Groote Eylandt Bush Blitz

Terrestrial Vertebrate Survey of Groote Eylandt: Bats

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Contents

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List of contributors to this report.			
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Cover Photo: *Vespadelus* sp. captured at Angurugu, Groote Eylandt

Abstract

A total of 12 bat species were documented during a two-week survey of the Anindilyakwa IPA on Groote Eylandt, Northern Territory in June 2021. The species detected during the survey have been recorded previously on Groote Eylandt. Tissue samples from one group (*Vespadelus* spp) were collected using non-lethal methods to resolve the identity of the species present on the island. The survey detected the Vulnerable Ghost Bat on an offshore island where this species had not been previously recorded.

1. Introduction

Bats are an important component of Australia's contemporary mammalian fauna, exceeding 30% of mammal species and including many endemic species (Milne et al., 2005). Australian mammal and bat diversity is highest in the wet tropics and Cape York regions of north-eastern Queensland, however the savanna ecosystems of the northern Australian monsoonal tropics also support a rich bat fauna, including approximately 40% of Australian species and 75% of Australian microbat genera (Milne et al., 2005, Milne, 2006). The bat fauna of this region remains poorly known and broad areas of Top End of the Northern Territory have been subjected to limited and often unsystematic sampling (Milne et al., 2005). There have been few surveys of the bats of northern Australia's offshore islands (McKenzie and Bullen, 2012).

Groote Eylandt is in the western Gulf of Carpentaria approximately 45 km from the east Arnhem Land coastline. It is the largest island in the Gulf of Carpentaria and at 2258 km^2 is Australia's fourth largest continental island (Crase and Hempel, 2005). Groote Eylandt and its surrounding archipelago of satellite islands were isolated from the mainland by rising sea levels relatively recently in geological time, with the land connection severed between 12,000 to 8,000 years before present (Voris, 2000; Abbott and Burbidge, 1995).

In the Anindilyakwa classification of fauna, bats are included in the *wurrajija* group. The principal criteria for inclusion in this group is the ability to fly. The *wurrajija* therefore includes birds, microbats, flying foxes and many insects (Waddy 1982). The Anindilyakwa recognise three bat taxa (Waddy 1982), including all microbats (Anindilyakwa = *Yiningmunbalpa*), little red flying-fox (*Pteropus scapulatus*) (=*Yellilya*) and black flying-fox (*Pteropus alecto*) (=*Wurramalkwa*) (Groote Eylandt Linguistics 1993). The three recognised bat taxa are identified as occupying a distinct sub-group of the *wurrajija* (Waddy 1982).

1.1 History of Bat Collection and Survey

Prior to 2008, eleven bat species were known to occur on Groote Eylandt based on vouchered specimens, with material held by the Australian Museum (AM), Museums Victoria (NMV, Donald Thomson collection), Museum and Art Gallery of the Northern Territory (MAGNT) and the Smithsonian Museum of Natural History (SMNH). Early knowledge of the island bat fauna was based on opportunistic collecting by visiting biologists and staff at a mission station established on the island in 1924 (Dewar, 1995). Six bat taxa were collected during early scientific expeditions which occurred in three phases between 1921 and 1948. These included visits by Norman Tindale (South Australian Museum) in the company of Reverend. H. E. Warren of the Catholic Missionary Society (1921-1922), Donald Thomson's in 1935 collections held by the Museums Victoria (Dixon and Huxley, 1985) and the American-Australian Arnhem Land Expedition of 1948 (Johnson, 1964). Five additional species were added to the island fauna list through informal collections by mission staff and visiting biologists between 1960 and 1980.

Fauna surveys of mining leases on the western coastal plain of Groote Eylandt between 1989 and 1992 recorded several bat species for which there were pre-existing museum vouchers from the island (Webb, 1992). These surveys were the first to include the limited use of mist nets on Groote Eylandt and bat specimens collected at several locations within the vicinity of Alyangula and the western mining leases by T. Flannery are held by the Australian Museum (Webb, 1992). Several visits to Groote Eylandt and its satellite islands by Northern Territory government biologists between 2006 and 2009 generated incidental sightings of bats and these records are documented in the NT Government Fauna Atlas and unpublished reports. Two bat species, including the Black Flying-fox (*Pteropus alecto*) and Ghost Bat (*Macroderma gigas*), were recorded from small islands to the north and west of Groote Eylandt in 2006 (Woinarski et al., 2007). A fauna survey of sites on Groote Eylandt, Winchelsea Island and Bickerton Island in 2009 recorded two species of flying-fox (Mahney et al., 2009).

