Pardalote	
Cissomela pectoralis	Banded Honeyeater		Pardalotus striatus	Striated Pardalote	
Cisticola exilis	Golden-headed Cisticola		Pelecanus conspicillatus	Australian Pelican	

Species	Common Name	Cons. Stat	Species	Common Name	Cons. Stat
Colluricincla harmonica	Grey Shrike-thrush		Petrochelidon ariel	Fairy Martin	
Conopophila rufogularis	Rufous-throated Honeyeater		Petrochelidon nigricans	Tree Martin	
Coracina novaehollandiae	Black-faced Cuckoo-shrike		Phalacrocorax carbo	Great Cormorant	
Coracina papuensis	White-bellied Cuckoo-shrike		Phalacrocorax sulcirostris	Little Black Cormorant	
Corvus Bennetti	Little Crow		Phalacrocorax varius	Pied Cormorant	
Corvus orru	Torresian Crow		Philemon argenticeps	Silver-crowned Friarbird	
Coturnix ypsilophora	Brown Quail		Philemon citreogularis	Little Friarbird	
Cracticus nigrogularis	Pied Butcherbird		Platalea flavipes	Yellow-billed Spoonbill	
Cygnus atratus	Black Swan		Platalea regia	Royal Spoonbill	
Dacelo leachii	Blue-winged Kookaburra		Plegadis falcinellus	Glossy Ibis	IA
Dacelo leachii	Blue-winged Kookaburra		Podargus strigoides	Tawny Frogmouth	
Daphoenositta chrysoptera	Varied Sittella		Poephila acuticauda	Long-tailed Finch	
Daphoenositta chrysoptera	Varied Sittella		Poephila personata	Masked Finch	
Dendrocygna arcuata	Wandering Whistling Duck		Poliocephalus	Hoary-headed Grebe	
			poliocephalus		
Dendrocygna eytoni	Plumed Whistling Duck		Pomatostomus temporalis	Grey-crowned Babbler	
Dicaeum hirundinaceum	Mistletoebird		Psitteuteles versicolor	Varied Lorikeet	
Dromaius novaehollandiae	Emu		Ptilonorhynchus nuchalis	Great Bowerbird	
Egretta garzetta	little Egret		Ptilonorhynchus nuchalis	Great Bowerbird	
Egretta novaehollandiae	White-faced heron		Ptilotula flavescens	Yellow-tinted Honeyeater	
Elanus axillaris	Black-shouldered kite		Rhipidura albiscapa	Grey Fantail	
Elsyornis melanops	Black-fronted Dotterel		Rhipidura leucophrys	Willie Wagtail	
Eolophus roseicapillus	Galah		Smicronis brevirostris	Weebill	
Ephippiorhynchus asiaticus	Black-necked Stork		Stiltia isabella	Australian Pratincole	
Eremiornis carteri	Spinifex-bird		Tachybaptus	Australasian Grebe	
			novaehollandiae		
Erythronys cinctus	Red-kneed Dotterel		Taeniopygia bichenovii	Double-barred Finch	
Erythrura gouldiae	Gouldian Finch	P4	Taeniopygia guttata	Zebra Finch	
Eurostopodus argus	Spotted Nightjar		Threskiornis spinicollis	Straw-necked Ibis	
Eurystomus orientalis	Dollarbird		Todiramphus pyrrhopygius	Red-backed Kingfisher	
Falco berigora	Brown Falcon		Todiramphus sanctus	Sacred Kingfisher	
Falco cenchroides	Australian Kestrel		Trichoglossus haematodus	Rainbow Lorikeet	
Falco longipennis	Australian Hobby		Tringa glareola	Wood Sandpiper	IA
Fulica atra	Eurasian Coot		Turnix pyrrhothorax	Red-chested Button-quail	
Gelochelidon nilotica	Gull-billed Tern	IA	Turnix velox	Little Button-quail	
Geopelia cuneata	Diamond Dove		Tyto alba	Barn Owl	
Geopelia humeralis	Bar-shouldered Dove		Vanellus miles	Masked Lapwing	

