



Judbarra / Gregory National Park Northern Territory

24 May–5 June 2015

Bush Blitz Species Discovery Program



Australian Government

Department of the Environment and Energy



bhpbilliton

Sustainable Communities



Australian
Biological
Resources
Study

What is Bush Blitz?

Bush Blitz is a multi-million dollar partnership between the Australian Government, BHP Billiton Sustainable Communities and Earthwatch Australia to document plants and animals in selected properties across Australia.

This innovative partnership harnesses the expertise of many of Australia's top scientists from museums, herbaria, universities, and other institutions and organisations across the country.

Abbreviations

ABRS

Australian Biological Resources Study

ANU

Australian National University

CDU

Charles Darwin University

DENR

Department of Environment and Natural Resources (Northern Territory)

EPBC Act

Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

MAGNT

Museum and Art Gallery of the Northern Territory

NTH

Northern Territory Herbarium, Department of Environment and Natural Resources

QM

Queensland Museum

TPWCA

Territory Parks and Wildlife Conservation Act 2000 (Northern Territory)

UNSW

University of New South Wales

UofA

University of Adelaide

WAM

Western Australian Museum

Summary

The Judbarra / Gregory National Park in the Northern Territory (NT) was the focus of a Bush Blitz expedition from 24 May to 5 June 2015. The park is managed jointly by the Traditional Owners and the Parks and Wildlife Commission of the NT.

As the second largest national park in the NT, its size, ruggedness and the inaccessibility of much of the park has meant that previously significant areas of both the Victoria River Gorge and Bullita sections had not been adequately surveyed. Bush Blitz provided a unique opportunity to sample a region where, in many cases, there was no background information. The new records obtained add significantly to knowledge of the distribution of species, and are important for future biodiversity modelling in the NT.

The Bush Blitz recorded 794 species, 217 of which had not been recorded previously in the park (5 vertebrates, 168 invertebrates and 40 vascular plants). Twenty-nine species may be new to science (2 mammals, 2 reptiles, 5 true bugs and 20 spiders). Of the new records, 35 are noticeable range extensions for plants and animals. Further surveys during the wet season or early dry season in a year with higher rainfall will probably record additional species in most plant and animal groups.

Among the hundreds of plant and animal records obtained, some highlights included:

- Four terrestrial vertebrate species recorded for the first time in the park: the Sombre Whip Snake (*Demansia quaesitor*), Straw-necked Ibis (*Threskiornis spinicollis*), Northern Brushtail Possum (*Trichosurus vulpecula arnhemensis*) and Northern Brown Bandicoot (*Isoodon macrourus*)
- discovery of a possible new glider species in the Top End
- genetically and phenotypically distinct individuals of North-west Prickly Gecko (or Bynoe's Prickly Gecko) (*Heteronotia planiceps*) collected from limestone sites. Analysis of this group is ongoing and expected to result in the description of the Judbarra / Gregory limestone population as a separate species
- first record of the Swamp Eel (*Ophisternon gutturale*) from the Victoria River catchment
- 168 invertebrates newly recorded for the park (4 butterflies, 1 moth, 95 true bugs, 20 dragonflies and damselflies, 48 spiders)
- 40 vascular plant species newly recorded for the park, with significant range extensions of up to 370km.

The EPBC-listed Gouldian Finch (*Erythrura gouldiae*) was observed feeding in clearings of unburnt, grassy woodland: the park contains important breeding habitat for this species. The semi-aquatic Mertens' Water Monitor (*Varanus mertensi*) was observed in the East Baines River, and the Angalarrri Grunter (*Scortum neili*) was collected at Limestone Gorge. The Angalarrri Grunter is considered vulnerable in the NT; it is one of Australia's rarest fish.

No EPBC-listed plants were collected; however, 18 taxa of conservation significance under the NT *Territory Parks and Wildlife Conservation Act 2000* (TPWCA) were collected (1 vulnerable, 6 near threatened and 11 data deficient).

Introduced species noted included Cattle (*Bos taurus*), Donkey (*Equus asinus*) and Cat (*Felis catus*). Cats were recorded on remote cameras at more sites than any other feral vertebrate, yet not one was actually seen. Cane Toads (*Rhinella marina*) have been in the park for less than 10 years and were detected at most sites. A significant attribute of the survey sites was the lack of introduced fish species.

No gazetted weeds were recorded; however, Buffel Grass (*Cenchrus ciliaris*) was recorded in Limestone Gorge and probably occurs elsewhere in the park.

Particular areas of the park have special attributes and warrant the focus of management. The limestone karst landscape, some gorges and escarpments have large areas of dry vine thicket that support many species, particularly frugivores. The permanent watercourses in the large spring-fed refuges of the Wickham River and East Baines River have high species richness and populations of rare, restricted or threatened species, and high cultural values. The northern portion of the park is probably the most significant area in terms of rare and restricted flora. This area may have endemic terrestrial vertebrates living on the flat tops of isolated rocky outcrops.

Although the park's vegetation and watercourses appear to be in relatively good condition, several key threatening processes were observed throughout the park, in particular the prevalence of feral livestock and fire. Extensive fires and grazing by feral livestock interact to create open habitats that can threaten native wildlife. Fire is likely to be the most significant threat, particularly in fire sensitive habitats such as dry vine thickets and sandstone shrublands.

It is strongly recommended that dedicated flora and fauna monitoring programs be re-established in the park to provide information on species in the context of current management regimes. The status of populations of fire-sensitive plants (particularly obligate-seeding shrubs) is largely unknown. Likewise, the status of fauna populations, particularly the trajectory of small mammals, is unknown. Based upon the prevailing fire regimes and the observed number of feral animals, small mammal diversity has probably declined.

Other suggestions for park management include:

- Explore alternative fire management strategies associated with carbon-trading and greenhouse gas reduction projects.
- Encourage ongoing vigilance and awareness of potential fish invaders, particularly Eastern Gambusia (*Gambusia holbrooki*), aquarium fishes such as Guppy (*Poecilia reticulata*) and the highly invasive Tilapia (*Oreochromis mossambicus*). Continue to discourage the use of live fish bait within the park.
- Identify and map other locations where the Angalarri Grunter occurs. A study combining traditional knowledge and fishing effort with scientific data collection would be an ideal future project.
- Conduct additional research on the Freshwater Sawfish (*Pristis pristis*) in large river habitats to improve understanding of its local status and conservation needs.
- Encourage future cave explorers to look for cave fishes, for example blind gudgeons and white swamp eels.
- Map suitable habitat for the Purple Beak butterfly in limestone outcrops in the park.
- Undertake long-term sampling at a number of key habitats, especially during the wet season, to improve understanding of the spider fauna.
- Protect all patches of vine thicket flora, no matter how small, from fire and weeds. Vine thicket conservation is dependent upon maintenance of the mosaic of habitat patches, along with the bird and bat populations that link them.
- To locate potential problem weeds, conduct targeted and incidental surveys in wetter seasons.

Contents

What is Bush Blitz?	2
Summary	3
Introduction	6
Acknowledgements	7
Reserve overview	8
Description	8
Conservation values	8
Methods	10
Taxonomic groups studied and personnel	10
Site selection	11
Survey techniques	11
Identification	13
Results	14
Species lists	15
Discussion	16
Putative new species	16
Threatened species	19
Exotic and pest species	22
Range extensions	24
Other points of interest	28
Glossary	34

Introduction

This is a report for the Bush Blitz program, which aims to improve our knowledge of Australia's biodiversity. Bush Blitz is an initiative of the Australian Government, through the Australian Biological Resources Study (ABRS), in partnership with BHP Billiton Sustainable Communities and Earthwatch Australia. Bush Blitz aims to:

- promote, publicise and demonstrate the importance of taxonomy through species discovery
- undertake a national species discovery program
- support the science of taxonomy in Australia through training of students and early career researchers, and by providing grants for species description and resolution of taxonomically problematic, nationally important groups
- promote partnerships between scientific institutions, government, industry and non-government organisations
- inform reserve managers and other stakeholders of the results of Bush Blitz projects.

The Judbarra / Gregory National Park Bush Blitz

This survey took place between 24 May and 5 June 2015: the results are therefore representative of those taxa present/active in the early to mid dry season. The wet season rainfall was well below average and the weather was warm and dry in the lead up and during the survey. Although the warm days and nights were generally good for sampling, particularly for reptiles, the dry conditions combined with a large portion of the park having been burnt prior to the survey meant that some species were found in low numbers, others were absent or impossible to detect.

An important feature of this Bush Blitz was the participation of Traditional Owners of Judbarra / Gregory National Park with assistance from the Northern Land Council. Rangers from the Wardaman Indigenous Protected Area worked with the scientists, which was a good opportunity to learn new skills, particularly camera trapping. Traditional Owners welcomed the team with a head-wetting ceremony. They also performed traditional dances, shared stories of the park's history and of their experiences living there.

