

ABM Resources NL

Report for Old Pirate
Vegetation, Flora and Fauna
Survey

June 2012



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1. Glossary

EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GHD	GHD Pty Ltd
MNES	Matters of National Environmental Significance
ABM	ABM Resources NL
n.d.	No date (referring to an undated reference)
NT	Northern Territory
NTG	Northern Territory Government
NVIS	National Vegetation Information System
PMST	Protected Matters Search Tool
NRETAS	Department of Natural Resources and, Environment and the Arts
DSEWPac	Department of Sustainability, Environment, Water, Populations and Communities
SOCS	Sites of Conservation Significance
subsp.	subspecies
TPWC	<i>Territory Parks and Wildlife Conservation Act 2000</i>
var.	variety



2. Executive Summary

GHD Pty Ltd (GHD) was engaged by ABM Resources NL (ABM) to undertake baseline flora and fauna surveys of Old Pirate in April 2012. Surveys included vegetation mapping, flora quadrat surveys and fauna trapping and observation according to NT Guidelines.

GHD found three distinct vegetation types present in the study area. The vegetation types are not unique to the study area. These were classified as rocky outcropping, gravelly spinifex grassland with acacia shrubland and Grassland with Sparse Woodland. All of the vegetation types mapped in the study area would most appropriately be classified into the fine vegetation type 43: Eucalyptus low open-woodland and/or Acacia sparse-shrubland with *Triodia spicata* (Spike Flower Spinifex), *Triodia pungens* (Soft Spinifex) hummock grassland understorey.

Two flora species (*Acacia abbreviata* and *A. minutifolia*) are endemic to the Tanami Desert and two species are of regional significance due to their restricted ranges in the NT: *Dampiera candidans* (observed in the north of the study area) and *Sclerolaena muelleri* (observed in the west of the study area). The presence of these flora species of local and regional significance has no legislative consequence to the project.

No individuals of the native walnut (*Owenia reticulata*) (of cultural significance to the local Aboriginal people (GHD 2012a)) were identified in the study area.

Two exotic flora species were recorded during the April flora surveys: buffel grass (*Pennisetum (Cenchrus) ciliaris*) and purple-top chloris (*Chloris barbata*). These species occur in the cleared and disturbed area known as 'Wilson's Camp'. The occurrences of buffel grass in the study area are relatively small (patch sizes less than 10 m in diameter). The plants are mature (producing seeds) and could easily spread, posing a threat to native plant diversity and animal habitat. It is recommended the area of infestation be isolated by fencing (up to 1.2 m high with a small mesh aperture to contain windblown seed) and targeted for eradication.

The number of fauna species detected during fauna survey was moderate. A total of 93 species were detected, including 20 mammals, 49 birds and 24 reptiles. The presence of two EPBC listed threatened species, the greater bilby and brush-tailed mulgara, will require referral of any proposed action (e.g. mining) to DSEWPaC. The purpose of a referral is to obtain a decision on whether a proposed action will need formal assessment and approval under the EPBC Act.

GHD recommends that targeted threatened fauna surveys be conducted to determine the abundance of these species on the mineral lease and to map suitable habitat important to these species in preparation for having to meet obligations under the EPBC Act should ABM proceed with Mining.

Relatively few introduced fauna species were detected (cat and one-humped camel).



3. Introduction

3.1 Background and Project Description

ABM Resources NL (ABM) is a mineral exploration company focused on gold and gold-copper discovery in the Tanami and Arunta regions of the Northern Territory, Australia. ABM engaged GHD to undertake fauna and flora surveys of Old Pirate in April 2012.

3.2 Objectives

The objectives of this flora and fauna survey are to:

- ▶ Identify and map the main vegetation types in the study area.
- ▶ Conduct a systematic flora survey of vegetation types in the study area.
- ▶ Examine the habitat, floristics and structure of the vegetation present in the study area.
- ▶ Undertake targeted surveys for threatened flora species that may be present at the site.
- ▶ Identify introduced flora (weeds) present in the area and, if appropriate, map significant infestations;
- ▶ Assess the significance of the study area's vegetation in local and regional contexts.
- ▶ Conduct a wet season systematic baseline fauna survey of vegetation types in the study area (ABM's 2012 drilling program in addition to a 2.5 km buffer) using the NRETAS sampling design.
- ▶ Present a baseline fauna survey of the study area, identifying fauna species of national conservation significance present, or potentially present in the project area and which may be affected by the project.
- ▶ Provide a report detailing relationships among the faunas of the vegetation types and the roles of habitat variables in determining patterns of abundance and species richness.
- ▶ Address applicable legislation, policies and guidelines and provide recommendations for ABM.

Commonwealth and Northern Territory legislation relevant to the area's biodiversity and environmental impacts assessment and management are listed in Appendix G.

3.3 Study Area

The study area encompasses the drilling program focus area of Old Pirate for 2012 with a 2.5 km buffer (Figure 3-1).

The site is located approximately 625 km north-west of Alice Springs and 267 km south-east of Halls Creek. It is accessed via the Tanami Road from Alice Springs or Halls Creek.

The study area is in the Tanami bioregion which is characterised by Baker *et al.* (2005) as:

- ▶ Occurring entirely in the Northern Territory, encompassing an area of 258,224 km².
- ▶ Being comprised of red Quarternary sandplains overlying Permian and Proterozoic strata, which are exposed locally as hills and ranges.
- ▶ Having sandplains supporting mixed shrub steppes of *Hakea suburea*, desert bloodwoods, acacias and grevilleas over *Triodia pungens* hummock grasslands. Acacia shrublands over hummock grass

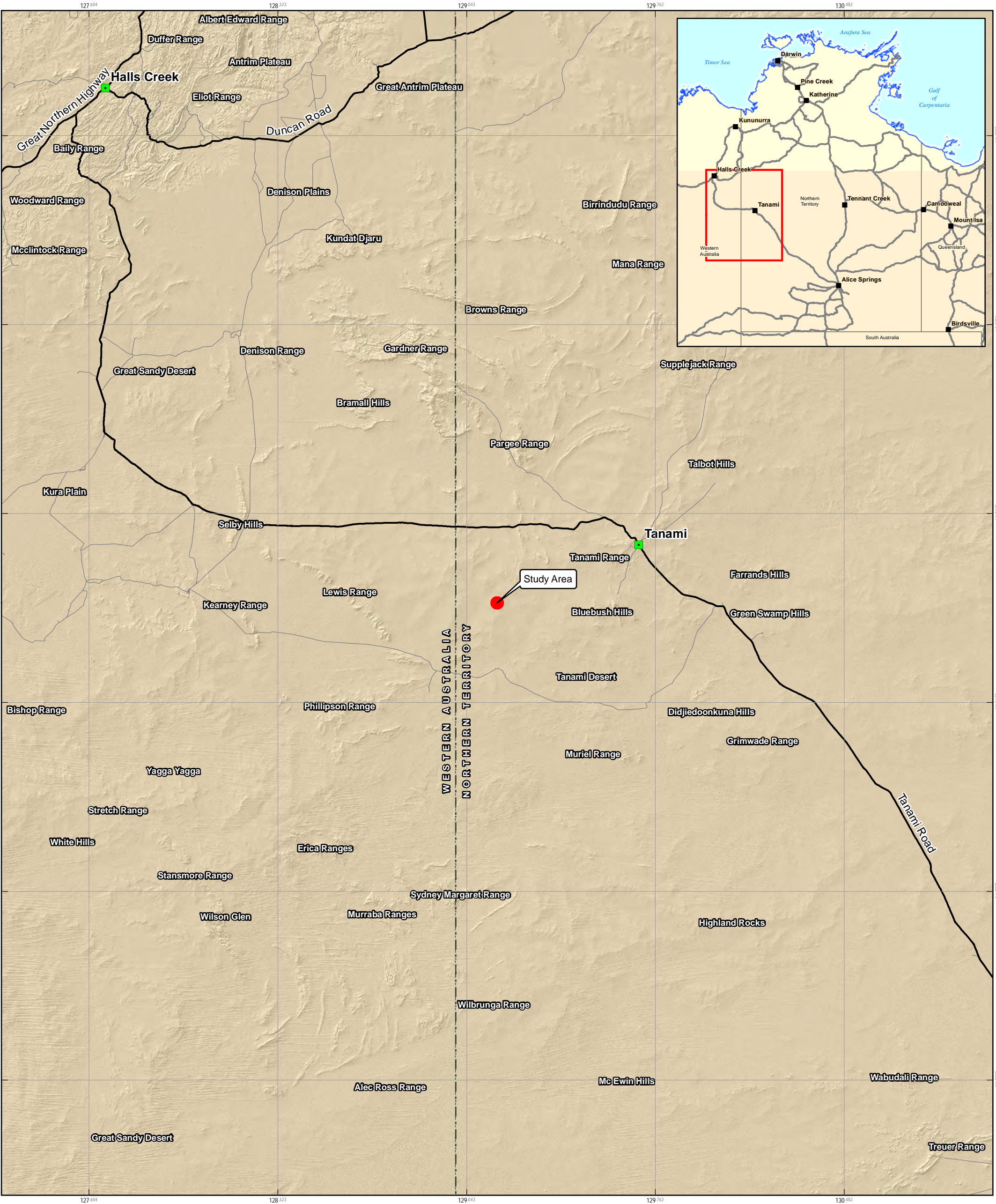


communities occur on the ranges. The Stuart Creek drainage in the north supports *Chrysopogon* spp. and *Iseilema* spp. short grasslands, often as savannah ecosystems in association with river gum (*Eucalyptus* sp.).

- ▶ Having a climate that is arid tropical with summer rainfall.
- ▶ Exhibiting relatively frequent fires, occurring at an average rate of once every two to three years across a mosaic of habitats.

3.4 Climate

The climate in the Tanami Desert is arid tropical with summer rainfall. The mean annual rainfall at Rabbit Flat (closest weather station to site) is 426.9 mm with the majority falling in December through till March (BOM 2012b). The mean annual minimum and maximum temperatures are 16.4 °C and 33.6 °C respectively with the hottest month being December where average minimum and maximum temperatures are 23.3 °C and 39.2 °C respectively. The coolest month is July where average minimum and maximum temperatures are 6.6 °C and 25.9 °C respectively.



LEGEND

Towns

Study Area

Major Roads

Local Roads

020406080

Kilometres

Map Projection: Universal Transverse Mercator

Horizontal Datum: Geocentric Datum of Australia

Grid: Map Grid of Australia 1994, Zone 53

ABM Resources NL

Old Pirate Flora and Fauna

Job Number

Revision

Date

43-21899

0

31 May 2012

Study Area

Figure 3-1

G:\43\21899\GIS\Maps\4321899_01.mxd

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Data source: Navteq - Roads, Towns, Administrative Boundaries, Oceans (2011). ESRI - STRM (2009). GA - Place Names (2008). GHD - Study Area (2012). Created by: CM



4. Method

4.1 Flora and Vegetation Assessment

4.1.1 Background

Tasks involved in the preparation the flora and vegetation assessment included:

- ▶ Literature review of existing studies for the study area.
- ▶ Database searches to identify threatened flora and ecological communities, and essential habitats recorded or predicted to occur in the area.
- ▶ Flora field surveys including habitat assessment.
- ▶ Targeted threatened species survey.
- ▶ Compilation of flora species lists for the study area.
- ▶ Mapping and description of the vegetation types occurring in the study area.
- ▶ Assessment of the likelihood of occurrence of threatened flora species listed under the TPWC Act and/or the EPBC Act.

4.1.2 Desktop Assessment

A desktop literature and database review was undertaken to identify threatened flora species and ecological communities listed under the TPWC Act and the EPBC Act that may occur in the area. Results of the searches provide an overview of previous records, known distributional ranges and habitats types, and are used to provide an overview of species known or predicted to occur in the study area. The following databases were reviewed prior to conducting the field investigations:

- ▶ The NT Herbarium Database.
- ▶ Commonwealth Department of Sustainability, Environment, Water, Population and Communities website search program, the Protected Matters Search Tool (PMST), was used to identify Matters of National Environmental Significance (*Environment Protection and Biodiversity Conservation Act 1999*) potentially occurring in the locality (including 10 km radius buffer).
- ▶ NT land systems/vegetation mapping.

The area and the majority of all exploration leases owned by ABM are dominated by level to undulating sand plains with red sands (the Coolindie and Singleton land systems). Small areas of a few of the leases include minority areas of:

- ▶ Stony plateaux, tablelands and hills on sandstone, quartzite, siltstone and conglomerate (deeply weathered in places); outcrop with shallow stony soils (Atlas_B5 land system).
- ▶ Salt pans with waterlogged saline clays and fringing (Atlas_SV10 land system).
- ▶ Plateaux, plains and rises on sandstone, claystone, shale and limestone; outcrop with shallow stony soils (Winnecke land system).

A preliminary vegetation map was created based on recurring patterns observed on the aerial image of the study area.



4.1.3 Field Survey

Two GHD botanists conducted a survey of the study area during 11-16 April 2012. The survey was in accordance with NT Guidelines and Field Methodology for Vegetation Survey and Sampling (Brocklehurst *et al.* 2007).

The field assessments were to:

- ▶ Collect data from 20 m x 20 m quadrats, including an inventory of all flora species present and the structural characteristics of the preliminary vegetation types and representative vegetation types observed in the field. Data were collected from twelve quadrats (Figure 4-1).
- ▶ Create a vegetation map of the study area.
- ▶ Determine the presence of individuals or suitable habitat for threatened flora.
- ▶ Map the distribution of introduced flora across the lease areas.

A Trimble Nomad GPS unit was used to record spatial locations.

Vegetation Mapping

A classification of vegetation 'types' was based on groups of characteristic species (Brocklehurst *et al.* 2007). Structural attributes were assigned to the groups to produce a structural vegetation type classification.

Vegetation types were described according to the National Vegetation Information System, Level V: Association (NVIS; Brocklehurst *et al.* 2007). The NVIS description identifies the following characteristics of a community:

- ▶ Landform/lithology.
- ▶ Dominant stratum (layer).
- ▶ Dominant species.
- ▶ Average height and height range.
- ▶ Cover (percentage canopy cover for upper layers (trees and shrubs) and percentage cover for ground vegetation).
- ▶ Growth form (e.g. tree, shrub, tussock grass, Brocklehurst *et al.* 2007).

Mapping of vegetation communities was undertaken by visually interpreting an aerial image.

Quadrat floristic cover abundance data were standardised (absolute cover scores grouped into seven categories) and analysed using the Bray Curtis classification in PATN statistical software. This method grouped quadrats based on their floristic characteristics. These groupings were combined with field observation of structural characteristics and qualitative data on vegetation surrounding the quadrats to determine the vegetation types present. Each grouping was assigned a name which best described all representative quadrats of the group and qualitative data collected in field notes.

The *NT Parks and Conservation Masterplan* (Baker *et al.* 2005) describes vegetation types in each bioregion of the NT, how much area they cover and what proportion is reserved. The vegetation types of the study area were compared to *NT Parks and Conservation Masterplan* vegetation types to determine which vegetation type in the plan best describes the vegetation of the study area.



4.1.4 Nomenclature

Identifications of flora were made in the field using CSIRO (2006), Jessop (1981), Latz (1995), Maslin (2001), Moore (2005), Sharp and Simon (2001), Wheeler (1992) and Woinarski *et al.* (2007). The nomenclature applied is consistent with the Northern Territory Flora Checklist (Short *et al.* 2011), the NT Southern Region Flora Checklist (Albrecht *et al.* 2007) and the Mabberley update to family nomenclature adopted by the NT Herbarium. In some cases the most current plant species names are unpublished and were provided by D. Albrecht and P. Latz (*pers. comm.*). Species of flora were identified to species level where possible. The absence of certain diagnostic features (this is a function of the seasonal cycles of flora species) prevented identification of some plants to species level. They were identified to genus level. Samples of taxa where positive identification was not possible in the field were identified in the Alice Springs Herbarium with the assistance of P. Latz.

4.1.5 Limitations

Mapping

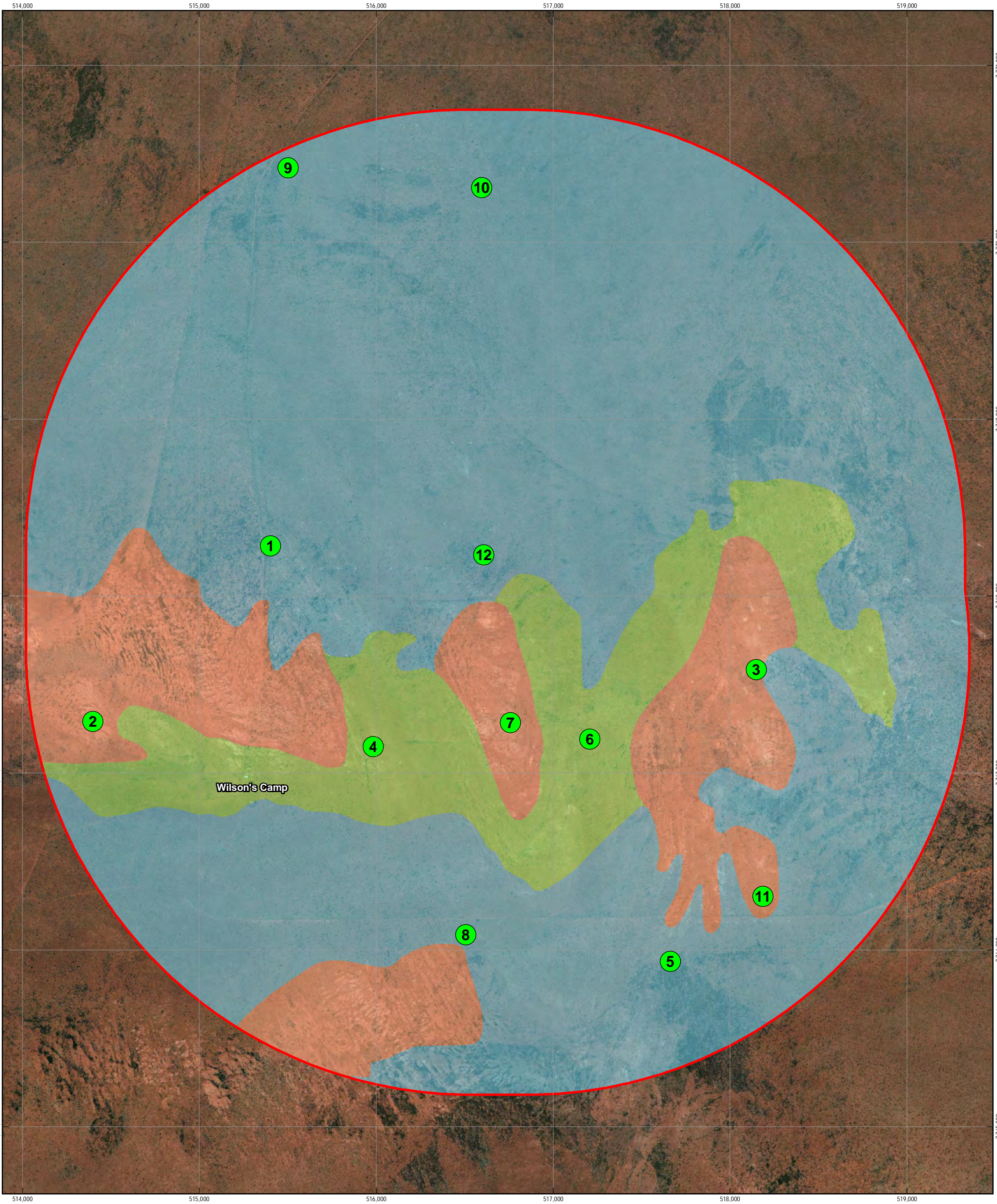
A subset of the study area was ground-truthed during the field survey. The extent of vegetation communities was mapped by interpretation of aerial imagery. The scope of the assessment did not allow for detailed validation of the spatial or attribute accuracy of the vegetation and weed maps.

Flowering Seasonality

Field surveys were conducted during 11-16 April 2012. The results represent the flora that were fertile at the time of survey. This survey will not have identified all the ephemeral species that might be present on the site in stored energy (either in the soil seed bank or present as underground tubers). Some species were not identified to species level due to an absence of flowering material.

General

Mapping of quadrat locations using handheld GPS was accurate to c. ± 10 metres. Locations of the quadrats may be inaccurate to this extent.



LEGEND

Study Area

Flora Quadrats

Vegetation Types

1

2

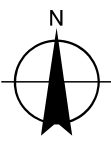
3

02505007501,000

Metres

Paper Size A3

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53



ABM Resources NL	Job Number	43-21899
Old Pirate Flora and Fauna	Revision	0
	Date	31 May 2012

Flora Survey Sites
and Vegetation Types

Figure 4-1



4.2 Fauna Assessment

4.2.1 Desktop Assessment

A desktop literature and database review was undertaken to identify threatened fauna species and ecological communities listed under the TPWC Act and the EPBC Act that may occur in the study area. Results of the searches provide an overview of previous records, known distributional ranges and habitats types, and were used to provide an overview of species known or predicted to occur in the study area. The following databases were reviewed using a 10 km buffer around the whole of ABM's Tanami tenements prior to conducting the field investigations:

- ▶ The Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) website search program, the Protected Matters Search Tool (PMST), was used to identify MNES potentially occurring in the study area. The PMST only considers flora and fauna species listed in one or more provisions of the EPBC Act, and is based on the predicted distributions of flora and fauna species and/or their habitat, rather than known records.
- ▶ The Department of Natural Resources, Environment, the Arts and Sport (NRETAS) Fauna Atlas database records (not predictions) from the study area.

4.2.2 Field Survey

Five GHD ecologists conducted baseline fauna surveys of Old Pirate over a period of six days and five nights (11 April to 16 April 2012). The surveys were conducted in accordance with a permit to disturb wildlife under the Territory Parks and Wildlife Conservation Act (Permit number 40623, expiry date 30th April 2014).

Selection of Survey Sites

Vegetation maps produced by GHD botanists were used to select nine fauna survey sites consisting of three sites per vegetation community present. These are discussed in section 5.1.2 (Figure 4-2). Photos of survey sites can be found in Appendix C.

Survey Techniques

Survey methods followed the Northern Territory Parks and Wildlife Commission's "Survey methods used for fauna and flora on standard Biodiversity Unit survey sites". Surveys at each site were based on a 50 m x 50 m quadrat.

1. **Baited Elliot-type traps** – Twenty Elliot-type box traps (size A) were placed approximately 8 m apart along the perimeter of the quadrat boundary at each site. Traps were placed in a suitable microhabitat (e.g. with suitable cover and shade) and marked with a labelled piece of flagging tape attached to a nearby tree or shrub to assist with finding traps twice daily. Traps were baited with a suitably moist mixture of rolled-oats, honey and peanut butter (widely used recipe for attracting mammals). Traps remained open for three days and three nights. Traps were checked once each morning and once each mid-late afternoon.
2. **Baited cage traps** – One cage trap was placed at each corner of the quadrat boundary at each site (four cage traps per site). Traps were placed in suitable microhabitats and covered with a hessian

sack for shade. Each trap was individually marked with a labelled piece of flagging tape attached to a nearby tree or shrub to assist with finding traps twice daily. Traps were baited with a suitably moist mixture of rolled-oats, honey and peanut butter. Traps remained open for three days and three nights. Traps were checked once each morning and once each mid-late afternoon.