Surveys conducted between 2008 and 2021 by Barden (in prep) using a range of survey techniques have recorded an additional nine species in the archipelago. These bat surveys collectively improved the understanding of the species composition and distribution of bats on Groote Eylandt by applying a range of contemporary survey techniques. As a single survey method is unlikely to provide a realistic estimate of bat species richness (Huang et al., 2014), these surveys employed a combination of harp trapping, mist netting, roost searches, acoustic surveys, review of museum collections and consultation with indigenous traditional owners, indigenous rangers and other island residents (Barden in prep).

Groote Eylandt supports a high diversity of bat species for an offshore island with up to 20 taxa present and is considered of regional importance for the conservation of a suite of northern Australian bats, including regionally vulnerable and declining taxa (Barden in prep). Unresolved

issues relating to the bat fauna of Groote Eylandt include additional survey of remote areas of the island that have not been previously sampled, additional survey of difficult to access habitats, including coastal mangrove forests and escarpments, capture of specimens for species that have only been detected in acoustic sampling and resolution of taxonomic issues for some groups (e.g., *Vespadelus, Scotorepens*).

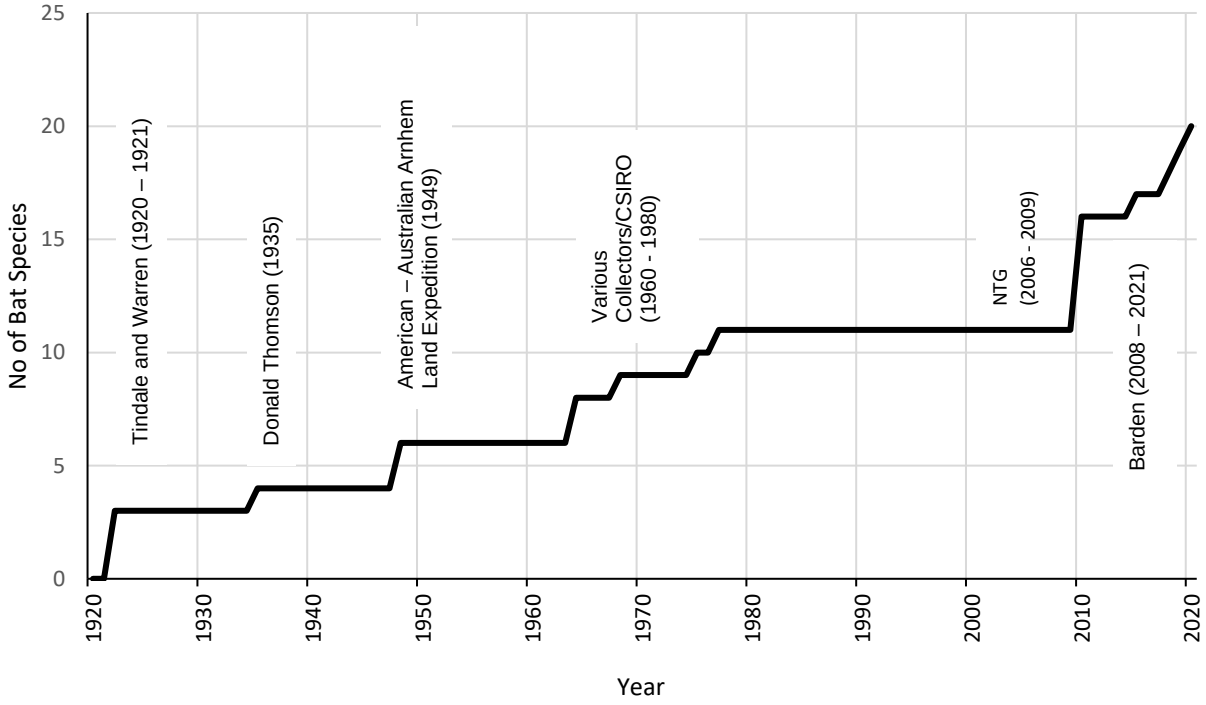

Figure 1. Accumulation of bat species on Groote Eylandt over the 100-year period 1920-2021. Major expeditions and collecting periods are indicated.

2. Methods

2.1 Site selection

Sites were selected based on locations determined by the Bush Blitz coordinating team and the Anindilyakwa Land and Sea Rangers (Table 1). This included the two standard sites at Top Crossing and the lower Emerald River, as well as several sites that could be easily accessed from the Umbakumba Road and at Little Paradise. Two additional sites were accessed using a helicopter for one night of sampling, including Ayangkijirumanja (Hawk Island) and the sandstone site at S180 south-east of Angurugu.

2.2 Survey techniques

Acoustic, trapping and observational surveys targeting bats were undertaken during the Groote Eylandt Bush Blitz. This included hand-held acoustic sampling, spotlighting, roost searches, remote acoustic recording from fixed stations and harp trapping.