Table 8-3 Amphibians

Species	Common Name	Species	Common Name
Cyclorana australis	Giant Frog	Litoria watjulumensis	Wotjulum Frog
Cyclorana longipes	Long-footed Frog	Neobatrachus aquilonius	Northern Burrowing Frog
Litoria caerulea	Green Tree Frog	Notaden nicholli	Desert Spadefoot
Litoria pallida	Pale Rocket Frog	Platyplectrum ornatum	Ornate Burrowing Frog
Litoria rubella	Little Red Tree Frog		

Table 8-4 Mammals

Species	Common Name	Cons. Stat	Species	Common Name	Cons. Stat
Chaerephon jobensis	Northern free-tailed Bat		Pseudomys nanus	Western Chestnut Mouse	
Chalinolobus gouldii	Gould's Wattled Bat		Pteropus scapulatus	Little Red Flying-fox	
Leggadina lakedownensis	Northern Short-tailed Mouse	P4	Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat	
Macropus agilis	Agile Wallaby		Scotorepens balstoni	Inland Broad-nosed Bat	
Macropus antilopinus	Antilopine Wallaroo		Scotorepens greyii	Little Broad-nosed Bat	
Macropus rufus	Red Kangaroo		Sminthopsis macroura	Stripe-faced Dunnart	
Miniopterus schreibersii	Common Bentwing-bat		Tachyglossus aculeatus	Short-beaked Echidna	
Onychogalea unguifera	Northern Nailtail Wallaby		Taphozous georgianus	Common Sheath-tailed Bat	
Pipistrellus westralis	Northern Pipistrelle		Bos taurus	European Cattle	Feral
Pseudomys delicatulus	Delicate Mouse		Felis catus	Cat	Feral
Pseudomys desertor	Desert Mouse		Mus musculus	House Mouse	Feral
Pseudomys hermannsburgensis	Sandy Inland Mouse		Sus scrofa	Pig	Feral

Table 8-5 Reptiles

Species	Common Name	Cons. Stat	Species	Common Name	Cons. Stat
Amphibolurus gilberti	Gilbert's Dragon		Gehyra pilbara		
Antaresia childreni	Children's Python		Gehyra punctata		
Antaresia stimsoni	Stimson's Python		Gehyra variegata		
Aspidites melanocephalus	Black-headed Python		Heteronotia binoei	Bynoe's Gecko	
Brachyurophis roperi	Northern Shovel-nosed Snake		Heteronotia planiceps		
Carlia munda	Shaded-litter Rainbow Skink		Lerista bipes		
Cryptoblepharus ruber			Lerista simillima		
Cryptoblepharus tythos			Lialis burtonis		
Ctenophorus isolepis	Military Dragon		Lucasium stenodactylum		
Ctenophorus nuchalis	Central Netted Dragon		Menetia greyii		
Ctenotus inornatus			Morethia ruficauda		
Ctenotus pantherinus	Leopard Ctenotus		Nephrurus sheai		
Ctenotus piankai			Notoscincus ornatus		
Ctenotus saxatilis	Rock Ctenotus		Pogona minor	Dwarf Bearded Dragon	
Ctenotus serventyi			Proablepharus tenuis		
Ctenotus uber	Spotted Ctenotus	P2	Pseudechis australis	Mulga Snake	
Cyclodomorphus melanops	Slender Blue-tongue		Pseudonaja mengdeni	Western Brown Snake	
Delma borea			Pseudonaja nuchalis	Northern Brown Snake	
Delma tinca			Strophurus ciliaris		
Demansia angusticeps			Suta punctata	Spotted Snake	
Demansia olivacea	Olive Whipsnake		Tiliqua multifasciata	Central Blue-tongue	
Diporiphora lalliae			Tiliqua scincoides	Common Blue-tongue	
Diporiphora magna			Varanus acanthurus	Spiny-tailed Monitor	
Diporiphora pindan	Pindan Dragon		Varanus brevicauda	Short-tailed Pygmy Monitor	
Furina ornata	Moon Snake		Varanus eremius	Pygmy Desert Monitor	
Gehyra australis			Varanus gouldii	Sand Monitor	
Gehyra nana					