3. **Pitfall traplines** – Four pitfall traplines were established in the quadrat at each site. Each pitfall trap comprised a single 20-litre bucket dug into the ground such that its lip was flush with ground-level, and bisected by a fly-wire ‘drift fence’ (10 m long and 30 cm high) to direct animals into pits. One funnel trap was placed at each end of the fence with the fence ending in the middle of one end of the funnel. Each bucket was supplied with 3 cm of soil, a damp sponge, a piece of bark and some leaf litter to provide protection for animals whilst in the trap. Traps remained open for three days and three nights. Pits were scattered through the different microhabitats in the quadrat (e.g. in open ground; in dense grass; close to trees). Traps were checked once each morning and once each mid-late afternoon. Pitfall traps were not used at site 7 due to the rocky nature of the site. Instead additional funnel traps (see below) were used at this site.
4. **Funnel traplines** - Two funnel traplines were established in the quadrat at each site. Each funnel trapline consisted of a fly-wire ‘drift fence’ (10 m long and 30 cm high) to direct animals into funnel traps. Two funnel traps were placed mid-way along the fence and on each side of the fence and one funnel trap was placed at each end of the fence with the fence ending in the middle of one end of the funnel. Each funnel trap was covered with grass and bark to protect and shade animals while in the trap. Traps remained open for three days and three nights. Funnel lines were placed in different microhabitats in the quadrat (e.g. in open ground; in dense grass; close to trees; in rocky areas). Traps were checked once each morning and once each mid-late afternoon.
5. **Anabat® bat call detection** – An Anabat® bat call detection unit was used at survey sites to collect the high frequency calls of micro-chiropteran bats flying in the vicinity of the microphone. Anabat® units were deployed for one night at each site (except Site 6), and placed in an open area (i.e., devoid of nearby vegetation to avoid interference and non-bat noise) with the microphone oriented upwards at 45°. Recordings were downloaded and referred to a bat specialist for analysis.
6. **Bird surveys (including instantaneous bird count)** – Bird survey counts involved one zoologist compiling a complete list of all birds seen, heard or otherwise detected in the vicinity of the survey quadrat. GHD ecologists incorporated the standard NT ‘instantaneous’ bird count method from a single point, but then increased the survey effort by moving gradually around the 50 m x 50 m quadrat area (also covering a width of around 25 m on all sides of the transect) to survey a one hectare area (approximately) over a time period ranging from 15 minutes to 20 minutes. Notes were kept on whether birds were in or outside the quadrat, and whether species were detected during the ‘instantaneous’ count or during the period that followed. Where possible, numbers of individuals were noted, along with any detected breeding activity, unusual habitat use or other specific interactions (e.g. potential predation). The surveys were mostly completed early in the morning (within two hours of sunrise) and in the late afternoon when birds were most active (i.e. not during the heat of the day). At least five bird surveys were conducted at each site.
7. **Active search** – Each active search involved two zoologists thoroughly searching for the presence or signs of animals in a quadrat for a period of at least 15 minutes. One active search was conducted during the day at each site. Active searching is generally useful for detecting cryptic ground and tree-dwelling fauna, particularly reptiles. The ground, rock and tree surfaces were scanned, and under surfaces of rocks, logs, bark, clumps of vegetation and other debris examined for reptiles and

other animals. All vertebrate fauna detected were noted. Where possible, reptiles were captured or photographed for identification. Some species were identifiable without the need for capture. Indirect evidence of fauna species was documented or collected for later identification (i.e. tracks, scats, bones, sloughed skin and hair samples).

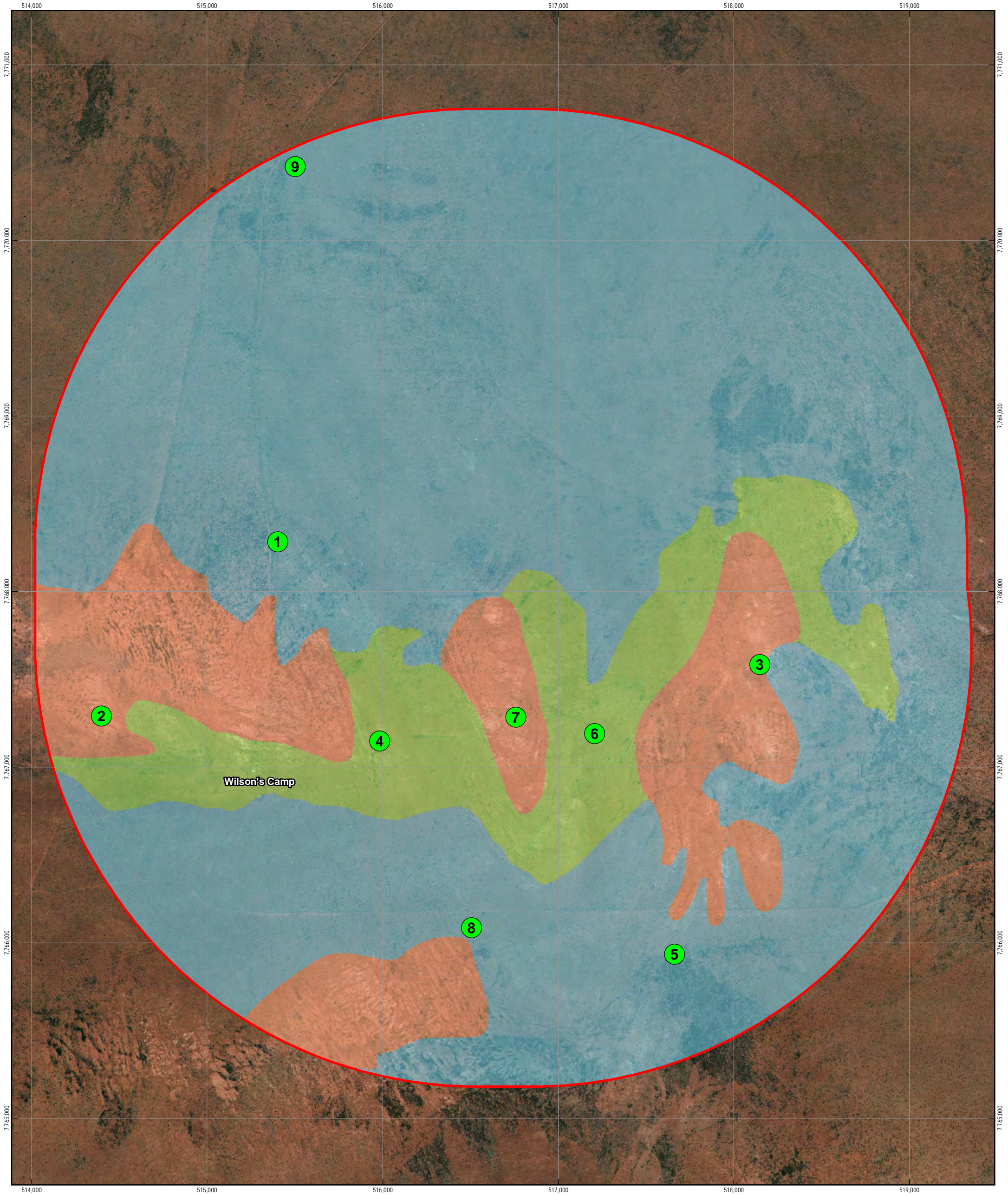
8. **Nocturnal survey** – One nocturnal survey was conducted at each site by two or three ecologists for at least 20 minutes, using head torches to identify fauna species. All vertebrate fauna detected were noted. One driven nocturnal survey was conducted along the main track from ‘Wilson’s Camp’ to the Tanami Road for approximately 15 km driving at approximately 15 km/h.
9. **Scat / hair / bone / skin analysis** – Hair, bones, sloughs (shed reptile skin), scats (animal faeces) and pellets (e.g. regurgitated material from owls) can be used to determine the presence of an animal at a site or in a nearby area. Scats and pellets can be used to identify the animals that produced them as well as the animals that were eaten. Scats, hair, bones, skins seen at sites were noted, and where possible, the species responsible for the signs were determined immediately.
10. **Opportunistic observations** – Opportunistic observations of fauna across the entire study area were documented, whether or not the observations were made at the nine fauna survey sites. These observations involved single or multiple species recorded from a single location, or over a small area, on any day or night. Where possible, numbers of individuals of each species were noted, along with other relevant details (e.g. breeding activity, habitat type, location, unusual habitat use).

Table 1 Summary of fauna survey effort during baseline surveys of the project area.


Survey Type	Survey Effort
Baited Elliot-type traps	20 baited Elliot traps (type A) per site, checked twice daily for three days and nights. 540 trap-nights in total; 60 trap-nights per site.
Baited cage traps	Four baited cage traps per site, checked twice daily for three days and nights. 108 trap-nights in total; 12 trap-nights per site.
Pitfall traplines	Four 10 m pitfall traplines (each with one bucket and two funnels) per site, checked twice daily for three days and nights. 324 trap-nights in total; 36 trap-nights per site.
Funnel traplines	Two 10 m traplines (each with four funnel traps) per site, checked twice daily for three days and nights. 216 trap-nights in total; 24 trap-nights per site.
Anabat® bat call detection	One survey-night at each site, except Site 6; 8 survey-nights in total.
Bird surveys	At least five 20-minute (or more) diurnal surveys at each site, incorporating ‘instantaneous bird counts’. 48 bird counts in total.
Active search	One 20-minute diurnal search by one or more ecologists. Minimum of 3 person-hours active searching in total.




Survey Type	Survey Effort
Nocturnal survey	One 20-minute (or more) nocturnal search by two or three ecologists at each site; and One one-hour driven transect along the main access track by five ecologists. Minimum of eleven person-hours active searching in total.
Scat / hair / bone / skin analysis	Assessed / Collected opportunistically.
Opportunistic observations	Five ecologists over the entire survey period, including two 12-hour days during set-up. Total survey effort: > 265 hours.





LEGEND


 Fauna Quadrats

 Study Area

Vegetation Types

 1

 2

 3

Paper Size A3

0

250

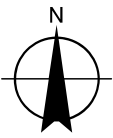
500

750

1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53



ABM Resources NL
Old Pirate Flora and Fauna

Job Number 43-21899
Revision 0
Date 31 May 2012

Fauna Survey Sites
and Vegetation Types

Figure 4-2



4.2.3 Nomenclature

Common and scientific names for birds follow Christidis and Boles (2007). The NRETAS fauna database was used for the nomenclature of mammals, reptiles and frogs.

4.2.4 Statistical analysis

Multiple linear regression was used to investigate which habitat characteristics had the strongest relationship with fauna species richness (all species) at sites. Characteristics were entered into the model using the forward stepwise method. Using this method, the data are examined to identify the habitat characteristic that has the greatest influence on the dependent variable (fauna species richness, in this case), then the next most influential characteristic is determined, then the next, and so on until addition of further characteristics has no bearing on the outcome of the model. The model is run and results produced after each step.

Ten habitat characteristics were included in the analysis: Period since fire (years), proportional cover of litter (%), proportional cover of bare ground (%), proportional cover of crust (%), proportional cover of exposed rocks (%), proportional cover of gravel (%), proportional cover of vegetation taller than 3 m (%), proportional cover of vegetation 1 to 3 m tall (%), proportional cover of vegetation 0.5 to 1.0 m tall (%), and canopy height (m).

Other variables were measured, but many turned out to be common across sites (e.g., distance to nearest water) or relevant to small numbers of sites (e.g., evidence of disturbance), so were excluded in an effort to simplify the analysis.

All proportional data (i.e., percentages) were arcsine transformed before being used for analysis.

Regression models were run in SPSS Inc (PASW Statistics Version 18.0.0).

4.2.5 Limitations and Assumptions

Use of the Protected Matters Search Tool (PMST)

The PMST is a predictive system. It produces lists of species, communities and other MNES that are likely to or may occur in a defined search area, or for which there may be potentially suitable habitat in the defined search area. It does not represent known records.

Use of the NRETAS Database

The NRETAS database is based on information recorded from previous surveys. Using the database, results of surveys in a defined geographical area can be searched to produce lists of species known to occur or known to have occurred in the case of extinct species.

The accuracy of this is limited by the quality and quantity of data recorded from the search area, and does not necessarily reflect survey effort, type, or timing.

Non-threatened species have not been mapped, hence distribution and density of fauna locations across the study area has not been assessed. Threatened species records present in the study area have been mapped, both as individual records and numbers of threatened species for each of the vegetation communities.

The records were collected between 1933 and 2005. This expansive time range may not reflect fauna currently occupying the area because of possible extinctions and there being a lack of recent records i.e.



there are no records since 2005. Some species recorded in this time range may no longer inhabit the area, or other species not previously recorded may now be present.

Weather Conditions during Fauna Survey

The daily average maximum temperature during the survey period was 30.8 °C (range 24.2 °C to 34.0 °C) with an overnight average minimum of 15.9 °C (range 11.1 °C to 16.5 °C) (Rabbit Flat Weather Station; Bureau of Meteorology 2012b). Wind strength and direction were highly variable. Rainfall for the months October 2011 through to the end of March 2012 totalled 254.3 mm at Rabbit Flat, 106.6 mm lower than the average 360.9 mm for the same period. The rainfall in the previous twelve months before the survey was 284.5 mm. No rainfall was recorded during the survey period and the weather was generally warm with plentiful sunshine. It is likely that with higher daily maximum temperatures additional species and a higher abundance would have been recorded. No amphibians were observed during the survey. This is likely to be due to the dry conditions.

Fauna Survey Method

The fauna assessment focused on species of terrestrial vertebrate fauna (mammals, birds, reptiles and amphibians). Existing databases and species prediction tools are biased towards vertebrates. The occurrence of terrestrial invertebrates was not assessed.

The standard requirements for fauna surveys in the NT include three days and three nights only for a trapping program (Elliot, cage, pitfall and funnel traps). This short duration for trapping is likely to influence the diversity and abundance of fauna detected. Animals that visit the surveyed area only occasionally are less likely to be detected than animals that live nearby. Rarer or less common animals may be more likely to be detected with additional survey effort.

Mapping

Mapping of quadrat locations using handheld GPS was accurate to c. ± 10 metres. Locations of the fauna survey sites may be inaccurate to this extent.



5. Flora Results

5.1 Desktop Results

The NT Government flora records for the area covering all of ABM's Tanami tenements (plus a 20 km buffer) contain 2431 records of 813 species. A full species list is provided in Appendix A.

These records include one record of a threatened species [dwarf spike rush (*Eleocharis papillosa*)] from the area covering all Tanami tenements (plus a 20 km buffer).

This species is listed as vulnerable under the TPWC Act and the EPBC Act. *Eleocharis papillosa* is a small (<10 cm high), erect perennial sedge. Although perennial the above ground parts of the plant grow only in response to moisture. It is endemic to the NT and known from eight locations in an area measuring 600 km by 560 km. It grows in temporary wetlands with one record from the fringe of an ephemeral riverine waterhole (Woinarski *et al.* 2007).

The NT Government flora records for the area covering all of ABM's Tanami tenements (plus a 20 km buffer) include records of 22 introduced flora species.

5.1.1 Land Systems

Land systems are mapping units that describe areas of similar topography, vegetation and soils at a broad scale (Christian and Stewart 1953). The Land Systems of the Ord-Victoria report (1970) identified the land system of the study area as the Coolindie land system characterised by level to undulating sandplains with red sands (Stewart *et al.* 1970). The land systems mapping is broad scale and this description broadly described the environments of the study area.

5.1.2 Vegetation Types

The available vegetation mapping covering the site is 1:1,000,000 scale mapping of the NT (mapped at NVIS Level IV: Sub-Formation allows for description of one dominant genus for each stratum).

Description of this vegetation type and occurrence is taken from the NT Government database (GHD 2012). This product identifies the vegetation of the site as: Eucalyptus low isolated trees\Acacia tall sparse shrubland\Triodia low open hummock grassland. An alternative description is *Eucalypts and acacias over spinifex on sand*. This vegetation type occurs on red siliceous sandy soils throughout the Tanami Desert.

A preliminary vegetation map was created based on recurring patterns observed on the aerial image of the study area. Five preliminary vegetation types were identified.

5.2 Regional Context

The study area is not in the South-west Tanami Desert Site of Conservation Significance whose western extent reaches approximately 5 km east of the study area (NRETA 2007).

5.3 Vegetation Types

The five preliminary vegetation types were found to describe a level of complexity in the vegetation that was not observed in the field. Field observation refined the vegetation types to three.



The results of the PATN analysis grouped quadrats with similar floristic characteristics and is represented in a dendrogram and an ordination. These are attached in Appendix B. This was used to support the grouping of quadrats based on qualitative observations in the field.

The vegetation types of the study area are described to NVIS Level V: Association as:

Vegetation Type 1: Rocky outcropping

This vegetation type is a *Triodia schinzii* grassland with scattered *Eucalyptus brevifolia*. The grass density is sparse and there is a very sparse (almost non-existent) shrub layer. There is a very high presence of quartz gravel and very skeletal soil. This vegetation type generally occurs on the tops of the low rises on outcropping in the study area.

NVIS Level V Classification - U ^*Eucalyptus brevifolia*^tree\6\r; M ^*Acacia acradenia*, *Senna sericea*, *Acacia sp. Urandangi*^shrub\2\r; G+ ^*Triodia intermedia*, *Triodia schinzii*^hummock grass\2\i

Plain English Classification - Mid open *Triodia intermedia* and *T. schinzii* hummock grassland with *Eucalyptus brevifolia* low open woodland with low sparse *Acacia acradenia*, *Senna sericea* and *A. sp. Urandangi* shrubland

Vegetation Type 2: Gravelly Spinifex Grassland with Acacia Shrubland

This vegetation type is a *Triodia sp.* grassland with scattered *Eucalyptus brevifolia* on gravelly, clayey sand soil. A notable element of this vegetation type is the presence of a low shrubland dominated by *Acacia minutifolia* with some *Acacia adoxa* var. *adoxa*. It generally occurs lower down the slope from VT 5 as the soils become slightly deeper.

NVIS Level V Classification - M ^*Acacia minutifolia*, *Acacia adoxa* var. *adoxa*, *Senna sericea*^shrub\2\i; G+ ^*Triodia basedowii*, *T. intermedia*^hummock grass, tussock grass\2\i

Plain English Classification - *Triodia basedowii* and *T. intermedia* mid open hummock grassland with *Acacia minutifolia* and *A. adoxa* var. *adoxa* low open shrubland

Vegetation Type 3: Grassland with Sparse Woodland

This vegetation type is a grassland with scattered *Eucalyptus/Corymbia spp.* The grass density is higher and the soil is deeper than vegetation types 1 and 2. Gravel presence is lower than vegetation types 1 and 2. A feature of this vegetation type is the groves of broadleaf acacia shrubs that form dense shrublands. This is likely to be a function of variable fire regimes.

This vegetation type has two forms that are structurally similar with different soil types resulting in different dominant trees.

Vegetation Type 3: northern form

The form to the north of the study area grows on deep sandy soils (<1.5 m deep) and is dominated by *Aristida* grasses and sparse *Corymbia candida*. It is likely the *Aristida* grasses recolonise more rapidly than *spinifex* following fire. *Aristida* dominance gives way to *spinifex* dominance as time since last fire increases.

NVIS Level V Classification - U ^*Corymbia candida*^tree\6\r; G+ ^*Aristida holathera*, *Triodia schinzii*, *T. intermedia*^hummock grass, ^tussock grass\1\i

Plain English Classification - *Aristida holathera*, *Triodia schinzii* and *T. intermedia* low open tussock/hummock grassland with *Corymbia candida* low open woodland



Vegetation Type 3: southern form

The form in the south of the study area grows on slightly gravelly clayey sand soils and is dominated by spinifex grasses and sparse *Eucalyptus brevifolia* and *E. gametophylla*.

NVIS Level V Classification - U ^*Eucalyptus brevifolia*, *E. gametophylla*^tree\6\r; M ^*Acacia lysiphloia*^shrub\3\r; G+ ^*Triodia basedowii*, *Triodia intermedia*^hummock grass\2\i

Plain English Classification - Mid open *Triodia basedowii* hummock grassland with *Eucalyptus brevifolia* low open woodland with mid sparse *Acacia lysiphloia* shrubland

Vegetation Types in a Regional Context

The broad and fine vegetation types in the *NT Parks and Conservation Masterplan* (Baker *et al.* 2005) which best describe the vegetation of the study area are:

- ▶ Broad vegetation type: (4) Eucalyptus Woodland with Hummock Grass Understorey.
- ▶ Fine vegetation type: 43 – Eucalyptus low open-woodland and/or Acacia sparse-shrubland with *Triodia spicata* (Spike Flower Spinifex), *Triodia pungens* (Soft Spinifex) hummock grassland understorey.

All of the vegetation types mapped in the study area in this investigation would most appropriately be classified into the fine vegetation type 43. There is 18,092 km² of this vegetation in the NT with 7.22% reserved.

5.4 Overall Condition of Vegetation in the Study Area

The vegetation of the study area is primarily influenced by fire as observed during the field survey. Broad-scale fires range across the landscape pushed by prevailing winds. It was estimated that the northern part of the study area had been burnt less than one year prior to the field survey. The centre and southern parts of the study area had possibly been burnt two to three years prior to the field survey. The fires tend to be of a broad scale with few isolated pockets of vegetation avoiding fire in each fire event.

A secondary influence on the vegetation of the study area is land clearing for the exploration program. There is a large clearing in the area known as Wilson's camp in the south west of the study area and tracks and drill pads cleared throughout the study area.

5.5 Flora Diversity

The GHD flora survey identified 135 taxa from 30 families in the 12 flora quadrats and incidental records from the study area. A full species list is provided in Appendix A.

5.6 Terrestrial Noxious and Environmental Weeds

Two exotic flora species were recorded during the April flora surveys: buffel grass (*Pennisetum (Cenchrus) ciliaris*) and purple-top chloris (*Chloris barbata*). These species occur in the cleared and disturbed area known as 'Wilson's Camp' (Figure 5-1).

The NT herbarium has records of an additional 22 introduced flora species for the area covering all of ABM's Tanami tenements (plus a 20 km buffer) area. These species are listed in Table 2.



Table 2 Introduced flora of the study area and surrounds.

Common Name	Scientific Name	Form	NT Status*
-	<i>Cyperus hamulosus</i>	Sedge	?
-	<i>Eragrostis amabilis</i>	Grass	N
-	<i>Portulaca pilosa</i> subsp. <i>indeterminate</i>	Forb	N
Awnless barnyard grass	<i>Echinochloa colona</i>	Grass	PN
Bitter paddy melon	<i>Citrullus colocynthis</i>	Vine	N
Buffel grass	<i>Pennisetum (Cenchrus) ciliaris</i>	Grass	N
Buffel grass	<i>Pennisetum (Cenchrus)</i> <i>pennisetiformis</i>	Grass	PN
Couch grass	<i>Cynodon dactylon</i> var. <i>dactylon</i>	Grass	N
Feathertop Rhodes grass	<i>Chloris virgata</i>	Grass	N
Gallons curse	<i>Pennisetum (Cenchrus) biflorus</i>	Grass	N
Giant pigweed	<i>Trianthema portulacastrum</i>	Forb	N
Hyptis	<i>Hyptis suaveolens</i>	Shrub	B/C
Kapok bush	<i>Aerva javanica</i>	Shrub	N
Hairy finger grass	<i>Digitaria bicornis</i>	Grass	N
Hairy indigo	<i>Indigofera hirsuta</i>	Shrub	N
Indian hedge mustard	<i>Sisymbrium orientale</i>	Forb	N
Malvastrum	<i>Malvastrum americanum</i>	Forb	N



Purple-top chloris	<i>Chloris barbata</i>	Grass	N
Sabi grass	<i>Urochloa mosambicensis</i>	Grass	N
Sheda grass	<i>Dichanthium annulatum</i>	Grass	N
Sicklepod	<i>Senna obtusifolia</i>	Shrub	B/C
Smooth mustard	<i>Sisymbrium erysimoides</i>	Forb	N
Spinyhead sida	<i>Sida acuta</i>	Shrub	B/C
Umbrella sedge	<i>Cyperus involucratus</i>	Sedge	N

*note: Status according to the WM Act, Short *et al.* (2011) and Albrecht *et al.* (2007). All Schedule Class A and B weeds in the NT are also Scheduled as Class C weeds.