Hand-held acoustic sampling was conducted using a Titley Scientific Walkabout (full spectrum) recorder during spotlight survey (9.5 hours). Hand-held acoustic recordings (Titley Walkabout) were identified in the field as the bat was observed using spotlight or thermal scope. These recordings were also visually inspected in the laboratory to confirm field identifications using Sonobat Version 4.5.0. Spotlighting sessions included the use of thermal scope (Pulsar Helion XQ38F) to improve detection of larger bats (including Ghost Bat and flying-foxes), to detect roosting bats and identify flyways.

At several locations, opportunistic searches of potential bat roosts and nocturnal bat feeding sites were undertaken, including shallow caves in sandstone areas (Hawk Island, S180), under buildings in Angurugu and Alyangula and culverts under roads.

Fixed acoustic surveys were conducted using Titley Scientific AnaBat Swift bat detectors (sampling rate 500 kHz, set to turn on automatically at sunset and off at sunrise) with an external microphone, mounted at 1.5 m and facing a water body or flyway. Calls were recorded in full spectrum WAV format and analysed using an R script developed by Dr. Kyle Armstrong (Specialised Zoological). Fixed detectors were placed at the two standard survey sites and three other locations (Little Paradise, Hawk Island and S180) for a total of 27 remote acoustic detection nights (Table 1).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong et al. 2021a, b) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language script that performed three tasks:

1. Undertook a Discriminant Function Analysis on training data from representative calls from northern Australia, including signals from low frequency emitting bats (Armstrong et al. 2021a);

2. From the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived

from the analysis of training data, and plotted these resulting coordinates over confidence regions for the defined call types; and

3. Facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition version 14.2.0.34.

Species were identified based on information in the author's own unpublished reference call material from Groote Eylandt and other areas of eastern Northern Territory, Milne (2002), Churchill (2008) and Armstrong et al. (2021a). Nomenclature follows Jackson and Groves (2015).

Limited opportunistic bat trapping was undertaken using harp traps several sites (10 harp trap nights). The number of harp trap sites was limited, as only two harp traps were available for the survey. This was partly caused by logistical issues related to moving traps to the island in combination with Covid restrictions. Alternate NT government harp traps that have been used in past Groote Eylandt surveys were unavailable. Harp traps were placed at sites where bats would be expected to fly along creek lines or tracks and adjacent to culverts on the Umbakumba Road (Table 1). An acoustic lure (Sussex Auotbat) playing generic bat social calls to attract microbats (Hill et al. 2015) was placed at a subset of the harp traps, including one trap at each of the Little Paradise, Top Crossing and Umbakumba Road sites.

Table 1 Bat Survey Locations and Effort – Fixed Acoustic Recording and Harp Traps

SAAL = Sussex Autobat Acoustic Lure; SS = Standard Site; FS = Full Spectrum; Zone = 53

Site Type	Equipment Type	Site Number	Easting	Northing	Location	Habitat	Nights
Fixed Acoustic	FS Swift	SS2	654558	8442706	Emerald River	Mangroves/Estuary	8
Fixed Acoustic	FS Swift	SS1	660047	8453542	Top Crossing	Riparian Woodland	8
Fixed Acoustic	FS Swift	S180	668797	8451078	Sharks Fin	Sandstone woodland/Riparian	2
Fixed Acoustic	FS Swift	H1	705293	8488318	Hawk Island	Beach strand - coastal	1
Fixed Acoustic	FS Swift	H2	705219	8487804	Hawk Island	Melaleuca Swamp Forest	1
Fixed Acoustic	FS Swift	H3	705680	8488016	Hawk Island	Mixed open forest - camp	1
Fixed Acoustic	FS Swift		667965	8464660	Umbakumba Rd	Open Forest/Sandstone	2
Fixed Acoustic	FS Swift		657313	8471065	Little Paradise	Open woodland/ Sandstone	4
Harp Trap	2 Bank SAAL	SS1	659950	8453611	Top Crossing	Riparian Woodland	2
Harp Trap	2 Bank SAAL		657313	8471065	Little Paradise	Open woodland/ Sandstone	4
Harp Trap	2 Bank SAAL		663080	8463449	Umbakumba Rd	Open woodland/ Sandstone	2
Harp Trap	2 Bank		667965	8464660	Umbakumba Rd	Riparian woodland	2

2.2.1 Methods used at standard and other survey sites

Top Crossing Standard Site 1

The following microbat survey methods were applied at the Top Crossing site:

- Spotlight/thermal survey conducted on one night (2 person hours);
- Acoustic recording using a hand-held full spectrum bat detector during spotlight survey;
- Remote acoustic call detection at one location near the crossing using a Titley Anabat Swift detector with a full spectrum microphone (17/6/2021 to 24/6/2021);
- A single 2 bank harp trap (Austbat) was used to capture bats at the crossing. The harp trap was augmented by an acoustic bat lure (Sussex Autobat) designed to improve capture rates of microbats by broadcasting generic social calls at the trap.