D. Native Fauna observed in reconnaissance survey

Frog Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Incidental
Green Tree Frog																	X
Northern Snapping Frog																	X
Wailing frog																	X
Bird Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Incidental
Australasian Grebe																	X
Australasian Pipit																	
Australian Bustard										X			X		X	X	X
Australian Kestral																	X
Black Kite																	X
Black-breasted buzzard																	X
Black-chinned honeyeater				X													
Black-faced woodswallow													X		X		
Boobook																	X
Brolga																	X
Bronzewing Pigeon																	X
Brown Falcon														X			X
Brown Honeyeater															X		
Budgerigar									X								X
Cockatiels																	X
Corella								X									X
Crested pigeon																	X

Bird Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Incidental
Crimson Chat														X			
Diamond Dove		X										X					
Emu				X													X
Fairy martin														X			
Galah																	X
Grey Shrike-thrush				X											X		
Grey-crowned babbler															X		
Grey-crowned friarbird												X					
Horsfields bushlark						X											X
Inland Dotteral																	X
Little Crow										X			X				
Little friarbird				X											X		
Little shrike-thrush																	
Little woodswallow	X																
Masked Lapwing																	X
Mistletoebird			X													X	
Mudlark										X			X				
Owlet Nightjar							X										
Pacific wood duck																	X
Pied butcherbird										X							
Pink-eared duck																	X
Plumed Whistling Duck																	X
Rainbow bee-eater	X																
Red winged parrot																	X
Red-backed fairywren				X			X		X			X			X		
Red-backed kingfisher										X							
Red-browed pardalote											X			X	X		

Bird Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Incidental
Red-tailed black cockatoos													X				X
Rufous Songlark														X			
Rufous throated honeyeater											X				X		
Rufous whistler											X				X		
Sacred Kingfisher				X								X					
Scaly-breasted lorikeet															X		
Singing honeyeater														X			
Striated pardalote																	
Swamp Harrier																	X
Wedge-tailed eagle																	X
Weebill				X							X						
Whistling kite																	X
White winged triller														X			
White-breasted woodswallow																	X
Willy wagtail	X									X				X			
Yellow-throated miner	X						X			X	X					X	
Zebra finch														X			

Invertebrate Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Incidental
<i>Trigona</i> sp. (Bush bees)			X							X							X
Scorpion sp.							X										

Mammal Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Incidental
Agile Wallaby				X			X								X		
Nail-tail Wallaby																	X
Red Kangaroo				X													X
Little broad-nosed bat/*				X		X											
Hoary Wattled Bat																	
Yellow-bellied sheath-tailed bat*				X		X											
White-striped free-tailed bat/*				X		X											
Greater Northern Free-tailed Bat																	
Common Sheath-tailed Bat*				X		X											
Northern Free-tailed Bat*				X		X											
Long-eared bat species*				X		X											
Black-tailed Monitor																	
Common Blue Tongue								X									X
Military Dragon									X					X			
Sand Goanna		X					X										X
Yellow-spotted monitor																	X

E. Habitat descriptions from site surveys

Site description	Location	Flora species richness	Fauna species richness	Track plot observations density ¹
Savannah low, open forest	Site 1	18	4	NA
Mixed Eucalypt and Acacia woodland,	Site 2	12	2	NA
Low open woodland over stony ground	Site 3	12	3	NA
Riparian open forest	Site 4	17	7	9
Low open woodland pindan understory	Site 5	8	0	14
Low open spinifex grassland	Site 6	9	1	NA
Low open woodland with pindan understory	Site 7	14	5	12
Open boab woodland	Site 8	12	2	2
Low open woodland with Box	Site 9	13	3	1
Recently burnt low open woodland	Site 10	6	7	21
Recently burnt open woodland	Site 11	7	5	NA
Riparian open forest	Site 12	11	4	14
Recently burnt open woodland	Site 13	6	5	9
Low woodland on sand dune	Site 14	12	10	8
Riparian woodland	Site 15	7	11	8
Open boab woodland	Site 16	5	7	8
Interdune swale	Site 17	10	7	NA

1: Track plot observations density is indicative of density and activity of fauna at the site, but should not be interpreted as actual count of fauna at the site. Numbers presented are for native fauna only, feral fauna and cattle track and scat observations are excluded.

