

Groote Eylandt Bush Blitz

Herpetological Survey

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Dane Trembath and Jodi Rowley

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List of contributors

List of contributors to this report.			
Name	Institution/affiliation	Qualifications/area of expertise	Level/form of contribution
Dane Trembath	AM	Herpetology	Principal Author
Jodi Rowley	AM	Herpetology	Principal Author

Abstract

Groote Eylandt is a biologically diverse and important part of northern Australia, with a poorly scientifically-known amphibian and reptile fauna. During the Bush Blitz, we surveyed a variety of sites from 1m to 25m elevation, and ranging from open eucalypt woodlands to rugged sandstone gorges and escarpments, and recorded 12 frog species and 33 reptile species. Preliminary molecular data revealed the presence of 5 morphologically cryptic frog and reptile species that are potentially new to western science. Follow-up research using voucher specimens and associated tissues and advertisement call recordings collected during the surveys, and comparison with related taxa will allow confirmation. Further research on material collected on this Bush Blitz, and additional surveys on Groote Eylandt, are likely to reveal additional species, some of which are likely to be new to science.

1. Introduction

Vast areas in northern Australia remain poorly surveyed for amphibians and reptiles, and our understanding of the true biodiversity of these important vertebrate groups is lacking. In addition, despite their diversity and abundance, the taxonomy and systematic relationships of many northern Australian amphibian and reptile groups have received little attention. However, recent molecular systematic work on particular groups in the region have revealed that many well-known ‘species’ in northern Australia are composites of morphologically cryptic taxa (Horner 2007; Doughty et al. 2018; Oliver et al. 2019; Oliver et al. 2020a). A greater understanding of the amphibian and reptile biodiversity of northern Australia is urgently needed to ensure that it is taken into account in conservation planning, particularly in the face of land-use change, climate change and other threats.

Groote Eylandt is the largest island in the Gulf of Carpentaria and the fourth largest island in Australia, being located off the eastern coast of Arnhem Land in the Northern Territory. The island is mostly covered in open eucalypt forest, but also contains remote sandstone ranges combined with associated valleys and waterways

Historical scientific collections of reptiles and frogs on Groote Eylandt commenced in the 1920s when Norman Tindale spent 12 months collecting natural history specimens on the island. This was further supplemented by Captain Wilkins, who collected natural history specimens for the British Museum (Gow, 1981). Upon the establishment of the Groote Eylandt Mission, a number of specimens were also collected and sent to the Australian Museum by the Reverend Hubert Ernest de Mey Warren (Kinghorn 1931).

The first major collections from Groote Eylandt were made when the Australian – American Arnhem Land Expedition spent 17 weeks on the island, while based at Umbakumba and collected a large array of reptiles and frogs (Mitchell 1955). In 1979, Graeme Gow collected reptiles and frogs including a visit to North East Island (Gow, 1981). Mike Tyler, from the South Australian Museum also conducted surveys in 1984 (Tyler, 1986).

More recently, formal standardised fauna surveys have been conducted throughout Groote Eylandt, in relation to resource development by the mining company GEMCO FTA (Webb, 1992; Barden 2012), or by the Northern Territory Government (Mahney et al. 2009). These surveys were intensive but voucher specimens and or associated genetic material was typically not taken, limiting our ability to reveal the true diversity and biogeographic relationships in this region. Pre-survey expectations were to target groups known to harbour cryptic species in other parts of northern Australia. Nevertheless, the general habitat diversity and remoteness of the region meant that completely scientifically unexpected discoveries remained a real possibility, especially for smaller species with potentially narrow ranges.

This report summarises the results of a two-week survey of reptiles and frogs on Groote Eylandt in June 2021.

2. Methods

2.1 Site selection

Sites were selected to maximise the range of habitat types and topography accessed, in order to most effectively sample the highest diversity of herpetofauna and to maximise the chances of both encountering the following target groups:

- Frogs (Families Hylidae, Limnodynastidae, Microhylidae & Myobatrachidae)
- Geckos (Families Diplodactylidae and Gekkonidae)
- Skinks (Family Scincidae)

and detecting species new to science.

Seven main sites were visited during the day and night along with one trapping site during the survey (Table 1).