A = Schedule Class A Weeds: Reasonable effort must be made to eradicate these weeds.

B = Schedule Class B Weeds: Reasonable attempts must be made to contain the growth and prevent the movement of these plants.

C = Schedule Class C Weeds: Not to be sold or traded in the NT.

N = Naturalised

PN = Possibly naturalised


I = Introduced, not naturalised.


? = Although widely regarded to be introduced to Australia, Southern NT populations appear to be native Albrecht *et al.* (2007).





LEGEND

Introduced Flora

 Buffel grass

 *Chloris barbata*

 Study Area


 Wilson's Camp

01020304050

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N





CLIENTS | PEOPLE | PERFORMANCE

ABM Resources NL
Old Pirate Flora and Fauna

Job Number
Revision
Date

43-21899
0
31 May 2012

Introduced Flora

Figure 5-1



5.7 Threatened or Significant Terrestrial Flora

No threatened species of flora were identified during the survey. No habitat suitable for the region's threatened flora was identified in the study area.

Two flora species (*Acacia abbreviata* and *A. minutifolia*) endemic to the Tanami Desert were identified in the study area. These species were present on the gravelly rises of vegetation types 1 and 2. These species are considered to be locally significant due to their restricted distribution in the north-west Tanami region.

GHD identified two species of regional significance. These have restricted ranges in the NT (NRETA 2007): *Dampiera candidans* (quadrat 10) and *Sclerolaena muelleri* (quadrat 2 and noted as an incidental around the study area).

GHD understands that ABM Resources NL have committed to avoid disturbing individuals of the native walnut (*Owenia reticulata*) as it is of cultural significance to the local Aboriginal people (GHD 2012a). No individuals of this species were identified in the study area.



6. Fauna Results

6.1 Desktop Results

Only four indigenous terrestrial vertebrate fauna species and five individual records had been recorded in the study area and in the 10 km buffer around the study area (based on NRETAS database search). This illustrates the extremely relatively low survey effort in the area in the past.

The NRETAS database contains known records of 281 indigenous species (47 mammals, 162 birds, nine frogs and 63 reptiles) from the Tanami tenements. The PMST predicted that four additional species (three mammals, one bird) excluding migratory and marine species, may occur in the study area. These species are listed in Appendix D. In total, 285 terrestrial vertebrate fauna species are known or predicted to occur in the larger Tanami area and Tanami tenements owned by ABM, including 50 mammals, 163 birds, nine frogs and 63 reptiles. Additional species could be documented with more survey effort at various times of the year and conditions.

Among the 285 species, ten mammal species would have occurred in the study area prior to European colonisation but are now believed to be extinct (seven are extinct nationally and three are extinct in the wild in the Northern Territory).

A total of seven introduced species of mammal have been recorded (100 individual records) in the larger Tanami area and Tanami tenements owned by ABM, and another is predicted to occur there by the PMST (red fox).

There are 4156 individual records (of 281 species, indigenous and introduced) in the NRETAS database for the Tanami area (3328 birds, 455 mammals, 56 frogs, 317 reptiles).

Many of these species could be expected to use one or more of the vegetation types in the area either as residents, occasional visitors for foraging or roosting, fly-overs or vagrants.

The results of the desktop survey are detailed in *GHD's Report for ABM Resources NL EMP and Biodiversity Desktop: Tanami Tenements* (GHD 2012b).

6.2 Regional Context

The study area is not in the South-west Tanami Desert Site of Conservation Significance whose western extent reaches approximately 5 km east of the study area (NRETA 2007).

6.3 Fauna Survey

6.3.1 Overview of results from this survey

The survey of the site resulted in records of 93 fauna species, which included mammals, birds and reptiles (Table 3). No amphibians were detected during the survey.

Five species detected during the survey were new records for this area (i.e., the larger Tanami area and Tanami tenements owned by ABM). These include two native species of mammal (one bat and one rodent) and three native species of reptile (all skinks).

Table 3 Numbers of species (by vertebrate group) detected in the survey undertaken by GHD.

Group	Total
Mammals	20
Birds	49
Reptiles	24
Amphibians	0
Total	93

All species detected during the survey are listed in Appendix D.

A small number of animals captured, observed or detected during the surveys could not be identified to species level. This was because they escaped/fled before identification could be made (e.g., unidentified species of rodent), or species identification was uncertain (e.g., scats of a macropod, calls of some microbats). These records are identified in Appendix D.

6.3.2 Assessment of sampling effectiveness

Assessment of sampling techniques

Each of the sampling techniques resulted in effective sampling of differing taxonomic groups or combinations of groups. For example, pitfall and funnel trapping were particularly successful at detecting reptiles, while the most successful technique for detecting birds was bird surveys (Table 4). In combination, the sampling techniques effectively sampled the fauna as a whole.

Table 4 Success of sampling techniques in detecting species of different taxonomic groups.

Group	Bird surveys	Pits / funnels	Elliot's / cages	Active (daytime)	Active (night)	Anabat	Incidental obs.
Mammals	0	5	6	3	3	7	3
Birds	38	1	0	1	4	-	35
Reptiles	0	19	3	0	4	-	10
Total	38	25	9	4	11	7	48

More than two-thirds of the species were detected by one method alone. Of the 93 species recorded during the survey, 63 were detected by one method alone and 30 were detected by more than one method. Of those detected by one method alone, 25 were detected through incidental observations, 21 were detected during bird surveys, 13 were detected in pits/funnels, seven were detected using Anabat, three were detected in cage or Elliot traps, three were detected during active night searches, and one was detected during active daytime searches.

Accumulation of detected species with time

Survey results exhibited a species accumulation curve through time that was tending towards a plateau, indicating that the majority of species susceptible to the sampling techniques had been detected prior to the conclusion of the survey (Figure 6-1). Approximately 2% of the total number of species detected during the survey period were detected for the first time on the final day of the survey (2 of 93 species).

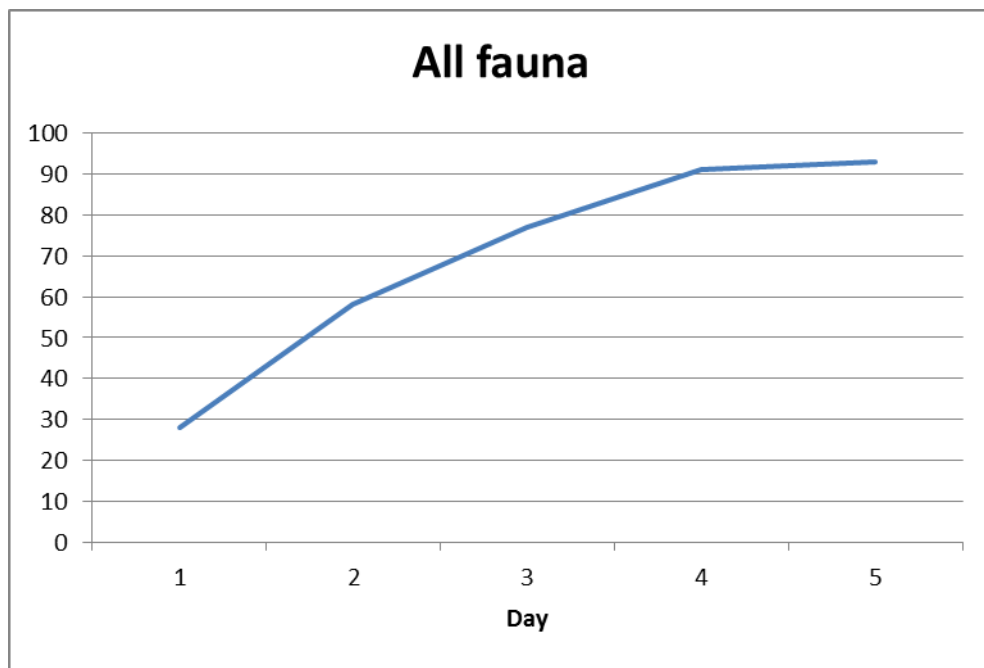


Figure 6-1 Accumulation of species detected through time (day of survey period).

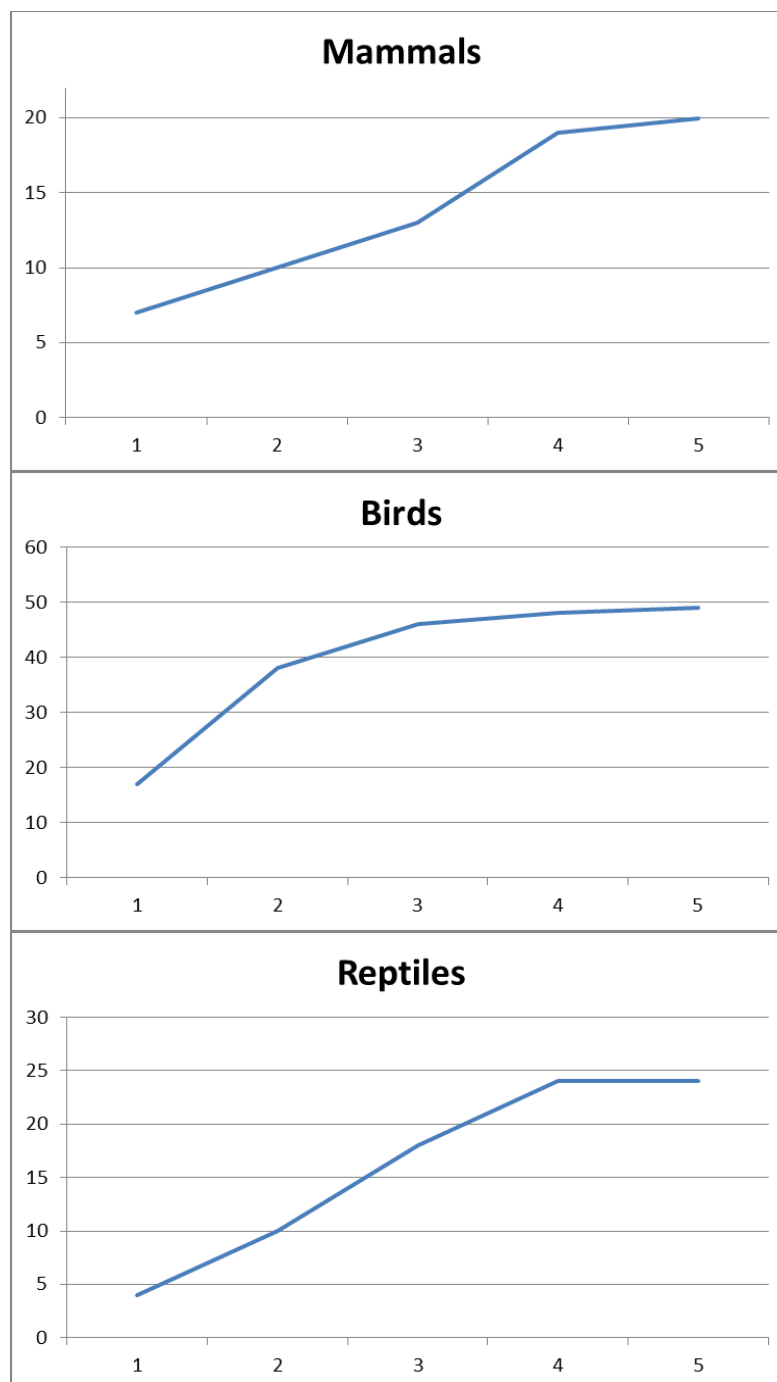


Figure 6-2 Accumulation of species in each taxonomic group detected during the survey.

In all graphs, the vertical axis represents count of species and the horizontal axis represents time in days.

When divided into taxonomic groups, the species accumulation curves varied in their asymptotic pattern (Figure 6-2). The curve for birds showed that the majority of bird species susceptible to the sampling

techniques were detected during the survey. The curves for mammals and reptiles, however, showed less of an asymptotic pattern. The numbers of mammal species recorded continued to rise throughout the survey, with the largest increase in species numbers observed on day 4 (6 of 20 species recorded for the first time that day). The observed accumulation of reptiles was linear until day 4, with no new species recorded on the final day (note, however, that traps were removed on the morning of day 5, giving no opportunity for diurnally active reptiles to encounter traps and be captured on that day).

6.3.3 Fauna diversity and abundance

Mammals

Twenty species of mammal were detected during the survey. This included two species of non-native mammals. A complete list of mammal species recorded during the survey is provided in Appendix D.

The mammals detected comprised the following ecological/morphological/taxonomical sub-groups:

- ▶ Bilby – greater bilby (*Macrotis lagotis*).
- ▶ Bats – Seven species of micro-chiropteran bats (insectivorous bats).
- ▶ Carnivores – three species of large or meso-predators [dingo (*Canis lupus dingo*), cat (*Felis catus*), and brush-tailed mulgara (*Dasymercus blythi*)].
- ▶ Large herbivores – one native and one non-native species [one unidentified macropod, one-humped camel (*Camelus dromedarius*)].
- ▶ Small ground-dwelling mammals – seven species of native rodents and small dasyurids [spinifex hopping-mouse (*Notomys alexis*), desert mouse (*Pseudomys desertor*), sandy inland mouse (*Pseudomys hermannsburgensis*), central pebble-mound mouse (*Pseudomys johnsoni*), western chestnut mouse (*Pseudomys nanus*), stripe-faced dunnart (*Sminthopsis macroura*), and lesser hairy-footed dunnart (*Sminthopsis youngsoni*)].

Bats and small ground-dwelling mammals had the highest species richness (7 species of each), followed by carnivores and then herbivores (Table 5).

Table 5 Diversity and abundance of sub-groups of mammals detected during the survey.

Sub-group	Count of species	Count of individuals
Bilby	1	1
Bats	7	21*
Carnivores	3	9
Herbivores	2	5
Small ground mammals	7	25
Total	20	61

* This number represents one individual for each occasion that a species was detected. Note that Anabat surveys document numbers of calls rather than numbers of individuals.

Other than bats, most large mammals were detected by opportunistic observations (incidental) or active searching (e.g., macropod scat), and most small mammals were detected through the use of Elliot, pitfall and funnel traps.

Two species of mammal detected during the survey are listed as *Vulnerable* under the Commonwealth EPBC Act and as *Vulnerable* under NT legislation (brush-tailed mulgara, greater bilby). Another mammal species detected is listed as Near Threatened under NT legislation (western chestnut mouse).

Eight mammal species (40% of mammals) were recorded once only (greater bilby, northern freetail bat, brush-tailed mulgara, cat, macropod (species unknown), central pebble-mound mouse, sandy inland mouse, and spinifex hopping-mouse). Three species were detected more than five times (inland broad-nosed bat, dingo, desert mouse). The desert mouse was the most recorded mammal (nine records during the survey).

Two mammal species detected during the survey have not been recorded in the area before [northern freetail bat (*Chaerephon jobensis*), and central pebble-mound mouse (*Pseudomys johnsoni*)].

Two non-native mammals were recorded (one-humped camel and cat). The cat is listed as 'invasive' under the EPBC Act.

Birds

In total, 49 species of bird (all native) were detected during the survey. Birds showed the highest species richness of all the taxonomic groups of vertebrate fauna. A complete list of bird species recorded during the survey is provided in Appendix D.

The birds detected were assigned to sub-groups determined on the basis of taxonomy (i.e., related types of birds) and/or ecology (e.g., similar habitat use). The following sub-groups were considered:

- ▶ Grassland birds – large and small species of birds that use grassland habitats predominantly or entirely (e.g., Australian bustard, budgerigar, quail, grasswren, finches, and one fairy-wren);
- ▶ Woodland birds – a large group of species generally associated with treed habitats, including honeyeaters, cuckoo-shrikes, woodswallows, cuckoos, pardalotes, thornbills;
- ▶ Woodland/Grassland birds – a group of generalist species that use grassland and treed habitats, but do not rely solely on either. This group includes: songlarks, doves/pigeons, crows/ravens, one fairy-wren, willie wagtail, and chat;
- ▶ Raptors – birds of prey, including falcons, kites, goshawks, harrier;
- ▶ Night birds –frogmouth and nightjar.

Woodland birds included the most species and were the most abundant in terms of numbers of individuals recorded (Table 6). Grassland birds were the most abundant group if the ratio of species to individuals is considered (overall totals show an average of 9 individuals observed per species of grassland birds, versus 6 individuals per species of woodland birds).

Table 6 Diversity and abundance of sub-groups of birds detected during the survey.

Sub-group	Count of species	Count of individuals
Grassland birds	11	99
Woodland birds	19	114

Sub-group	Count of species	Count of individuals
Woodland/Grassland birds	8	42
Raptors	9	37
Night birds	2	7
Total	49	299

One threatened species and one near-threatened species of bird were detected during the survey: Australian bustard (*Ardeotis australis*) and striated grasswren (*Amytornis striatus*) respectively. The Australian bustard is listed as Vulnerable under NT legislation, while the striated grasswren is listed as Near Threatened.

Ten bird species (20% of birds) were recorded once only. Nine species (18% of birds) were recorded more than 10 times and four species (8% of birds) were recorded more than 20 times each during the survey. The most commonly reported species were budgerigar (*Melopsittacus undulatus*), grey-headed honeyeater (*Lichenostomus keartlandi*), zebra finch (*Taeniopygia guttata*) and diamond dove (*Geopelia cuneata*), with 44, 35, 25 and 21 records respectively. Together, these records make up 42% of all bird observations.

Reptiles

Twenty-four species of reptile (all native) were detected during the survey. A complete list of reptile species is provided in Appendix D.

Reptiles were categorised into the following taxonomical sub-groups: dragons (agamids), geckoes, monitors (varanids), pygopods (legless lizards), skinks and snakes.

Of the sub-groups, skinks were easily the most diverse, with 11 species detected (Table 7). Skinks were also the most abundant group in terms of numbers of individuals recorded (overall total shows an average of 4.9 individuals per species). Geckoes were also relatively common, with an average of 4.0 individuals per species. Snakes and dragons were relatively species poor and uncommon, with three species each and on average only 2.3 and 3.0 individuals per species (respectively).

Eleven reptile species (46% of reptiles) were recorded once only. Three species (12.5% of reptiles) were recorded more than 10 times each and one species was recorded more than 20 times during the survey. The most commonly reported species were the leopard ctenotus (*Ctenotus pantherinus*), northern spiny-tailed gecko (*Strophurus ciliaris*), Tanami ctenotus (*Ctenotus tanamiensis*), and military dragon (*Ctenophorus isolepis*), with 25, 12, 10 and 7 records respectively. Together, these records make up 57% of all reptile observations.

Table 7 Diversity and abundance of sub-groups of reptiles detected during the survey.

Sub-group	Count of species	Count of individuals
Dragons	3	9
Geckoes	4	16
Monitors	2	7

Sub-group	Count of species	Count of individuals
Pygopods	1	1
Skinks	11	54
Snakes	3	7
Total	24	94

No reptile species detected during the survey are listed as threatened or near threatened under Commonwealth or NT legislation.

Three reptile species detected during the survey have not been recorded in the area before [metallic snake-eyed skink (*Cryptoblepharus metallicus*), Pianka's ctenotus (*Ctenotus piankai*), and an unnamed skink (*Proablepharus reginae*)].

6.3.4 Fauna diversity - variation among sites and habitats

Fauna richness varied across the nine sites and across the three vegetation communities. This section identifies the spatial patterns recorded. The combined taxonomic groups are evaluated, then each taxonomic group is evaluated separately to determine which species groups/sub-groups show the greatest variation in species richness across vegetation types.

Sites and vegetation types

Nine sites were sampled for fauna, with three sites in each of the three vegetation types (defined in section 5.3). Sites representing the vegetation types are shown in Table 8.

Table 8 Diversity and abundance of sub-groups of reptiles detected during the survey.

Vegetation type	Description	Sites
1	Rocky outcropping	2, 3, 7
2	Gravelly Spinifex Grassland with Acacia Shrubland	4, 6, 8
3	Grassland with Sparse Woodland	1, 5, 9

All species

Species richness of the fauna varied among sites. Site 1 had the highest diversity of all sites, closely followed by Site 2 (Figure 6-3; upper). Sites 3, 7 and 8 had the lowest diversity of the sites.

When sites were grouped by vegetation type, grassland/woodland had the highest species richness, with approximately 55 species recorded (Figure 6-3; lower). Spinifex grassland and rocky outcrops had lower species richness, with approximately 40 species recorded at each habitat type. All three fauna groups contributed to the high species richness at grassland/woodland sites; in each group, more species were found in the grassland/woodland habitat than in the other habitats.

The species richness of all three faunal groups varied among habitat types. More bird species were found in the woodland habitat (i.e., sites with shrubs and trees) than in the other habitats, fewer mammal

species were found in the spinifex habitat than in the other habitats, and fewer reptile species were found in the rocky outcrops than in the other habitats.

Mammals

The species richness of mammals across the area was moderately low, but mammals were recorded at all sites during the survey (Figure 6-4, upper). The highest mammal species richness recorded at any site was 10 species at Site 2 (Figure 6-4, upper), while the lowest recorded was two species at site 5, although three species were recorded at four other sites (Sites 4, 6, 8, 7).

When sites were grouped by vegetation type, grassland/woodland had the highest species richness of mammals, with 12 species recorded (Figure 6-4, lower). Rocky outcrops had similar species richness (11 species), and spinifex grassland had the lowest, with seven species recorded.

The high mammal species richness in the woodland habitat is due largely to richness of small mammals (five species). The high mammal species richness in the rocky outcrops is due largely to richness of insectivorous bats (five species). No evidence of herbivores (macropods and camel) was recorded at any of the spinifex grassland sites.

Birds

The species richness of birds across the area was low to moderate, and varied among sites. The highest bird species richness recorded at any site was 22 species at Site 1 (Figure 6-5, upper), while the lowest recorded was nine species at Sites 7 and 8.

When sites were grouped by vegetation type, grassland/woodland had the highest species richness of birds, with nearly 30 species recorded (Figure 6-5, lower). Spinifex grassland had intermediate species richness (24 species), and rocky outcrops had the lowest, with approximately 20 species recorded. The high bird species richness in the woodland habitat is due entirely to richness of woodland birds (15 species, versus 6 species at other habitats). All other bird sub-groups had relatively similar species richness across vegetation types.

Reptiles

The species richness of reptiles across the area was generally low, and varied among sites. The highest reptile species richness recorded at any site was 9 species at Site 1 (Figure 6-6, upper), while the lowest recorded was two species recorded at Site 3.

Sites varied in the types of reptiles present. Skinks were the only reptiles recorded at Site 4, while three sites (Sites 1, 5, 2) were represented by five reptile sub-groups (Figure 6-6, upper).

When sites were grouped by vegetation type, grassland/woodland had the highest species richness of reptiles, with 14 species recorded (Figure 6-6, lower). Spinifex grassland had intermediate species richness (12 species), and rocky outcrops had the lowest, with nine reptile species recorded. The high reptile species richness in the woodland habitat is due to diversity of reptile sub-groups (all six sub-groups were recorded in woodland habitats). No snakes were recorded in spinifex grassland sites. One pygopod (legless lizard) was recorded during the survey, in a grassland/woodland site (Site 1).

6.3.5 The relationship between habitat characteristics and fauna species richness

Multiple linear regression showed that fauna species richness (all species) at sites corresponded most strongly with proportional cover of vegetation less than 0.5 m tall. Sites with more cover of low vegetation tended to have higher species richness ($r^2 = 0.480$; $\alpha < 0.05$) (Table 9). Detailed results are



provided in Appendix H (Analysis 1). No other habitat characteristic was identified in that model as having an influence on species richness.

When the regression model was repeated without proportional cover of vegetation less than 0.5 m tall as a variable, the model failed to run indicating that no other variable had a strong relationship with species richness of fauna.

