Mungalla Terrestrial Fauna Survey

Overview of eastern sand ridge terrestrial vertebrate fauna

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May 2016

Contents

1 INTRODUCTION

1.1 Mungalla context

Mungalla Station is an approximately 830 ha property owned and managed by the Nywaigi Aboriginal people. Numerous ventures are undertaken on the property including cattle agistment, tourism (educational, recreational), education programmes for schools and conservation and natural resource management.

Mungalla is located 12 km east southeast to southeast of the town of Ingham in north east Queensland, Australia, and its eastern boundary is less than one kilometre from the Pacific Ocean. It is located within the Herbert subregion (Sattler & Williams, 1999), of the Wet tropics Bioregion (Thackway & Cresswell, 1995). The Herbert subregion has the lowest rainfall of the generally very wet Wet Tropics Bioregion, and is dominated by the Herbert River floodplain. Remnant vegetation in the coastal lowlands is dominated by woodlands: *Eucalyptus* and *Corymbia* spp. on the better drained sandy areas; *Melaleuca* spp. dominated in poorly drained, low lying freshwater areas; mangrove communities along the many short estuaries; and pockets of littoral and gallery rainforest and vine scrubs in areas that are protected from fire and have sufficient moisture to support such communities.

1.2 Vegetation communities

Approximately 390 ha has been cleared in the past (non-remnant vegetation), a further 200 ha partially cleared and likely to be significantly different to the original vegetation. Over 150 ha of the property is low lying permanently or semi-permanently inundated grass and sedge-lands to swamps, with few or no trees and varying degrees of tidal, saltwater intrusion. These areas occupy much of the central and eastern portion of Mungalla. East of these low lying areas is an area of remnant beach dune ("sand ridge") country of Holocene origin. In the sand ridge country and its immediate surrounds, there is approximately 16 hectares of uncleared vegetation (remnant) but most (approximately 100 ha) of the sand ridge country has been cleared in the past, and is now regrowing, with the vegetation community dominated by thick *Acacia* spp. Other species regrowing include tree species, such as *Melia azedarach*, *Alphitonia excelsa*, *Macaranga tanarius* with *Mallotus philippensis* gradually emerging. There are two areas within the sand ridge part of the property that are still cleared, open grassland or grassland with orchard trees (mangoes) growing. The northern of these two clearings is approximately five hectares, and the southern clearing is roughly four hectares, with much of its area being dominated by very large mango trees. This southern clearing is where the old homestead of Mungalla was situated prior to 1944 (Wallace, undated). It is this area of sand ridge country – the regrowth, remnants, and cleared grassy patches, that were the focus of this survey. Figure 1 shows the context of Mungalla in its geographical location in the north Queensland region, and the specific locations of the survey sites on Mungalla Station.

2 Methods

2.1 Background data collection

Prior to commencement of field survey activities, online data for terrestrial vertebrates (amphibians, reptiles, birds, mammals) were collected from the Atlas of Living Australia (ALA, 2015) using the Spatial Portal function and defining a 5 km buffer around the Mungalla boundary. Records from the same 5 km buffer held in a CSIRO biodiversity database were also collated. This databases includes systematic monitoring data from a large number of standardised surveys in northern Australia, plus the Black-throated Finch Recovery Team database, Qld WildNet and Birds Australia databases. To assess bird populations, the eBird website was accessed (Eremaea, 2016) for Mungalla Station alone (i.e. no buffer was used).

2.2 Standardised survey

2.2.1 Site monitoring

Monitoring of vertebrate fauna was undertaken in late January 2016. Ten monitoring sites were established and monitored from 18th – 23rd January 2016. Sites were located in the vegetated sand ridges that runs roughly north-south, along the eastern edge of Mungalla Station (Figure 1).

Four sites were established with full trapping and searching effort in accordance with methods used in (Vanderduys *et al.*, 2012), while the remaining sites were surveyed by using active searching and bird counts, using the same methodology as in the four more intensely surveyed sites.

The full trapping and search effort involved four pitfall traps (20 L buckets), each bucket being 40 cm deep x 30 cm diameter. These were arranged in a 'T' configuration, joined by 10 m of 30 cm high drift fence and finished with two funnel traps at each end of the 'T' (Figure 2). Figure 3 shows how the completed pitfall and funnel trap array appears for the duration of the survey.

In addition to the pitfall trap array, 20 Elliott traps were set in a 50 x 50 m square centred on the pitfall trap array. Two cage traps were set, one at each diagonal corner of the square of Elliott traps. Elliott and cage traps were baited with a mix of peanut butter, rolled oats, honey and vanilla essence with a small dog biscuit in each trap. Elliot and funnel traps were opened for the same four night trapping period as the rest of the survey activities.