Emerald River Standard Site 2

At the Emerald River a remote acoustic recorder (Titley Swift) was left in place from the 17/6/2021 to 24/6/2021 adjacent to mangroves at the mouth of the river.

Umbakumba Road

Bat trapping and hand-held acoustic detection were conducted at several sites near the Pass on the Umbakumba Road. The trapping focussed on several road culverts that microbats are known to use as nocturnal feeding roosts. Two traps were set over two nights at this location, with one trap augmented with an acoustic lure (Sussex Autobat).

Creek West of Pelicans (S180)

The creek at S180 was the site of an overnight camp accessed by helicopter (22/6/2021). The following microbat survey methods were applied at this location:

- Spotlight survey conducted on one night (3 person hours);
- Acoustic recording using a hand-held full spectrum bat detector (Titley Walkabout) during spotlight survey;
- Remote acoustic call detection using two Titley Anabat Swift detectors with full spectrum microphones set close to the creek (two detection nights).

Little Paradise

During trapping targeting other mammal species at Little Paradise, a harp trap with an acoustic lure (Sussex Autobat) was set on a small drainage line adjacent to sandstone and operated over 4 nights. An acoustic recorder (Titley Swift) was set adjacent to the harp trap.

Ayangkijirumanja (Hawk Island)

The following microbat survey methods were applied at Hawk Island:

- Spotlight survey conducted on one night in the central component of the island (4.5 person hours);
- Acoustic recording using a hand-held full spectrum bat detector (Titley Walkabout) during spotlight survey;
- Remote acoustic call detection at three locations using Titley Anabat Swift detectors with full spectrum microphones (3 detector nights);
- Searches of sandstone caves and crevices to locate potential roost sites and feeding stations (approximately 1 person hour);
- A long-term deployment of a Titley Swift full spectrum detector by the Anindilyakwa Land and Sea Rangers. The data from this recorder was not available for this report.

2.3 Identifying the collections

Microbats captured in the field were identified in the field by Paul Barden using existing morphometric measurements and other data combined with sequenced tissue collections compiled for Groote Eylandt between 2015 and 2020. These tissues were analysed in collaboration with Dr Kyle Armstrong (South Australian Museum). This data has shown that some Groote Eylandt bats are smaller and have slightly different call characteristic frequencies when compared to adjacent mainland populations. Bat calls recorded during the survey were identified using locally recorded reference calls for most species, except for some groups, particularly *Ozimops* and *Saccolaimus*. The later genera were identified using Northern Territory mainland data bat call data held by Barden and Armstrong. Existing field guides were also used, including Churchill (2008) and Van Dyck et al. (2013). Sequencing of bat tissue samples collected during the 2021 Bush Blitz is underway at the Australian Museum (Dr Mark Eldridge).

3. Results and Discussion

12 bat species were recorded during the Groote Eylandt Bush Blitz (Appendix 1). Acoustic recordings identified 8 species, three species captured in harp traps or using hand nets and two species were detected during spotlight surveys. Harp trapping captured three individuals of two species (*Nyctophilus arnhemensis* and *Chalinolobus nigrogriseus*) and all captures were in traps that included an acoustic lure (Sussex Autobat). Non-lethal tissue samples were obtained from 13 *Vespadelus sp.* captured at roosts in Alyangula and Angurugu. Three species were observed during roost searches in sandstone and/or road culverts. Appendix 1 lists the bat species recorded during the Groote Eylandt Bush Blitz.

3.1 Un-named or not formalised taxa

None.

3.2 Putative new species (new to science)

None.

3.3 Weed or pest species

None.

3.4 Threatened species

During the surveys on Hawk Island, a Ghost Bat was observed hunting large moths in dune habitat in the central part of the island. Subsequent searches of small sandstone overhangs at a nearby locations revealed the presence of several nocturnal Ghost Bat feeding sites, identified by characteristic scats and prey remains. The remains including large insects (mainly Orthoptera) and several birds, including the remains (wings and feathers) of a juvenile Sacred Kingfisher (*Todiramphus sanctus*) (Plate 1) and a Brown Honeyeater (*Lichmera indistincta*). This is the first record of a Ghost Bat on Hawk Island, however this species has been previously sighted on the adjacent Amburrkba (North East Island). There are several other Ghost Bat records from satellite islands in the Groote Archipelago, including Anambajuwa off the northern coast and Yilikamarra (Connection Island) (NT Fauna Atlas).