Eight BHP Billiton employees, coordinated by Earthwatch Australia, participated as field assistants to the scientists. This professional development opportunity is available to BHP Billiton employees twice a year, and their involvement is highly regarded by the Bush Blitz team.

Bush Blitz provided the logistical coordination and overall leadership for the survey. The Museum and Art Gallery of the Northern Territory and the Northern Territory Herbarium were the host institutions for this Bush Blitz, providing the core group of personnel and accessioning the specimens into their collections. Experts from the following organisations conducted the field and laboratory work:

- Australian Biological Resources Study (ABRS)
- Australian National University (ANU)
- Charles Darwin University (CDU)
- Department of Environment and Natural Resources (Northern Territory) (DENR)
- EcOz Environmental
- Museum and Art Gallery of the Northern Territory (MAGNT)

- Northern Land Council
- The Parks and Wildlife Commission of the Northern Territory
- Queensland Museum (QM)
- University of New South Wales (UNSW)
- University of Adelaide (UofA)
- Western Australian Museum (WAM)

Acknowledgements

The Bush Blitz team were Mim Jambrecina, Beth Tully and Kate Gillespie. They would like to thank the Traditional Owners of Judbarra / Gregory National Park and the Northern Territory Parks and Wildlife Commission for allowing Bush Blitz to conduct research in the park.

Park staff provided vital on-ground information, assistance and access to facilities. Special thanks to Michael Kessner (Chief District Ranger), Andrew Peckham (Senior District Ranger), Jenny Petursson (Senior Park Ranger, Bullita) and Toby Read (Senior Park Ranger, Timber Creek).

The team would also like to thank the Northern Land Council for conducting extensive consultation with traditional owners prior to the survey and for their invaluable assistance in the field, in particular Michelle Cullen, Richard Campbell and Paul Simonato. The Wardaman IPA rangers who took part included Jason Raymond, Michael Murrimal, Matthew Birdum, Basil Murrimal, Kenny Allyson and Ted Croker Junior. Traditional Owners Larry Johns and Ivy Yajingali also took part in the Bush Blitz.

The interest and enthusiasm of BHP Billiton employees and their coordinator Bruce Paton (Earthwatch Australia) were gratefully received. BHP Billiton employees on the trip were Alice Taysom, Amanda Walsh, Jeremy Monaghan, Michael Evans, Brad Yabsley, Sarah Knoll, Troy Harris and Rosie Turley.

Finally, the team wishes to thank Dan Driscoll the helicopter pilot from HeliSpirit (Kununurra) and all other participants.

Reserve overview¹

Reserve name: Judbarra / Gregory National Park (also known as Jutpurra)

Area: approximately 13,000 km²

Description

The park was established in 1990 in the Victoria River District of the western NT. It is the second largest national park in the NT. The park is divided into two sections: the eastern Victoria River Gorge section, primarily to the north of where the Victoria Highway crosses the Victoria River; and the western Bullita section, centred on the former Bullita Station and portions of adjoining pastoral properties. The Wambardi Aboriginal Land Trust has leased adjoining Aboriginal Land to the NT government, effectively increasing the size of the park and linking the two sections.

Historically, it was named Gregory National Park in honour of the early explorer Augustus Charles Gregory. In 2011, under a joint management plan with the traditional owners, it was given the dual name Judbarra / Gregory for a period of ten years.

The park's wide latitudinal range spans a strong gradient in mean annual rainfall from approximately 950 mm in the north to 650mm in the south, between the seasonally dry monsoonal tropics and the semi-arid zones. Due to its location in the transition zone between tropical and semi-arid regions, the park contains a multitude of habitats; these broadly include monsoon rainforest, tropical and savanna woodlands dominated by a range of tree species, sandstone heathland and Spinifex grassland.

The park encompasses a variety of landforms and lithologies with the central portion of the Bullita section dominated by carbonate sediments (dolomite and dolomitic siltstone), forming terraced hills and karst systems. The northern and southeastern sections of the park are dominated by relatively flat-lying, medium to coarse-grained clastic sediments many of which have been deeply weathered.

Significant areas along the park's southern boundary are characterised by extensive basalt and 'black-soil' plains. This broad scale environmental variation results in distinct geographic patterns in species' occurrence relating to bioclimatic factors and a diverse assemblage of vegetation associations seemingly correlated with parent lithology and regolith development.

Conservation values

The park is a living cultural landscape for many groups of traditional owners who continue to have deep and ongoing connections with the land. The park encompasses the traditional lands of several Aboriginal language groups, including the Ngarinyman, Karrangpurru, Malngin, Wardaman, Ngaliwurru, Nungali, Bilinara, Gurindji and Jaminjung. It is an invaluable resource for traditional owners, who continue to use the natural resources of the park and maintain cultural traditions. Numerous archaeological sites in the

¹ Information sourced from <https://nt.gov.au/leisure/parks-reserves/find-a-park-to-visit/judbarra-gregory-national-park> and <http://www.austlii.edu.au/au/journals/NativeTitleNlr/2010/22.pdf>

park testify to the long history of Aboriginal occupation. The area is known for distinctive rock art, including many composite engraved and painted figures.

The park also contains an internationally significant limestone landscape, which includes one of the longest cave systems² in the southern hemisphere.

² Helictite. 2012, A history of cave exploration in the Judbarra / Gregory National Park. 41: 5–14.
<http://helictite.caves.org.au/pdf1/41.Kershaw.History.pdf>.

Methods

Taxonomic groups studied and personnel

A number of taxonomic groups were selected as targets for study. Table 1 lists the groups surveyed and the specialists who undertook the fieldwork.

Table 1 Taxonomic groups surveyed and personnel

Group	Common name	Expert	Affiliation
Vertebrata	General vertebrates	Kym Brennan	DENR
		Terry Mahney	DENR
		Graeme Gillespie	DENR
Mammalia	Gliders	Teigan Cremona	CDU
		Alyson Stobo-Wilson	CDU
Amphibia and Reptilia	Amphibians and reptiles	Dane Trembath	EcOz
		Gaye Bourke	ANU
Pisces	Fishes	Michael Hammer	MAGNT
		Glenn Moore	WAM
Lepidoptera	Butterflies and moths	Jared Archibald	MAGNT
Heteroptera	True bugs	Anna Namyatova	UNSW
Odonata	Damselflies and dragonflies	Jared Archibald	MAGNT
		Michael Hammer	MAGNT
Arachnida	Spiders	Robert Raven	QM
		Sophie Harrison	UofA
Vascular and non-vascular plants	Vascular and non-vascular plants	Ian Cowie	NTH, DENR
		Peter Jobson	NTH, DENR
		Nicolas Cuff	NTH, DENR
		Donna Lewis	NTH, DENR
		Kym Brennan	DENR

Site selection

All terrestrial scientists surveyed two standard survey sites selected by Bush Blitz using modelling prepared by CSIRO. Each standard survey site was centred on a point (permanently marked), but the actual area surveyed varied between taxa. Standard methodologies were used to sample these sites.

The use of standard survey sites provides a unique opportunity to examine broad-spectrum biodiversity. Among other benefits, this will enable CSIRO to test assumptions (e.g. about relationships between the diversity of different taxa) that underpin many conservation decisions. It will also allow comparisons between sites, and establish a basis for future monitoring by reserve managers.

Site selection was also dependent on access, proximity to water, safe night access, suitability for trapping and time restrictions. Site locations were recorded using global positioning systems.

Aside from the standard survey sites, site selection and collection methods were at the discretion of the individual scientists.

Survey techniques

A standard suite of survey techniques was used:

- **Terrestrial vertebrates** were surveyed intensively at 12 sites using standard trapping and observation methods. In addition, remote camera arrays were deployed for the first time in the park. The results from these sites were combined with additional records from a further 56 sites, obtained by other survey participants with interests in terrestrial vertebrate taxa.

Twenty-four live capture traps (16 small Elliott traps, 8 small tomahawk cage traps) were used to sample small mammals. These were placed at equidistances around the perimeter of a 50 m x 50 m sampling quadrat, and opened and baited at night for four consecutive nights. Early each morning the traps were inspected, cleared and closed for the day. Four pitfall traps, also placed within the 50 m x 50 m quadrat, were effective for sampling reptiles and some of the smaller mammals. Each pitfall trap comprised a 20 L plastic bucket set into the ground to its depth, flush with the surrounding soil surface with a 30 cm high x 10 m long 'drift fence', erected across its mouth to help direct any ground fauna into it. The pits were checked and cleared at regular intervals from early each morning and throughout the day for four days.

Three additional 10 minute, diurnal, counts of reptiles were conducted within the trap-defined quadrat. Logs, loose bark, rocks and leaf litter on the site were examined during these active searches.

A diurnal bird census was conducted which consisted of 8 instantaneous (~10 minute) counts of all species seen (or heard) perched or foraging within a 100 m x 100 m quadrat centred on the trap-defined quadrat. Birds detected outside the census area were noted as being within or outside the habitat of the survey quadrat. The counts were spread across a range of times during the day over the four-day survey period.