When the vertebrate groups (mammals, birds, reptiles) were investigated separately, species richness of birds corresponded most strongly with proportional cover of litter (Table 9, Appendix H, Analysis 3). Sites with more litter tended to have higher species richness of birds ($r^2 = 0.544$; $\alpha < 0.05$). When the regression model was repeated without litter as a variable, the model failed to run indicating that no other variable had a strong relationship with species richness of birds.

The regression models with forward stepwise entry of variables would not run for mammals or reptiles, indicating that no habitat characteristics corresponded strongly or significantly (using $\alpha < 0.1$) with species richness of those groups. Exploratory efforts (e.g., backward stepwise removal of variables) to determine which of the variables had the greatest influence (albeit non-significant) on richness of those species groups failed to identify any influential characteristics.

Some of the assumptions that accompany linear regression models may have been violated to some degree by the data used. An inherent assumption of multiple regression is that all variables are independent of one another, which is unlikely to be true for our sites. For example, proportional cover of ground layer vegetation is likely to correlate strongly (and inversely) with proportional area of bare ground. Also, areas that have evidence of more recent fire are likely to have lower values of proportional cover of some layers of vegetation. Violation of assumptions may have altered the statistical results to some degree, but is considered unlikely to have altered the patterns found by using the regression analysis.

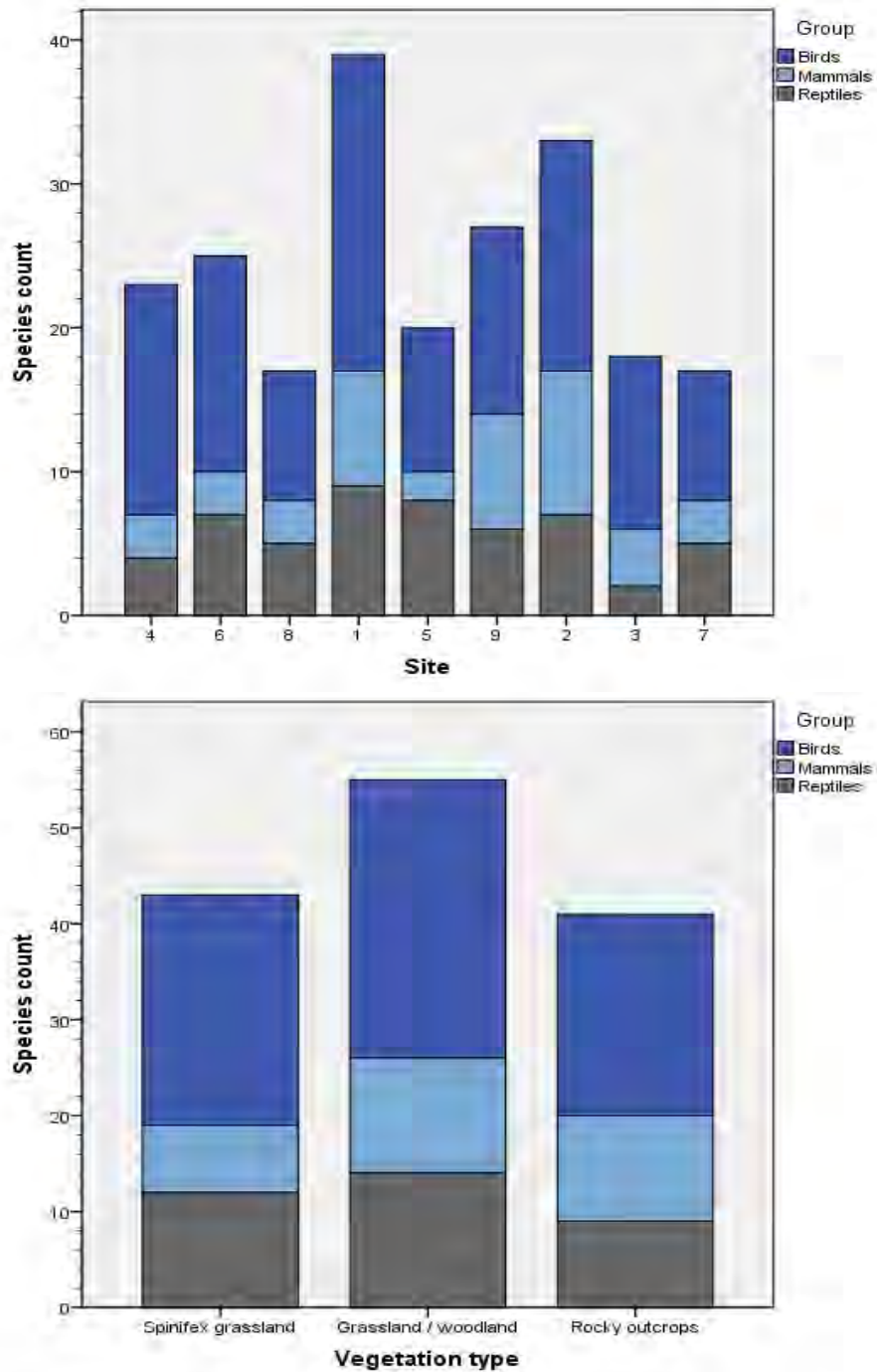


Figure 6-3 Species richness of all fauna recorded at each site (upper) and in each vegetation type (lower).

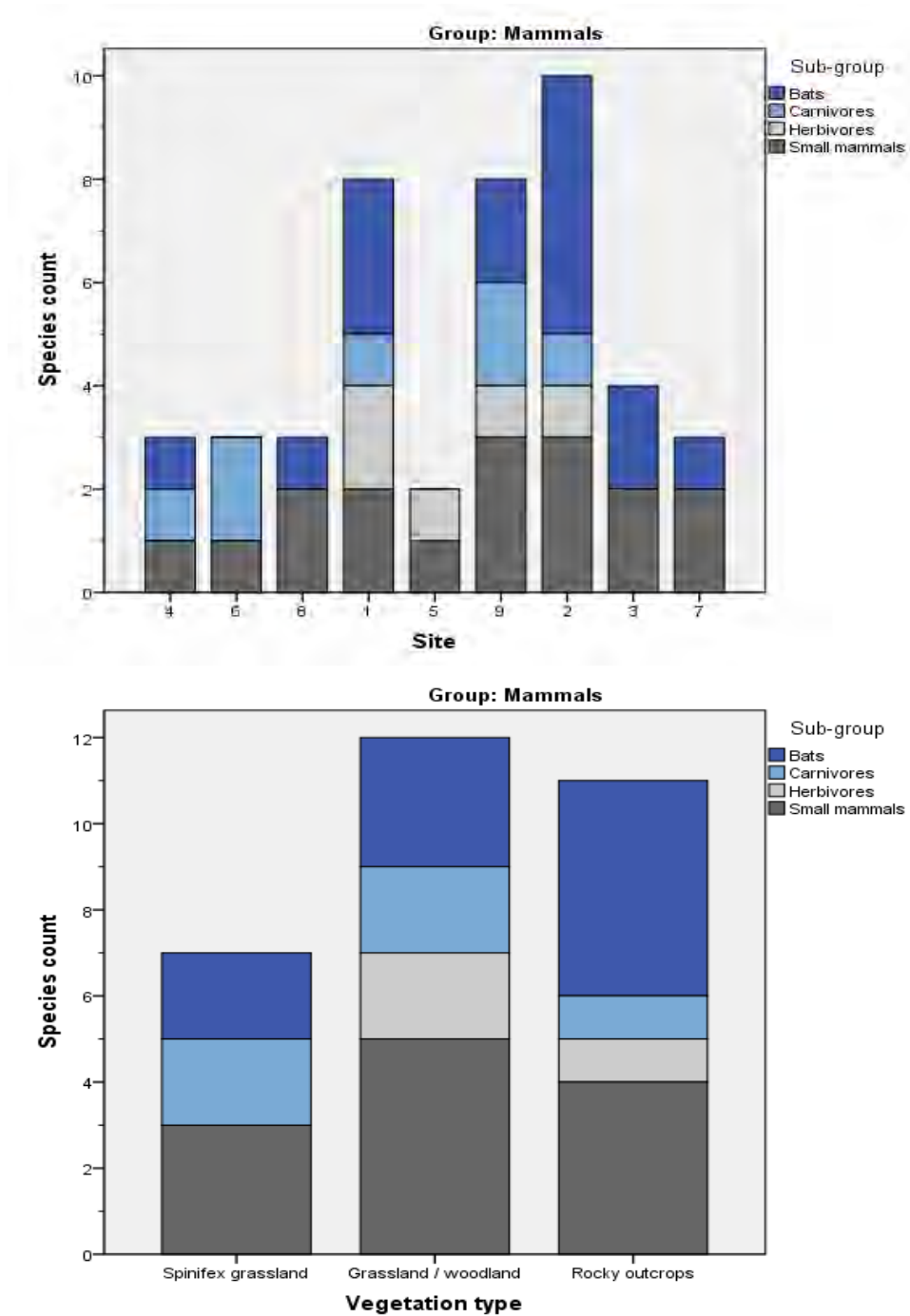


Figure 6-4 Species richness of mammals recorded at each site (upper) and in each vegetation type (lower).

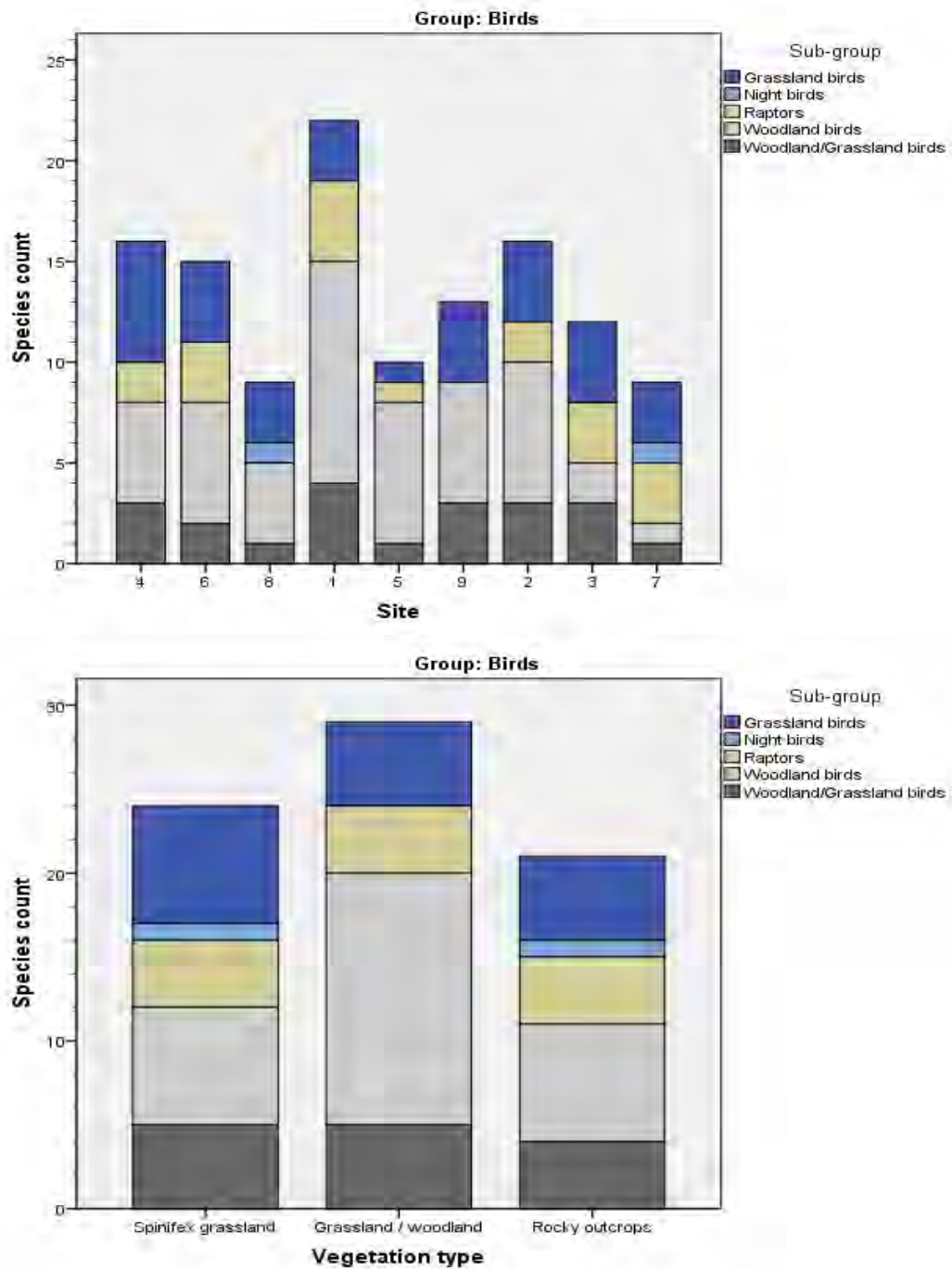


Figure 6-5 Species richness of birds recorded at each site (upper) and in each vegetation type (lower).

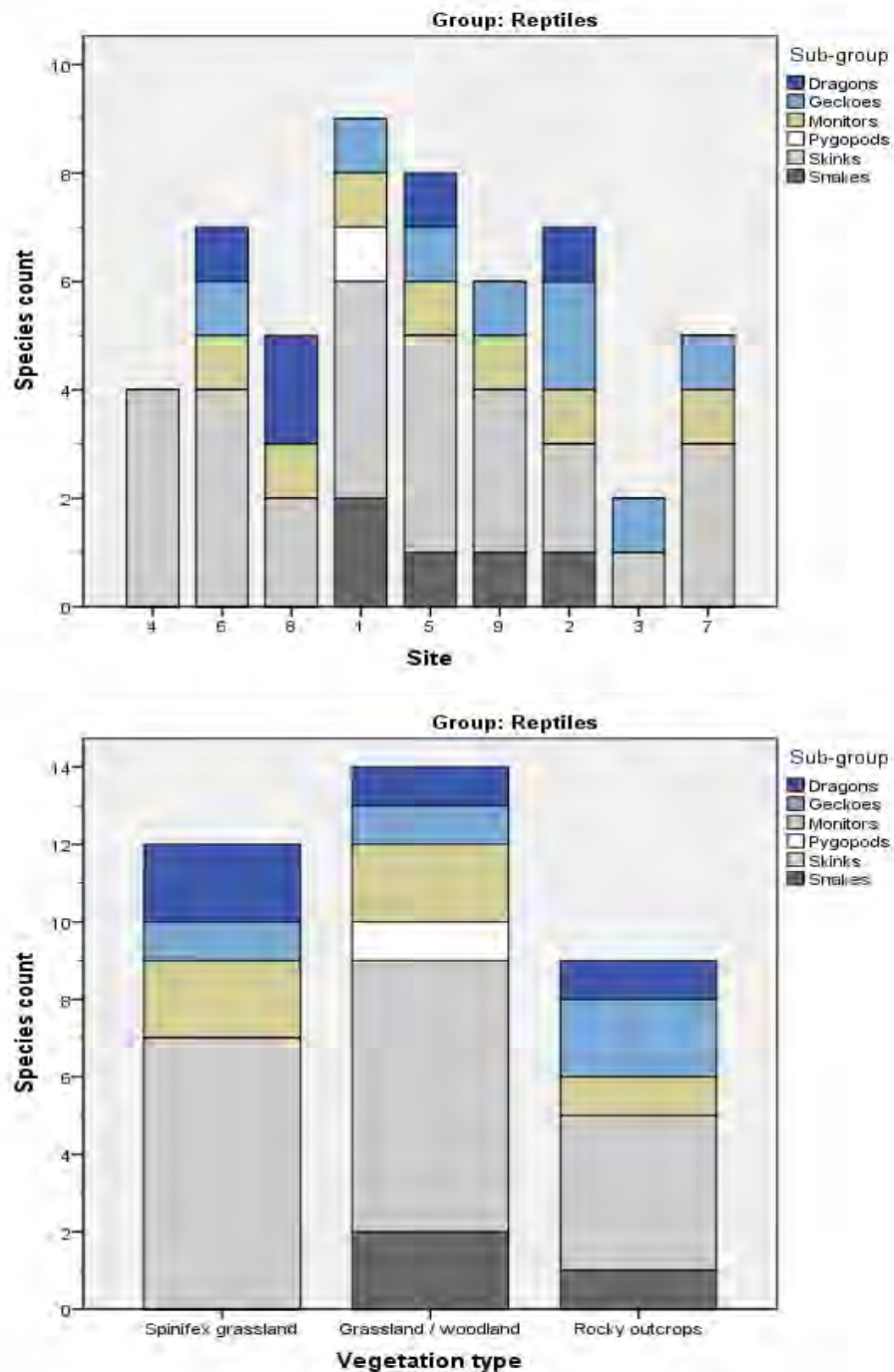


Figure 6-6 Species richness of reptiles recorded at each site (upper) and in each vegetation type (lower).



Table 9 Summarised results of multiple linear regression models investigating relationships between fauna species richness and habitat characteristics at sites.

Model	R Square	Std. Error of the Estimate	Sum of Squares	df	F	Sig.	Strongest predictor/s
All fauna All habitat characteristics, forward stepwise entry of variables (1)	.480	5.808	218.119	1,7	6.467	.038	% vegetation <0.5 m tall
Mammals All habitat characteristics, forward stepwise entry of variables (2)	-	-	-	-	-	> 0.1	None
Birds All habitat characteristics, forward stepwise entry of variables (3)	.544	3.043	77.387	1,7	8.355	.023	% cover of litter
Reptiles All habitat characteristics, forward stepwise entry of variables (4)	-	-	-	-	-	> 0.1	None

6.3.6 Introduced Species

Eight feral fauna species were predicted or known to occur in the survey area. Signs of two feral species were recorded during the April fauna survey. These were the one-humped camel (*Camelus dromedarius*) and cat (*Felis catus*). Camel tracks were observed in four of the fauna survey sites and cat tracks were observed at site 4. There were no signs of cattle, donkey, swamp buffalo, red fox, house mouse or rabbits. A detailed list of the potential introduced species can be found in Appendix F.

6.3.7 Threatened Terrestrial Fauna

Two EPBC listed species were recorded during the fauna survey. These were the greater bilby (*Macrotis lagotis*) and brush-tailed mulgara (*Dasycercus blythi*). These are listed as vulnerable under the EPBC Act and the TPWC Act. The Australian bustard (*Ardeotis australis*) was recorded also; it is listed as vulnerable in the Northern Territory under the TPWC Act. These three species are discussed in more detail below.

No other threatened fauna species were detected on site. This does not mean that they are not there. A full list of threatened fauna species which are known or predicted to occur in the study area (10 km buffer) is in Table 10.

Brief reviews of threatened fauna species biology and conservation status can be found in Appendix E.

Greater Bilby (*Macrotis lagotis*)

The greater bilby is listed as vulnerable under the EPBC and TPWC Acts. Wild bilby populations are restricted predominantly to the Tanami Desert, Northern Territory (Johnson and Southgate 1990), the Great Sandy and Gibson Deserts, Western Australia (Friend 1990), and an outlying population between Boulia and Birdsville in south-west Queensland (Gordon *et al.* 1990).

The species occupies three major vegetation types, open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Southgate 1990a). In the Tanami Desert the greater bilby is less abundant on dune and sand substrate than on laterite/rock features or drainage/calcrete substrates (Southgate *et al.* 2007).

Bilbies are known to consume a wide range of foods, including root-dwelling larvae, nasute termites, hypogaeal fungi, bulbs, fruit and seed (Gibson 2001). Fire and the promotion of key food plants are thought to be important processes affecting bilby distribution. Fire management may present an opportunity to improve habitat suitability and the status of the bilby (Southgate and Carthew 2006).

Bilbies burrow and are able to survive in habitats that have little vegetation. Southgate and Carthew (2006) found that a large part of their diet consisted of seeds from fire-promoted plants.

The bilby was once distributed over 70% of mainland Australia (Southgate 1990b). The distribution of the bilby has significantly decreased to about 20% of its former range since European settlement (Southgate 1990b). Fox predation may be the primary factor associated with regional declines of the species (Abbott 2001). Feral cats have been known to take the greater bilby as prey (Southgate 1990b). Clearing of habitat for grazing and as a result of fire are potential threats (Southgate 1990b).

Bilbies are allogenic ecosystem engineers, meaning that their burrows are used by other species (Read *et al.* 2008). Bilby warrens provide shelter for germinating seeds deposited by ants or other dispersers, and are important sites of microbial activity and decomposition (Read *et al.* 2008).

One greater bilby was observed during a spotlighting survey 4.1 km north of 'Wilson's Camp' along the main track that leads to the Tanami Road. This was in *Triodia* grassland with scattered *Eucalyptus/Corymbia* sp. habitat (see Figure 6-7 and Figure 6-8).



Figure 6-7 Greater bilby found by GHD zoologists during a spotlighting of Old Pirate in April 2012 (Source: Catherine Whitehead GHD).



Figure 6-8 *Triodia* grassland with scattered *Eucalyptus/Corymbia* sp. habitat where greater bilby was observed (Source: Dan Eyles GHD).

Brush-tailed Mulgara (Dasycercus blythi)

The brush-tailed mulgara is listed as vulnerable under the EPBC and TPWC Acts and occurs in isolated populations in the NT. This species occupies spinifex (*Triodia* spp.) grasslands, and burrows in flats between sand dunes. It is generally a solitary species that hunts at night, although it is not strictly nocturnal (Woolley 2008).

The mulgara has a relatively patchy distribution and sedentary lifestyle with home ranges of males (25.5 ha) significantly larger than those of females (10.8 ha) (Kortner *et al.* 2007). Its diet consists of insects, other arthropods and small vertebrates (Menkhorst and Knight 2004). Populations fluctuate with quality of seasons (Menkhorst and Knight 2004).

The mulgara has declined over 50–90% of its historical range (Maxwell *et al.* 1996). Its habitat has been adversely affected by the grazing of introduced species (e.g., camels, rabbits, cattle), and changes to the fire regime. Studies have shown that the abundance of mulgara is greater in areas of high *Triodia* cover compared with recently burnt areas with low *Triodia* cover (Masters 1993; Baker 1996).

Fire appears to have an impact on population size, with fewer animals found in the years after a burn (Masters 1993). Alteration of fire regimes following European settlement and appropriate use of fire management are potentially significant conservation issues. Predation by introduced feral cats and foxes may threaten this species. Climate change may pose a threat to this species in the future (Woolley 2008).

One brush-tailed mulgara was trapped in an Elliot trap at site 6. This was in gravelly spinifex grassland with Acacia shrubland just west of the middle of the project area (see Figure 6-9 and Figure 6-10).



Figure 6-9 Brush-tailed mulgara trapped by GHD zoologists during the fauna survey of Old Pirate in April 2012 (Source: Alex Holmes GHD).



Figure 6-10 Gravelly spinifex grassland with Acacia shrubland habitat where brush-tailed mulgara was trapped at site 6 (Source: Dan Eyles GHD).

Australian bustard (Ardeotis australis)

The Australian bustard is listed as vulnerable under the TPWC Act and is widespread, although generally scarce in the Northern Territory. It is more common in the north of Australia, occurring in loose aggregations, particularly during the breeding season when they exhibit a unique ‘exploded’ lek mating system, where the males occupy display arenas that females visit for mating purposes. This species’ strongholds in the Northern Territory include the Barkly Tableland, Daly River region, the Victoria River District and the Tanami Desert.

The Australian bustard typically occurs in open habitats, preferring grasslands, low shrublands, grassy woodlands and other structurally similar but artificial habitats such as croplands and airfields. This species responds favourably to fire and is often located in recently burnt habitats, including woodlands.

Threats to this species include impacts such as fluctuations in rainfall, altered fire regimes, predation by exotic species, habitat alteration, pesticides, grazing and hunting pressure (e.g. traditional hunting with access to modern weapons on a species with a low reproductive rate).

Methods to detect this species generally involve covering large distances in appropriate habitat, possibly vehicle-based or via transects.