F. Examples of Bat Calls from Acoustic Analysis

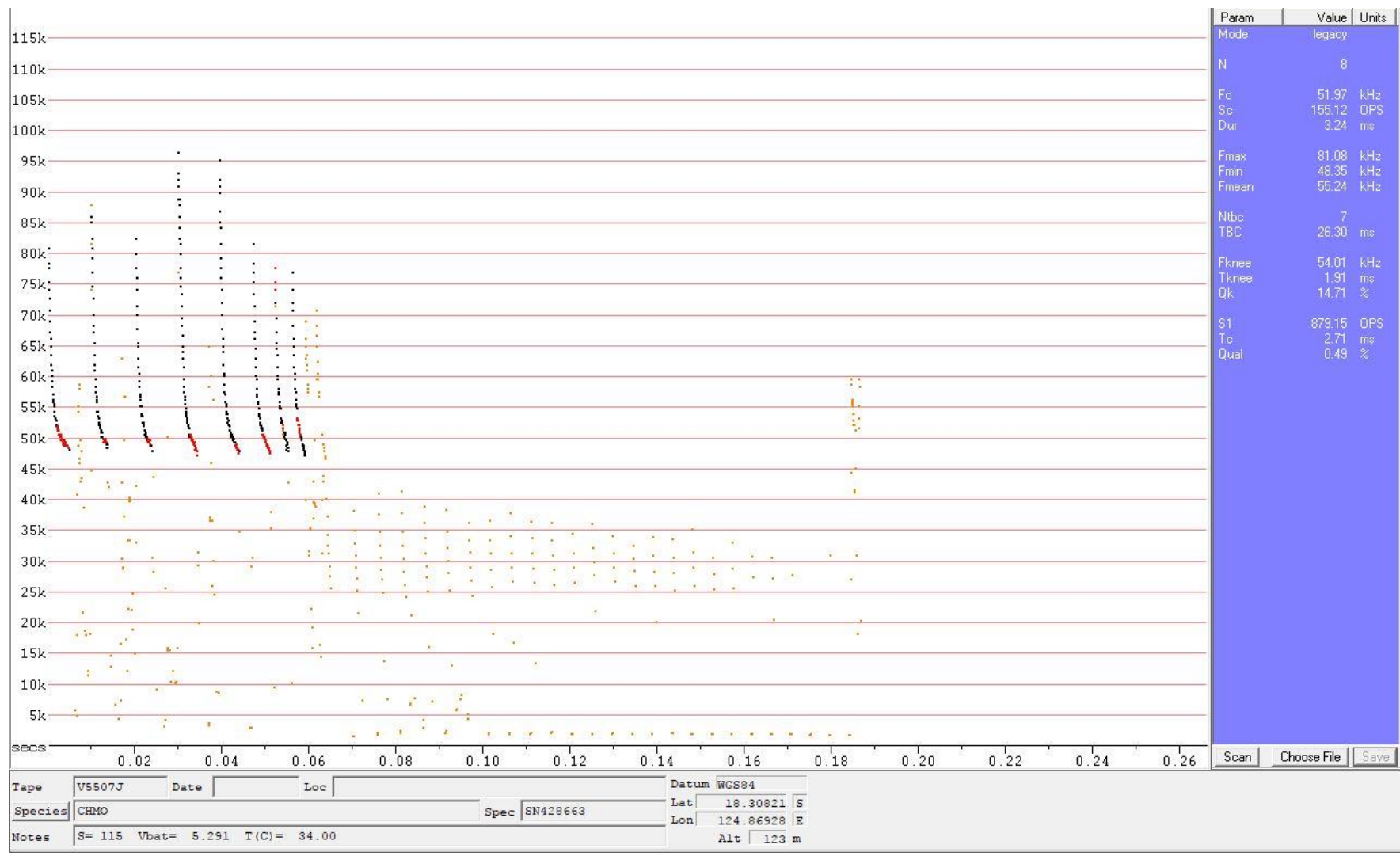


Figure 15 *Nyctophilus* species (Long-eared bat). This genus is difficult to record acoustically, and cannot be easily identified from recordings