2.2.2 Targeted spotlighting

Targeted spotlighting was conducted over five nights from 18th – 22nd January 2016, for roughly 3 – 4 hours per night, commencing soon after dark, generally around 19:30 – 19:45. Spotlighting was mostly conducted by walking slowly along existing tracks scanning for "eye-shine" of vertebrates, especially arboreal mammals, and in particular, the endangered mahogany glider.

The central north south track running from the entrance gate off Victoria Mill Road through to the Bird Hide Lagoon, and the eastern boundary track, were surveyed twice with spotlights. Each of these tracks is 2 km in length. Roughly 19.9 km of walking spotlighting was conducted at an

average of 1.1 km/h, allowing accurate identification of any animals seen or heard. This pace generally allows for quite thorough coverage out to a distance of 15 – 20 m, depending on the thickness of the vegetation and foliage. Some species, such as flying-foxes (*Pteropus* spp.) and barking owls (*Ninox connivens*) were identifiable at distance up to 80+ m from the observer (using binoculars). However, smaller species such as geckos and amphibians were generally not detected further than 15 m from the observer. For this reason, when calculating the approximate area observed, a conservative buffer of 10 m radius was used. Using this method, an area of approximately 27.5 hectares was surveyed by spotlighting. The central north south track and the eastern boundary track, which were surveyed twice, were only counted once in calculating the total area surveyed. Figure 4 shows the survey area over the five nights.

Spotlighting was faster on the established tracks than when conducted in thick *Melaleuca* forest along the eastern boundary of Mungalla. All vertebrates were recorded on a GPS (decimal degrees, GDA94). Records from within 50 m of standardised sites were grouped with site data as opposed to being reported as incidental records.