Seven observations of Australian bustards were recorded during this fauna survey at various locations throughout the study area (see Figure 6-11).



Figure 6-11 Australian bustard near 'Wilson's Camp' (Source: Kelly Dalton GHD).



Table 10 Summary of the threatened fauna species known or predicted to occur within the study area.

Key to table:

EPBC Commonw ealth *Environment Protection and Biodiversity Conservation Act 1999*.
 NRETAS The Department of Natural Resources, Environment, the Arts and Sport (NRETAS) fauna records (not predictions) database.
 PMST Information sourced from the EPBC Protected Matters Search Tool
Conservation Significance:
 EX Extinct
 EW Extinct in the Wild
 CR Critically Endangered
 EN Endangered
 VU Vulnerable
 NT Near Threatened

Likelihood of occurrence of rare/threatened fauna is assessed on a 3-tier scale:

Present – Species was recorded by GHD during April fauna survey
Possible - Suitable habitat occurs within the study area but species not recorded within study area
Unlikely - Suitable habitat unlikely to occur within the study area, or suitable habitat substantially modified, or suitable habitat present but species not recorded for over 50 years

Conservation Status		Species Name	Data Source	NRETAS Records within and surrounding Tanami Tenements			Likelihood of Occurrence within the Study Area
EPBC Act	NT			Within tenement	From 0-10 km	From 10-20 km	
Mammals							
EX	EX	Brush-tailed bettong (<i>Bettongia penicillata</i>)	NRETAS	EL23659			Unlikely – species is thought to be extinct
EX	EX	Burrowing bettong (inland subspecies) (<i>Bettongia lesueri graii</i>)	NRETAS	EL23659	EL9250		Unlikely – species is thought to be extinct
EX	EX	Central hare-wallaby (<i>Lagorchestes asomatus</i>)	NRETAS	EL23659			Unlikely – species is thought to be extinct
EX	EX	Crescent nailtail wallaby (<i>Onychogalea lunata</i>)	NRETAS	EL23659			Unlikely – species is thought to be extinct
EX	EX	Desert bandicoot (<i>Perameles eremiana</i>)	NRETAS	EL23659			Unlikely – species is thought to be extinct
EX	EX	Lesser Bilby (<i>Macrotis leucura</i>)	NRETAS	EL23659			Unlikely – species is thought to be extinct
EX	EX	Pig-footed bandicoot (<i>Chaeropus ecaudatus</i>)	NRETAS	EL23659			Unlikely – species is thought to be extinct
EN	EX	Red-tailed phascogale (<i>Phascogale calura</i>)	NRETAS	EL23659			Unlikely – species is thought to be extinct in the NT
VU	EX	Western quoll (<i>Dasyurus geoffroii</i>)	NRETAS	EL23659			Unlikely – species is thought to be extinct in the NT



Conservation Status		Species Name	Data Source	NRETAS Records within and surrounding Tanami Tenements		Likelihood of Occurrence within the Study Area
EPBC Act	NT					
EN	EW	Mala (<i>Lagorchestes hirsutus</i>)	NRET AS / PMST	EL2365 9	EL2365 9 EL2366 1	Unlikely – species is thought to be extinct in the wild in the NT
EN	EN	Central Rock-rat (<i>Zyzomys pedunculatus</i>)	PMST			Unlikely – may occur in areas with a high proportion of rock outcrop and a very stony soil surface associated with various tussock grasses and dense spinifex, however the only recent records (1996) are from the West MacDonnell Ranges and it was presumed extinct prior to this.
EN	VU	Southern Marsupial Mole (<i>Notoryctes typhlops</i>)	NRET AS / PMST		EL2770 5 EL2756 6	Unlikely – probably restricted to sandy desert country including dunefields and flats and country with deep loose soils outside of study area.
EN	VU	Northern Marsupial Mole (<i>Notoryctes typhlops</i>)	PMST			Unlikely – probably restricted to sandy desert country including dunefields and flats and country with deep loose soils outside of study area.
VU	VU	Crest-tailed Mulgara (<i>Dasycercus cristicauda</i>)	PMST			Possible – may occur throughout study area where suitable habitat occurs in hummock grass plains, sand ridges and mulga shrubland. Can occur sympatrically with Brush-tailed Mulgara (Pavey <i>et al.</i> 2011) which was trapped on the April fauna survey.
VU	EN	Golden Bandicoot (<i>Isoodon auratus</i>)	NRET AS	EL2365 9		Unlikely - range has contracted considerably across the Northern Territory, and is now restricted to a small island off Arnhem land (Woinarski <i>et al.</i> 2007). On this island, it uses heathland, shrubland on sandstone and sandsheets (Woinarski <i>et al.</i> 2007). Its former use of habitat across the remainder of the state is poorly known.



Conservation Status		Species Name	Data Source	NRETAS Records within and surrounding Tanami Tenements			Likelihood of Occurrence within the Study Area
EPBC Act	NT						
VU	VU	Greater Bilby (<i>Macrotis lagotis</i>)	NRET AS	EL5888 EL2770 5 EL2365 9 EL1013 9 EL7911	EL2770 5 EL2756 6 EL9250 EL9474 EL9295 EL9616 EL8825 EL2217 8 EL2365 9	EL277 05 EL588 8 EL884 5 EL961 6 EL882 5 EL236 59 EL791 1	Present – occurs in study area. Suitable habitat is present in form of open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas. Numerous past records of this species are also documented from the study area.
VU	VU	Brush-tailed Mulgara (<i>Dasyercus blythi</i>)	NRET AS	EL2365 9 EL7911	EL2770 5 EL2756 6 EL7911	EL947 4	Present - occurs in the study area. Occupies a range of vegetation types; however, the principal habitat is mature hummock grasslands of spinifex, especially <i>Triodia basedowii</i> and <i>T. pungens</i> (Masters <i>et al.</i> 2003).
VU	NT	Black-footed Rock-wallaby (<i>Petrogale lateralis</i>)	NRET AS	EL2365 9	EL7911		Unlikely – occur in rocky outcrops and associated steep rockyslopes which are not present in the study area.
-	EN	Common Brushtail Possum (Southern N.T.) (<i>Trichosurus vulpecula vulpecula</i>)	NRET AS				Unlikely – species occupies riverine habitat that is close to rocky outcrops and moist gullies within the ranges or rocky slopes (Kerle <i>et al.</i> 1992). This habitat is not present in the study area.
Birds							
VU	VU	Princess Parrot (<i>Polytelis alexandrae</i>)	NRET AS / PMST	EL2365 9			Possible – may occur within study area in habitats including sand dunes and sand flats and open savanna woodlands and shrublands that usually consist of scattered stands of <i>Eucalyptus</i> , <i>Casuarina</i> or <i>Allocasuarina</i> trees, an understorey of shrubs, and a ground cover dominated by <i>Triodia</i> species.
VU	VU	Australian Painted Snipe (<i>Rostratula australis</i>)	PMST				Unlikely- occupies ephemeral and permanent terrestrial shallow freshwater wetlands, and occasionally brackish wetlands, including modified habitats.



Conservation Status		Species Name	Data Source	NRETAS Records within and surrounding Tanami Tenements	Likelihood of Occurrence within the Study Area
EPBC Act	NT				
-	VU	Australian Bustard (<i>Ardeotis australis</i>)	NRET AS		Present – Occurs in the study area. Occupies a wide range of habitats, but prefers grasslands, low shrublands, and grassy woodlands.
-	VU	Emu (<i>Dromaius novaehollandiae</i>)	NRET AS		Possible - may occur within most habitats of the study area. Species is wide ranging and nomadic.
Reptiles					
VU	VU	Great Desert Skink (<i>Liopholis kintorei</i>)	NRET AS / PMST	EL882 4	Possible – species may occur in a range of habitat types with the study area including sandplains and adjacent swales and vegetation consisting of hummock grassland (<i>Triodia sp.</i>), with some scattered shrubs and occasional trees (e.g. <i>Acacia spp.</i> , <i>Eucalyptus spp.</i>).
-	VU	Floodplain Monitor (<i>Varanus panoptes</i>)	NRET AS		Possible – species may occur over broad range of habitats within the study area, from grasslands to woodlands.

6.4 Migratory Species

No EPBC migratory species were recorded during the GHD April fauna survey.

7. Discussion and Recommendations

7.1 Fauna

7.1.1 Overview of Results

The numbers of fauna species detected during fauna survey was moderate. A total of 93 species were detected, including 20 mammals, 49 birds and 24 reptiles. The species accumulation curves presented in Figure 6-1 and Figure 6-2 show that additional survey effort in the area would likely result in the slow and gradual accumulation of relatively few additional species.

7.1.2 Fauna Diversity Patterns

Each of the sampling techniques resulted in effective sampling of differing taxonomic groups, supporting the importance of using multiple techniques to detect fauna.

The fact that eight of the mammal species detected were only recorded once during the survey could indicate that mammal abundance across the site is relatively low.

Site 1 (grassland/woodland) had the highest diversity of all fauna species, closely followed by Site 2 (rocky outcrops). Sites 3 (rocky outcrop), 7 (rocky outcrop) and 8 (spinifex grassland) had lowest diversity.

The results and analysis show that grassland/woodland had the highest species richness, with approximately 55 species recorded. Thus this is an important habitat and activities which have the potential to disturb this habitat, such as driving off-tracks/clearing for drilling etc., should be avoided or minimised where possible. Spinifex grassland and rocky outcrops had lower species richness, with approximately 40 species recorded at each habitat type. However, two species of threatened fauna (EPBC Act) were found in spinifex grassland (see Section 7.1.5).

Large numbers of few species of birds and reptiles were recorded.

Fauna species richness (all species) at sites corresponded most strongly with proportional cover of vegetation less than 0.5 m tall. Sites with more cover of low vegetation tended to have higher species richness. This pattern is likely to reflect the close relationship that many of the arid species have with *Triodia*.

7.1.3 Effects of Weather on Results

The weather was relatively cool during the April fauna survey. The week leading up to the survey had been hot, with maximum temperatures ranging from 31.8 °C - 40.7 °C (3 - 9 April 2012; BOM 2012). If temperatures had been higher during the survey period, it is possible that a higher abundance of individuals as well as additional reptile and mammal species could have been recorded.

7.1.4 Introduced Fauna Species

Relatively few introduced fauna species were detected (cat and one-humped camel). Evidence of camels (tracks/prints) was ubiquitous, but no camels were actually seen on site. It is possible that camels prints in wet desert soils are long-lasting and that camel abundance on site is not as high as the results suggest. Evidence of cats was seen at one site only – cats do not appear to be common on site, but they



are present. It is possible that as part of their environmental management plan ABM could undertake feral animal control targeting feral cats on site.

7.1.5 Threatened Species

One brush-tailed mulgara was trapped in vegetation type 2, *gravelly spinifex grassland with Acacia shrubland*, indicating that this is an important vegetation type in the area and development should be minimised in this vegetation type. Of all the vegetation types within the study area, this one has the smallest area (301.58 ha). The greater bilby was observed in *Triodia grassland with scattered Eucalyptus/Corymbia sp. habitat*, indicating that this is also an important vegetation type in the area and development should be minimised in this area.

The presence of two EPBC listed species on site, the greater bilby and brush-tailed mulgara, will require referral of any proposed action (e.g. mining) to DSEWPac. The purpose of a referral is to obtain a decision on whether a proposed action will need formal assessment and approval under the EPBC Act.

GHD recommends that targeted threatened fauna surveys be conducted to determine the relative abundance and distribution of these species on the mineral lease and to map suitable habitat important to these species in order to satisfy ABM's future obligations under the EPBC Act.

If ABM is able to show that there is sufficient habitat for both mulgara and bilby outside of the drilling/mining area, and that patches of potential habitat are not isolated or fragmented by drilling/mining activities (i.e., drilling/mining activities do not disrupt connectivity between patches that remain), then it could be argued that the drilling/mining operations will not have a significant impact on the local populations of these threatened species.

Targeted threatened species survey of these species should follow the "Survey guidelines for Australia's threatened mammals" (DSEWPac 2011) as well as those discussed below. Brief overviews of suitable targeted species survey methods for each species are listed below.

Greater bilby (*Macrotis lagotis*)

Similar survey techniques to those used by Moseby and O'Donnell (2003) and those outlined by DSEWPac (2011) are recommended to detect the presence of the greater bilby. Survey techniques include but are not limited to:

- ▶ Daytime searches for potentially suitable habitat resources, such as hummock grassland in arid regions.
- ▶ Daytime searches for signs of activity, including burrows, tracks, scats and diggings.
- ▶ Cage traps baited with rolled oats, honey and peanut butter mix and carrot. Traps should be placed next to a tree or, shrub or log, as close as possible to the burrow/diggings or tracks. Hessian sacks should be used around the trap to provide shelter.
- ▶ Spotlighting (both walked and driven) surveys in areas of suitable bilby habitat.

Brush-tailed mulgara (*Dasycercus blythi*)

Similar survey techniques to those used by Pavey *et al.* (2011) and those outlined by DSEWPac (2011) are recommended to detect the presence of the mulgara. Survey techniques include but are not limited to:

- ▶ Daytime searches for potentially suitable habitat resources, signs including burrows, pop-holes, particularly those with freshly excavated earth, tracks and scats.
- ▶ Systematic trapping sites established in areas of suitable habitat. Each trapping site should consist of a 5 x 5 trapping grid of 25 Elliott traps placed at 25 m intervals, baited with a mixture of rolled oats, peanut butter, tuna oil and pilchards. Five nights of trapping could be considered appropriate trapping effort. Approximately 16-20 sites consisting of 25 Elliot traps each would be an appropriate survey level with half of the sites within the drilling/mining area and half outside of the area to assess the suitability of habitat outside the site for population persistence.
- ▶ Spotlighting for active individuals on foot or from a moving vehicle.
- ▶ Placement of baited camera traps (same as for predator pads) in suitable habitat as this technique is ideal for cryptic species occurring at low densities, particularly as this species can be relatively easily separated from other sympatric species.

7.2 Vegetation and Flora

The vegetation types of the study area are not unique to the study area. All of the vegetation types mapped in the study area in this investigation would most appropriately be classified into the fine vegetation type 43: Eucalyptus low open-woodland and/or Acacia sparse-shrubland with *Triodia spicata* (Spike Flower Spinifex), *Triodia pungens* (Soft Spinifex) hummock grassland understorey. There is 18,092 km² of this vegetation in the NT with 7.22% reserved.

Two flora species (*Acacia abbreviata* and *A. minutifolia*) present on the gravelly rises of vegetation types 1 and 2 are endemic to the Tanami Desert. These species are considered to be locally significant due to their restricted distribution in the north-west Tanami region.

Two species of regional significance due to their restricted ranges in the NT were identified in the study area: *Dampiera candidans* (observed in the north of the study area) and *Sclerolaena muelleri* (observed in the west of the study area).

The presence of these flora species of local and regional significance has no legislative consequence to the project.

No individuals of the native walnut (*Owenia reticulata*) (of cultural significance to the local Aboriginal people (GHD 2012a)) were identified in the study area.

7.3 Noxious Weeds

Two exotic flora species were recorded during the April flora surveys: buffel grass (*Pennisetum (Cenchrus) ciliaris*) and purple-top chloris (*Chloris barbata*) both of these species occur in the cleared and disturbed area known as 'Wilson's Camp'.

Buffel grass has been identified by NRETAS to be a species representing a key threatening process for conservation values in arid and semi-arid rangelands (NRETAS 2012). The species is valued for grazing fodder, soil stabilisation and dust suppression. In the southern NT it has become naturalised and can dominate and out-compete other grasses reducing native plant diversity and altering vegetation composition and structure by altering fire regimes (NRETAS 2012). Buffel grass is an opportunistic coloniser spread along transport/infrastructure corridors by wind, water, animal, vehicle and human movement (NTG n.d.). Greening NT have produced a weed management plan to educate land managers



to prepare buffel grass management plans. This plan recommends that eradication may be feasible for isolated occurrences.

The occurrences of buffel grass in the study area are relatively small (patch sizes less than 10 m in diameter) but are mature (producing seeds) and could easily spread, posing a threat to native plant diversity and animal habitat.

It is recommended the area of infestation be isolated by fencing (up to 1.2 m high with a small mesh aperture to contain windblown seed) and targeted for eradication. A plan should be developed to control this weed in the study area and should include:

- ▶ A figure showing the area of known infestation;
- ▶ Diagnostic features of the plant (in text and photos) to enable site staff to identify the species should it appear elsewhere on the site;
- ▶ Procedures for removal of any individuals identified on the site (including capturing all seeds from the plant in a plastic bag); and
- ▶ Weed seed inspection and cleaning processes for vehicles, machinery and equipment coming onto the site.

To further prevent the introduction and/or spread of weeds through the site it is recommended that weed appropriate hygiene measures are implemented including the thorough inspection and cleansing of vehicles and machinery prior to arriving at the site.

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Appendix A

Flora species lists

NT flora records

GHD Survey Flora Records and Cover/Abundance Values by
Quadrat



FAMILY	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	Wilson Camp	Incidental
AIZOACEAE	<i>Trianthema glossostigma</i>														x
AMARANTHACEAE	<i>Alternanthera nana</i>													x	x
AMARANTHACEAE	<i>Ptilotis astrolasius</i>				b										
AMARANTHACEAE	<i>Ptilotis calostachyus</i>				b	a						a	a		x
AMARANTHACEAE	<i>Ptilotis exaltatus var exaltatus</i>			a				a							
AMARANTHACEAE	<i>Ptilotis gaudichaudii</i>								a	b	a			x	
AMARANTHACEAE	<i>Sclerolaena crenata</i>		a												x
AMARANTHACEAE	<i>Sclerolaena eriacantha</i>		a	a											
AMARANTHACEAE	<i>Sclerolaena muelleri</i>		b												x
APOCYNACEAE	<i>Carrisa lanceolata</i>	b													
APOCYNACEAE	<i>Marsdenia australis</i>	a													
APOCYNACEAE	<i>Marsdenia sp. ?viridiflora (infert)</i>								a						
APOCYNACEAE	<i>Rhyncharhena linearis</i>	a													
ASTERACEAE	<i>Pluchea ?tetranthera</i>	a	a		a			a		a	a	a			
ASTERACEAE	<i>Pluchea ferdinandi-muelleri</i>														x
ASTERACEAE	<i>Pterocaulon serrulatum var serrulatum</i>	a													
ASTERACEAE	<i>Vittadinia virgata</i>		a					a						x	
BORAGINACEAE	<i>Halgania solanacea var. Rabbit Flat</i>				b				a		a		b	x	
BORAGINACEAE	<i>Heliotropium pachyphyllum</i>				a	a								x	
BORAGINACEAE	<i>Heliotropium parviantrum</i>									a					
BORAGINACEAE	<i>Heliotropium tanythrix</i>		a								a			x	
BRUNONIACEAE	<i>Brunonia australis</i>										a				



FAMILY	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	Wilson Camp	Incidental
CAPPARACEAE	<i>Capparis umbonata</i>								a						
CLEOMACEAE	<i>Cleome viscosa</i>													x	x
CONVOLVULACEAE	<i>Bonamia media</i>									b					
CONVOLVULACEAE	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>								a		a				x
CONVOLVULACEAE	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	a								a	a				
CONVOLVULACEAE	<i>Ipomoea costata</i>													x	
CUCURBITACEAE	<i>Cucumis argenteus</i>	a									a				
CYPERACEAE	<i>Fimbristylis caespitosa</i>														x
CYPERACEAE	<i>Fimbristylis dichotoma</i> (desert form)			b	a		c	b	a		a				
CYPERACEAE	<i>Fimbristylis eremophila</i>									b					
CYPERACEAE	<i>Fimbristylis oxystachya</i>									a	3			x	
EUPHORBIACEAE	<i>Euphorbia</i> sp. <i>Simpson Desert</i>									a	a			x	
FABACEAE	<i>Acacia abbreviata</i>				a										
FABACEAE	<i>Acacia acradenia</i>			1		a		b							
FABACEAE	<i>Acacia adoxa</i> var. <i>adoxo</i>				a				a					x	
FABACEAE	<i>Acacia adsurgens</i>	a				25							2		
FABACEAE	<i>Acacia ancistrocarpa</i>					2					a		2	x	x
FABACEAE	<i>Acacia aneura</i> var. <i>tenuis</i>													x	
FABACEAE	<i>Acacia chippendalei</i>									a	a				x
FABACEAE	<i>Acacia cuthbertsonii</i>	b				a									
FABACEAE	<i>Acacia elecantha</i>								a					x	
FABACEAE	<i>Acacia holoserica</i>														x



FAMILY	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	Wilson Camp	Incidental
FABACEAE	<i>Acacia lysiphloia</i>	15				40			2			a			
FABACEAE	<i>Acacia maitlandii</i>				a							a		x	
FABACEAE	<i>Acacia minutifolia</i>				20		1					b		x	
FABACEAE	<i>Acacia sp. Urandangi</i>				2							5	30	x	
FABACEAE	<i>Acacia stipuligera</i>										a			x	
FABACEAE	<i>Acacia tenuissima</i>	a				25		b						x	x
FABACEAE	<i>Indigofera georgei</i>	b				a			a						x
FABACEAE	<i>Indigofera linnaei</i>														x
FABACEAE	<i>Leptosema anomalum</i>								b		a				x
FABACEAE	<i>Mirbelia viminalis</i>							b			a		b	x	
FABACEAE	<i>Senna curvistyla</i>										a			x	
FABACEAE	<i>Senna glutinosa subsp. glutinosa</i>					b									
FABACEAE	<i>Senna notabilis</i>									a	a			x	
FABACEAE	<i>Senna oligophylla</i>												a		x
FABACEAE	<i>Senna sericea</i>		a	b			b	1				a			
FABACEAE	<i>Tephrosia brachycarpa</i>	a								c	b			x	x
FABACEAE	<i>Tephrosia supina</i>										a		a		
FABACEAE	<i>Zornia albiflora</i>						a						a		x
GOODENIACEAE	<i>Goodenia triodiophila</i>								a	c	a				
GOODENIACEAE	<i>Dampiera calostachyus</i>			a				a			b		b	x	
GOODENIACEAE	<i>Dampiera candicans</i>										a				
GOODENIACEAE	<i>Goodenia armitiana</i>													x	x



FAMILY	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	Wilson Camp	Incidental
GOODENIACEAE	<i>Goodenia azurea</i>										a				
GOODENIACEAE	<i>Scaevola parviflora subsp. parviflora</i>										a				x
GOODENIACEAE	<i>Scaevola spinescens</i>													x	
GOODENIACEAE	<i>Velleia connata</i>										b				x
HALORAGACEAE	<i>Haloragis uncatipila</i>										b				
LAMIACEAE	<i>Clerodendrum floribundum</i>														x
LAURACEAE	<i>Cassytha capillaris</i>	c		a	b	c	b	b	b				c		
LORANTHACEAE	<i>Lysiana spathulata subsp. parvifolia</i>												a		
MALVACEAE	<i>Abutilon macrum</i>	a	a												
MALVACEAE	<i>Abutilon otocarpum</i>	a	a											x	
MALVACEAE	<i>Gossypium australe</i>	a					a							x	
MALVACEAE	<i>Hibbiscus sturtii var. camplochamys</i>							a				a	a		x
MALVACEAE	<i>Hibiscus sturtii var. truncata</i>			b	a						b			x	
MALVACEAE	<i>Keraudrenia nephrospema</i>					a			a					x	
MALVACEAE	<i>Sida brachypodia</i>	a	a	a		a		b	a			b			
MALVACEAE	<i>Sida filiformis</i>	b	a		b	b				a	a		a		
MALVACEAE	<i>Sida filiformis</i>													x	
MALVACEAE	<i>Sida sp. Pindan</i>		a		c			a				a		x	
MENISPERMACEAE	<i>Tinospora smilacina</i>	a												x	
MOLLUGINACEAE	<i>Mollugo molluginea</i>										a			x	x
MYRTACEAE	<i>Calytrix carinata</i>														x
MYRTACEAE	<i>Corymbia candida</i>										2				x