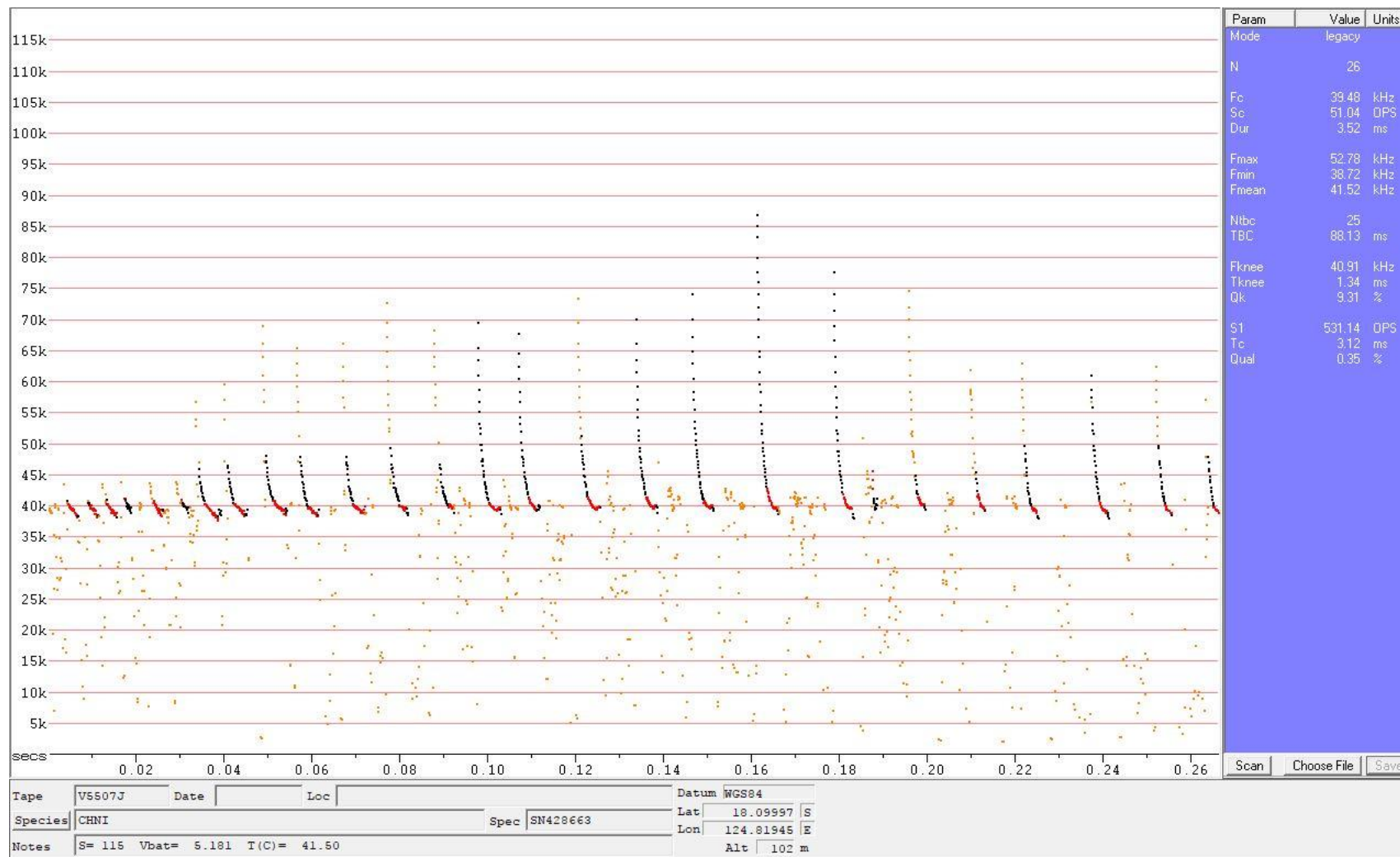


Figure 16 *Chalinolobus nigrogiseus* or *Scotorepens greyii* (Hoary wattled bat / Little broad-nosed bat). These two species cannot be accurately separated based on echolocation characteristics