Ghost Bats appear to be widespread on Groote and adjacent islands, with 21 post-2010 records (Barden in prep) and 13 pre-2010 records (NT Fauna Atlas). In 2014, Ghost Bats were recorded preying on delicate mice (*Pseudomys delicatulus*) and northern hopping mice (*Notomys aquilo*) in deep pitfall traps on Groote Eylandt and scats derived from one of these individuals contained microbat hair (Diete et al., 2016).

Table 2 Threatened Species

Species	Listing status and level	Location sighted/observed	Indication of abundance
Ghost Bat *Macroderma gigas*	Vulnerable (EPBC Act)	Hawk Island	One individual observed, small number of nocturnal feeding sites, roost not discovered

Plate 1. The remains of a juvenile Sacred Kingfisher (*Todiramphus sanctus*) found at a Ghost Bat feeding station in a sandstone overhang on Ayangkijirumanja (Hawk Island).

Plate 2. Common Sheathtail-bat (*Taphozous georgianus*) at Wurruwarrkbadenumanja (Cave Paintings), Groote Eylandt.

Plate 3. *Vespadelus sp* captured at Angurugu, Groote Eylandt. Analysis of tissue collected during the Bush Blitz is underway at the Australian Museum to determine the species.

3.5 Range Extensions

None.

3.6 Genetic information

Tissue samples were collected in the field from a selection of captured bats (n=15) using a biopsy punch to remove a small sample of the wing patagium or uropatagium, which reduces the requirement for collecting whole vouchers. The biopsy site mimics natural wing injuries and have been shown to heal within a short period of time (Weaver et al., 2009, Faure et al., 2009). One specimen of each of the Arnhem Long-eared bat (*Nyctophilus arnhemensis*) and the Hoary Wattled Bat (*Chalinolobus nigrogriseus*) was retained by MAGNT. Tissue sample processing is underway at the Australian Museum. The collection of additional *Vespadelus* tissue will allow clarification of the species that occur on Groote Eylandt.

Table 3 Collections and Tissue

Scientific Name	Site	Collection	Reference	Easting	Northing
Nyctophilus arnhemensis	Little Paradise	NTM U.6331	EBU115375	657397	8471151
Chalinolobus nigrogriseus	Little Paradise	NTM U.6332	EBU115376	657397	8471151
Vespadelus cf *finlaysoni*	Alyangula	AM patagium biopsy	EBU115379	653372	8468023
Vespadelus cf finlaysoni	Alyangula	AM patagium biopsy	EBU115380	653372	8468023
Vespadelus cf *finlaysoni*	Alyangula	AM patagium biopsy	EBU115381	653372	8468023
Vespadelus cf *finlaysoni*	Alyangula	AM patagium biopsy	EBU115382	653372	8468023
Vespadelus cf *finlaysoni*	Angurugu	AM patagium biopsy	EBU111383	658408	8453860
Vespadelus cf *finlaysoni*	Angurugu	AM patagium biopsy	EBU111384	658408	8453860
Vespadelus cf *finlaysoni*	Angurugu	AM patagium biopsy	EBU111385	658408	8453860
Vespadelus cf *finlaysoni*	Angurugu	AM patagium biopsy	EBU111385	658408	8453860
Vespadelus cf *finlaysoni*	Angurugu	AM patagium biopsy	EBU111387	658408	8453860
Vespadelus cf *finlaysoni*	Angurugu	AM patagium biopsy	EBU111388	658408	8453860
Vespadelus cf *finlaysoni*	Angurugu	AM patagium biopsy	EBU111389	658408	8453860
Vespadelus cf *finlaysoni*	Angurugu	AM patagium biopsy	EBU111390	658408	8453860
Vespadelus cf *finlaysoni*	Angurugu	AM patagium biopsy	EBU111391	658408	8453860

4. Information on species lists

The list appended to this report includes bat species identified using a variety of survey techniques. Some taxa contributing to acoustic recordings were not listed, as they may include several species that cannot currently be separated using this method (e.g., *Nyctophilus* sp. *Scotorepens* sp.). The status of the species of forest bat (*Vespadelus* sp.) on Groote Eylandt is currently unresolved. A single characteristic frequency peak has been detected for *Vespadelus* type calls in the analysis of large volumes of acoustic data. This indicates strongly that only one species of *Vespadelus* is present and call characters are closer to *V. finlaysoni*. While there are multiple museum specimens and other records of *Vespadelus caurinus* from Groote Eylandt (~16 specimens in collections), the only *Vespadelus* sequenced from Groote in recent years was a single *Vespadelus finlaysoni.* This call and genetic data suggests that the species present is *V. finlaysoni* but with a smaller size than mainland individuals, leading to confusion in past identifications based on body measurements such as forearm length. The samples collected in the current survey will contribute to the resolution of the *Vespadelus* on Groote Eylandt.