For nocturnal vertebrates less likely to be caught in traps (snakes, frogs, some geckos and night birds), two 10 minute spotlight searches at each site were conducted after dark.

Seven cameras were installed in and around each site at five locations. A basic camera station comprised a Reconyx Hyperfire heat/motion sensitive camera attached to a tree at a height of either 0.7 m or 0.4 m, aimed at a bait holder (fixed to a metal post 30 cm high). Bait holders were placed in front of the cameras at a distance of either 2.5 m (at three camera stations) or 1.5 m (at two camera

stations). Two camera stations at each site had two cameras fixed to the same tree at different heights, aimed at a common bait holder. The bait was a mixture of peanut butter, oats and honey. No two camera stations were less than 30 m apart or greater than 200 m apart, with the standard configuration consisting of one camera station in the middle of the 50 m x 50 m quadrat and the other four spread around it, outside the 50 m x 50 m quadrat to form a square or diamond-like pattern.

- **Gliders** were surveyed using live trapping at sites near Bullita and Limestone Gorge, based on proximity to water and vegetation type. Clusters of traps were installed at these sites and trapping was conducted according to standard operating procedures for arboreal mammal trapping. Traps were baited and opened at various sites for a minimum of three nights and a maximum of five nights. Upon capture, animals were weighed, sexed and their age and reproductive status assessed. Various morphometric measurements were made and a small tissue sample was taken for DNA analysis before the animals were released.
- **Fishes** were sampled using appropriate gear (i.e. mainly compact gear including backpack electrofisher and seine net, with some gill-netting) and with access provided by a combination of helicopter, vehicles and small boats. The survey focus was on isolated upland habitats including small to medium-sized rivers and streams, springs and gorges. Sampling large lowland rivers was beyond the scope of the current survey, but has been done in the past (e.g. Victoria River near the highway).

Sixteen sites were targeted where previous minimal survey effort overlapped with unique or interesting habitat that could be included in a rapid survey design. The sites were primarily upland areas with springs, gorges and permanent pools identified from aerial imagery during the dry season. Other sites were selected in order to study species of particular interest for broader taxonomic research and of conservation/management interest as viewed from a review of museum specimens and historical data.

Backpack electrofishing was employed at wadeable habitats using a Smith-Root model LR-20B with voltage and frequency adjusted according to water conductivity. For larger sites within moderate reach of the base camp (Bullita), a small boat was employed to set multi-panel monofilament gill nets during daylight hours (20 to 100 mm mesh). Nets were set and monitored for approximately two to three hours in the morning or afternoon parallel or perpendicular to the bank near structures such as snags or trees. Angling was an additional method used at several sites.

Environmental data including physical characteristics, habitat components and water quality was recorded for each site. Samples of larger crustaceans caught opportunistically as part of fish sampling were also taken for future processing and investigation.

- **Butterflies and moths** were collected using a standard 40 cm hand sweep net or recorded visually. Twenty sites of approximately 2 ha were sampled, primarily targeting wet areas in the northern half of the park that were likely to be butterfly refugia at the time of sampling. Each site was sampled for at least two daylight hours between 10am and 4pm when butterfly activity was expected to be greatest. Butterfly activity and abundance were lower than normal due to the low rainfall since February 2015.
- **True bugs** were collected from 28 localities and 52 host plant species, by beating, sweeping, and hand collection, focusing on flowers, fruits and seeds. Pyrethrum knockdown and litter sampling were used to collect cryptozoic Heteroptera.
- **Damselflies and dragonflies** were caught with a 40 cm hand sweep net or identified with binoculars. The 20 sites chosen mirrored those of the fish fauna teams as this allowed maximum efficiency of sampling in a range of aquatic habitats across the park (mostly only accessible by helicopter). All sites, except the standard survey sites, comprised an area of approximately 2 ha and were sampled for about two hours.

- **Spiders** were sampled by hand searching under rocks, logs and bark, and sifting of leaf litter during the day and night. Other specimens were collected at creek banks or during the night. Conditions were generally very dry with the best collections made at overnight campsites, narrow waterside refuges and recently burnt standard survey sites. The least surveyed habitat was Spinifex.
- **Flora** was collected in accordance with the full-floristic vegetation site-assessment methodology used by the NT Government. Final selection of sampling locations was guided by the most up-to-date available satellite imagery (Landsat 8) and on-ground information from Parks and Wildlife Commission NT staff regarding ongoing prescribed burning activities and burnt areas within the vicinity of candidate locations. At each of these locations, potential 'sites' were selected along a field traverse representing the major physical strata and the variation in photo-pattern observed on available remotely sensed imagery. The number of 'sites' along these traverses ranged between four and six; in total 22 locations were sampled.

Selective collecting of suitable plant material was routinely undertaken on the traverses between suggested survey sites. This allowed development of a more comprehensive inventory of the flora of the park than if plant records were only collected from the detailed survey sites. This approach is routinely employed by the NT Herbarium in floristic surveys across the NT.

Plants were generally pressed and dried, with some small, fragile plants or parts such as flowers or fleshy fruits being preserved in Kew mixture (70% alcohol, 29% water, 1% glycerol). For molecular analyses, material from taxa of particular interest was sub-sampled from the larger preserved specimen and stored in airtight plastic bags with silica gel. Specimens from lower plant groups, typically including part of the attached substrate of rock or bark, were packaged in paper or plastic bags in the field.

Identification

The specimens taken were identified using available literature and the holdings of museums and herbaria to provide final confirmation of identifications. Fauna specimens were deposited with MAGNT, with the exception of glider samples that were deposited in the Australian Biological Tissue Collection, and true bugs that were deposited with the UNSW. Flora collections were deposited with the NT Herbarium. All specimen data are available through the Atlas of Living Australia.

Results

Locational data for all collection or observational records are available to reserve managers. At least 217 species were new records for the reserve (some results are yet to be finalised), including 29 putative new species—these await formal identification. Three threatened animal species were observed and 18 threatened plants. Six exotic or pest animal species and three weed species were also recorded.

Table 2 provides a summary of the flora and fauna records for the park.

Table 2 Summary of flora and fauna records

Group	Common name	Total species recorded	Species newly recorded for park	Putative new species	Threatened species*	Exotic and pest species**
Mammalia	Mammals	22	4	2	0	3
Aves	Birds	118	1	0	1	0
Reptilia	Reptiles	45	3	2	1	0
Amphibia	Frogs and toads	10	0	0	0	1
Pisces	Fishes	28	1	0	1	0
Lepidoptera	Butterflies	26	4	0	0	1
Lepidoptera	Moths	2	1	0	0	0
Heteroptera	True bugs	95	95	5	0	0
Odonata	Damselflies and dragonflies	26	20	0	0	0
Arachnida	Spiders	48	48	20	0	1
Vascular plants	Vascular plants	362	40	0	18	3
Non-vascular plants	Non-vascular plants	12	0	0	0	0
Total		794	217	29	21	9

* Species listed under the Commonwealth EPBC Act or TPWCA (NT).

** Includes native species that at times are pests or are exotic to this region.

Species lists

Lists of all species recorded during the survey are provided in [Appendix A](#). Species lists were compiled using data from participating institutions.

Names in **red bold text** are putative new species. Species marked with an asterisk (*) have not been recorded previously. Those without an asterisk have been recorded previously and were confirmed by this survey.

Some specimens have been identified only to family or genus level for the purpose of this report. This is partly because identifying specimens is very time-consuming, with detailed microscopic examination needed. Some groups are 'orphans' (i.e. there are no experts currently working on them), species-level identification is therefore not possible for these groups. Unidentified Bush Blitz specimens are held in institutional collections where they are available for future study. Bush Blitz grants support taxonomic research for the description of new species and the re-working of problematic groups.

Nomenclature and taxonomic concepts used in this report are consistent with the Australian Faunal Directory, Australian Plant Name Index and Australian Plant Census.

Discussion

Putative new species

The term ‘putative new species’ means an unnamed species that, as far as can be ascertained, was collected for the first time during the survey. It is confirmed as a new species once it is named and its description published. Specimens collected during the Bush Blitz also include unnamed taxa that are already known from museum and herbarium collections—these are not counted as putative new species.

Fauna

Vertebrates

Mammals

The taxonomic identity of the Sugar Glider (*Petaurus breviceps ariel*) found in northern Australia is currently being investigated by researchers from Charles Darwin University. As part of their study, these scientists joined the Bush Blitz for the first week of the survey. Preliminary taxonomic work by the university has revealed that the glider has stronger affiliations with Squirrel and Mahogany Gliders (*P. norfolcensis* and *P. gracilis*), neither of which is known to occur in the NT.

Tissue samples and morphometrics have been collected from live animals across NT and Western Australia. Judbarra / Gregory NP is on the southern edge of the species’ distribution and is represented by a single specimen in the MAGNT. This specimen is significantly larger than other specimens in the MAGNT and larger than any of the live gliders trapped at a range of locations across the NT. For these reasons, genetic samples and morphometrics of gliders found in the park are of interest to researchers.