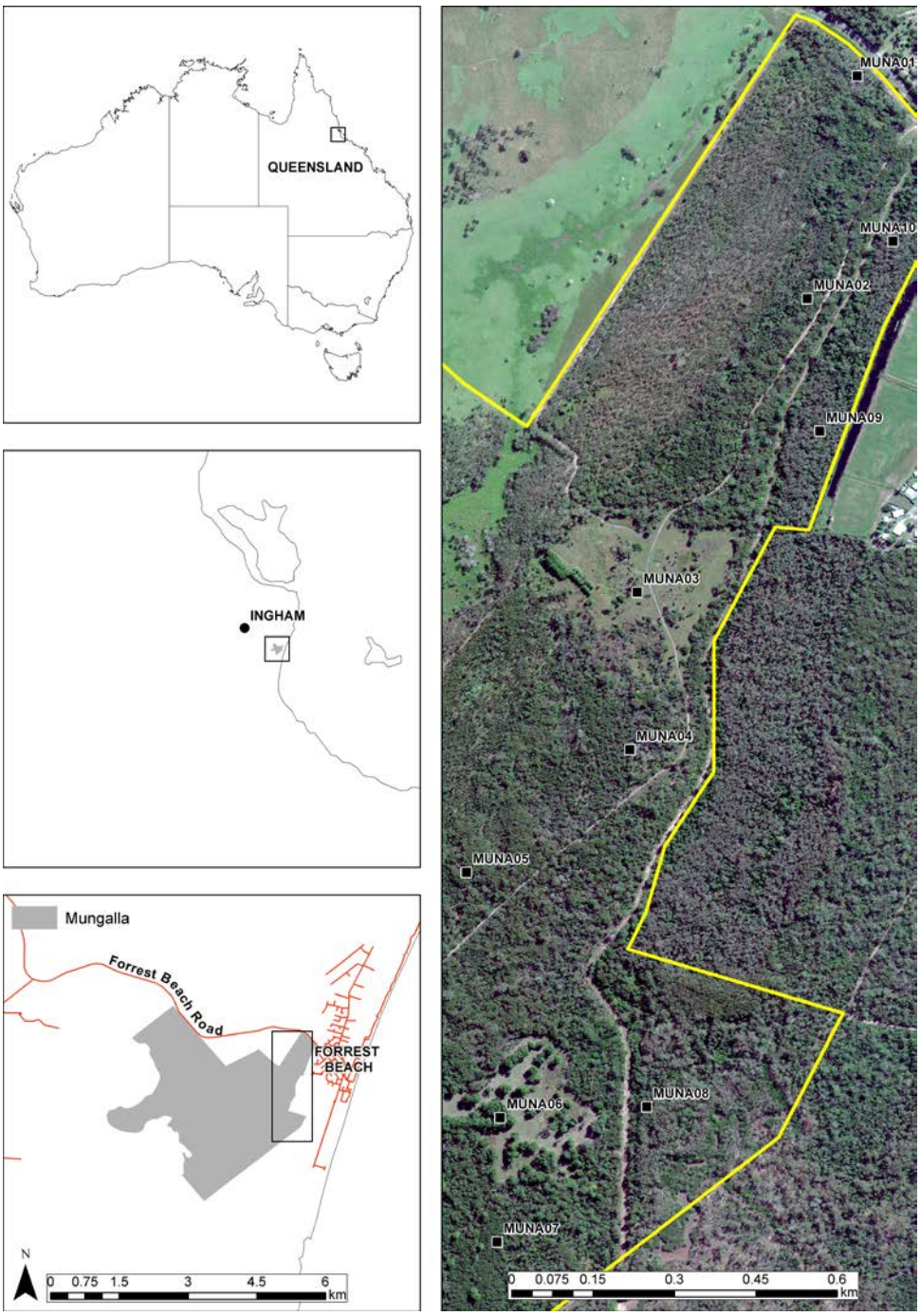

Figure 1 Maps showing location of standardised fauna survey sites on Mungalla Station, location in the sand ridges along the eastern boundary of the property. Location maps relative to Australia, the Ingham region and Forrest Beach township are shown. Yellow lines in the right hand image indicates the Mungalla property boundary.

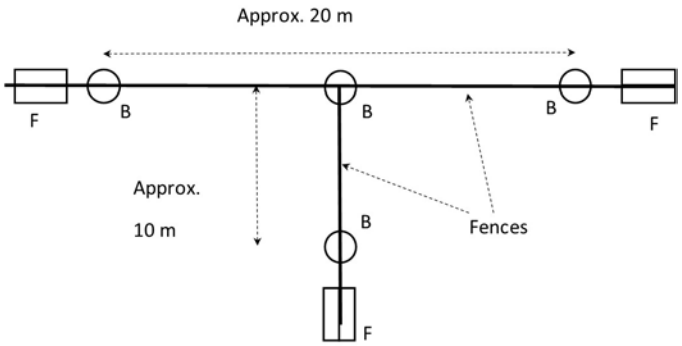

Figure 2 Site layout for pitfall and funnels trap array used during standardised fauna surveys. B = pitfall bucket, F = 2 x funnel traps.

Figure 3 Pitfall, drift fence and funnel traps at site MUNA02 (top: cleared but regrowing on sand ridge) and MUNA08 (bottom: mixed forest on swamp edge).