FAMILY	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	Wilson Camp	Incidental
MYRTACEAE	<i>Corymbia opaca</i>													x	
MYRTACEAE	<i>Eucalyptus brevifolia</i>	3	3	1				2	3	2		1			
MYRTACEAE	<i>Eucalyptus gamophylla</i>													x	x
MYRTACEAE	<i>Eucalyptus limitaris</i>													x	
MYRTACEAE	<i>Eucalyptus pachyphylla</i>														x
MYRTACEAE	<i>Melaleuca lasiandra</i>														x
NYCTAGINACEAE	<i>Boerhavia coccinea</i>									a					
NYCTAGINACEAE	<i>Boerhavia sp. ?coccinea (infert)</i>													x	
POACEAE	<i>Amphipogon sericeus</i>				a								a		
POACEAE	<i>Aristida holathera</i>									2	30			x	
POACEAE	<i>Aristida inaequiglumis</i>	a			a	b	a						a	x	x
POACEAE	<i>Cenchrus ciliaris*</i>													x	
POACEAE	<i>Chloris barbata*</i>													x	
POACEAE	<i>Cymbopogon oblectus</i>					b	a	a	a					x	
POACEAE	<i>Dactyloctenium radulans</i>													x	
POACEAE	<i>Digitaria brownii</i>	b				a	a			a					
POACEAE	<i>Enneapogon polyphyllus</i>													x	
POACEAE	<i>Eragrostis cumingii</i>														x
POACEAE	<i>Eragrostis eriopoda subsp. Sandy fireweed</i>									a	b			x	x
POACEAE	<i>Eriachne aristidea</i>									b	b			x	
POACEAE	<i>Eriachne helmsii</i>										b	a	a		
POACEAE	<i>Eriachne obtusa</i>														x



FAMILY	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	Wilson Camp	Incidental
POACEAE	<i>Eriachne obtusa</i>													x	
POACEAE	<i>Eriachne pulchella</i>									b					
POACEAE	<i>Eulalia aurea</i>	7	5	a	b	b	b	b	b		b	1	a	x	
POACEAE	<i>Panicum decompositum</i>		a												
POACEAE	<i>Paraneurachne meulleri</i>	1	b	b	2	b	b			a	b	1	b	x	
POACEAE	<i>Paspalidium rarum</i>									a					
POACEAE	<i>Schyzachyrium fragile</i>									a	c			x	
POACEAE	<i>Setaria surgens</i>										b			x	
POACEAE	<i>Sorghum plumosum var. plumosum</i>	a													
POACEAE	<i>Sporobolus australasicus</i>		b				b							x	
POACEAE	<i>Triodia basedowii</i>				20	10	3		35				20	x	x
POACEAE	<i>Triodia intermedia</i>			25	2	5	32	10	a	25		20	1		
POACEAE	<i>Triodia pungens</i>	50	5							a					
POACEAE	<i>Triodia schinzii</i>	1	20					20		b	10		3		x
POACEAE	<i>Yakirra australiense</i>									b	b				
PROTEACEAE	<i>Grevillea wickhamii</i>								a	a				x	
PROTEACEAE	<i>Hakea chordophylla</i>														x
PROTEACEAE	<i>Hakea macrocarpa</i>								a				a		
SAPINDACEAE	<i>Dodonaea coriacea</i>				a	a		a	a				a	x	
SCROPHULARIACEAE	<i>Eremophila latrobei</i>							a							
SCROPHULARIACEAE	<i>Eremophila longifolia</i>	a	a											x	
SOLANACEAE	<i>Solanum centrale</i>														x



FAMILY	SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	Wilson Camp	Incidental
SOLANACEAE	<i>Solanum quadriloculatum</i>														x
VIOLACEAE	<i>Hybanthus aurantiacus</i>							a						x	
ZYGOPHYLLACEAE	<i>Tribulopsis angustifolia</i>														x

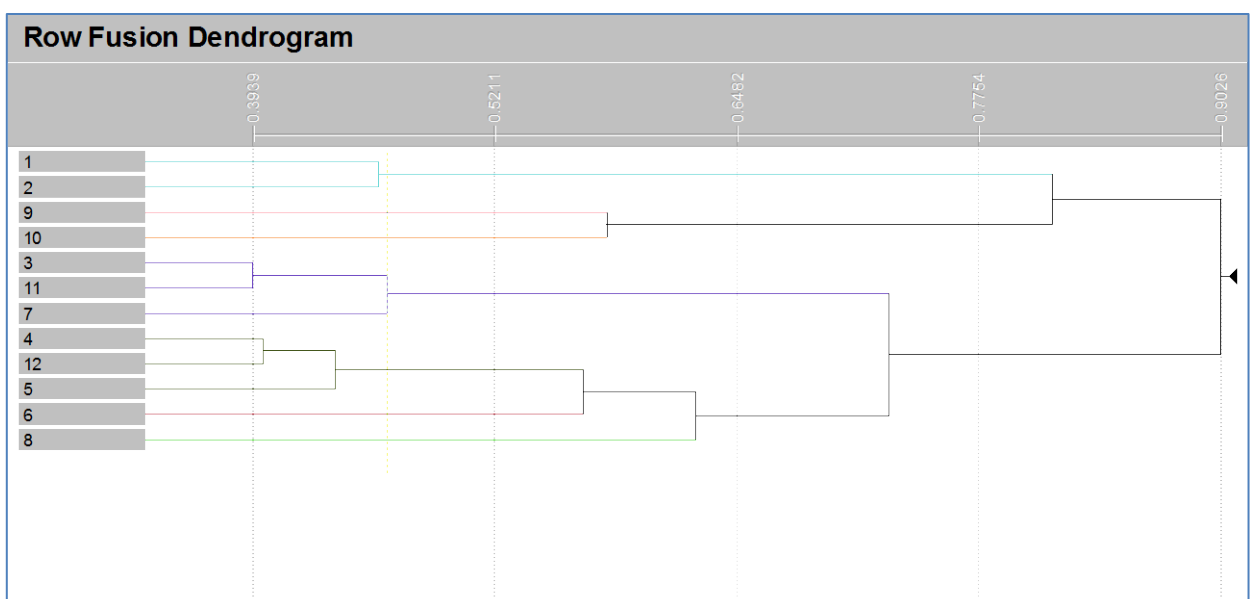
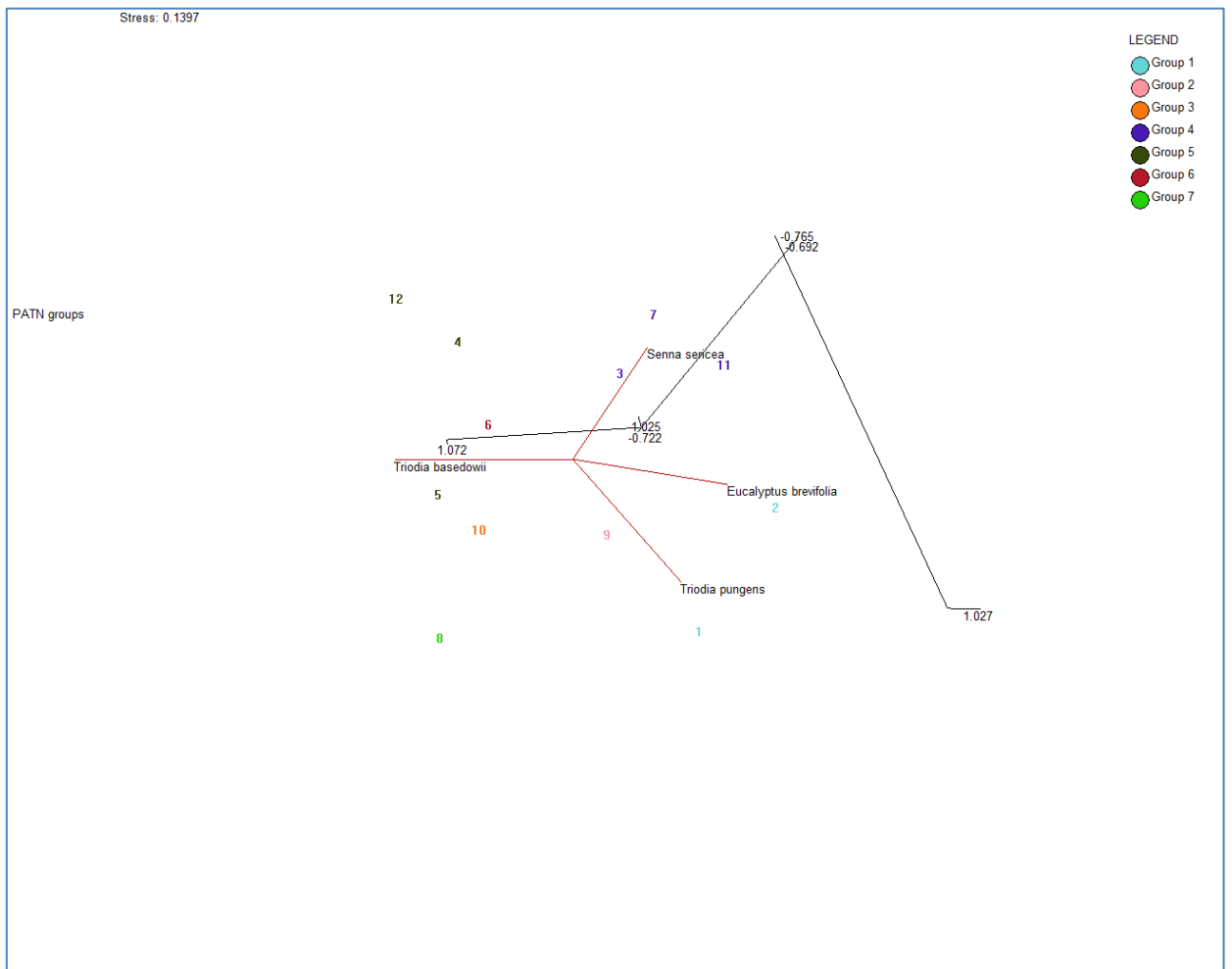
- a* <1% cover, <5 individuals
b <1% cover, 6-50 individuals
c <1% cover, 51+ individuals
x Species present



Appendix B

Quadrat statistical analyses (flora)

Ordination Plot and Dendogram





Appendix C

Fauna survey site photos



Plate 1 Fauna survey site 1 (Source: Dan Eyles GHD).



Plate 2 Fauna survey site 2 (Source: Dan Eyles GHD).



Plate 3 Fauna survey site 3 (Source: Dan Eyles GHD).



Plate 4 Fauna survey site 4 (Source: Dan Eyles GHD).



Plate 5 Fauna survey site 5 (Source: Dan Eyles GHD).



Plate 6 Fauna survey site 6 (Source: Dan Eyles GHD).



Plate 7 Fauna survey site 7 (Source: Dan Eyles GHD).



Plate 8 Fauna survey site 8 (Source: Dan Eyles GHD).



Plate 9 Fauna survey site 9 (Source: Dan Eyles GHD).



Appendix D

List of fauna species for the study area recorded during the current survey and past records



Common Name	Scientific Name	GHD	NRETAS	PMST	EPBC	NT Legislation	non-native
Mammals							
Echidna	<i>Tachyglossus aculeatus</i>		X				
Brush-tailed Mulgara	<i>Dasycercus blythi</i>	X	X		VU	VU	
Crest-tailed Mulgara	<i>Dasycercus cristicauda</i>		X	X	VU	VU	
Western Quoll	<i>Dasyurus geoffroyi</i>		X		VU	EX	
Fat-tailed Antechinus	<i>Pseudantechinus macdonnellensis</i>		X				
Red-tailed Phascogale	<i>Phascogale calura</i>		X		EN	EX	
Long-tailed Planigale	<i>Planigale ingrami</i>		X				
Fat-tailed Dunnart	<i>Sminthopsis crassicaudata</i>		X				
Stripe-faced Dunnart	<i>Sminthopsis macroura</i>	X	X				
Lesser Hairy-footed Dunnart	<i>Sminthopsis youngsoni</i>	X	X				
Pig-footed Bandicoot	<i>Chaeropus ecaudatus</i>		X		EX	EX	
Golden Bandicoot	<i>Isodon auratus</i>		X		VU	EN	
Desert Bandicoot	<i>Perameles eremiana</i>		X		EX	EX	
Greater Bilby	<i>Macrotis lagotis</i>	X	X	X	VU	VU	
Lesser Bilby	<i>Macrotis leucura</i>		X		EX	EX	
Common Brushtail Possum (Southern N.T.)	<i>Trichosurus vulpecula vulpecula</i>			X		EN	
Burrowing Bettong	<i>Bettongia lesueur</i>		X		EX	EX	
Brush-tailed Bettong	<i>Bettongia penicillata</i>		X		EX	EX	
Central Hare-wallaby	<i>Lagorchestes asomatus</i>		X		EX	EX	
Spectacled Hare-wallaby	<i>Lagorchestes conspicillatus</i>		X			NT	
Mala	<i>Lagorchestes hirsutus</i>		X	X	EN	EW	
Common Wallaroo	<i>Macropus robustus</i>		X				
Red Kangaroo	<i>Macropus rufus</i>		X				
Macropod (unidentified)	Macropod (unidentified)	X					
Crescent Nailtail Wallaby	<i>Onychogalea lunata</i>		X		EX	EX	
Northern Nailtail Wallaby	<i>Onychogalea unguifera</i>		X			NT	
Black-footed Rock-wallaby	<i>Petrogale lateralis</i>		X		VU	NT	
Northern Marsupial Mole	<i>Notoryctes caurinus</i>		X	X	EN	VU	
Southern Marsupial Mole	<i>Notoryctes typhlops</i>		X	X	EN	VU	
Ghost Bat	<i>Macroderma gigas</i>		X			NT	
Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>	X	X				
White-striped Free-tailed bat	<i>Tadarida australis</i>		X				
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	X?	X				
Northern Freetail Bat	<i>Chaerephon jobensis</i>	X					
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	X	X				
Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>	X	X				
Little Broad-nosed Bat	<i>Scotorepens greyii</i>	X?	X				
Inland Forest Bat	<i>Vespadelus baverstocki</i>	X?	X				
Inland Cave Bat	<i>Vespadelus finlaysoni</i>	X	X				



Common Name	Scientific Name	GHD	NRETAS	PMST	EPBC	NT Legislation	non-native
Central Short-tailed Mouse	<i>Leggadina forresti</i>		X				
Spinifex Hopping-mouse	<i>Notomys alexis</i>	X	X				
Desert Mouse	<i>Pseudomys desertor</i>	X	X				
Sandy Inland Mouse	<i>Pseudomys hermannsburgensis</i>	X?	X				
Central Pebble-mound Mouse	<i>Pseudomys johnsoni</i>	X					
Western Chestnut Mouse	<i>Pseudomys nanus</i>	X	X			NT	
Central Rock Rat	<i>Zyzomys pedunculatus</i>		X	X	EN	EN	
Long-haired Rat	<i>Rattus villosissimus</i>		X			NT	
Dingo	<i>Canis lupus</i>	X	X				
House Mouse	<i>Mus musculus</i>		X				non-native
Cat	<i>Felis catus</i>	X	X	X	Invasive		non-native
Red Fox	<i>Vulpes vulpes</i>			X	Invasive		non-native
Rabbit	<i>Oryctolagus cuniculus</i>		X	X	Invasive		non-native
Donkey	<i>Equus asinus</i>		X				non-native
One-humped Camel	<i>Camelus dromedarius</i>	X	X				non-native
Swamp Buffalo	<i>Bubalus bubalis</i>		X				non-native
Cattle	<i>Bos taurus</i>		X				non-native
Birds							
Emu	<i>Dromaius novaehollandiae</i>		X			VU	
Stubble Quail	<i>Coturnix pectoralis</i>		X				
Brown Quail	<i>Coturnix ypsilophora</i>	X	X				
Wandering Whistling-Duck	<i>Dendrocygna arcuata</i>		X				
Plumed Whistling-Duck	<i>Dendrocygna eytoni</i>		X				
Black Swan	<i>Cygnus atratus</i>		X				
Australian Wood Duck	<i>Chenonetta jubata</i>		X				
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>		X				
Grey Teal	<i>Anas gracilis</i>		X				
Pacific Black Duck	<i>Anas superciliosa</i>		X				
Hardhead	<i>Aythya australis</i>		X				
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>		X				
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>		X				
Common Bronzewing	<i>Phaps chalcoptera</i>		X				
Flock Bronzewing	<i>Phaps histrionica</i>		X			NT	
Crested Pigeon	<i>Ocyphaps lophotes</i>	X	X				
Spinifex Pigeon	<i>Geophaps plumifera</i>		X				
Diamond Dove	<i>Geopelia cuneata</i>	X	X				
Peaceful Dove	<i>Geopelia striata</i>		X				
Tawny Frogmouth	<i>Podargus strigoides</i>	X	X				
Spotted Nightjar	<i>Eurostopodus argus</i>	X	X				
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>		X				



Common Name	Scientific Name	GHD	NRETAS	PMST	EPBC	NT Legislation	non-native
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>		X				
Great Cormorant	<i>Phalacrocorax carbo</i>		X				
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>		X				
Pied Cormorant	<i>Phalacrocorax varius</i>		X				
Australian Pelican	<i>Pelecanus conspicillatus</i>		X				
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>		X				
Cattle Egret	<i>Ardea ibis</i>			X	Mi/Ma		
White-necked Heron	<i>Ardea pacifica</i>		X				
Eastern Great Egret	<i>Ardea modesta</i>		X	X	Mi/Ma		
Intermediate Egret	<i>Ardea intermedia</i>		X				
White-faced Heron	<i>Egretta novaehollandiae</i>		X				
Little Egret	<i>Egretta garzetta</i>		X				
Nankeen Night Heron	<i>Nycticorax caledonicus</i>		X				
Glossy Ibis	<i>Plegadis falcinellus</i>		X				
Straw-necked Ibis	<i>Threskiornis spinicollis</i>		X				
Royal Spoonbill	<i>Platalea regia</i>		X				
Yellow-billed Spoonbill	<i>Platalea flavipes</i>		X				
Black-shouldered Kite	<i>Elanus axillaris</i>	X	X				
Black-breasted Buzzard	<i>Hamirostra melanostemon</i>		X				
Whistling Kite	<i>Haliastur spheerulus</i>		X				
Black Kite	<i>Milvus migrans</i>	X	X				
Brown Goshawk	<i>Accipiter fasciatus</i>	X	X				
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	X	X				
Spotted Harrier	<i>Circus assimilis</i>	X	X				
Swamp Harrier	<i>Circus approximans</i>		X				
Wedge-tailed Eagle	<i>Aquila audax</i>		X				
Little Eagle	<i>Hieraaetus morphnoides</i>		X				
Nankeen Kestrel	<i>Falco cenchroides</i>	X	X				
Brown Falcon	<i>Falco berigora</i>	X	X				
Australian Hobby	<i>Falco longipennis</i>	X	X				
Grey Falcon	<i>Falco hypoleucos</i>		X			NT	
Black Falcon	<i>Falco subniger</i>	X	X				
Brolga	<i>Grus rubicunda</i>		X				
Black-tailed Native-hen	<i>Tribonyx ventralis</i>		X				
Eurasian Coot	<i>Fulica atra</i>		X				
Australian Bustard	<i>Ardeotis australis</i>	X	X			VU	
Bush Stone-curlew	<i>Burhinus grallarius</i>		X			NT	
Black-winged Stilt	<i>Himantopus himantopus</i>		X				
Red-capped Plover	<i>Charadrius ruficapillus</i>		X				
Oriental Plover	<i>Charadrius veredus</i>		X	X	Mi/Ma		



Common Name	Scientific Name	GHD	NRETAS	PMST	EPBC	NT Legislation	non-native
Black-fronted Dotterel	<i>Elseya melanops</i>		X				
Red-kneed Dotterel	<i>Erythronyx cinctus</i>		X				
Banded Lapwing	<i>Vanellus tricolor</i>		X				
Masked Lapwing	<i>Vanellus miles</i>		X				
Australian Painted Snipe	<i>Rostratula australis</i>		X	X	VU / Mi / Ma	VU	
Little Curlew	<i>Numenius minutus</i>		X				
Common Sandpiper	<i>Actitis hypoleucos</i>		X				
Common Greenshank	<i>Tringa nebularia</i>		X				
Marsh Sandpiper	<i>Tringa stagnatilis</i>		X				
Wood Sandpiper	<i>Tringa glareola</i>		X			NE	
Red-necked Stint	<i>Calidris ruficollis</i>		X				
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>		X				
Red-chested Button-quail	<i>Turnix pyrrhorostris</i>		X				
Little Button-quail	<i>Turnix velox</i>	X	X				
Oriental Pratincole	<i>Glareola maldivarum</i>		X	X	Mi/Ma		
Australian Pratincole	<i>Stiltia isabella</i>	X	X				
Gull-billed Tern	<i>Gelochelidon nilotica</i>		X				
Whiskered Tern	<i>Chlidonias hybrida</i>		X				
Silver Gull	<i>Chroicocephalus novaehollandiae</i>		X				
Major Mitchell's Cockatoo	<i>Lophochroa leadbeateri</i>		X				
Galah	<i>Eulophus roseicapilla</i>		X				
Little Corella	<i>Cacatua sanguinea</i>		X				
Cockatiel	<i>Nymphicus hollandicus</i>		X				
Princess Parrot	<i>Polytelis alexandrae</i>		X	X	VU	VU	
Australian Ringneck	<i>Barnardius zonarius</i>	X	X				
Budgerigar	<i>Melopsittacus undulatus</i>	X	X				
Bourke's Parrot	<i>Neopsephotus bourkii</i>		X				
Pheasant Coucal	<i>Centropus phasianinus</i>		X				
Horsfield's Bronze-Cuckoo	<i>Chalcites basalis</i>	X	X				
Black-eared Cuckoo	<i>Chalcites osculans</i>		X				
Pallid Cuckoo	<i>Cacomantis pallidus</i>		X				
Southern Boobook	<i>Ninox novaeseelandiae</i>		X				
Eastern Barn Owl	<i>Tyto javanica</i>		X				
Blue-winged Kookaburra	<i>Dacelo leachii</i>		X			DD	
Red-backed Kingfisher	<i>Todiramphus pyrrhopygius</i>	X	X				
Sacred Kingfisher	<i>Todiramphus sanctus</i>		X				
Rainbow Bee-eater	<i>Merops ornatus</i>		X	X	Mi/Ma		
Splendid Fairy-wren	<i>Malurus splendens</i>		X				
Red-backed Fairy-wren	<i>Malurus melanocephalus</i>		X				
White-winged Fairy-wren	<i>Malurus leucopterus</i>	X	X				