5. Information for land managers

Groote Eylandt supports a high diversity of bat species for an offshore island and is considered of regional importance for the conservation of a suite of northern Australian bats, including nationally listed and regionally declining taxa. Groote Eylandt represents an important refuge for species such as the Ghost Bat and if confirmed the Northern Leaf-nosed Bat (*Hipposideros stenotis*), as the IPA is a large area of unmodified habitat where threatening processes that have impacted mammals on the mainland are less intense or absent (Harrison et al., 2009).

There are several bat species within the IPA are of conservation significance, including a population of the Vulnerable (EPBC Act) Ghost Bat. Several escarpment areas that have been surveyed supported small numbers of roosting Ghost Bats and they are present on several offshore islands in the archipelago. Approximately 40% of Groote Island is covered by sandstone habitats and there are high densities of potential Ghost Bat prey species such as small mammals and rodents. This suggests there could be a relatively large population of Ghost Bats on the island, contributing significantly to regional Ghost Bat numbers. An important management objective would be to identify and protect important roost sites for this species, particularly maternity roosts. There is potentially a population of the Vulnerable (NT) Northern Leaf-nosed Bat on the island, although this requires confirmation.

6. Other significant findings

During the bat surveys undertaken for the Bush Blitz, several other threatened or noteworthy species were observed, including several sightings of Northern Masked Owl (*Tyto novaehollandiae kimberli*), Black Bittern (*Ixobrychus flavicollis*), Merten's Water Monitor (*Varanus mertensi*) and Carpentarian False-antechinus (*Pseudantechinus mimulus*). A list of vertebrate fauna species sighted incidentally during the Groote Eylandt Bush Blitz is included in Appendix 1.2.

7. Conclusions

Groote Eylandt and the Anindilyakwa IPA supports a high diversity of terrestrial vertebrates, including up to 20 species of bats (Barden in prep). It is possible that several additional bat species occur within the IPA and several species require further investigation and taxonomic clarification. This includes the Broad-nosed Bats (*Scotorepens* sp.), Orange Diamond-faced Bat (*Rhinonicteris aurantia*) and the Vulnerable (Northern Territory) Northern Leaf-nosed Bat. The Orange Diamond-faced Bat is only known from a single specimen found in Angurugu and the Northern Leaf-nosed Bat has potential sighting based on recordings and observations at a site on the lower Angurugu River (Barden in prep). Several species that occur or potentially on the island require confirmation through capture or additional genetic investigation, including the Broad-nosed Bat (*Scotorepens* sp.), forest bats (*Vespadelus caurinus* or *V. finlaysoni*), *Nyctophilus daedalus* and Northern Coastal Free-tailed Bat (*Ozimops cobourgianus*) (Barden in prep). The collection of tissue from *Vespadelus* in the current survey will assist in the resolution of one of these outstanding taxonomic matters. There has been some progress in improving understanding of the distribution and population of the Vulnerable (EPBC) Ghost Bat in the archipelago, however important roost and maternity sites remain unknown.

Despite the surveys reported by Barden (in prep) and here, significant areas of Groote Eylandt and its archipelago remain poorly sampled for bats. Habitats that require further investigation include mangroves and sandstone escarpment areas. Surveys are required in areas of the central sandstone escarpment, as well as the northern, eastern and south-eastern coastal areas. It would also be beneficial to sample bats in the broader Anindilyakwa IPA during a greater variety of seasonal conditions, including across the wet season.

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logistics. Dane Trembath (Australian Museum) aided with sample processing. Dr Kyle Armstrong developed the code that was used to scan bat acoustic data and inform species identification.

References

Abbott, I. & Burbidge, A. 1995. The occurrence of mammal species on the islands of Australia: a summary of existing knowledge. CALM Science.

Armstrong K.N., Broken-Brow J., Hoye G., Ford G., Thomas M. and Corben C. (2021a). Effective detection and identification of sheath-tailed bats of Australian forests and woodlands. *Australian Journal of Zoology* https://doi.org/10.1071/ZO20044

Armstrong K.N., Clarke S., Linke A., Scanlon A., Roetman P., Hitch, A.T. and Donnellan S.C. (2021b). Citizen science implements the first intensive acoustics-based survey of insectivorous bat species across the Murray-Darling Basin of South Australia. *Australian Journal of Zoology*. https://doi.org/10.1071/ZO20051

Armstrong, K.N., Aplin, K.P. and Crotty, S. (2016). *A pipeline and app for massive filtering, and assisted inspection of enormous acoustic datasets.* Poster presentation at the 17th Australasian Bat Society Conference, 29 March-1 April 2016, Hobart, Tasmania, Australia. The Australasian Bat Society Newsletter 46: 51.