Table 1. Site at Groote Eylandt			
Site Name	Latitude (S)	Longitude (E)	Day(D)/Night (N)
Main Sites			
Hawk Island	-13.666873	136.898916	D&N
Hidden Valley	-14.093165	136.707657	D&N
North East Island	-13.63586	136.94499	D&N
Site QRS	-14.00727	136.56529	D&N
Site 18	-13.888967	136.5093493	D&N
Site K100	-13.991233	136.47369	D&N
Top Crossing	-13.98417	136.481995	D&N
Umbakumba Road Creek	-13.886977	136.536362	D&N
Trapping Site			
Anindilyakwa Ranger Station	-13.857148	136.436752	D&N

2.2 Survey techniques

We undertook intensive visual and acoustic searches for frogs, and visual surveys for reptiles at each site. All sites were searched in the afternoon, followed by extensive spotlighting in the

evening. Intensive pit-fall and funnel trapping was conducted at the Anindilyakwa Ranger Station and freshwater turtles were sampled using aquatic turtle traps for one day at Top Crossing. Each herpetofauna trapping site incorporated nine 10 m transects each with a 30 cm high fence, one 20 L bucket and 2 funnel traps. Trap-lines were checked and emptied every morning and afternoon.

Tissue samples for DNA analysis were obtained from all vouchers retained during the survey; vouchers were carefully prepared (e.g. toes spread) and fixed in shallow trays of formalin prior to preservation in ethanol. Sampling was conducted under Parks and Wildlife Commission NT Permit (65097) and permits, in accordance with Charles Darwin University Animal Ethic Committee approval A12009 and the Australian Museum Animal Ethic Committee Approval 20-01, and with Anindilyakwa Land Council Board approval.

2.2.1 Methods used at standard survey sites

We used the standard survey techniques as outlined by Bush Blitz. This consisted of a search for 2 person-hours (e.g. 2 people for 1 hour, or 1 person for 2 hours) in the morning and spotlighting for 2 person-hours after full dark with headtorches.

2.3 Identifying the collections

Specimens retained as vouchers were processed in the field with the majority lodged at MAGNT (some duplicate samples to the AM). On return to the Australian Museum a subsample of the material was sorted and re-examined to provide final confirmation of identifications using the works of Cogger (2014), Horner (1992, 2007) and Wilson & Swan (2021); and by comparison with previously identified vouchers registered in the MAGNT collection. To confirm the identification of several morphologically cryptic species, we obtained mitochondrial DNA sequences from tissue samples collected during the surveys.

3. Results and Discussion

We documented 12 frog and 33 reptile species during the survey (Appendix 1). Voucher specimens of 33 individuals of 12 frog species and 86 voucher specimens of 31 reptile species were retained with associated tissues as an available resource for further research. All remaining animals were identified and released at the point of capture. This study brings the number of terrestrial frogs and reptiles known from Groote Eylandt to 85 (Appendix 1).

3.1 Un-named or not formalised taxa

Two individual Pygmy Mulga Snakes (*Pseudechis aff. weigeli*) were collected during the trip, one found in the Rangers Camp, and another brought in as a roadkill from the Umbakumba Road. These have been sequenced as part of an ongoing study, and our preliminary results show that these were most closely related to the Pygmy Mulga Snake that are present throughout the Top end of the Northern Territory.

We also sequenced a range of Della's (*Gehyra* spp.) collected throughout Groote Eylandt and two offshore islands (Figures 1-3). Preliminary molecular data reveals that two of these *Gehyra* sp. 1 and 2 are currently un-named and match previous material from Groote Eylandt cited in Oliver (et al. 2019) and Laver (et al. 2018).

Table 1. Putatively un-named or not formalised taxa	
Taxon	Comment
<i>Gehyra</i> sp. 1	Multiple specimens found on Groote and offshore islands
<i>Gehyra</i> sp. 2	Multiple specimens found on sandstone on Groote
<i>Pseudechis</i> aff. <i>weigelei</i>	Two specimens found.

3.2 Putative new species (new to science)

Previous studies have shown that reptiles and frogs from a single widely distributed species can be genetically divergent and sometimes also morphologically different to individuals of the same species from another location (i.e. cryptic species complexes of two or more species). Such variation may relate to differences in ecology such as the use of different habitats, or be related to biogeographic barriers. For example, the Groote Eylandt Marbled Gecko (*Oedura nesos*), endemic to the sandstone ranges on Groote Eylandt was recently scientifically described (Oliver et al. 2020b). This species was previously thought to be the widespread Marbled Velvet (*Oedura marmorata*). On this trip we were able to collect individuals of several species for which preliminary molecular work indicates the likelihood that they are scientifically undescribed.