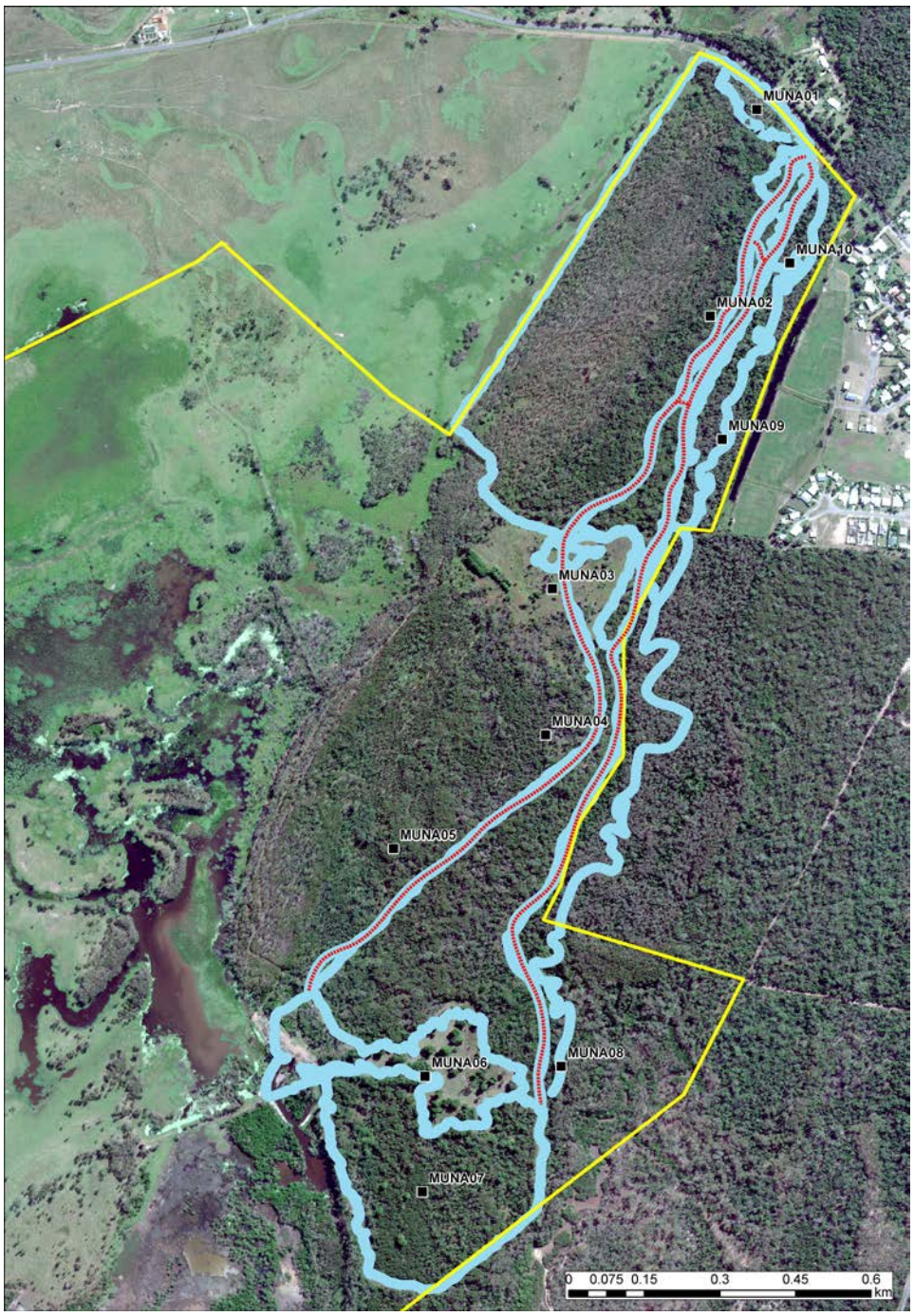

Figure 4 Map showing area surveyed by spotlight on Mungalla Station; the blue are is the spotlighting transects buffered to 10 m. The red dotted lines are the central north-south track and the eastern boundary track, both of which were surveyed twice.

2.3 Threatened species

2.3.1 Desk top

Threatened species that are known to occur in habitats similar to those of the sand ridge country along the eastern boundary of Mungalla were considered in a desktop study prior to commencement of field work. Species that were considered possibly present on Mungalla were assessed on the basis of Atlas of Living Australia records (ALA, 2016), records held in a CSIRO biodiversity database which includes systematic monitoring data from a large number of standardized surveys in northern Australia, plus the Black-throated Finch Recovery Team database, Qld WildNet and Birds Australia databases. Table 1 details the species considered potentially present for the purposes of the desktop study and their likelihood of occurrence on Mungalla.

Threatened species that are likely to be present at Mungalla but not particularly likely to use the sand ridge country, or the adjacent swales, were not assessed in the desk top study.

Table 1: Eleven threatened species that were considered as potentially occurring on sand ridges and adjacent country on Mungalla based on habitat, known range, previous experience and existing databases. Listings under Commonwealth (EPBC) and Queensland (NCA) legislation for each are given. Assessment of likelihood on Mungalla, nearest records (from databases or previous experience), and approximate dates and locations for near records are given. V = vulnerable; E = endangered; CE = critically endangered.

SCIENTIFIC NAME	COMMON NAME	EPBC LISTING	NCA LISTING	LIKELIHOOD ON MUNGALLA	NEAREST RECORD	NOTES
Dasyurus hallucatus	northern quoll	E		Unlikely	~30 km	1990s: Paluma Range, 2000s: Mount Leach Range
Petaurus gracilis	mahogany glider	E	E	Likely	2.5 km	2013: Forrest Beach
Pteropus conspicillatus	spectacled flying-fox	V	V	Occasional	26 km	2000s: Trebonne
Rhinolophus robertsi	large-eared horseshoe bat	E	E	Likely	~45 km	1999: Clemant SF
Saccolaimus saccolaimus nudicluniatus	bare-rumped sheathtail bat	CE	E	Likely	50 – 70 km	undated: Cardwell, 2015: Magnetic Island
Xeromys myoides	false water-rat	V	V	Unlikely	200 km	2000s: Cape Upstart
Erythrotriorchis radiatus	red goshawk	V	E	Occasional	~30 km	1990s: Paluma Range
Geophaps scripta scripta	squatter pigeon (southern subspecies)	V	V	Occasional	20 – 30 km	2000s: Ingham plains, 2000s: Paluma Range
Tyto novaehollandiae kimberli	masked owl (northern subspecies)	V	V	Likely	~20 km	2000s: Trebonne
Poephila cincta cincta	black-throated finch (southern subspecies)	E	E	Unlikely	~30 km	2000s: Rollingstone
Crocodylus porosus	estuarine crocodile		V	Present		2016: Mungalla