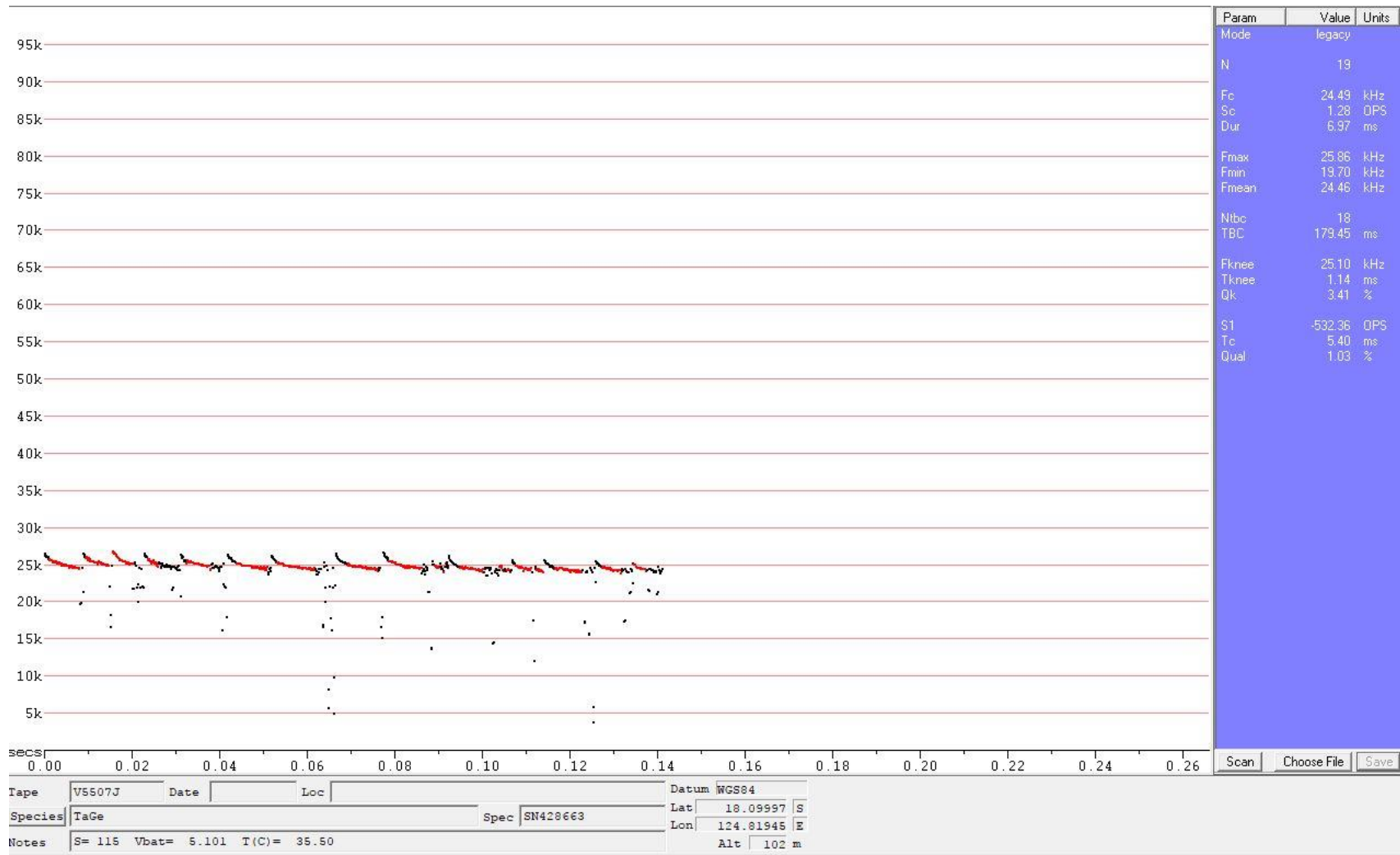


Figure 17 *Taphozous georgianus* (Common sheath-tailed bat)