Tissue samples from two individual gliders were collected as part of the survey; these represent the southernmost tissue samples from gliders in the NT, more than 100 km further south than previous samples. Preliminary analysis of the samples supports the possibility of more than one species existing in the region. The gliders sampled were larger in weight, body size and tail length than other gliders previously sampled in the NT despite having similar head sizes. Additional specimens are needed to finalise the taxonomic description of one, or potentially two, new species of glider.

Reptiles

Previous studies have shown that geckos from a single widely distributed species can be genetically divergent and sometimes also morphologically different from individuals of the same species from another location (i.e. comprise species complexes of two or more species). Such variation may relate to differences in ecology such as the use of different substrates. For these reasons, genetic samples and morphometrics of reptiles found in the park, particularly geckos are of interest to researchers.

DNA sequencing suggests that North-west Prickly Gecko, also known as Bynoe’s Prickly Gecko, (*Heteronotia planiceps*) collected from limestone sites is genetically and phenotypically distinct from individuals of the same species collected from elsewhere in the park. Analysis of this group is ongoing and expected to result in the description of the Judbarra / Gregory limestone population as a separate species.

One specimen of Northern Dwarf Skink (*Menetia maini*) appears to have some distinct head scalation, which suggests it could be an undescribed species. The tissues from this specimen will aid further studies on this species.

Frogs and toads

Tissue samples and specimens of frog species will contribute to continuing efforts to identify unique genetic diversity within many currently recognised single species. For example, one species of frog (two individuals) collected from a riverbank along the Victoria River area was tentatively identified as a variation of the standard Common Rock Frog or Copland’s Rock Frog (*Litoria coplandi*). This species is normally abundant around rock holes and was therefore an unexpected find in this habitat. Although genotyping has since confirmed the *Litoria coplandi* identification, further investigation is required to determine whether these represent a genetically and morphologically distinct group within this frog species.

Fishes

No distinct new species were observed on the survey. However more subtle variation in the form of cryptic species cannot be ruled out, especially in the Northern Purple-spotted Gudgeon (*Mogurnda mogurnda*), which showed variation in appearance across the property. Quite a number of obligate freshwater fishes need to be reviewed based on the presence of likely cryptic taxa (e.g. catfishes, Blackmast, Mouth Almighty, Swamp Eel), and the survey successfully collected paired tissue and voucher material to advance future research.

Table 3 lists the putative new vertebrate species that were collected in the park.

Table 3 Putative new vertebrate species

Family	Species	Comments
Mammals		
Petauridae	Gn_ <i>Petaurus</i> sp.1	Adult female exhibiting clinal variation and larger area requirements compared with other gliders in NT
Petauridae	Gn_ <i>Petaurus</i> sp.2	Adult female exhibiting clinal variation and larger area requirements compared with other gliders in NT
Reptiles		
Gekkonidae	<i>Heteronotia</i> cf. <i>planiceps</i>	Likely to be represented by two distinct species associated with limestone and sandstone substrates
Scincidae	<i>Menetia</i> cf. <i>maini</i>	Appears to have some distinct head scalation, which suggests it could be an undescribed species (DNA confirmation required)

Invertebrates

True bugs

Five species of true bugs were recognised as probably new to science, all belonging to the plant bug family (Miridae). Apart from these new species, at least 77 undescribed species were collected.

Spiders

Forty-eight different spider species were collected from across 22 families. Of these, eight are unequivocally new species and 12 are possibly new or unnamed. Further analysis is required to confirm their status. Despite the number of exciting new species, their descriptions cannot be published until male specimens are collected, since males are essential for spider identification.

Table 4 lists the putative new invertebrate species that were collected in the park.

Table 4 Putative new invertebrate species

Family	Species
True Bugs	
Miridae	Gn_Cremnorrhinina sp.1
Miridae	Gn_Zanchiini sp. 1
Miridae	Gn_Zanchiini sp. 2
Miridae	<i>Pseudoloxops</i> sp. 1
Miridae	<i>Singhalesia</i> sp. 2
Spiders	
Barychelidae	<i>Mandjelia</i> sp. nov.
Clubionidae	<i>Clubiona</i> sp. nov. 1
Clubionidae	<i>Clubiona</i> sp. nov. 2
Corinnidae	<i>Iridonyssus</i> ?sp. nov.
Corinnidae	<i>Nyssus</i> ?sp. nov.
Ctenizidae	<i>Conothele</i> sp. nov.
Dictynidae	<i>Arangina</i> sp. nov.
Filistatidae	<i>Wandella</i> ?sp. nov.
Gnaphosidae	<i>Ceryerda</i> ?sp. nov.
Gnaphosidae	<i>Encoptarthria</i> sp. nov.
Gnaphosidae	Gnaph_gen nov sp. nov.
Gnaphosidae	<i>Hemicloea</i> ?sp. nov.
Lycosidae	<i>Zoica</i> sp. nov.
Miturgidae	<i>Argoctenus</i> ?sp. nov.
Oonopidae	<i>Opopaea</i> ?sp. nov.

Family	Species
Oonopidae	<i>Pelcinus</i> ?sp. nov.
Salticidae	<i>Grayenulla</i> ?sp.nov.
Theraphosidae	<i>Therap_genov</i> sp. nov.
Theridiidae	<i>Hadrotarsus</i> ?sp. nov.
Zodariidae	<i>Hetaerica</i> ?sp. nov.

Flora

No putative new species of vascular plant were discovered although it is worth noting the collection of further records and locations of the soon to be formalised *Triodia* sp. Matt Wilson. Two more or less well defined taxa (*Acacia* sp. Timber Creek, *Sida* sp. Tawallah Ck) thought to be currently undescribed were also collected during the survey and require further investigation.

Threatened species

Australia is home to an estimated 580,000–680,000 species, most of which have not been described. Approximately 92% of Australian plants, 87% of mammals, 93% of reptiles and 45% of birds are endemic. Changes to the landscape resulting from human activity have put many of these unique species at risk. Over the last 200 years, many species have become extinct; many others are considered to be threatened, i.e. at risk of extinction.³

Fauna

Vertebrates

Birds

The EPBC-listed Gouldian Finch (*Erythrura gouldiae*) was recorded at Standard Survey Site 2 where small flocks were observed feeding in clearings of unburnt, grassy woodland. Taking account of overall distributions, the park is particularly important as breeding habitat for the Gouldian Finch.

Reptiles

The semi-aquatic Mertens' Water Monitor (*Varanus mertensi*) was observed at the East Baines River. This species is known to have experienced population declines in the Daly River region due to its predation on toxic Cane Toads⁴. The Freshwater Crocodile (*Crocodylus johnstoni*) was also observed. While not threatened, the Freshwater Crocodile is marine-listed under the EPBC Act and protected under the TPWCA.

Fishes

Two individuals (205 mm and 250 mm standard length) of Angalarri Grunter (*Scortum neili*) were collected from the East Baines River at Limestone Gorge. The Angalarri Grunter, also known as Neil's

³ Chapman, A.D. 2009, *Numbers of Living Species in Australia and the World*, 2nd edn. Australian Biological Resources Study, Canberra.

⁴ Doody, J.S., et al. 2009, Population-level declines in Australian predators caused by an invasive species. *Animal Conservation* 12: 46–53.

Grunter and by several Aboriginal language names, is one of Australia’s rarest fish. It is only known from two scientifically recorded locations: the East Baines River (this survey) and a series of large pools on a tributary of the Angalarri River in Bradshaw Station to the north⁵. Traditional Owners reported this species (known to them as Spring Bream) as being a rare inhabitant of the area and found in specific large, deep spring-fed pools fringed with monsoon rainforest⁶. Managing this type of habitat, for example controlling feral animals and using appropriate fire regimes, will help protect the Angalarri Grunter.

Better mapping of other locations within the park where the Angalarri Grunter occurs will improve the ability of land managers to consider the needs of the species. Anecdotal information from traditional owners suggests this rare species is encountered more widely in ‘spring country’, and a study combining traditional knowledge and fishing effort with scientific data collection would be an ideal future project. Likewise, additional research on Freshwater Sawfish (*Pristis pristis*) in large river habitats is likely to lead to a better understanding of its local status and conservation needs.

Table 5 lists the threatened vertebrate species that were observed in the park.