Armstrong, K. N. & Aplin, K. P. (2014). *Identifying bats in an unknown acoustic realm using a semi-automated approach to the analysis of large full spectrum datasets.* Oral presentation at the 16th Australasian Bat Society Conference 22-25 April 2014. The Australasian Bat Society Newsletter 42, 35-36.

Barden, P.A. (in prep). Yiningmunbalpa, Yellilya and Wurramalkwa: A Review and Inventory of the Bats of Groote Eylandt and the Anindilyakwa Indigenous Protected Area.

Churchill, S.K. (2008). *Australian bats.* 2nd ed. Allen and Unwin, Crows Nest, NSW.

Crase, B. & Hempel, C. 2005. Object based land cover mapping for Groote Eylandt: A tool for reconnaissance and land based surveys. Proceedings of NARGIS 2005–Applications in Tropical Spatial Science, 4-7.

Dewar, M. 1995. The Black War in Arnhem Land: Missionaries and the Yolngu 1908-1940, North Australia Research Unit, Australian National University.

Diete, R.L., Dixon, K.M. and Barden, P.A., 2016. Predation of pitfall-trapped rodents by the ghost bat, Macroderma gigas. *Australian Mammalogy,* **38(2),** pp.249-252.

Dixon, J. & Huxley, L. 1985. Donald Thomson's mammals and fishes of northern Australia. Nelson: Melbourne.

Faure, P. A., Re, D. E. & Clare, E. L. 2009. Wound healing in the flight membranes of big brown bats. *Journal of Mammalogy,* **90,** 1148-1156.

Groote Eylandt Linguistics 1993. *Eningerribirra-langwa jurra. Groote Eylandt Linguistics-langwa*. Groote Eylandt Linguistics, Angurugu NT.

Harrison, L., L, M., Ward, S., Fisher, A., Pavey, C. R. 2009. An inventory of sites of international and national significance for biodiversity values in the Northern Territory, Department of Natural Resources, Environment, the Arts and Sport.

Hill, D.A., Armstrong, K.N. and Barden, P.A., 2014. Preliminary assessment suggests that acoustic lures can increase capture rates of Australian echolocating bats. *Australian Mammalogy*, **37(1),** pp.104-106.

Huang, J. C.-C., Jazdzyk, E. L., Nusalawo, M., Maryanto, I., Wiantoro, S. & Kingston, T. 2014. A recent bat survey reveals Bukit Barisan Selatan Landscape as a chiropteran diversity hotspot in Sumatra. *Acta Chiropterologica,* **16**, 413-449.

Jackson, S.M. and Groves, C.P. (2015). *Taxonomy of Australian mammals*. CSIRO Publishing, Victoria.

Johnson, D. H. 1964. Mammals of the Arnhem Land expedition. *Records of the American-Australian scientific expedition to Arnhem Land,* **4,** 427-515.

Mahney, T., McKay, L., Liddle, D., Fisher, A., Westaway, J., Fegan, M. and Dally, G., 2009. Bickerton, Winchelsea and south-east Groote Eylandt Wildlife Survey. Department of Natural Resources, Environment, the Art and Sports.

McKenzie, N. & Bullen, R. 2012. An acoustic survey of zoophagic bats on islands in the Kimberley, Western Australia, including data on the echolocation ecology, organisation and habitat relationships of regional communities*. Records of the Western Australian Museum, Supplement*, **81**, 67-108.

Milne, D., Fisher, A. & Pavey, C. 2006. Models of the habitat associations and distributions of insectivorous bats of the Top End of the Northern Territory, Australia. *Biological Conservation,* **130,** 370-385.

Milne, D. J., Armstrong, M., Fisher, A., Flores, T. & Pavey, C. R. 2005. Structure and environmental relationships of insectivorous bat assemblages in tropical Australian savannas. *Austral Ecology,* **30**, 906-919.

Milne, D.J. (2002). *Key to the bat calls of the Top End of the Northern Territory*. Parks and Wildlife Commission of the Northern Territory, Technical Report No. 71.

Van Dyck, S., Gynther, I. and Baker, A., 2013. *Field companion to the mammals of Australia*. New Holland Publishers.

Voris, H. K. 2000. Maps of Pleistocene sea levels in Southeast Asia: shorelines, river systems and time durations. *Journal of Biogeography*, **27**, 1153-1167.

Waddy, J. A. 1982. Biological classification from a Groote Eylandt Aborigine's point of view, Center for Western Studies.

Weaver, K. N., Alfano, S. E., Kronquist, A. R. & Reeder, D. M. 2009. Healing rates of wing punch wounds in free-ranging little brown myotis (*Myotis lucifugus*). *Acta Chiropterologica,* **11**, 220-223.

Webb, G. 1992. Flora and fauna surveys on the western side of Groote Eylandt, N. T. Report prepared for BHP Manganese - GEMCO.