Two individuals of Dtella's (*Gehyra* sp. 3) were sequenced and found to be a distinct molecular clade from the already known Dtella's (*Gehyra* sp. Groote) cited in Oliver (et al. 2019) and Laver (et al. 2018).. This finding supports the recognition of up to three scientifically undescribed species present on Groote Eylandt.

Seven individuals of the Northern Sedge Frog (*Litoria bicolor*) were collected at various localities throughout Groote Eylandt, and some may represent a distinct species (*Litoria* aff. *bicolor*) as they formed a distinct molecular clade from other individuals on the island. Further molecular, morphological and bioacoustic work is underway to confirm their status.

Tissue samples and specimens of other amphibian and reptile species from Groote Eylandt will contribute to continuing efforts to identify the true diversity of herpetofauna in the area.

Table 2. Putative new species (new to science)	
Species	Comment
<i>Gehyra</i> sp. 3	Two specimens found on sandstone on Groote.
<i>Litoria</i> aff. <i>bicolor</i>	Four specimens found.

3.3 Exotic and pest species

The only exotic species that was found was the Asian House Gecko (*Hemidactylus frenatus*). The species was detected throughout Alyangula.

Although Cane Toads (*Rhinella marina*) are present and common throughout much of the Northern Territory, they are not present on Groote Eylandt. Continued vigilance to prevent their introduction and establishment on Groote Eylandt is of the utmost importance. Several reptile species (e.g. *Pseudechis australis*, *Tiliqua scincoides*, and *Varanus panoptes*) are known to experience population declines following the arrival of Cane Toads (Doody *et al.* 2009; Price-Rees *et al.* 2010).

Table 3. Exotic and pest species recorded

Exotic/pest species	Location sighted/observed	Indication of abundance	Comments
<i>Hemidactylus frenatus</i>	Alyangula	Common on buildings	
<i>Rhinella marina</i>	Alyangula	Very rare	A recently intercepted specimen was provided by the rangers for the museum.



Figure 1. *Gehyra* sp. 1 from Groote Eylandt.



Figure 2. *Gehyra* sp. 2 from Groote Eylandt.



Figure 3. *Gehyra* sp. 3 from Groote Eylandt.



Figure 4. *Litoria* aff. *bicolor* from Groote Eylandt.

3.4 Threatened species

One listed threatened species, the semi-aquatic Merten's Water Monitor (*Varanus mertensi*) was recorded during the survey. These species are known to have experienced population declines in the Daly River region due to predation on toxic Cane Toads (Doody *et al.* 2009).

Species	Listing status and level (EBPC, State/Territory)	Location sighted/observed	Indication of abundance
<i>Varanus mertensi</i>	Vulnerable (TPWC)	Seen at multiple sites at Groote Eylandt	Tracks and or seen at all freshwater sites.

3.5 Range extensions

None.

3.6 Genetic information

All specimens that were vouchered had tissue samples preserved in the field prior to fixation of the specimen. Upon return to the Australian Museum a subset of specific genera that were difficult to morphologically identify or were part of known species complexes were analysed using molecular genetics. These analyses confirmed that;

- Two species of Toadlets, the Floodplain (*Uperoleia inundata*) and Stonemason Toadlet (*Uperoleia lithomoda*) are present on the island. These two species are very hard to distinguish in the field unless they are calling.
- The Froglets (*Crinia* sp.) that were collected were confirmed as the Remote Froglet (*Crinia remota*), and not the often-confused Bilingual Froglet (*Crinia bilingua*), which have previously been reported from the island
- One large tadpole was confirmed to be a Marbled Frog (*Limnodynastes convexiusculus*), our only record of the species during the survey.
- The Northern Sedge Frogs (*Litoria* aff. *bicolor*) that are present on the island form two distinct genetic clades, with a possible scientifically undescribed species.
- The Dtella's (*Gehyra* sp.) that are present on the island form three distinct genetic clades not present on the mainland and each represents a potentially undescribed species.
- The Pygmy Mulga Snakes (*Pseudechis* aff. *weigeli*) that are present on the island, are possibly an undescribed species, that is present throughout the entire Top End of the Northern Territory
- The identity of the Death Adders collected were confirmed as the Rugose Death Adder (*Acanthophis rugosus*).
- The varanids in the woodlands of Groote Eylandt are Sand Goannas (*Varanus gouldii*).