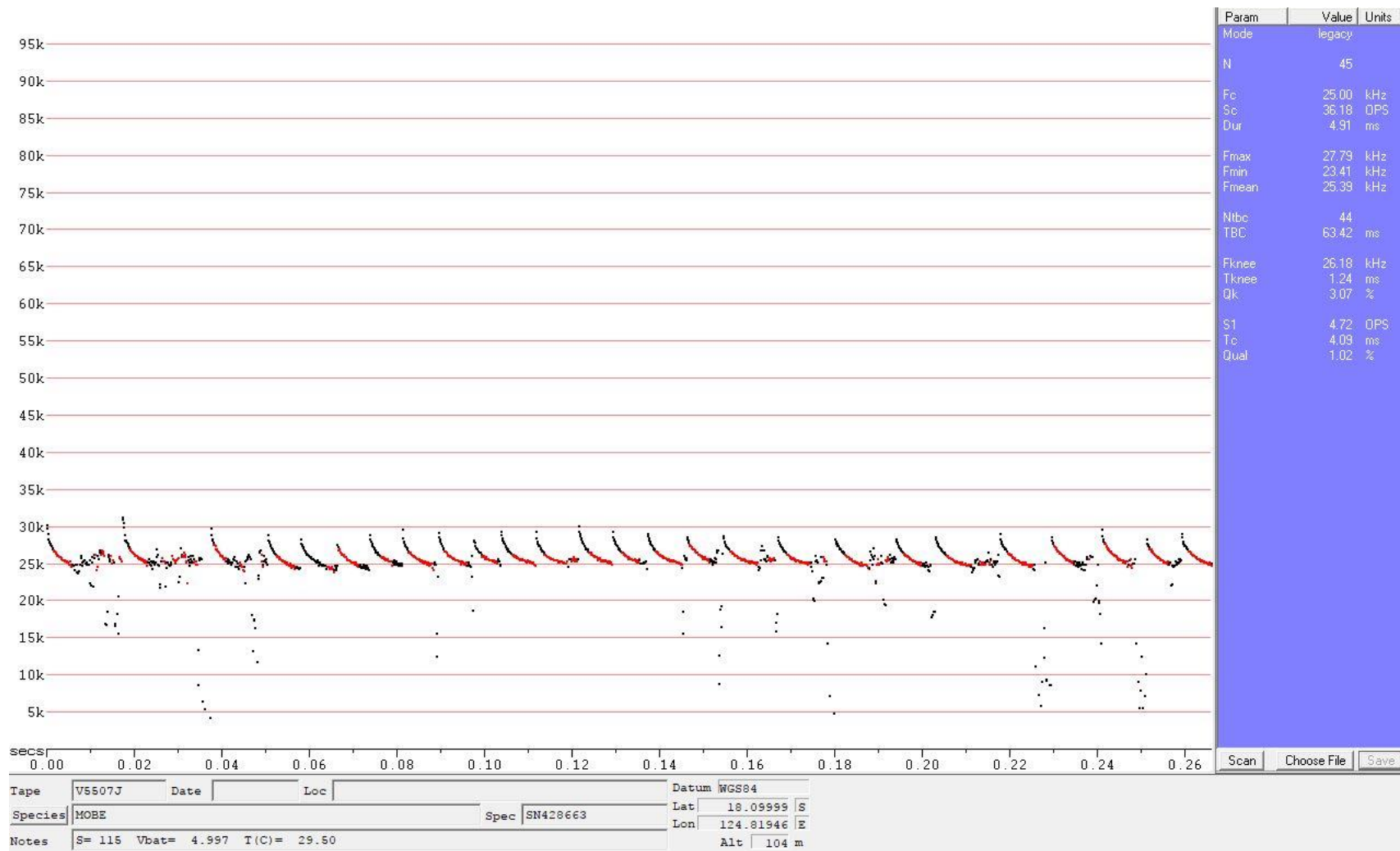


Figure 18 *Mormopterus (Ozimops) lumsdenae* (Northern Free-tailed Bat)