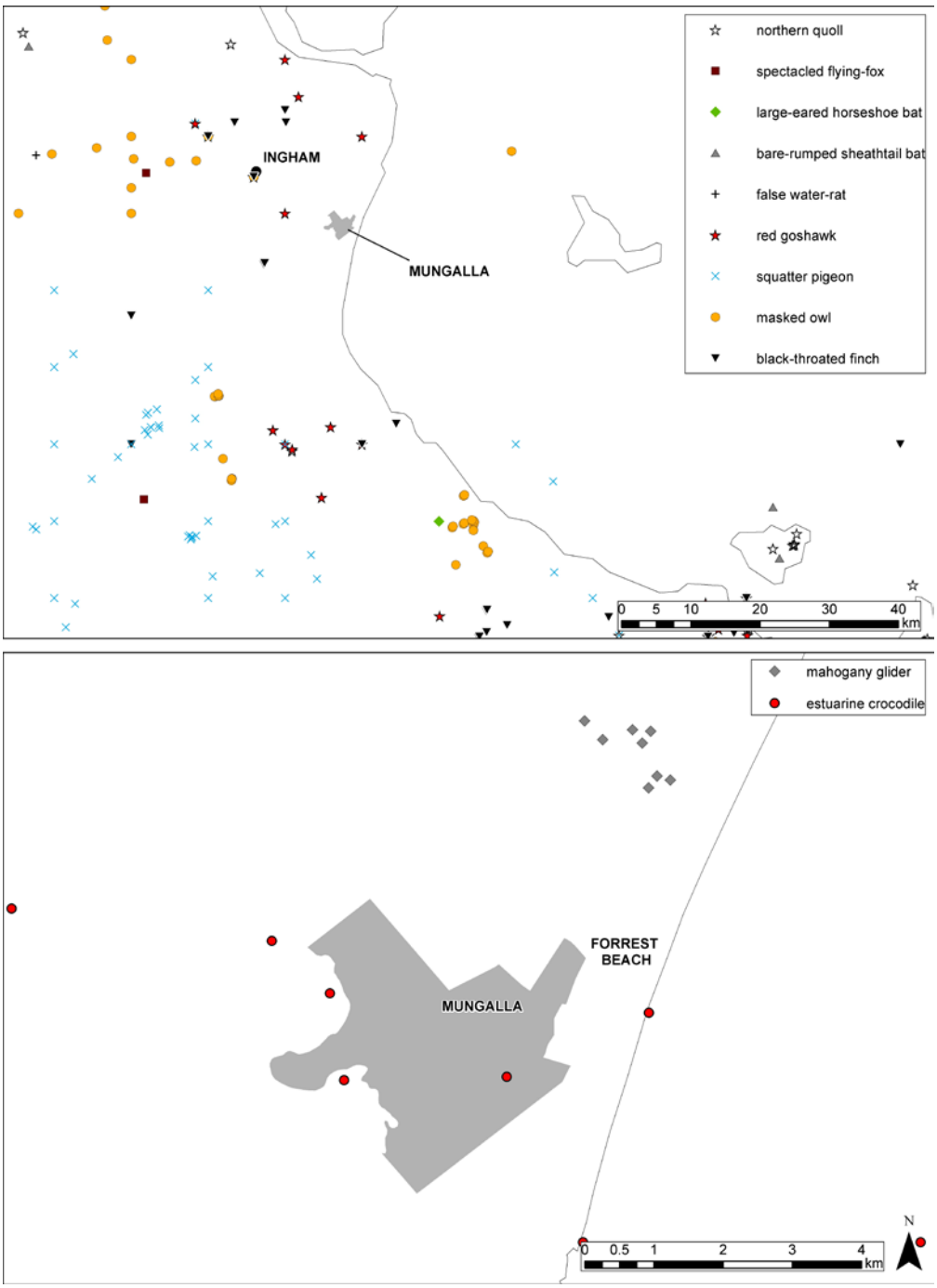

Figure 5 Maps showing existing records of threatened species listed in Table 1 within and around Mungalla. Top map shows species only known from 20 km or more from Mungalla. Bottom map shows mahogany glider and estuarine crocodile records in close proximity to (or within) Mungalla. Mahogany glider and estuarine crocodile records are not shown on the top map to avoid clutter. Records located in the ocean are likely errors.

2.3.2 Field survey

Threatened species listed in table 1 are generally detectable using the methods employed in the standardised site monitoring and spotlighting (above). The most likely threatened species on the Mungalla sand ridge country are detectable by the spotlighting, bird counting and trapping regime used. The large-eared horseshoe bat and bare-rumped sheathtail bat are exceptions to this; both are best detected using appropriately by ultrasonic detection. The latter may also be detected by "stag-watching" suitable hollows at dusk. Both species are difficult to physically capture, the large-

eared horseshoe bat because it is very skilful at evading harp traps and mist nets, and the bare-rumped sheathtail bat because it generally flies too high for traps. Ultrasonic bat detectors, harp traps and mist nets were not employed for this survey. Several large trees (*Corymbia tessellaris*) along the eastern boundary track appear to have hollows that may be of sufficient size to be used by bare-rumped sheathtail bats for roosting. These were observed for sounds of bats and for emerging bats around dusk, on an *ad hoc* basis while conducting other survey activities.