4. Information on species lists

The database used to compile this report was the Atlas of Living Australia (ALA), which combines all the government sighting and trapping data with museum data from throughout Australia. This database showed an extensive species list already known from Groote Eylandt, but the collection of vouchers and tissues from Groote Eylandt on this survey will be vital in resolving the true diversity and list of amphibians and reptiles on Groote Eylandt.

5. Information for land managers

While Groote Eylandt supports a high diversity of vertebrates due to its range of habitats, it is very hard to survey the area comprehensively as access is quite limited. In particular it appears that the south and south-western sections of the region are virtually unsurveyed due to limited access. It is possible that these areas may have endemic terrestrial and freshwater vertebrates present on the flat tops of the rock outcrops. A wet season survey, focusing on frogs within the south-western sandstone would have the highest probability of detecting undescribed frogs, as they are very difficult or impossible to locate when not calling. Future surveys and management should focus on these areas. Use of the FrogID app to record frog calls will also aid in adding occurrence records of frogs across Groote Eylandt, and also inform ongoing taxonomic work.

6. Other significant findings

While on Groote Eylandt we were able to observe that the Cane Toad's (*Rhinella marina*) have not established themselves on the island. We were also able to observe the large amounts of effort put in by the rangers to ensure the biosecurity of the island is preserved. By keeping Groote Eylandt Cane Toad free, will ensure that impacts to native animals seen elsewhere through the Northern Territory will not happen on the island.

7. Conclusions

Groote Eylandt supports a high diversity of amphibians and reptiles, and sound management of the island will ensure the long-term conservation of a fauna broadly characteristic of the arid interior and northern tropical forests of the Northern Territory, but with unique elements. The Bush Blitz survey allowed the collection and analysis of molecular data, revealing up to five currently scientifically undescribed species. This survey and collection of vouchers and genetic material presents a significant advance in our understanding of the true diversity of the amphibians and reptiles of Groote Eylandt. Further research, combined with additional, targeted field surveys are likely to reveal that the island holds a much greater diversity of amphibians and reptiles than currently scientifically understood. Wet-season surveys for frogs will be particularly important. Groote Eylandt provides a fantastic opportunity for documenting biodiversity as part of a two way learning process involving indigenous rangers, and we would recommend that the rangers continue to document biodiversity by collecting roadkill for eventual deposition at MAGNT. In addition, we recommend the further promotion and use of the FrogID project throughout the island by rangers and the wider community, and the Australian Museum can provide support in this regard.

Acknowledgements

We wish to acknowledge the Traditional Owners of Groote Eylandt and recognise their ongoing connection to Land and Sea Country, and thank them for allowing us to conduct our surveys. We also wish to thank Anindilyakwa Land and Sea Rangers for supporting our survey and also by providing us with on-ground information regarding the terrain. Paul Barden of Ecological Management Services provided a large amount of help with logistics, sample processing and extensive knowledge of the islands herpetofauna. Last but not least, we wish to thank the Helicopter pilot, catering staff and Bush Blitz team for help on the trip.