Table 5 Threatened vertebrate species

Family	Species	Common name	Status	Abundance
Birds				
Estrildidae	<i>Erythrura gouldiae</i>	Gouldian Finch	Endangered (EPBC Act)	Low
Reptiles				
Varanidae	<i>Varanus mertensi</i>	Mertens’ Water Monitor	Vulnerable (TPWCA)	Low
Fishes				
Terapontidae	<i>Scortum neili</i>	Angalarri Grunter	Vulnerable (TPWCA)	Low

Flora

No EPBC-listed species were collected as part of the survey. However, 18 taxa of particular conservation significance under TPWCA (Table 6) were identified. One species was vulnerable, six near threatened and 11 data deficient. Highly restricted Victoria River Gorge endemic species such as *Stenostegia congesta* and *Melaleuca triumphalis* are likely to be upgraded to a threatened category in the future due to their susceptibility to Myrtle Rust (*Puccinia psidii*). The Myrtle Rust fungus infects plants in the family Myrtaceae, causing leaf distortion, death of soft plant material and, potentially, the death of the whole plant in highly susceptible hosts. It is an emerging threat in northern Australia, with species in humid microhabitats such as springs and gorges most at risk.

⁵ Corbett, L., Batterham, R., Sewell, S., Welch, M., Richards, G., Larson, H.K. 2002, The Angalarri grunter, *Scortum neili* Allen, Larson and Midgley (Teleostei: Terapontidae): description of adults and their habitat. *The Beagle, Records of the Museum and Arts Gallery of the Northern Territory* 18: 57–62.

⁶ Hector, I.K., Kalabidi, G.J., Banjo, S., Dodd, T.N.N., Wavehill, R.J.W., et al. 2012. *Bilinarra, Gurindji and Malngin Plants and Animals: Aboriginal knowledge of Flora and Fauna from Judbarra / Gregory National Park, Nitjpurru, Kalkarindji and Daguragu, North Australia*. Diwurruwurru-jaru Aboriginal Corporation and Mimi Aboriginal Art and Craft, Katherine.

Table 6 Flowering plants of conservation significance

Family	Species	Status	Abundance
Amaranthaceae	<i>Gomphrena leptoclada</i> subsp. <i>saxosa</i>	Data Deficient (TPWCA)	Rare in low hills of sandstone
Cyperaceae	<i>Cyperus viscidulus</i>	Data Deficient (TPWCA)	Found in broken sandstone in the central and south eastern parts of Bullita
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>sericeus</i>	Data Deficient (TPWCA)	Found in various locations; further curation of the herbarium collection is required
Fabaceae	<i>Acacia setulifera</i>	Near Threatened (TPWCA)	Locally common in sandstone plateau habitat on sandy soils
Fabaceae	<i>Acacia stipulosa</i>	Near Threatened (TPWCA)	Occasional on summit surface of plateau in the central and south eastern parts of Bullita section
Fabaceae	<i>Isotropis faucicola</i>	Near Threatened (TPWCA)	Known from only 7 locations in the Victoria River Gorge area
Fabaceae	<i>Nomismia rhomboidea</i>	Near Threatened (TPWCA)	Occasional in incised gully SSW of Bullita airstrip
Goodeniaceae	<i>Goodenia malvina</i>	Data Deficient (TPWCA)	Rare in a very restricted habitat north of Victoria River Roadhouse
Malvaceae	<i>Hibiscus setulosus</i>	Data Deficient (TPWCA)	Relatively widespread, found in central and south eastern parts of Bullita
Malvaceae	<i>Triumfetta antrorsa</i>	Data Deficient (TPWCA)	Uncommon within habitat, found in broken sandstone in the central and south eastern parts of Bullita
Myrtaceae	<i>Stenostegia congesta</i>	Near Threatened (TPWCA)	Rare at Jasper Gorge section but known from other areas of the Victoria River Gorge section
Myrtaceae	<i>Eucalyptus gregoriensis</i>	Data Deficient (TPWCA)	Widespread and common on the steep slopes of coarse sandstone plateaux in Bullita section
Phyllanthaceae	<i>Sauropus hubbardii</i>	Near Threatened (TPWCA)	Occasional on clay plain of summit surface north of Victoria River Roadhouse

Family	Species	Status	Abundance
Poaceae	<i>Triodia</i> sp. Matt Wilson (I.D.Cowie 2446 & P.S.Brocklehurst)	Vulnerable (TPWCA)	The subpopulation at Matt Wilson Lookout numbers many thousands
Poaceae	<i>Panicum latzii</i>	Data Deficient (TPWCA)	Relatively widespread, found in clay plain in Matt Wilson Creek system
Sapindaceae	<i>Alectryon kimberleyanus</i>	Data Deficient (TPWCA)	Relatively uncommon where found in the Bullita section
Sapindaceae	<i>Dodonaea hispidula</i> var. <i>phylloptera</i>	Data Deficient (TPWCA)	Found in various locations
Stylidiaceae	<i>Stylidium fluminense</i>	Data Deficient (TPWCA)	Common in restricted habitat within the park

Exotic and pest species

Conservation reserves help to protect Australia's rare and threatened ecosystems and provide refuge for species at risk. Invasive species can have a major impact on already vulnerable species and ecosystems, as well as economic, environmental and social impacts. The inclusion of exotic and pest species records as part of this report is designed to provide land managers with baseline information to assist with further pest management programs.

Fauna

Vertebrates

Mammals

Three species of introduced mammals were recorded. Cattle (*Bos taurus*) were observed frequently throughout the park, particularly along waterways. Donkeys (*Equus asinus*) were also recorded in the higher country. Large numbers of feral herbivores such as donkeys and cattle can cause extensive structural damage to riparian habitats and the native fauna therein, especially towards the end of the dry season as they concentrate at waterholes and streams.

Cats (*Felis catus*) were detected by remote cameras at more sites than any other feral vertebrate, yet not one was seen or trapped. Cats have been implicated as contributing to small mammal declines across northern Australia⁷ with their impact enhanced considerably when combined with unmanaged fire regimes that result in removal of extensive tracts of ground cover⁸.

⁷ Woinarski, J.C.Z., Legge, S., Fitzsimons, J.A., Traill, B.J., Burbidge, A.A., Fisher, A., Firth, R.S.C., Gordon, J.J., Griffiths, A.D., Johnson, C.N., McKenzie, N.L., Palmer, C., Radford, I., Rankmore, B., Ritchie, E.G., Ward, S., Ziembicki, M. 2011, The disappearing mammal fauna of northern Australia: context, cause and response. *Conservation Letters* 4(3): 192–201.

⁸ McGregor, H., Legge, S., Jones, M.E., Johnson, C.N. 2015, Feral cats are better killers in open habitats, revealed by animal-borne video. *PLoS ONE* 10(8): e0133915.

Frogs and toads

Cane toads (*Rhinella marina*) were recorded at most sites. The high abundance and wide occurrence (throughout the park and region) of this recently arrived pest make any specific management recommendations, other than research into broader biological control, difficult.

Fishes

No introduced fish species were recorded in the survey, and there are no historical records of such species from the Victoria River catchment. Fishing is heavily promoted as a recreational activity in the park, and a potential risk is the accidental transfer of fish used as live bait for fishing (although this practice is discouraged within the park). The release of unwanted aquarium fish into natural waterways is another common means by which introduced species are spread. Ongoing multi-agency and stakeholder awareness and vigilance are recommended. Potential invaders to be aware of include Eastern Gambusia (*Gambusia holbrooki*) which is known in restricted areas of the Kimberley⁹, aquarium fishes such as Guppy (*Poecilia reticulata*), and the highly invasive Tilapia (*Oreochromis mossambicus*) that is already established in the Pilbara and eastern Australia¹⁰.

Invertebrates

Butterflies and moths

The Tawny Coster (*Acraea terpsicore*) is a recently self-introduced (now cosmopolitan) Asian species that was recorded for the first time in the park. This Asian species has recently become established in northern Australia¹¹ and has since spread rapidly across the monsoon tropics of the Kimberley and Top End.

Spiders

No pest species were taken. However, the Redback Spider (*Latrodectus hasseltii*), considered native only to southwestern Western Australia and South Australia, has probably been introduced on vehicles.

Table 7 lists the exotic and pest fauna species that were observed in the park.

Table 7 Exotic and pest fauna species

Family	Species	Common name	Abundance
Vertebrates			
Bovidae	<i>Bos taurus</i>	Cattle	Medium
Bufoidea	<i>Rhinella marina</i>	Cane Toad	High
Equidae	<i>Equus asinus</i>	Donkey	Medium
Felidae	<i>Felis catus</i>	Cat	High

⁹ Morgan, D.L., Allen, G.R., Pusey, B.J., Burrows, D.W. 2011, A review of the freshwater fishes of the Kimberley region of Western Australia. *Zootaxa* 2816: 1–64.

¹⁰ Morgan, D.L., Allen, M.G., Beatty, S.J., Keleher, J.J., Ebner, B.C. 2014, A Field Guide to the Freshwater Fishes of the Pilbara Province Western Australia. Freshwater Fish Group, Murdoch University, Murdoch.

¹¹ Braby, M.F., Bertelsmeier, C., Sanderson, C., Thistleton, B. 2014, Spatial distribution and range expansion of the Tawny Coster butterfly, *Acraea terpsicore* (Linnaeus, 1758) (Lepidoptera: Nymphalidae), in South-East Asia and Australia. *Insect Conservation and Diversity* 7: 132–143.