3 Results

3.1 Summary

3.1.1 Site monitoring, spotlighting, incidentals, background data

A total of 118 species of vertebrates was recorded from the sand ridges and adjacent areas of Mungalla. This total consisted of 15 mammals, 74 birds, 18 reptiles and 11 amphibians. There were three introduced species of mammals recorded: pig, cat and house mouse, and possibly a fourth, a canid, which was identified by foot prints but it could not be determined whether it was a dog or dingo.

Introduced birds recorded were the nutmeg mannikin and spotted dove, while for reptiles, two introduced species, the Asian house gecko and flowerpot blind snake, were recorded. The most frequently recorded introduced species was the cane toad, which was also one of the most abundant species recorded in absolute terms. 11 species were only recorded incidentally, that is, they were not within standardised sites. These were: striped possum, pig, Australian brush-turkey, black bittern, barn owl, estuarine crocodile, tree gecko, amethystine python, carpet python, brown tree snake and white-lipped treefrog. Four species of birds not previously reported from Mungalla (Eremaea, 2016) were recorded: Australian brush-turkey, Papuan frogmouth, noisy friarbird and broad-billed flycatcher, though these had all been previously reported in the more generous search using a 5 km buffer in ALA (2015).

A summary of the most abundant and ubiquitous species is provided in Table 2. A complete checklist of species and numbers recorded is provided in Table 3, which also cross-references common names used in the report, to appropriate scientific names.

3.1 Threatened species

3.1.1 Desk top

Based on the field surveys and proximity of existing records, five of the threatened species identified in the desk top study (Table 1) were considered likely to occur within the sand ridge country of in very close proximity to it. One of these, the estuarine crocodile, was already known to inhabit the area.

Of the remaining four likely species, the mahogany glider has been recorded within 2.5 km of the north east boundary of Mungalla (Figure 5, bottom) in a swathe of coastal *Melaleuca* woodland and forest that is contiguous with similar forests on the eastern boundary of Mungalla. These records were obtained in 2013 and there is no reason to expect that mahogany gliders would not still be present in those woodlands to the north of Mungalla. Mahogany gliders have also been observed in the *Acacia* regrowth along the main north-south track along the sand ridge, on a "couple of occasions" (Jacob Cassady; pers. comm).

Large-eared horseshoe bats are not known in the immediate vicinity of Mungalla, but suitable roosting trees may be present locally. Suitable habitat for this species is present on Mungalla and its surrounds.

Bare-rumped sheathtail bats are not known in the immediate vicinity of Mungalla, but nevertheless, suitable roosting trees are present, and Mungalla falls within their likely area of occupancy and has likely suitable foraging habitat of mangroves , coastal woodland and forest communities, near by.

Masked owls are not known in the immediate vicinity of Mungalla, but suitable roosting trees are present on Mungalla, and foraging habitat and prey are likely to be present within and around Mungalla.

Additional information on the potential threatened species listed in Table 1 is given in the discussion.

3.1.2 Field survey

Of the threatened species listed in Table 1, the estuarine crocodile was observed during spotlighting activities. This record, from Bird Hide Lagoon, is shown as the red dot within the Mungalla boundary in Figure 5, bottom.

None of the other threatened species were observed during field activities. Suitable roost hollows for mahogany gliders, bare-rumped sheathtail bats and masked owls were observed on Mungalla. Suitable habitat is present for the large-eared horseshoe bat in much of the sand ridge country along the eastern boundary of Mungalla.

Table 2: Summary of most common and ubiquitous species from standardised sites. The SUM column is the total number counted for each species. The COUNT column is the number of sites standardised sites that each species was recorded at; 10 is the highest possible COUNT.