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Appendix 1. List of Herpetofauna recorded during the Groote Eylandt Bush Blitz						
Family	Species	Common name	Putative new species	Threatened (EPBC Act)	Threatened (State/Territory Act)	Exotic/ pest
Agamidae	<i>Chlamydosaurus kingii</i>	Frilled Lizard	No	No	No	No
Agamidae	<i>Diporiphora bilineata</i>	Two-lined Dragon	No	No	No	No
Agamidae	<i>Lophognathus gilberti</i>	Gilbert's Dragon	No	No	No	No
Bufo	<i>Rhinella marina</i>	Cane Toad	No	No	No	Yes
Colubridae	<i>Boiga irregularis</i>	Brown Tree Snake	No	No	No	No
Colubridae	<i>Dendrelaphis punctulatus</i>	Common Tree Snake	No	No	No	No
Colubridae	<i>Tropidonophis mairii</i>	Freshwater Snake	No	No	No	No
Diplodactylidae	<i>Amalosa rhombifer</i>	Zigzag Velvet Gecko	No	No	No	No
Diplodactylidae	<i>Lucasium stenodactylus</i>		No	No	No	No
Diplodactylidae	<i>Oedura nesos</i>	Marbled Velvet Gecko	No	No	No	No
Elapidae	<i>Acanthophis rugosus</i>	Papuan Death Adder	No	No	No	No
Elapidae	<i>Furina ornata</i>	Moon Snake	No	No	No	No
Elapidae	<i>Pseudechis aff. weigeli</i>	Pygmy Mulga Snake	No	No	No	No
Gekkonidae	<i>Gehyra</i> sp. 1	Dtella	No	No	No	No
Gekkonidae	<i>Gehyra</i> sp. 2	Dtella	No	No	No	No
Gekkonidae	<i>Gehyra</i> sp. 3	Dtella	Yes	No	No	No
Gekkonidae	<i>Hemidactylus frenatus</i>	Asian House Gecko	No	No	No	Yes
Gekkonidae	<i>Heteronotia binoei</i>	Bynoes Gecko	No	No	No	No
Hylidae	<i>Litoria bicolor</i>	Northern Dwarf Tree Frog	No	No	No	No
Hylidae	<i>Litoria</i> aff. <i>bicolor</i>	Dwarf Tree Frog	Yes	No	No	No
Hylidae	<i>Litoria nasuta</i>	Rocket Frog	No	No	No	No
Hylidae	<i>Litoria rothii</i>	Northern Laughing Tree Frog	No	No	No	No
Hylidae	<i>Litoria rubella</i>	Desert Tree Frog	No	No	No	No
Hylidae	<i>Litoria spaldingi</i>	Spaldings Rocket Frog	No	No	No	No
Limnodynastidae	<i>Limnodynastes convexiusculus</i>	Marbled Frog	No	No	No	No
Myobatrachidae	<i>Crinia remota</i>	Remote Froglet	No	No	No	No
Myobatrachidae	<i>Platyplectrum ornatum</i>	Ornate Burrowing Frog	No	No	No	No
Myobatrachidae	<i>Uperoleia inundata</i>	Floodplain Toadlet	No	No	No	No

Family	Species	Common name	Putative new species	Threatened (EPBC Act)	Threatened (State/Territory Act)	Exotic/ pest
Myobatrachidae	<i>Uperoleia lithomoda</i>	Stonemason Toadlet	No	No	No	No
Pygopodidae	<i>Delma borea</i>	Rusty-topped Delma	No	No	No	No
Pythonidae	<i>Morelia spilota variegata</i>	Carpet Python	No	No	No	No
Scincidae	<i>Carlia amax</i>	Bauxite Rainbow-skink	No	No	No	No
Scincidae	<i>Carlia munda</i>	Shaded-litter Rainbow-skink	No	No	No	No
Scincidae	<i>Carlia sexdentata</i>	Robust Rainbow Skink	No	No	No	No
Scincidae	<i>Cryptoblepharus metallicus</i>	Metallic Snake-eyed Skink	No	No	No	No
Scincidae	<i>Ctenotus inornatus</i>	Bar-shouldered Ctenotus	No	No	No	No
Scincidae	<i>Ctenotus quirinus</i>	Arnhem Land Ctenotus	No	No	No	No
Scincidae	<i>Eremiascincus isolepis</i>	Northern Bar-lipped Skink	No	No	No	No
Scincidae	<i>Lerista carpentariae</i>	Carpentarian Slider	No	No	No	No
Scincidae	<i>Menetia alanae</i>	Top-end Dwarf Skink	No	No	No	No
Scincidae	<i>Notoscincus ornatus</i>	Ornate Soil-crevice Skink	No	No	No	No
Scincidae	<i>Tiliqua scincoides intermedia</i>	Northern Blue-tongued Skink	No	No	No	No
Varanidae	<i>Varanus gouldii</i>	Gould's Goanna	No	No	No	No
Varanidae	<i>Varanus mertensi</i>	Mertens' Water Monitor	No	No	Yes	No
Varanidae	<i>Varanus scalaris</i>	Spotted Tree Monitor	No	No	No	No