Family	Species	Common name	Abundance
Invertebrates			
Nymphalidae	<i>Acraea terpsicore</i>	Tawny Coster	Unknown
Theridiidae	<i>Latrodectus hasseltii</i>	Redback Spider	Unknown

Flora

No gazetted weed species were recorded during the survey. However, Buffel Grass (*Cenchrus ciliaris*) was recorded in Limestone Gorge and additional 'hot spots' probably also exist. These are likely to include sites of previous habitation, camping areas, roadsides, old stockyards and other disturbed areas. The more invasive of the weeds may also occur well away from disturbed sites. Targeted and incidental survey in more appropriate seasons would give a better indication of the location of potential 'problem' weeds. In total, three introduced taxa were recorded for the park.

Table 8 lists the introduced weeds that were identified in the park.

Table 8 Weed species

Family	Species	Abundance
Amaranthaceae	<i>Aerva javanica</i>	Unknown
Asteraceae	<i>Tridax procumbens</i>	Uncommon
Poaceae	<i>Cenchrus ciliaris</i>	Common

Range extensions

Of the 217 new records for the park, 35 are noticeable range extensions or infills in distribution for the taxa (Table 9). Helicopter access during this Bush Blitz enabled scientists to collect from a wide range of sites.

Fauna

Fishes

Swamp Eel (*Ophisternon gutturale*) in the Victoria River catchment, was previously only recorded as far west as the Daly River (approximately 500 km aquatic distance).

True bugs

All records of true bugs identified during the Bush Blitz represent minor range extensions. These range extensions are not considered significant because of a lack of background data, there being no previous records of true bugs from the park.

Damselflies and dragonflies

Of the 26 species of Odonata sampled during the survey, 13 represented significant infill records for species distribution, and one was a significant range extension. Four healthy populations of the Gold-

fronted Riverdamsel (*Pseudagrion aureofrons*) were found within the park. Previously this species was known in the NT from only a few early records near Borroloola (Gulf country), and in Western Australia from the East Kimberley west of Kununurra. These new records extend the range of this species into the western Top End (approximately 250 km). The assemblage of species recorded is characteristic of watercourses in tropical savanna woodland habitats of the Australian wet/dry tropics. Overall, the park appears to support a moderate diversity of Odonata, but further surveys during the wet season or following years of higher rainfall are likely to detect additional species.

Flora

Significant range extensions were recognised for a number of taxa, among them trees, woody and non-woody shrubs, tussock and hummock grasses, sedges and forbs. Range extensions could be broadly categorised into those that represented:

1. *Northern taxa*: a suite of taxa, many of which were new records for the park, represent southerly range extensions of 'Top End' taxa. Many of these are characteristic tropical elements of the NT flora and could also be considered as range extensions associated with specialist habitat types for example dry vine thicket and wetlands.
2. *Taxa from similar latitudes to the west*: collections from this survey were range extensions along latitudinal parallels and often represent extensions or outliers from adjacent biogeographic regions or sub-regions. Many of these taxa could also be considered as range extensions associated with specialist habitat types, for example the flat-lying sandstones of the east Kimberley, Keep River/Spirit Hills and Bradshaw training areas.
3. *Southern taxa*: there were few range extensions for taxa from the semi-arid/arid southern NT. A number of taxa found during the survey represented minor range extensions from the adjacent Tanami Biogeographic Region; the majority of these had been collected previously in the southern, semi-arid sections of the park.
4. *Habitat*: many of the taxa collected during this survey and assessed as representing significant range extensions were associated with specialist or rare habitat types. These included wetland and aquatic habitats associated with permanent or semi-permanent water sources, sandstone plateaux and dry vine thicket. These habitats provide suitable outlying patches within the broader savanna matrix for taxa outside the core of their distributions. Many of these taxa are likely to be at the limits of their range in the NT.
5. *Infill species*: species with distributions to the east and west of the park, collected during this survey from locations between the previously known locations. A number of such taxa were collected from small areas of cracking clay soils in the north of the park, between the more extensive occurrences in the Ord/Victoria and Roper River alluvial plains.

Table 9 Range extensions

Family	Species	Nearest previous record	Comments
Mammals			
Petauridae	Gn_ <i>Petaurus</i>	>100 km	Southernmost tissue samples from gliders in NT

Family	Species	Nearest previous record	Comments
Fishes			
Synbranchidae	<i>Ophisternon gutturale</i>	500 km (aquatic), 250 km direct line	First scientific record from the Victoria River
Damselflies and dragonflies			
Aeshnidae	<i>Anax papuensis</i>	Approx. 200 km	Infill between Kimberley and central Top End
Coenagrionidae	<i>Argiocnemis rubescens</i>	Approx. 200 km	Infill between Kimberley and central Top End
Coenagrionidae	<i>Austroagrion exclamationis</i>	Approx. 200 km	Infill between Kimberley and central Top End
Coenagrionidae	<i>Ceriagrion aeruginosum</i>	Approx. 200 km	Infill between Kimberley and central Top End
Coenagrionidae	<i>Pseudagrion aureofrons</i>	Approx. 250 km	Range extension east into western Top End
Coenagrionidae	<i>Pseudagrion microcephalum</i>	Approx. 200 km	Infill between Kimberley and central Top End
Coenagrionidae	<i>Xanthagrion erythroneurum</i>	Approx. 200 km	Infill between Kimberley and central Top End
Corduliidae	<i>Hemicordulia intermedia</i>	Approx. 200 km	Infill between Kimberley and central Top End
Gomphidae	<i>Austroepigomphus turneri</i>	Approx. 200 km	Infill between Kimberley and central Top End
Lestidae	<i>Austrolestes insularis</i>	Approx. 200 km	Infill between Kimberley and central Top End
Libellulidae	<i>Crocothemis nigrifrons</i>	Approx. 200 km	Infill between Kimberley and central Top End
Libellulidae	<i>Nannophlebia injibandi</i>	Approx. 200 km	Infill between Kimberley and central Top End
Libellulidae	<i>Neurothemis stigmatizans</i>	Approx. 200 km	Infill between Kimberley and central Top End
Libellulidae	<i>Orthetrum migratum</i>	Approx. 200 km	Infill between Kimberley and central Top End
Flowering plants			

Family	Species	Nearest previous record	Comments
Amaranthaceae	<i>Ptilotus gardneri</i>	155 km	Known from WA and to the west of the park in the NT (Birrindudu and Mistake Creek Stations)
Apocynaceae	<i>Marsdenia hemiptera</i>	67 km	Extension of range from the Fitzmaurice River catchment
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>sericeus</i>	70 km	Unlikely to be a true range extension as further curation is likely to include the park in recalculations
Convolvulaceae	<i>Polymeria angusta</i>	Possibly 260 km from closest confirmed record	Range extension from Kununurra (WA) and possibly Birrindudu in NT
Cyperaceae	<i>Fimbristylis simulans</i>	78 km	Predominantly distributed in the southern NT
Cyperaceae	<i>Eleocharis sphacelata</i>	157 km	Likely to be more widespread
Cyperaceae	<i>Tricostularia undulata</i>	85 km	Common and widely distributed across the Top End; unlikely to be a significant range extension with further survey in suitable habitat more broadly in the region
Droseraceae	<i>Drosera darwinensis</i>	189 km	Unlikely to be a range extension of such significant magnitude as further curation is likely to result in recalculation
Fabaceae	<i>Acacia setulifera</i>	Maximum of 86 km	Sandstone-associated shrub known from the western plateaux and ranges of the park
Fabaceae	<i>Acacia thomsonii</i>	193 km	Infill in distribution to the south and east of the park
Goodeniaceae	<i>Goodenia malvina</i>	217 km from closest NT and 164 km from closest WA record	Significant infill in distribution between WA and the Jalboi River catchment in south-central Arnhem Land; occurs in a relatively restricted and under-sampled habitat type in the region
Malvaceae	<i>Triumfetta antrorsa</i>	23 km	Likely to be a negative collection bias for taxon
Myrtaceae	<i>Eucalyptus tintinnans</i>	97 km	A widespread and relatively common species across the Top End of the NT

Family	Species	Nearest previous record	Comments
Phyllanthaceae	<i>Sauropus hubbardii</i>	82 km	This species may prove to be more widespread than current data suggests
Plantaginaceae	<i>Limnophila australis</i>	100 km	Likely to be more widespread
Poaceae	<i>Dimeria acinaciformis</i>	370 km	Annual grass not commonly collected during dry season surveys
Poaceae	<i>Eriachne capillaris</i>	158 km	Widely distributed in sandstone habitats across the Top End
Poaceae	<i>Triodia</i> sp. Matt Wilson (I.D. Cowie 2446 & P.S. Brocklehurst)	160 km from closest NT location	Significant range extension west of the Matt Wilson Lookout population
Sapindaceae	<i>Alectryon kimberleyanus</i>	20 km	Unlikely to be a significant range extension

Other points of interest

Fauna

Vertebrates

The current vertebrate fauna data for the park is the product of a multitude of independent, mostly short, targeted surveys by various Australian museums, government agencies and private individuals, that focused on either particular taxa (bats, birds, frogs, turtles, reptiles), specific environments (vertebrate fauna of vine thickets) or specific (spatially restricted) areas of interest. As the park is large and supports a high diversity of terrestrial vertebrates, it is hard to survey the area comprehensively. In particular, the southern sections of the park are virtually unsurveyed due to limited access. In some northern sections of the park endemic terrestrial vertebrates could be present on the flat tops of isolated rocky outcrops; future surveys should focus on these areas.