Common Name	Scientific Name	GHD	NRETAS	PMST	EPBC	NT Legislation	non-native
Variegated Fairy-wren	<i>Malurus lamberti</i>	X	X				
Rufous-crowned Emu-wren	<i>Stipiturus ruficeps</i>		X				
Striated Grasswren	<i>Amytornis striatus</i>	X	X			NT	
Weebill	<i>Smicrornis brevirostris</i>	X	X				
Western Gerygone	<i>Gerygone fusca</i>		X				
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>		X				
Inland Thornbill	<i>Acanthiza apicalis</i>		X				
Southern Whiteface	<i>Aphelocephala leucopsis</i>		X				
Banded Whiteface	<i>Aphelocephala nigricincta</i>		X				
Red-browed Pardalote	<i>Pardalotus rubricatus</i>	X	X				
Pied Honeyeater	<i>Certhionyx variegatus</i>		X				
Singing Honeyeater	<i>Lichenostomus virescens</i>	X	X				
Grey-headed Honeyeater	<i>Lichenostomus keartlandi</i>	X	X				
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>		X				
White-fronted Honeyeater	<i>Purnella albifrons</i>		X				
Yellow-throated Miner	<i>Manorina flavigula</i>	X	X				
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>	X	X				
Rufous-throated Honeyeater	<i>Conopophila rufogularis</i>		X				
Grey Honeyeater	<i>Conopophila whitei</i>		X			DD	
Crimson Chat	<i>Epthianura tricolor</i>	X	X				
Black Honeyeater	<i>Sugomel niger</i>		X				
Brown Honeyeater	<i>Lichmera indistincta</i>		X				
Black-chinned Honeyeater	<i>Melithreptus gularis</i>	X	X				
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>		X				
Chiming Wedgebill	<i>Psophodes occidentalis</i>		X				
Ground Cuckoo-shrike	<i>Coracina maxima</i>		X				
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	X	X				
White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>		X				
White-winged Triller	<i>Lalage sueurii</i>	X	X				
Rufous Whistler	<i>Pachycephala rufiventris</i>	X	X				
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	X	X				
Crested Bellbird	<i>Oreoica gutturalis</i>	X	X				
Masked Woodswallow	<i>Artamus personatus</i>	X	X				
White-browed Woodswallow	<i>Artamus superciliosus</i>		X				
Black-faced Woodswallow	<i>Artamus cinereus</i>	X	X				
Little Woodswallow	<i>Artamus minor</i>		X				
Grey Butcherbird	<i>Cracticus torquatus</i>		X				
Pied Butcherbird	<i>Cracticus nigrogularis</i>	X	X				
Australian Magpie	<i>Cracticus tibicen</i>		X				
Willie Wagtail	<i>Rhipidura leucophrys</i>	X	X				



Common Name	Scientific Name	GHD	NRETAS	PMST	EPBC	NT Legislation	non-native
Little Crow	<i>Corvus bennetti</i>		X				
Torresian Crow	<i>Corvus orru</i>	X	X				
Magpie-lark	<i>Grallina cyanoleuca</i>		X				
Jacky Winter	<i>Microeca fascinans</i>		X				
Red-capped Robin	<i>Petroica goodenovii</i>		X				
Hooded Robin (Mainland)	<i>Melanodryas cucullata picata/westralensis</i>		X				
Horsfield's Bushlark	<i>Mirafrja javanica</i>		X				
Rufous Songlark	<i>Cinloramphus mathewsi</i>	X	X				
Brown Songlark	<i>Cinloramphus cruralis</i>	X	X				
Spinifexbird	<i>Eremiornis carteri</i>	X	X				
Fork-tailed Swift	<i>Apus pacificus</i>			X	Mi/Ma		
White-backed Swallow	<i>Cheramoeca leucosterna</i>		X				
Barn Swallow	<i>Hirundo rustica</i>		X			NE	
Fairy Martin	<i>Petrochelidon ariel</i>		X				
Tree Martin	<i>Petrochelidon nigricans</i>		X				
Mistletoebird	<i>Dicaeum hirundinaceum</i>	X	X				
Zebra Finch	<i>Taeniopygia guttata</i>	X	X				
Painted Finch	<i>Emblema pictum</i>	X	X				
Pictorella Mannikin	<i>Heteromunia pectoralis</i>		X			NT	
Australasian Pipit	<i>Anthus novaeseelandiae</i>	X	X				
Reptiles							
Fat-tailed Gecko	<i>Diplodactylus conspicillatus</i>	X	X				
Northern Dtella	<i>Gehyra australis</i>		X				
Centralian Dtella	<i>Gehyra montium</i>		X				
Purplish Dtella	<i>Gehyra purpurascens</i>		X				
Tree Dtella	<i>Gehyra variegata</i>	X	X				
Bynoe's Gecko	<i>Heteronotia binoei</i>		X				
Crowned Gecko	<i>Lucasium stenodactylum</i>		X				
Smooth Knob-tailed Gecko	<i>Nephurus laevis</i>		X				
Three-lined Knob-tailed Gecko	<i>Nephurus levis</i>		X				
Beaked Gecko	<i>Rhynchoedura ornata</i>	X	X				
Spiny-tailed Gecko	<i>Strophurus ciliaris</i>	X	X				
White-striped Gecko	<i>Strophurus taeniatus</i>		X				
Rusty-topped Delma	<i>Delma borea</i>	X	X				
Unbanded Delma	<i>Delma butleri</i>		X				
Sharp-snouted Delma	<i>Delma nasuta</i>		X				
Black-necked Snake-lizard	<i>Delma tinca</i>		X				
Burton's Legless Lizard	<i>Lialis burtonis</i>		X				
Red-Sided Rainbow Skink	<i>Carlia rufilatus</i>		X				
Three-Spined Rainbow Skink	<i>Carlia triacantha</i>	X	X				



Common Name	Scientific Name	GHD	NRETAS	PMST	EPBC	NT Legislation	non-native
Metallic Snake-eyed Skink	<i>Cryptoblepharus metallicus</i>	X					
Aboreal Snake-Eyed Skink	<i>Cryptoblepharus plagiocephalus</i>		X				
Grand Ctenotus	<i>Ctenotus grandis</i>		X				
Greer's Ctenotus	<i>Ctenotus greeri</i>		X				
Helen's Ctenotus	<i>Ctenotus helenae</i>	X	X				
Leonhardi's Ctenotus	<i>Ctenotus leonhardii</i>		X				
Leopard Ctenotus	<i>Ctenotus pantherinus</i>	X	X				
Pianka's Ctenotus	<i>Ctenotus piankai</i>	X					
Fourteen-Lined Ctenotus	<i>Ctenotus quattuordecimlineatus</i>		X				
Robust Ctenotus	<i>Ctenotus robustus</i>		X				
Rock Ctenotus	<i>Ctenotus saxatilis</i>		X				
Schomburgk's Ctenotus	<i>Ctenotus schomburgkii</i>	X	X				
Tanami Ctenotus	<i>Ctenotus tanamiensis</i>	X	X				
Great Desert Skink	<i>Liopholis kintorei</i>		X	X	VU	VU	
Striated Egernia	<i>Liopholis striata</i>		X				
Narrow-Banded Sand Swimmer	<i>Eremiascincus fasciolatus</i>		X				
Broad-Banded Sand Swimmer	<i>Eremiascincus richardsonii</i>		X				
Two-Toed Lerista	<i>Lerista bipes</i>	X	X				
Sand Lerista	<i>Lerista labialis</i>		X				
Grey's Menetia	<i>Menetia greyii</i>	X	X				
Red-Tailed Snake-Eyed Skink	<i>Morethia ruficauda</i>		X				
Ornate Snake-Eyed Skink	<i>Notoscincus ornatus</i>		X				
Unnamed skink	<i>Proablepharus reginae</i>	X					
Centralian Blue-Tongued Lizard	<i>Tiliqua multifasciata</i>	X	X				
Ring-tailed Dragon	<i>Ctenophorus caudicinctus</i>		X				
Military Dragon	<i>Ctenophorus isolepis</i>	X	X				
Central Netted Dragon	<i>Ctenophorus nuchalis</i>		X				
Unnamed dragon	<i>Diporiphora lalliae</i>		X				
Canegrass Dragon	<i>Diporiphora winneckeii</i>	X	X				
Long-nosed Water Dragon	<i>Lophognathus longirostris</i>		X				
Thorny Devil	<i>Moloch horridus</i>		X				
Dwarf Bearded Dragon	<i>Pogona minor</i>	X	X				
Lined Earless Dragon	<i>Tympanocryptis lineata</i>		X				
Ridge-tailed Monitor	<i>Varanus acanthurus</i>	X	X				
Rusty Desert Monitor	<i>Varanus eremius</i>	X	X				
Perentie	<i>Varanus giganteus</i>		X				
Pygmy Mulga Monitor	<i>Varanus gilleni</i>		X				
Sand Goanna	<i>Varanus gouldii</i>		X				
Floodplain Monitor	<i>Varanus panoptes</i>		X			VU	
Black-tailed Monitor	<i>Varanus tristis</i>		X				



Common Name	Scientific Name	GHD	NRETAS	PMST	EPBC	NT Legislation	non-native
Northern Blind Snake	<i>Ramphotyphlops diversus</i>		X				
Interior Blind Snake	<i>Ramphotyphlops endoterus</i>		X				
Stimson's Python	<i>Antaresia stimsoni</i>		X				
Black-headed Python	<i>Aspidites melanocephalus</i>	X	X				
Woma Python	<i>Aspidites ramsayi</i>		X			NT	
King Brown Snake	<i>Pseudechis australis</i>	X	X				
Western Brown Snake	<i>Pseudonaja nuchalis</i>		X				
Little Spotted Snake	<i>Suta punctata</i>	X	X				
Amphibians							
Desert Spadefoot Toad	<i>Notaden nicholli</i>		X				
Ornate Burrowing Frog	<i>Platyplectrum ornatus</i>		X			DD	
Spencer's Frog	<i>Platyplectrum spenceri</i>		X				
Tanami Toadlet	<i>Uperoleia micromeles</i>		X				
Giant Frog	<i>Litoria australis</i>		X			DD	
Knife-footed Frog	<i>Litoria cultripes</i>		X				
Green Tree-frog	<i>Litoria caerulea</i>		X				
Copland's RockFrog	<i>Litoria coplandi</i>		X				
Red Tree-frog	<i>Litoria rubella</i>		X				



Species		Site											Incidental	Notes	Total
		1	2	3	4	5	6	7	8	9	Camp				
Mammals															
All mammals		8	10	5	3	2	3	5	4	8	8	5			61
Greater Bilby	Macrotis lagotis											1	main road	1	
Bat (40 kHz Group)			1	1							1			3	
Gould’s Wattled Bat	Chalinolobus gouldii		1								1			2	
Inland Broad-nosed Bat	Scotorepens balstoni	1	1	1				1	1	1	1			7	
Inland Cave bat	Vespadelus baverstocki		1		1									2	
Unidentified Long-eared Bat		1	1							1	1			4	
Northern Freetail Bat	Chaerephon jobensis										1			1	
Yellow-bellied Sheath-tailed Bat	Saccolaimus flaviventris	1									1			2	
Brush-tailed Mulgara	Dasycercus blythi						1							1	
Dingo	Canu lupus	1	1		1		1			1	2			7	
Cat	Felis catus									1				1	
Macropod (unidentified)		1												1	
One-humped Camel	Camelus dromedarius	1	1			1				1				4	
Central Pebble-mound Mouse	Pseudomys johnsoni								1					1	
Desert Mouse	Pseudomys desertor		1	2				3	2	1				9	
Lesser Hairy-footed Dunnart	Sminthopsis youngsoni				1	1	1							3	
Sandy Inland Mouse	Pseudomys hermannsburgensis									1				1	
Rodent (unidentified)			1									3	main road	4	
Spinifex Hopping-mouse	Notomys alexis											1	Between site 1 and 9	1	
Stripe-faced Dunnart	Sminthopsis macroura	1		1				1		1				4	



Species		Site										Incidental	Notes	Total
		1	2	3	4	5	6	7	8	9	Camp			
Western Chestnut Mouse	<i>Pseudomys nanus</i>	1	1											2
Birds														
All birds		54	40	20	24	19	35	19	20	24	32	12		299
Australasian Pipit	<i>Anthus novaeseelandiae</i>			1			1							2
Australian Bustard	<i>Ardeotis australis</i>				2					2	2	1	main road	7
Australian Pratincole	<i>Stiltia Isabella</i>										1			1
Brown Quail	<i>Cortunix ypsilophra</i>	1												1
Budgerigar	<i>Melopsittacus undulatus</i>	7	6	4	4	3	5	6	4	4	1			44
Little Button-quail	<i>Turnix velox</i>		1	2	2			1	2	2		2	main road	12
Painted Finch	<i>Emblema pictum</i>										2			2
Spinifexbird	<i>Eremiornis carteri</i>				1									1
Striated Grasswren	<i>Amytornis striatus</i>				1		1							2
White-winged Fairy-wren	<i>Malurus leucopterus</i>		1									1	near site 2	2
Zebra Finch	<i>Taeniopygia guttata</i>	4	3	2	2		5	2	3	2	2			25
Spotted Nightjar	<i>Eurostopodus argus</i>							2	1		1	2	main road	6
Tawny Frogmouth	<i>Podargus strigoides</i>										1			1
Australian Hobby	<i>Falco longipennis</i>	1		1							2	1		5
Black Falcon	<i>Falco subniger</i>	1									2			3
Black Kite	<i>Milvus migrans</i>				1									1
Black-shouldered Kite	<i>Elanus axillaris</i>				1		1				1			3
Brown Falcon	<i>Falco berigora</i>	1					1							2
Brown Goshawk	<i>Accipiter fasciatus</i>		4					1			2			7
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>										1	1		2
Nankeen Kestrel	<i>Falco cenchroides</i>			1				1			1			3



Species		Site										Incidental	Notes	Total
		1	2	3	4	5	6	7	8	9	Camp			
Spotted Harrier	<i>Circus assimilis</i>	3	2	1		1	2	1			1			11
Australian Ringneck	<i>Barnardius zonarius</i>	1									1			2
Black-chinned Honeyeater	<i>Melithreptus gularis</i>	3												3
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	1	1								1	1		4
Black-faced Woodswallow	<i>Artamus cinereus</i>	1	1	1	1		4			1	1			10
Crested Bellbird	<i>Oreocia gutturalis</i>	5	3		2	4	2		2					18
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	1				1				1	1			4
Grey-headed Honeyeater	<i>Lichenostomus keartlandi</i>	4	6	4		3	5	4	5	2	2			35
Horsfield's Bronze-Cuckoo	<i>Chalcites basalis</i>										2			2
Masked Woodswallow	<i>Artamus personatus</i>				1		1							2
Mistletoebird	<i>Dicaeum hirundinaceum</i>	1												1
Pied Butcherbird	<i>Cracticus nigrogularis</i>					1								1
Red-backed Kingfisher	<i>Todiramphus pyrrhopygius</i>									1				1
Red-browed Pardalote	<i>Pardalotus rubricatus</i>		1								2			3
Rufous Whistler	<i>Pachycephala rufiventris</i>	3				1			1					5
Singing Honeyeater	<i>Lichenostomus virescens</i>	5			1	2	3		1	2				14
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>		1											1
Weebill	<i>Smicromis brevirostris</i>	2												2
White-winged Triller	<i>Lalage sueurii</i>		1		1	1	1					1		5
Yellow-throated Miner	<i>Manorina flavigula</i>									1				1
Brown Songlark	<i>Cincloramphus cruralis</i>			1								1		2
Crested Pigeon	<i>Ocyphaps lophotes</i>	1	3		1									5
Crimson Chat	<i>Epthianura tricolor</i>				2									2
Diamond Dove	<i>Geopelia cuneata</i>	6	5	1		2	2	1		3	1			21



Species		Site										Incidental	Notes	Total
		1	2	3	4	5	6	7	8	9	Camp			
Rufous Songlark	<i>Cincloramphus mathewsi</i>	1							1			1		3
Torresian Crow	<i>Corvus orru</i>		1	1	1		1							4
Variiegated Fairy-wren	<i>Malurus lamberti</i>	1								2				3
Willie Wagtail	<i>Rhipidura leucophrys</i>									1	1			2
Reptiles														
All reptiles		15	13	10	5	12	9	7	7	7	5	4		94
Canegrass Dragon	<i>Diporiphora winneckeii</i>								1					1
Dwarf Bearded Dragon	<i>Pogona minor</i>										1	near Site 4		1
Military Dragon	<i>Ctenophorus isolepis</i>		2			1	1		2		1			7
Beaked Gecko	<i>Rhynchoedura ornata</i>											1	main road	1
Fat-tailed Gecko	<i>Diplodactylus conspicillatus</i>						1							1
Northern Spiny-tailed Gecko	<i>Strophurus ciliaris</i>	4	1	2		1		1		1	1	1	Between site 1 and 9	12
Tree Dtella	<i>Gehyra variegata</i>		1								1			2
Ridge-tailed Monitor	<i>Varanus acanthurus</i>	1	1					1	1	1				5
Rusty Desert Monitor	<i>Varanus eremius</i>					1	1							2
Rusty-topped Delma	<i>Delma borea</i>	1												1
Centralian Blue-Tongued Lizard	<i>Tiliqua multifasciata</i>					1	1	1						3
Grey's Menetia	<i>Menetia greyii</i>						3							3
Helen's Ctenotus	<i>Ctenotus helenae</i>					2								2
Leopard Ctenotus	<i>Ctenotus pantherinus</i>	4	5	7	1	4		3		1				25
Metallic Snake-eyed Skink	<i>Cryptoblepharus metallicus</i>										1			1
Pi anka's Ctenotus	<i>Ctenotus piankai</i>							1						1
Schomburgk's Ctenotus	<i>Ctenotus schomburgkii</i>	1												1



Species		Site										Incidental	Notes	Total
		1	2	3	4	5	6	7	8	9	Camp			
Tana mi Ctenotus	<i>Ctenotus tanamiensis</i>	1	2		2	1			2	2				10
Three-spined Rainbow Skink	<i>Carlia triacantha</i>				1		1			1				3
Two-toed Lerista	<i>Lerista bipes</i>				1				1					2
Unidentified Ctenotus				1										1
unnamed skink	<i>Proablepharus reginae</i>	1					1							2
Black-headed Python	<i>Aspidites melanocephalus</i>											1	east of site 9	1
King Brown Snake	<i>Pseudechis australis</i>	1												1
Little Spotted Snake	<i>Suta punctata</i>	1	1			1				1		1	main road	5
All fauna		77	63	35	32	33	47	31	31	39	45	21		454



Appendix E

Brief reviews of threatened fauna species' biology and conservation status



Brief Reviews of Threatened Fauna Species Biology and Conservation Status

Below is an account of each of the threatened species known or predicted to occur in the study area. Near-threatened species (e.g. bush stone-curlew, grey falcon) are not included. Accounts include species' threat status at Northern Territory and national levels, details regarding their ecology, habitat use, current threats and possible survey techniques that could be applied to detect the species in the study area. Three of these threatened species were recorded during the fauna survey (greater bilby, brush-tailed mulgara and Australian bustard).

Mammals

Central rock-rat (Zyzomys pedunculatus)

The central rock-rat is listed as endangered under the EPBC Act and endangered under the TPWC Act, and is endemic to the Northern Territory.

Very little is known of the habitat requirements of the central rock-rat. They have been found in a variety of vegetation communities from hummock grassland through low open shrubland over hummock grassland to low open woodland. Most sites with positive signs have been very steep southerly to easterly slopes, although recent captures have been recorded from the valley floor and on north facing slopes. All sites have had a high proportion of rock outcrop and a very stony soil surface. Vegetation elements common to most sites are *Callitris glaucophylla*, *Acacia macdonnellensis*, various tussock grasses and close proximity to dense spinifex (DSEWPaC 2011a).

The current threats to the central rock-rat are unknown, but it is thought that grazing by stock and feral herbivores may have contributed to their decline. Feral predators (cats and foxes) could have a negative effect on the small, dispersed populations of the species, and fire may have a limiting effect on the spread of the central rock-rat by limiting the availability of suitable habitat (DSEWPaC 2011a).

Survey methods for this species include baited Elliot and camera traps, scat searches, spotlight surveys, hair sampling and predator scat/owl pellet analysis.

No central rock-rats were recorded during this fauna survey.

Northern (Notoryctes typhlops) and southern (Notoryctes caurinus) marsupial mole

The northern and southern marsupial moles are both listed as endangered under the EPBC Act and vulnerable under the TPWC Act, and are distributed across much of Australia's sandy desert country in Western Australia, Northern Territory and South Australia. The species inhabit desert country, most often recorded on sand dunes with various acacias and other shrubs, sometimes in association with spinifex (Benshemesh 2004). They can occur in sandy plains and possibly river flats, especially where Aeolian dunes occur. Most locations are those with deep loose soil (Benshemesh 2004).

Predation by feral cats, European foxes and dingoes on marsupial moles when they are above ground, and soil compaction by stock movements or by vehicles, may be potential threats to the long-term survival of the species. Other threats such as altered fire regimes and grazing may change the abundance of ants, insect larvae and termites (Benshemesh 2004).

The most efficient method of surveying marsupial moles is to count the number of tunnels underground (Benshemesh 2004).

No marsupial moles were recorded during this fauna survey.



Brush-tailed mulgara (Dasycercus blythi)

The brush-tailed mulgara is listed as vulnerable under both the TPWC and EPBC Acts and occurs in isolated populations in the NT. This species occupies spinifex (*Triodia spp.*) grasslands, and burrows in flats between sand dunes. It is generally a solitary species that hunts at night, although it is not strictly nocturnal (Woolley 2008).

Its habitat has been adversely affected by the grazing of introduced species (e.g., camels, rabbits, cattle), and changes to the fire regime. It is also possible that predation by introduced feral cats and foxes may threaten this species. Climate change is likely to pose a threat to this species in the future (Woolley 2008).

Survey methods include Elliot and pitfall trapping, baited camera surveys, scat collection (including predators), and spotlighting on foot or from vehicle.

One brush-tailed mulgara was trapped in an Elliot trap at site 6 (Vegetation type 2; gravelly spinifex grassland with Acacia shrubland) during this fauna survey.

Crest-tailed mulgara (Dasycercus cristicauda)

The crest-tailed mulgara is listed as vulnerable under the EPBC Act and is widespread but patchily distributed in central arid sandy regions of Northern Territory, South Australia, and Western Australia. The species is nocturnal and inhabits hummock grass plains, sand ridges and mulga shrubland.

The crest-tailed mulgara can be sympatric with brush-tailed mulgara (Pavey *et al.* 2011).

Threatening processes are unclear, but are thought to include changes in fire regimes, introduced predators and grazing by introduced herbivores causing a reduction in available cover for prey items (Pavey and Cole 2002).

Survey methods may include Elliot and pitfall trapping, baited camera surveys, scat collection (including predators), and spotlighting on foot or from a vehicle.

No crest-tailed mulgara were recorded during this fauna survey.

Golden bandicoot (Isoodon auratus)

The golden bandicoot is listed as vulnerable under the EPBC Act and endangered under the TPWC Act. Its present distribution is disjunct with populations on Marchinbar Island, Northern Territory (Southgate *et al.* 1996; Woinarski *et al.* 1999), and Uwins Island, Augustus Island and the nearby Kimberley mainland at Yampi Peninsula, George Water and Prince Regent Nature Reserve, Western Australia (Maxwell *et al.* 1996; McKenzie *et al.* 1975, 1978).

Most information on the ecology of the golden bandicoot is from a single short-term study on Marchinbar Island (Southgate *et al.* 1996). There it occurs mainly in heathland and shrubland on sandstone or sandsheets, and avoids vegetation with greater tree cover.

The most likely threat to the species is predation by feral cats, rather than land-use factors.

No golden bandicoots were recorded during this fauna survey.

Greater bilby (Macrotis lagotis)

The greater bilby is listed as vulnerable under both the EPBC and TPWC Acts. Wild bilby populations are restricted predominantly to the Tanami Desert, Northern Territory (Johnson and Southgate 1990), the



Great Sandy and Gibson Deserts, Western Australia (Friend 1990), and an outlying population between Boulia and Birdsville in south-west Queensland (Gordon *et al.* 1990).

The species occupies three major vegetation types, open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Southgate 1990b). In the Tanami Desert the greater bilby is less abundant on dune and sand substrate than on laterite/rock features or drainage/calcrete substrates (Southgate *et al.* 2007).

Fox predation was the primary factor associated with regional declines of the species (Abbott 2001). Feral cats have been known to take the greater bilby as prey. Clearing of habitat for grazing and as a result of fire are potential threats (Southgate 1990a).