	COMMON NAME	MUNA01	MUNA02	MUNA03	MUNA04	MUNA05	MUNA06	MUNA07	MUNA08	MUNA09	MUNA10	SUM	COUNT
Mammals	agile wallaby	2	1	3						1	2	9	5
	black flying-fox	1					6			1		8	3
	little red flying-fox	5										5	1
Birds	yellow oriole	4	8	5	20	17	5	6	12	10	11	98	10
	brown-backed honeyeater	18	10	7	6	4	6	10	2	11	13	87	10
	bar-shouldered dove	4	14	5	9	11	7	13	1	10	5	79	10
	peaceful dove	9	11	11	2	7	2	5		16	13	76	9
	graceful honeyeater	3	11		2	1	8	5	3	14	13	60	9
	silvereye	7	6	7	8	5	3	10	2	5	4	57	10
	varied triller	2	10	5	5	2	3	2	1	2	2	34	10
	brush cuckoo	3	5	1	6	7	1	3	2	1	4	33	10
	fairy gerygone	8	2		3	3		5	1	8	2	32	8
	white-throated honeyeater	4	8	3		1	9		1	4	2	32	8
	little bronze-cuckoo		5		1	4		4	7	6	2	29	7
	rainbow lorikeet	2		20		2					4	28	4
	white-bellied cuckoo-shrike	1	3	9	6	2	1	2	2	1	1	28	10
	mistletoebird	3		6	1	2			7	3	5	27	7
	Australasian figbird	5	1	2	8	3	1	1	3	2		26	9
Reptiles	red-throated skink	7	13		4			8	16	7	7	62	7
	Asian house gecko	14	3	5	1					6	1	30	6
	Storr's skink	2	3	1		1			5	1		13	6
Amphibians	cane toad	7	13	10	5	1	5		16	6	6	69	9
	eastern sedgefrog	13	7	4	2	1		3	2	4	7	43	9
	ornate burrowing frog		10	4	11	2					8	35	5

Table 3: Summary Table of Mungalla Fauna Survey

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	MUNA01	MUNA02	MUNA03	MUNA04	MUNA05	MUNA06	MUNA07	MUNA08	MUNA09	MUNA10	INC
mamm	Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna				1							
mamm	Dasyuridae	*Planigale maculata*	common planigale			1	2				1			
mamm	Dasyuridae	*Planigale* sp.	unspecified planigale				1							
mamm	Petauridae	*Dactylopsila trivirgata*	striped possum											2
mamm	Macropodidae	*Macropus agilis*	agile wallaby	2	1	3						1	2	8
mamm	Pteropodidae	*Pteropus alecto*	black flying-fox	1					6			1		11
mamm	Pteropodidae	*Pteropus scapulatus*	little red flying-fox	5										27
mamm	Muridae	*Hydromys chrysogaster*	water rat					1						
mamm	Muridae	*Melomys burtoni*	grassland melomys			2					1			
mamm	Muridae	*Mus musculus*	house mouse*			2								
mamm	Muridae	*Rattus sordidus*	canefield rat								1			
mamm	Muridae	*Uromys caudimaculatus*	giant white-tailed rat		1									1
mamm	Canidae	*Canis* sp.	dog or dingo*				1							
mamm	Felidae	*Felis catus*	cat*	1										
mamm	Suidae	*Sus scrofa*	pig*											3
bird	Megapodiidae	*Alectura lathami*	Australian brush-turkey											1
bird	Megapodiidae	*Megapodius reinwardt*	orange-footed scrubfowl	1	3	0	1	3		0	2	0		2
bird	Anseranatidae	*Anseranas semipalmata*	magpie goose										0	
bird	Ardeidae	*Nycticorax caledonicus*	nankeen night heron					1						1
bird	Ardeidae	*Ixobrychus flavicollis*	black bittern											1
bird	Burhinidae	*Burhinus grallarius*	bush stone-curlew	1										6
bird	Columbidae	*Streptopelia chinensis*	spotted dove*	0								0		
bird	Columbidae	*Phaps chalcoptera*	common bronzewing			0								
bird	Columbidae	*Geopelia striata*	peaceful dove	9	11	11	2	7	2	5	0	16	13	
bird	Columbidae	*Geopelia humeralis*	bar-shouldered dove	4	14	5	9	11	7	13	1	10	5	
bird	Columbidae	*Ducula bicolor*	pied imperial-pigeon	0	1	0		0	2	0	3	3	1	