Two possible undescribed reptiles were collected during the survey and it is highly probable that some of the wider-ranging species collected actually comprised several cryptic species. Voucher specimens and tissue samples from the survey will enable researchers to study the relationships of these taxa.

Information for land managers

During this brief survey, several key threatening factors were observed throughout the park, in particular the prevalence of feral livestock and the application of fire. Feral livestock, particularly cattle and donkeys, seemed abundant throughout the park and large areas were burnt just prior to the survey. These fires were prescriptive burns and observations while flying between remote sites indicated no evidence of post-ignition management. These fires appeared to have progressed in wide unbroken fronts, resulting in complete removal of the ground cover from much of the park. Examination of previous fire histories indicates that this type of burning is not unusual. Extensive unmanaged fire and grazing by feral livestock interact to create open habitats that can threaten sensitive native wildlife. This

park does not have an established wildlife-monitoring program and is not included in the Top End fire plot-monitoring program, which assesses the status of vertebrate fauna populations at five-year intervals, so the current trajectory of its small mammal fauna is unknown. However, based upon the prevailing fire regimes and observed number of feral livestock, mammal diversity has probably diminished.

While control of feral cats is currently unfeasible, the efficacy of feral herbivore and fire management has been well established in other parts of the Top End. Integrated management can improve fire regimes and reduce feral herbivore stocking rates with significant benefits for biodiversity conservation¹². The most promising fire management programs in the Top End are associated with carbon-trading and greenhouse gas reduction projects such as at Fish River Station¹³ and the Western Arnhem Land Fire Abatement (WALFA) project¹⁴. Each project employs Indigenous custodians with funding based on achieving specific goals, e.g. strategically controlled early season burning to discourage highly damaging uncontrolled wildfires. In the Kimberley region of WA, the Australian Wildlife Conservancy is achieving some success with its EcoFire project⁹, which relies on high level Indigenous engagement and ownership. Joint management provisions within the park could be useful for exploring alternative fire management strategies linked to conservation that involve a high level of participation and ownership by local Indigenous people.

Fishes

The survey's focus was on isolated upland habitats including small- to medium-sized rivers and streams, springs and gorges. As the northwestern edge of the park overlaps with the upper estuarine reach of the Victoria River, a range of other estuarine species could be considered occasional visitors to the park. Indeed, some 30 species are recorded from the estuary¹⁵, probably a conservative estimate of the true estuarine species diversity. Three species that are of particular importance to Traditional Owners are assumed to make journeys into the lower freshwater reaches of the Victoria River, namely Bull Shark (*Carcharhinus leucas*), Freshwater Whipray (*Himantura dalyensis*) and Queensland Grouper (*Epinephelus lanceolatus*)¹⁶.

In addition to the 28 species recorded during this survey, six freshwater species have been recorded in previous sampling in or near the park. These include Freshwater Sawfish (*Pristis pristis*), the large Boofhead Catfish (*Sciades leptaspis*), Rehdal's Catfish (*Porochilus rendahli*), Giant Glassfish (*Parambassis gulliveri*), Kimberley Sole (*Leptachirus triramus*), and an unnamed grunter similar to the Drysdale Grunter (*Syncomistes rastellus*).

Information for land managers

The park is a broad area of land with unregulated stream catchments, an important landscape feature when considering the level of development elsewhere in Australia. The park supports a high diversity of fishes in a vast and remote landscape. The large spring-fed refuge areas of the Wickham River and East

¹² Legge S, et al. 2015, *EcoFire — Part 1: Kimberley Regional Fire Pattern Analysis (200-2014)*. Australian Wildlife Conservancy, Perth WA.

¹³ <http://www.fishriver.com.au/FishRiver/media/Items/Files/Fish-River-ACCUs-brochure.pdf>

¹⁴ <http://nailsma.org.au/walfa-west-arnhem-land-fire-abatement-project>

¹⁵ ALA. 2015, Atlas of Living Australia, a free online resource providing access to a wealth of information about Australia's biodiversity. (Atlas of Living Australia, Australian Government.) <https://www.ala.org.au/>

¹⁶ Widjiburra, B. et al. 2010, *Ngarinyman Plants and Animals: Aboriginal Knowledge of Flora and Fauna from the Gregory National Park and the Victoria River Area*, Northern Australia. Department of Natural Resources, Environment, the Arts and Sport and Diwurruwurru-Jaru Aboriginal Corporation, Katherine.

Baines River are particularly important areas, having high species richness and populations of rare, restricted or threatened species. This is reflected in a combination of biological and cultural values^{17 18}.

The targeted survey for fishes during the Bush Blitz added significant spatial information on species distributions in the park, confirmed the presence of Angalarrri Grunter, documented a new record for the Victoria Catchment (Swamp Eel) and collected material for future studies that promise to uncover new information on the taxonomy of local and regional fishes.

The park has an extensive network of caves from some of which aquatic invertebrates have been recorded¹⁹. Future cave explorers should be encouraged to look for cave fishes, e.g. the blind gudgeons and white swamp eels such as are known from the Pilbara²⁰.

Invertebrates

Butterflies and moths

The park appears to support a relatively small diurnal butterfly fauna, which may reflect its geographical location within the lower rainfall (semi-arid) areas of the Australian monsoon tropics and associated lower floristic diversity. Further surveys during the wet season, or during the early dry season in a year of higher rainfall, may record additional species in the park.

In total 131 records (65 specimens and 66 observations) were obtained during this survey, representing 28 species of diurnal Lepidoptera (26 butterflies, 2 day-flying moths). Two species from the family HesperIIDae (Skippers and Darts) were recorded, but not positively identified: the Yellow Palm-dart (*Cephrenes trichopepla*) and Lyell's Swift (*Pelopidas lyelli*). Both of these butterflies are common and widely distributed in the Top End, although there appear to be no prior records from the park.

The most abundant species (in terms of relative abundance or frequency of occurrence across the 20 sites) were Darwin Ringlet or Orange Ringlet (*Hypocysta adiante*) (65%), Common Crow (*Euploea corinna*) (60%) and Lesser Wanderer (*Danaus petilia*) (55%). However, half of the species (14 or 50%) were rare, being sampled only once or twice. The large proportion of rare species probably reflects a combination of a poor wet season and below average rainfall prior to the survey. Many individuals observed or captured were in poor condition. This indicates that many specimens were nearing the end of their life, possibly due to the poor wet season and early onset of the dry. It was also observed that there were very few plants in flower throughout the park, thus limited food resources for the Lepidoptera.

Most of the butterfly species recorded are characteristic components of the tropical savanna woodland landscapes of northern Australia. The Canopus Butterfly (*Papilio fuscus canopus*) was the only monsoon forest specialist recorded. Other interesting records obtained were for the sun moth *Synemon wulwulam*, the Dark Grass-dart (*Suniana lascivia larrakia*) and the Little Grass-blue (*Zizula hylax*); the park appears to represent the southern edge of their distributions within the Top End.

¹⁷ PWCNT. 2001, *Gregory National Park Draft Management Plan*. Parks and Wildlife Commission of the Northern Territory, Northern Territory Government, 111 pp.

¹⁸ PWSNT. 2011, *Judbarra / Gregory National Park and Gregory's Tree Historical Reserve: Joint Management Plan*. Parks and Wildlife Service of the Northern Territory, Department of Natural Resources, Environment, The Arts and Sport, Katherine.

¹⁹ Moulds, T., Bannink, P. 2012, Preliminary notes on the cavernicolous arthropod fauna of Judbarra / Gregory karst area, northern Australia. *Helictite* 41: 75–85.

²⁰ Allen, G.R., Midgley, S.H., Allen, M. 2002, *Field Guide to the Freshwater Fishes of Australia*. Western Australian Museum, Perth.

Information for land managers

The patches of semi-deciduous monsoon vine thicket (e.g. at Limestone Gorge) are of special significance because this habitat supports a population of the rare Purple Beak (*Libythea geoffroyi*). This species, although not recorded during the survey, was recently discovered in the park²¹. It represents one of only three known extant populations of the butterfly in the NT, the two others being Fish River Station and the Wessel Islands. This habitat is highly susceptible to frequent fires because many rainforest plants are intolerant of, or sensitive to, fire. Further survey effort may reveal suitable habitat for the Purple Beak among other limestone outcrops in the park. The riparian habitats along seasonal gullies and creeks are also significant because many butterflies depend on these areas for refugia during the dry season, or use them for breeding. These habitats are highly susceptible to weed invasion as well as fire; thus, conservation management should aim to reduce the abundance and spread of weeds, and minimise frequent burning of these areas.