Woinarski, J., Rankmore, B., Fisher, A., Brennan, K. & Milne, D. 2007. *The natural occurrence of northern quolls Dasyurus hallucatus on islands of the Northern Territory: assessment of refuges from the threat posed by cane toads Bufo marinus.* Report to The Australian Government's Natural Heritage Trust. Northern Territory Government, Darwin.

Appendix 1. List of bats recorded during the Groote Eylandt Bush Blitz						
Family	**Species**	**Common name**	**Putative new species**	**Threatened (EPBC Act)**	**Threatened (State/ Territory Act)**	**Exotic/ pest**
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail Bat	No	No	No	No
Emballonuridae	*Taphozous georgianus*	Common Sheathtailed Bat	No	No	No	No
Hipposideridae	*Hipposideros ater*	Dusky Leaf-nosed Bat	No	No	No	No
Megadermatidae	*Macroderma gigas*	Ghost Bat	No	Vulnerable	No	No
Molossidae	*Chaerephon jobensis*	Greater Northern Free-tailed Bat	No	No	No	No
Molossidae	*Ozimops lumsdenae*	Northern Free-tailed Bat	No	No	No	No
Pteropodidae	*Pteropus alecto*	Black Flying-fox	No	No	No	No
Vespertilionidae	*Chalinolobus nigrogriseus*	Hoary Wattled Bat	No	No	No	No
Vespertilionidae	*Myotis macropus*	Southern Myotis	No	No	No	No
Vespertilionidae	*Nyctophilus arnhemensis*	Arnhem Leaf-nosed Bat	No	No	No	No
Vespertilionidae	*Pipistrellus westralis*	Northern Pipistrelle	No	No	No	No
Vespertilionidae	*Vespadelus* cf *finlaysoni*	Finlayson's Cave Bat	No	No	No	No

Appendix 2. List of other vertebrates recorded during the Groote Eylandt Bush Blitz						
Family	**Species**	**Common name**	**Putative new species**	**Threatened (EPBC Act)**	**Threatened (State/ Territory Act)**	**Exotic/ pest**
MAMMALS						
Dasyuridae	*Pseudantechinus mimulus*	Carpentarian False-antechinus	No	No	No	No
Muridae	*Notomys aquilo*	Northern Hopping-mouse	No	Endangered	Vulnerable	No
Petauridae	*Petaurus ariel*	Savanna Glider	No	No	No	No
Pseudocheiridae	*Petropseudes dahli*	Rock Ringtail Possum	No	No	No	No
BIRDS						
Acanthizidae	*Gerygone chloronota*	Green-backed Gerygone	No	No	No	No
Acanthizidae	*Gerygone levigaster*	Mangrove Gerygone	No	No	No	No
Ardeidae	*Ixobrychus flavicollis*	Black Bittern	No	No	No	No
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew	No	No	No	No
Campephagidae	*Lalage leucomela*	Varied Triller	No	No	No	No
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar	No	No	No	No
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover	No	No	No	No
Charadriidae	*Vanellus miles*	Masked Lapwing	No	No	No	No
Dicruridae	*Dicrurus bracteatus*	Spangled Drongo	No	No	No	No
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch	No	No	No	No
Laridae	*Chroicocephalus novaehollandiae*	Silver Gull	No	No	No	No
Megapodiidae	*Megapodius reinwardt*	Orange-footed Scrubfowl	No	No	No	No
Meliphagidae	*Lichenostomus unicolor*	White-gaped Honeyeater	No	No	No	No
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater	No	No	No	No
Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	No	No	No	No
Meliphagidae	*Philemon citreogularis*	Little Friarbird	No	No	No	No
Meropidae	*Merops ornatus*	Rainbow Bee-eater	No	No	No	No
Monarchidae	*Myiagra alecto*	Shining Flycatcher	No	No	No	No
Pachycephalidae	*Pachycephala melanura*	Mangrove Golden Whistler	No	No	No	No
Pachycephalidae	*Pachycephala simplex*	Grey Whistler	No	No	No	No
Pittidae	*Pitta iris*	Rainbow Pitta	No	No	No	No
Ptilonorhynchidae	*Ptilonorhynchus nuchalis*	Great Bowerbird	No	No	No	No

Family	Species	Common name	Putative new species	Threatened (EPBC Act)	Threatened (State/ Territory Act)	Exotic/ pest
Rallidae	*Eulabeornis castaneoventris*	Chestnut Rail	No	No	No	No
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	No	No	No	No
Strigidae	*Ninox novaeseelandiae*	Southern Boobook	No	No	No	No
Tytonidae	*Tyto novaehollandiae kimberli*	Northern Masked Owl	No	Vulnerable	Vulnerable	No