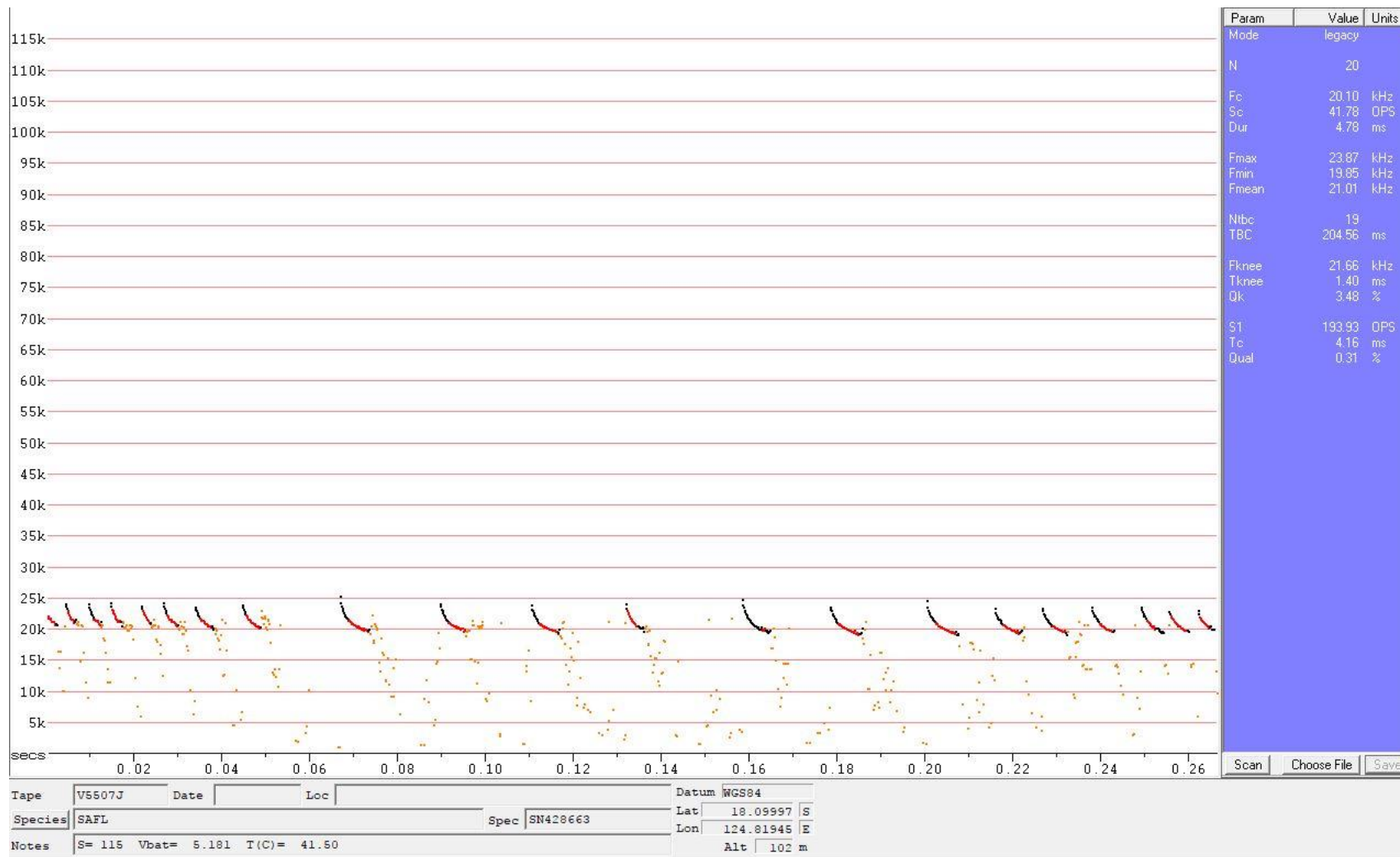


Figure 19 *Saccolaimus flaviventris* (Yellow-bellied sheath-tailed bat)



Figure 20 *Chaerophon jobensis* or *Austronomus australis* (Greater Northern Free-tailed Bat/ White-striped Free-tailed Bat). Most likely to be *C. jobensis* based on known range for both species.