True bugs

The seasonal conditions during the Bush Blitz were appropriate for collecting true bugs; however, large areas of the park were burnt, which could have affected their activity and abundance. The majority of the specimens collected belong to the family Miridae (20 species); the next most abundant group was the stink bug family Pentatomidae (16 species).

Damselflies and dragonflies

The park supports a moderate diversity of dragonflies that are characteristic of the tropical savanna woodland communities of northern Australia. The most abundant species (in terms of frequency of occurrence across the 20 sites) were the dragonflies Scarlet Percher (*Diplacodes haematodes*) (60% of sites) and Blue Skimmer (*Orthetrum caledonicum*) (45%) and the damselflies Northern Billabongfly (*Austroagrion exclamationis*) and Malachite Threadtail (*Nososticta liveringa*) (45%). Half of the species (13 or 50%) were rare, being sampled only once or twice. The large proportion of rare species probably reflects a combination of a poor wet season prior to the survey; while low stream productivity and rapid drying of temporary pools may have led to reduced dragonfly abundance.

This survey provided an opportunity to sample a poorly known region of the NT for odonate fauna. The list of species recorded during the Bush Blitz should be regarded as a foundation upon which to further document the odonate fauna. Additional surveys, conducted during different seasons, can be expected to increase this list.

Information for land managers

Dragonflies need high quality water bodies to produce diverse and healthy populations. The permanent watercourses in the park appear to be in excellent condition, and need to be maintained thus, to ensure the sustainability of dragonfly and other faunal populations that rely on these water bodies. Wildfires can completely destroy a freshwater stream habitat for a period. These habitats are also highly susceptible to weed invasion and damage by feral herbivores such as cattle, horses, donkeys and pigs. Thus, conservation management should aim to reduce the abundance and spread of weeds and feral animals, and minimise frequent burning of these areas, especially around permanent water refuges.

²¹ Braby, M.F. 2014, Remarks on the spatial distribution of some butterflies and diurnal moths (Lepidoptera) in the Top End of the Northern Territory, Australia. *Northern Territory Naturalist* 25: 29–49.

Spiders

Despite the number of exciting new species, publication of descriptions is withheld due to a lack of males, usually considered essential for identification. To obtain a more comprehensive understanding of the spider fauna of this region, long-term sampling at a number of key habitats is needed, especially during the wet season, to enable better understanding of the spider fauna of this region.

Flora

Overall, the park has been well surveyed for vascular plants, with some 18% of the NT vascular flora represented. The condition of the park is relatively good with few exotic plant species observed during the survey. Future survey work undertaken during wetter conditions, when many more plants are flowering, and targeting rare habitats would most likely yield collections of additional annual species.

The Victorian River District and the park itself have been relatively well surveyed for vascular plants with numerous land resources²², ecological and floristic²³ surveys²⁴ providing a comprehensive picture of the species. More recent survey effort²⁵ has focused on the distribution and abundance of rare species in specific habitats.

Non-vascular plants are less well known from the park generally, with records restricted to incidental collections and a small number of targeted surveys by specialists. The relatively rare and inaccessible nature of optimal habitats for these groups limited the intensity of sampling during the Bush Blitz. The 32 non-vascular plant specimens collected during the Bush Blitz represent approximately 12 taxa, and may include species recorded in the park for the first time.

Information for land managers

The northern portion of the park is probably the most significant area in terms of rare and restricted plants. The area supports highly localised endemics such as the shrubs *Melaleuca triumphalis* and *Stenostegia congesta* at springs in gorges; the herbs *Isotropis faucicola* and *Rhynchosia filiformis* on stabilised scree slopes; and *Triodia* sp. Matt Wilson on the tertiary plateau edge. Several highly disjunct species, such as the ferns (*Gleichenia* sp. Victoria River and *Pteris vittata*) at springs and the tree *Xanthostemon umbrosus* in gorges, also occur in the area. The high topographic diversity and hydrogeological complexity of this section of the park is likely to contribute to the observed levels of local endemism evident in the gorge systems associated with the Victoria River.

The distinctive 'limestone' karst landscape, some gorges and escarpments support extensive areas of dry vine thicket in good condition. These habitats support a range of plant species important in the broader context of closed forest conservation across northern Australia and provide important refugial habitat for a range of animal species, particularly frugivores. These dry vine thicket patches provide an important link between the Top End and Kimberley dry vine thicket flora, functioning as a network of interconnected mesic patches in an essentially dryland matrix. The numerous small patches, with generally small population sizes, function as a classic 'meta-population' with mobile vectors such as

²² Napier, D.E., Hill J.V. 2012, *Land Resources of the Victoria River District*. Department of Land Resource Management Technical Report 19/2012D, Palmerston.

²³ Brocklehurst, P. et al. 1996, *Vegetation and Land Unit Survey of Gregory National Park, Northern Territory (N.T.)*. Resource Capability Assessment Branch, Department of Lands, Planning & Environment Technical Report No. 96/10, Palmerston.

²⁴ Craven, L.A. 1998, A result of the 1996 Mueller Commemorative Expedition to northwestern Australia: *Melaleuca triumphalis* sp. nov. (Myrtaceae). *Muelleria* **11**: 1–4.

²⁵ Crase, B., Cowie, I.D., Michell, C.R. 2006, Distribution and conservation status of the rare plants *Melaleuca triumphalis* and *Stenostegia congesta* (Myrtaceae), Victoria River district, northern Australia. *Australian Journal of Botany* **54**(7): 641–643.

frugivorous birds and bats ensuring the longer-term viability of the vegetation type in the landscape through seed and pollen transfer between patches. While local populations of plants may appear too small to be viable in the long term, the conservation of the dry vine thicket flora is dependent upon retention and maintenance of the mosaic of habitat patches, along with the bird and bat populations that link these patches together.

Fire management within the park is likely to be the most significant factor influencing plant biodiversity, particularly in fire sensitive habitats such as dry vine thickets and sandstone shrublands. The seasonality, intensity and frequency of fire has the potential to significantly influence the long-term longevity and viability of populations within the park, particularly if fire-return-intervals are shorter than the time required for locally restricted, obligate-seeding species to mature, produce, set and store seed from which they are able to regenerate after fire.

Sandstone shrubland and woodland habitats in particular are likely to be at risk as a result of frequent, intense wildfires. The current status of populations of fire-sensitive taxa (particularly obligate-seeding shrubs) in these habitats is largely unknown and re-establishment of dedicated vegetation/flora monitoring programs within the park would provide useful information on the status of populations in the context of the current management regime.

Glossary

Clinal variation: a gradual change in an inherited characteristic across the geographic range of a species usually correlated with an environmental transition such as altitude, temperature or moisture.

Cryptic species (cryptospecies): species that are physically similar but genetically different and reproductively isolated from each other.

Cryptozoic: (of small invertebrates) living on the ground, but hidden in the leaf litter under stones or pieces of wood.

Diurnal: active during the day

Ecological communities: unique and naturally occurring associations of plants and animals. Their presence can be determined by factors such as soil type, position in the landscape, climate and water availability.

Host plant: a species of plant that is used by larvae of insects as a place to feed and grow up.

Morphospecies: a group of individuals considered to belong to the same species on the grounds of morphology (physical features) alone.

Putative new species: an unnamed species that, as far as can be ascertained, was collected for the first time during the survey.

Range extension: increase in the known distribution or area of occurrence of a species.

Species range: the geographical area within which a particular species can be found.

Taxon (plural taxa): a member of any particular taxonomic group (e.g. a species, genus, family).

Taxonomy: the categorisation and naming of species. The science of identifying and naming species, as well as grouping them based on their relatedness.

Type locality: the location where the holotype (type specimen) was found.

Type specimen(s) (holotype, syntypes): the specimen, or set of specimens, on which the description and name of a new species is based.

Undescribed taxon: a taxon (usually a species) that has not yet been formally described or named.

Vascular plants: A lineage of plants that possess well-developed veins (vascular tissue) in their stems, roots and leaves. Vascular plants include the majority of familiar land plants: flowering plants, ferns, conifers, cycads and fern allies, but not mosses, liverworts or algae.

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FRONT COVER The gliding marsupial found in the top end is currently recognised as a subspecies of the Sugar Glider (*Petaurus breviceps ariel*). Recent genetic work suggests the species is likely to be more closely aligned with the Squirrel Glider (*Petaurus norfolcensis*) and the Mahogany Glider (*Petaurus gracilis*), neither of which is known to occur in the Northern Territory © Copyright, Teigan Cremona, Charles Darwin University.

BACK COVER Sunset at the Bush Blitz camp site, photo by Beth Tully © Copyright, Department of the Environment and Energy.



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