Recommended survey techniques include habitat assessments, searching for signs of activity, collection of predator scats and soil plot surveys. Spotlight or camera surveys at burrow entrances may be effective following detection of signs.

One greater bilby was observed during a spotlighting survey 4.1 km north of Wilson's Camp along the main track that leads to the Tanami Road. The habitat there is spinifex grassland with isolated small *Eucalypt/Corymbia* trees.

Black-footed rock-wallaby (Petrogale lateralis)

The black-footed rock-wallaby is listed as vulnerable under the EPBC Act and near threatened under the TPWC Act. Northern Territory animals belong to a currently undescribed subspecies, centred in the MacDonnell Ranges. The distribution of the MacDonnell Ranges subspecies is centred on the MacDonnell Ranges bioregion of the southern Northern Territory. In the Northern Territory its range extends north to the Davenport and Murchinson Ranges, east to the Jervis Range, west to the Western Australian border and south to the South Australian border (Pavey 2006).

Black-footed rock-wallabies occur in rocky outcrops and associated steep rocky slopes. They feed on grass, but some herbs and some leaves and fruits are eaten. Though occasionally drinking when water is present they can survive extended periods without water. Water requirements are reduced by sheltering during the day in caves and under boulders where relative humidity is higher and air temperatures cooler. They usually emerge in the late afternoon or early evening to feed. Animals may bask in the sun during the early morning following a cold night (Pavey 2006).

Major threats faced by isolated populations in Western Australia and South Australia and parts of the Northern Territory include predation by introduced (red fox, feral cat) and native (wedge-tailed eagle) predators, and habitat degradation caused by grazing by introduced herbivores (Pavey 2006).

Survey methods include the use of a helicopter to access sites to conduct scat counts/analysis, baited camera and cage traps. Other methods include observing basking/feeding areas in the early morning and conducting spotlight surveys.

No black-footed rock-wallaby were recorded during this fauna survey. There was no suitable habitat for this species in the study area.

Common brushtail possum (central Australia population) (Trichosurus vulpecula vulpecula)

The subspecies *T. v. vulpecula* is listed as endangered under the TPWC Act and occurs in isolated populations in the southern NT. It commonly occupies riverine habitat that is close to rocky outcrops and moist gullies within the ranges or rocky slopes (Kerle *et al.* 1992). This habitat occurs on various



geological substrates but is characterized by a diverse association of fire-sensitive plant species. A range of sites is used as shelter including caves and rock holes, tree hollows and the tops of dense trees. The diet consists of the flowers, fruits and leaves of a wide range of non-eucalypt species (Evans 1986).

The decline of the species in central Australia has been attributed to the interaction between severe drought and threatening processes such as grazing by introduced herbivores (cattle and rabbits), increased hunting around Aboriginal settlements and (historically) for the commercial fur trade, altered fire regimes, and predation (Kerle *et al.* 1992; Woinarski 2004).

Survey methods may include spotlighting on foot or from vehicle, and trapping.

No common brushtail possums were recorded during this fauna survey.

Birds

Princess parrot (Polytelis alexandrae)

The princess parrot is listed as vulnerable under both the EPBC and TPWC Acts and is confined to arid regions of Western Australia, the Northern Territory, and South Australia (Barrett *et al.* 2003; Blakers *et al.* 1984; Higgins 1999).

The species inhabits sand dunes and sand flats in the arid zone of western and central Australia. It occurs in open savanna woodlands and shrublands that usually consist of scattered stands of Eucalyptus, Casuarina or Allocasuarina trees, an understorey of shrubs, and a ground cover dominated by Triodia species (Allen 1987; Baxter and Henderson 2000; Carter 1993b; Ford and Sedgwick 1967; Forshaw and Cooper 2002; Garnett 1993; Johnstone and Storr 1998; Parker 1971; Pianka and Pianka 1970).

Threats to the species may include habitat degradation and reduced availability of food, the introduction of new and unsuitable fire regimes, and introduction of grazing animals such as sheep, rabbits and camels.

Recommended survey methods include area searches or transect surveys of suitable habitat in the early morning with detection by sighting or call. Targeted searches and subsequent watches of waterholes for presence in late dry season may prove fruitful.

No princess parrots were recorded during this fauna survey.

Australian painted snipe (Rostratula australis)

The Australian Painted Snipe is listed as vulnerable under both the EPBC and TPWC Acts and occurs across much of Australia. It is most common in eastern Australia and has been recorded less frequently in South Australia, the Northern Territory and Western Australia (Barrett *et al.* 2003; Blakers *et al.* 1984; Marchant and Higgins 1993; Rogers *et al.* 2005). Migration patterns are poorly known for this species (Pringle 1987). Their movements are possibly dispersive or migratory (Lowe 1963) and likely to follow wetland habitat availability and condition.

The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* spp. or canegrass or sometimes tea-tree (*Melaleuca*). Nest records are all, or nearly all, from or near small islands in freshwater wetlands (D. Rogers 2002, *pers. comm.*), provided



that these islands are within a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover (Rogers *et al.* 2005).

The primary factor in the decline of the Australian Painted Snipe has probably been a loss and alteration of wetland habitat for agricultural activities. Predation by feral animals is also a potential threat to the species.

Recommended methods to detect the species include area searches or transects through suitable wetlands and stationary observations at dawn and dusk of suitable foraging locations within wetlands. Also a brief spotlight search shortly after dusk may detect birds.

No Australian painted snipes were recorded during this fauna survey. There was no standing water or wetland habitat in the study area which is required by this species.

Australian bustard (Ardeotis australis)

The Australian bustard is listed as vulnerable under the TPWC Act and is widespread, although generally scarce in the Northern Territory. It is more common in the north of Australia, occurring in loose aggregations, particularly during the breeding season when they exhibit a unique 'exploded' lek mating system, where the males occupy display arenas that females visit for mating purposes. The species' strongholds in the Northern Territory include the Barkly Tableland, Daly River region, the Victoria River District and the Tanami Desert.

The Australian bustard typically occurs in open habitats, preferring grasslands, low shrublands, grassy woodlands and other structurally similar but artificial habitats such as croplands and airfields. This species responds favourably to fire and is often located in recently burnt habitats, including woodlands.

Threats to this species include impacts such as fluctuations in rainfall, altered fire regimes, predation by exotic species, habitat alteration, pesticides, grazing and hunting pressure (e.g. traditional hunting with access to modern weapons on a species with a low reproductive rate).

Methods to detect this species generally involve covering large distances in appropriate habitat, possibly vehicle-based or via transects.

Seven observations of Australian bustards were recorded during this fauna survey.

Emu (Dromaius novaehollandiae)

The emu is listed as vulnerable under the TPWC Act and is extremely widespread across continental Australia. It occurs across most of the Northern Territory but is scarce in the driest desert regions and densities are low in most of the Top End woodlands (Marchant and Higgins 1990). Emus can move large distances in response to a decline in food or water resources. They are probably more sedentary in the north than the south of the Territory.

Threats to the species are thought to be primarily associated with changing fire regimes i.e. the occurrence of too frequent extensive fires.

Methods to detect this species could involve covering large distances in appropriate habitat, possibly vehicle-based or via transects.

No Emus were recorded during this fauna survey.



Reptiles

Great desert skink (Liopholis kintorei)

The great desert skink is listed as vulnerable under the EPBC Act and the TPWC Act. The current distribution consists of seven isolated populations. Three populations occur in WA including the vicinity of Lake Mackay, with NT populations in the Tanami Desert, including Rabbit Flat, Sangster's Bore, The Granites and near Kintore; in Uluru - Kata Tjuta NP including part of the Yulara borefields; and in the Yulara lease lands.

The great desert skink occupies a range of vegetation types with the major habitat being sandplain and adjacent swales. Vegetation usually consists of hummock grassland (*Triodia basedowii*, *T. pungens* and *T. schinzii*), with some scattered shrubs and occasional trees (e.g. *Acacia spp.*, *Eucalyptus spp.*, *Hakea spp.*, *Grevillea spp.* and *Allocasuarina decaisneana*) (Cogger *et al.* 1993; McAlpin 2001).

Threats to the species include intense large-scale fires, predation by foxes and cats, and rabbits digging up burrow systems.

The most appropriate survey technique is to locate burrow systems and communal latrines by walking transects in late summer and early autumn.

No great desert skinks were recorded during this fauna survey.

Floodplain monitor (Varanus panoptes)

The floodplain monitor is listed as vulnerable under the TPWC Act and has a broad geographical range across the far north of Australia. In the Northern Territory it has been recorded across most of the Top End and the Gulf Region. The Floodplain Monitor occupies a variety of habitats, including coastal beaches, floodplains, grasslands and woodlands (Ward *et al.* 2006).

The most severe threat to the species is its propensity to eat cane toads and it is highly susceptible to the ingested toxins (Ward *et al.* 2006).

Methods to detect this species could involve covering large distances in appropriate habitat, possibly vehicle-based or via transects or alternatively via camera traps baited with a meat-based product. Juvenile specimens are likely to be captured using pitfall trapping.

No floodplain monitors were recorded during this fauna survey.



Appendix F

Brief review of introduced fauna species



One-humped camel (Camelus dromedarius)

Feral camels occur over 40% of the Australian mainland (3.3 million km²), being confined primarily to the drier parts of Western Australia, South Australia and the Northern Territory. In the Northern Territory feral camels are found over an area of approximately 550,000 km², or around 40% of the land area.

Distribution is confined to two main regions: the eastern desert area comprised principally of the Simpson Desert and fringing pastoral properties, and the western desert area comprised of the Central Ranges, Great Sandy Desert and Tanami bioregions. Although commonly associated with sandy country, camels can be found in any of the habitat types in the southern half of the Northern Territory.

In central Australia camels feed on more than 80% of the available plant species, severely defoliating and suppressing the recruitment of shrub and tree species. Feral camels have a noticeable impact on fragile salt lake ecosystems and foul waterholes, which are important sites for Aboriginal people and native fauna. Feral camels are likely to destabilise dune crests thereby contributing to erosion. Feral camels are likely to be common in the study area.

Camel tracks were observed in four of the fauna survey sites.

Cat (Felis catus)

Feral cats occupy all Northern Territory habitats, ranging from rainforest to desert. Occupation of arid regions has apparently been facilitated by their ability to survive without drinking. Available data indicate that populations fluctuate markedly in time and space.

Predation by feral cats is appropriately listed as a key threatening process under the EPBC Act. Feral cats are likely to be present in the study area.

Cat tracks were observed at site 4 (Vegetation type 2; gravelly spinifex grassland with Acacia shrubland) during this fauna survey.

Feral cattle (Bos taurus/indicus)

In Australia, cattle negatively affect the natural environment by contributing to land degradation through trampling, soil compaction and erosion, increased nutrient loading, spread of weeds, and sedimentation of waterways. Feral cattle may be present within the study area, although it is more likely that widely ranging domesticated cattle would be encountered across the study area depending on conditions and available pasture.

No signs of feral cattle were recorded during this fauna survey.

Donkey (Equus asinus)

In Australia, donkeys pose a significant threat to the natural environment. They have been associated with increased erosion of soil and waterways, spread of weeds, trampling of native vegetation, consumption of native seedlings leading to reduced biodiversity, sedimentation of waterways and water bodies, destruction of infrastructure, and competition with native species and domestic cattle for resources. Feral donkeys may be present, particularly within rocky habitats within the study area.

No signs of donkeys were recorded during this fauna survey.

House mouse (Mus musculus)

Despite their distribution throughout Australia, house mice are not currently considered to be a great threat to biodiversity in the Northern Territory. Nevertheless, there have been some concerns about the



impacts of house mice seed predation on native vegetation. In some locations house mice prey on young birds. This species is likely to be present at varying levels of abundance depending on rainfall, with plagues potentially occurring following good rainfall, followed by relatively low numbers in dry years. Impacts from this species are likely to be low generally, except when their numbers are high.

No house mice were recorded during this fauna survey.

Swamp buffalo (Bubalus bubalis)

The most obvious signs of buffalo damage are disturbance of soils and vegetation owing to overgrazing and wallowing in mud. Buffalo have also been implicated in the spread of weeds, particularly *Mimosa pigra* on floodplain habitats.

On inundated floodplain habitats, buffaloes undertake regular movements along pathways called “swim channels”. The movement of buffaloes along these channels destroys vegetation and erodes the soil creating new drainage channels. The alteration of floodplain hydrology by swim channels has been implicated in the landward expansion of sea water, termed saltwater intrusion. Saltwater intrusion has been implicated in the loss of extensive areas of paperbark forest on the Mary River floodplains.

Habitat modification by feral buffaloes has been observed to reduce the nesting activity of magpie geese. There is anecdotal evidence that grazing by buffalo may also reduce nesting activity in crocodiles. It is likely that buffalo may have major impacts on other flora and fauna but these impacts have not been documented. Feral buffalo are of concern to agricultural and defence interests owing to their potential as reservoirs and vectors for disease. In particular, there is concern that buffalo have the potential to carry and spread foot and mouth disease, brucellosis and tuberculosis. Swamp buffalo may be present within the study area, although their abundance is likely to be low and confined to more reliably wet areas in the north of the study area (if this habitat is present with any regularity).

No signs of swamp buffalo were recorded during this fauna survey.

Rabbit (Oryctolagus cuniculus)

Rabbits compete with domestic stock for food, damage soils contributing to erosion, and cause profound damage to native plants. In the arid areas of Australia, including the southern Northern Territory, rabbits overgraze pasture plants and reduce trees and shrubs by killing mature plants and suppressing the recruitment of seedlings.

Rabbits have a deleterious impact on many native fauna either directly through competition for food or shelter, or indirectly through environmental modification. The result is loss of biodiversity. Rabbits have been linked to the decline of species like the greater bilby (*Macrotis lagotis*) and the disappearance of the burrowing bettong (*Bettongia lesueur*) in the Northern Territory.

Rabbits are patchily distributed in arid areas south of a line extending east-west across the Territory 100 km north of the tropic of Capricorn. A few isolated populations have been recorded further north.

Competition and land degradation by feral rabbits is listed as a key threatening process under the EPBC Act. Rabbits may be present in the study area with abundance varying depending on rainfall conditions.

No rabbits or signs of rabbits were recorded during this fauna survey.



Appendix G

Legislation



The following provides information with regard to specific biodiversity legislation and policy relevant to the Project. This information is not intended to provide an exhaustive list of legislative requirements but rather a summary of the key requirements. The information is based upon GHD's understanding of the legislation and policy, and GHD consultants' experience with their implementation. There is a possibility that regulatory authorities may interpret and/or implement the legislation and policy differently.

Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act 1999

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), any development requires assessment if it has the potential to affect one or more of eight Matters of National Environmental Significance (MNES). The MNES are:

- ▶ Listed threatened species and ecological communities.
- ▶ Migratory species protected under international agreements.
- ▶ Ramsar wetlands of international importance.
- ▶ The Commonwealth marine environment.
- ▶ World Heritage properties.
- ▶ National Heritage places.
- ▶ Great Barrier Reef Marine Park.
- ▶ Nuclear actions.

The environment under the EPBC Act includes:

- a) Ecosystems and their constituents;
- b) Natural and physical resources;
- c) Qualities and characteristics of locations, places and areas;
- d) Heritage values of places; and
- e) The social, economic and cultural aspects of a thing mentioned in paragraphs a), b) or c).

The EPBC Act promotes the conservation of biodiversity by providing protection for threatened species, threatened ecological communities, migratory and marine species and other protected matters.

Twenty-one EPBC listed threatened species and seven EPBC listed Migratory species are likely to, may, or are known to, occur in the search area (study area plus a 10 km buffer). Two EPBC listed threatened species were recorded during this survey. A referral will need to be submitted under the EPBC Act to determine if the Project may impact significantly on MNES i.e. listed threatened species and communities (sections 18 and 18A).

Northern Territory Legislation

Territory Parks and Wildlife Conservation Act 1998

The extended title of the *Territory Parks and Wildlife Conservation Act 1998* (TPWC Act) is:

“An Act to make provision for and in relation to the establishment of Territory Parks and other Parks and Reserves and the study, protection, conservation and sustainable utilisation of wildlife”.



The TPWC Act has provisions for parks and reserves, animals and plants (including wildlife and protected wildlife).

The TPWC Act defines wildlife as that being in a park, reserve, sanctuary, wilderness zone or area of essential habitat, or is a vertebrate that is indigenous to Australia (other than fish), or is specifically prescribed as being protected by the TPWC Regulations. Protected wildlife is protected wildlife whether or not the property in the wildlife is vested in the Territory.

The TPWC Act prohibits the intentional killing of any terrestrial or marine vertebrate (with the exception of fish).

All threatened species are classed as protected wildlife. The TPWC Act precludes the taking of and interference with protected species of wildlife. The Act includes "Principles of Management". These require that a threatened species be managed in a manner that "maintains or increases their population or the extent of their distribution at or to a sustainable level". Threatened species are defined under the Territory's Wildlife regulations as being species that are 'extinct', "critically endangered", "endangered" or "vulnerable".

Mining Management Act 2001

The *Mining Management Act 2001* provides for authorisation of mining activities, management of mining sites, preparation of the environment on mining sites and related purposes. The Mining Management Act is administered by NT Department of Resources (DoR). The objectives of the Mining Management Act are to:

- ▶ Ensure the development of the Territory's mineral resources are in accordance with environmental standards consistent with best practice in the mining industry.
- ▶ Protect the environment by:
 - The authorisation and monitoring of mining activities requiring appropriate management of mining sites;
 - Facilitating consultation and cooperation between management and workers in implementing environment protection management systems;
 - Implementing audits, inspections, investigations, monitoring and reporting to ensure compliance with agreed standards and criteria; and
 - Specifying the obligations of all persons on mining sites with respect to protection of the environment.
- ▶ Assist the mining industry to introduce programs of continuous improvement to achieve best practice environmental management.
- ▶ Enable persons connected with the mining industry to participate in the implementation of this Act through the establishment of a Mining Board to advise the Minister on:
 - Guidelines for the industry;
 - Specification of competencies required by persons involved in the industry;
 - Best practice in mining activities; and



- Minimise the liability of the Territory by requiring the payment of security to provide for the rehabilitation of mining sites or to rectify environmental harm caused by mining activities.

Planning Act 2009

The *Planning Act 2009* defines "development" as an activity that involves carrying out works on land, including clearing of native vegetation. "Works" is defined as any activity on land, other than mining or agriculture, resulting in a physical change to the land or a part of the land.

The planning scheme requires native vegetation to be cleared in accordance with the Land Clearing Guidelines 2010 (NRETAS 2010). This document contains guidelines for clearing, including the submission of a property management plan by the applicant. The Planning Act does not apply to mining. As the proposed works are being undertaken as part of a mining operation the Land Clearing Guidelines do not apply to this project. However one of the requirements stipulated in the Environmental Impact Statement (EIS) guidelines is to discuss proposed clearing with regard to issues raised and recommendations contained within the Clearing Guidelines. These guidelines refer to a number of issues not limited to flora and vegetation and are not treated in their entirety within this report.

Weeds Management Act 2001

The *Weeds Management Act 2001* (WM Act) is in place to prevent the spread of weeds and to ensure that the management of weeds is an integral component of land management. This is to be conducted in accordance with the Northern Territory Weeds Management Strategy 1996 2005 (NRETA n.d.) or any other strategy adopted to control weeds in the Territory.

Noxious Weeds

Declared noxious weeds in the NT are plants proclaimed under the WM Act. The legislation requires that reasonable attempts be made to control or eradicate these species. Categories of noxious weeds include the following:

Schedule Class A/C Weeds: These plants do not occur in the NT but pose a significant threat if they invade, or if present, pose a serious threat. Reasonable effort must be made to eradicate these weeds.

Schedule Class B/C Weeds: These weeds often occur widely in the NT. They are capable of spreading further and should be prevented from doing so. Continuing control measures are required to prevent their spread. Reasonable attempts must be made to contain the growth and prevent the movement of these plants.

Schedule Class C Weeds: This category includes plants that pose an unacceptable risk of spreading in the Territory or to other parts of Australia if they were to be sold or traded in the NT and are a serious threat to another State or Territory of Australia. All schedule Class A and B weeds are considered to be Class C weeds.

No declared noxious weeds were recorded within the study area.



Appendix H

Details of linear regression (fauna)



Analysis 1 – Multiple Linear Regression; METHOD=FORWARD.

Dependent variable - species count (**all fauna**).

Independent variables - Periodsincefire Litter Bareground Crust Exposedrocks Gravel veg_gt3 veg13 veg0.51 veg00.5 canopyht.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.693 ^a	.480	.406	5.808

a. Predictors: (Constant), veg0-0.5

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	218.119	1	218.119	6.467	.038 ^a
	Residual	236.103	7	33.729		
	Total	454.222	8			

a. Predictors: (Constant), veg0-0.5

b. Dependent Variable: All fauna

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11.183	5.562		2.011	.084
	veg0-0.5	40.802	16.045	.693	2.543	.038

a. Dependent Variable: All fauna

Excluded Variables^b

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Period since fire	.240 ^a	.833	.437	.322	.935
	Litter	.253 ^a	.708	.505	.278	.626
	Bare ground	.127 ^a	.426	.685	.171	.953
	Crust	-.148 ^a	-.507	.630	-.203	.980
	Exposed rocks	-.287 ^a	-1.030	.343	-.388	.948
	Gravel	-.116 ^a	-.357	.734	-.144	.798
	veg_gt3	.155 ^a	.528	.616	.211	.965



veg1-3	.201 ^a	.635	.549	.251	.807
veg0.5-1	.170 ^a	.591	.576	.235	.990
canopy ht	.025 ^a	.086	.934	.035	.988

a. Predictors in the Model: (Constant), veg0-0.5

b. Dependent Variable: All fauna

Analysis 2 – Multiple Linear Regression; METHOD=FORWARD.

Dependent variable - species count (**mammals**).

Independent variables - Periodsincefire Litter Bareground Crust Exposedrocks Gravel veg_gt3 veg13 veg0.51 veg00.5 canopyht.

Warnings

No variables were entered into the equation.

Analysis 3 – Multiple Linear Regression; METHOD=FORWARD.

Dependent variable - species count (**birds**).

Independent variables - Periodsincefire Litter Bareground Crust Exposedrocks Gravel veg_gt3 veg13 veg0.51 veg00.5 canopyht.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.738 ^a	.544	.479	3.043

a. Predictors: (Constant), Litter

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	77.387	1	77.387	8.355	.023 ^a
	Residual	64.836	7	9.262		
	Total	142.222	8			

a. Predictors: (Constant), Litter

b. Dependent Variable: All birds

Coefficients^a

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
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	B	Std. Error	Beta		
1 (Constant)	10.561	1.450		7.283	.000
Litter	91.289	31.582	.738	2.891	.023

a. Dependent Variable: All birds

Excluded Variables^b

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Period since fire	.191 ^a	.719	.499	.282	.994
	Bare ground	-.073 ^a	-.261	.803	-.106	.954
	Crust	-.243 ^a	-.910	.398	-.348	.936
	Exposed rocks	-.068 ^a	-.232	.824	-.094	.874
	Gravel	-.013 ^a	-.043	.967	-.018	.814
	veg_gt3	.285 ^a	1.137	.299	.421	.998
	veg1-3	-.115 ^a	-.415	.692	-.167	.961
	veg0.5-1	-.102 ^a	-.374	.721	-.151	1.000
	veg0-0.5	.401 ^a	1.302	.241	.469	.626
	canopy ht	.014 ^a	.051	.961	.021	.959

a. Predictors in the Model: (Constant), Litter

b. Dependent Variable: All birds

Analysis 4 – Multiple Linear Regression; METHOD=FORWARD.

Dependent variable - species count (**reptiles**).

Independent variables - Periodsincefire Litter Bareground Crust Exposedrocks Gravel veg_gt3 veg13 veg0.51 veg00.5 canopyht.

Warnings

No variables were entered into the equation.



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