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	MUNA01	MUNA02	MUNA03	MUNA04	MUNA05	MUNA06	MUNA07	MUNA08	MUNA09	MUNA10	INC
bird	Cacatuidae	*Calyptorhynchus banksii*	red-tailed black-cockatoo	0	0						3	0	0	
bird	Psittacidae	*Trichoglossus haematodus*	rainbow lorikeet	2	0	20	0	2	0		0	0	4	
bird	Psittacidae	*Trichoglossus chlorolepidotus*	scaly-breasted lorikeet	2		2		1			2			
bird	Cuculidae	*Centropus phasianinus*	pheasant coucal	0	1	0	0	0	0	0		0	0	
bird	Cuculidae	*Eudynamys orientalis*	eastern koel	0	0								0	
bird	Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo								0			
bird	Cuculidae	*Chrysococcyx basalis*	Horsfield's bronze-cuckoo			0					1			
bird	Cuculidae	*Chrysococcyx minutillus*	little bronze-cuckoo	0	5	0	1	4	0	4	7	6	2	
bird	Cuculidae	*Cacomantis pallidus*	pallid cuckoo			1								
bird	Cuculidae	*Cacomantis variolosus*	brush cuckoo	3	5	1	6	7	1	3	2	1	4	
bird	Strigidae	*Ninox connivens*	barking owl	0		0						3	9	5
bird	Tytonidae	*Tyto javanica*	barn owl											2
bird	Podargidae	*Podargus papuensis*	Papuan frogmouth									1		
bird	Apodidae	*Aerodramus terrareginae*	Australian swiftlet	1										
bird	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra								0			
bird	Halcyonidae	*Dacelo leachii*	blue-winged kookaburra			0	2		0	0	2	0		
bird	Halcyonidae	*Todiramphus macleayii*	forest kingfisher	1	0	0		1	2	1		6	4	
bird	Meropidae	*Merops ornatus*	rainbow bee-eater			7	2	1				2		
bird	Coraciidae	*Eurystomus orientalis*	dollarbird					0	0	2	1			
bird	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren	0		10	3							
bird	Pardalotidae	*Pardalotus striatus*	striated pardalote								1			
bird	Acanthizidae	*Gerygone magnirostris*	large-billed gerygone		2		1	1	2		3		2	
bird	Acanthizidae	*Gerygone palpebrosa*	fairy gerygone	8	2		3	3		5	1	8	2	
bird	Meliphagidae	*Meliphaga notata*	yellow-spotted honeyeater	2	2	1	1		4	1	4	4	4	
bird	Meliphagidae	*Meliphaga gracilis*	graceful honeyeater	3	11		2	1	8	5	3	14	13	
bird	Meliphagidae	*Lichenostomus unicolor*	white-gaped honeyeater	3	1	4			2					
bird	Meliphagidae	*Lichenostomus flavus*	yellow honeyeater	1								1		
bird	Meliphagidae	*Ramsayornis modestus*	brown-backed honeyeater	18	10	7	6	4	6	10	2	11	13	

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	MUNA01	MUNA02	MUNA03	MUNA04	MUNA05	MUNA06	MUNA07	MUNA08	MUNA09	MUNA10	INC
bird	Meliphagidae	*Myzomela obscura*	dusky honeyeater	3	2		1	1	1	1		3	1	
bird	Meliphagidae	*Lichmera indistincta*	brown honeyeater	4	0	0	1	15		2	1			
bird	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater	4	8	3	0	1	9		1	4	2	
bird	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater			2								
bird	Meliphagidae	*Philemon buceroides*	helmeted friarbird		3	2	2	1	2	3	2	2	4	
bird	Meliphagidae	*Philemon corniculatus*	noisy friarbird			1			0					
bird	Meliphagidae	*Philemon citreogularis*	little friarbird			0	3							
bird	Petroicidae	*Poecilodryas superciliosa*	white-browed robin					0		0				
bird	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		0	0	5	1	0	0		2		
bird	Pachycephalidae	*Colluricincla megarhyncha*	little shrike-thrush	1							2	1	0	
bird	Monarchidae	*Myiagra ruficollis*	broad-billed flycatcher		1									
bird	Monarchidae	*Myiagra rubecula*	leaden flycatcher	1	1	1	2	3		1		1		
bird	Monarchidae	*Myiagra alecto*	shining flycatcher	6	1		3			2				
bird	Monarchidae	*Symposiarchus trivirgatus*	spectacled monarch	1										
bird	Monarchidae	*Grallina cyanoleuca*	magpie-lark						0					
bird	Rhipiduridae	*Rhipidura rufiventris*	northern fantail			1	2	1		2		0	1	
bird	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail			6		0	2	0				
bird	Dicruridae	*Dicrurus bracteatus*	spangled drongo				7		4	8	2			
bird	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike	1	3	9	6	2	1	2	2	1	1	
bird	Campephagidae	*Coracina tenuirostris*	cicadabird		2	8	2	3			2	3	1	
bird	Campephagidae	*Lalage sueurii*	white-winged triller			1								
bird	Campephagidae	*Lalage leucomela*	varied triller	2	10	5	5	2	3	2	1	2	2	
bird	Oriolidae	*Oriolus flavocinctus*	yellow oriole	4	8	5	20	17	5	6	12	10	11	
bird	Oriolidae	*Oriolus sagittatus*	olive-backed oriole				1	1	2	2	0			
bird	Oriolidae	*Sphecotheres vieilloti*	Australasian figbird	5	1	2	8	3	1	1	3	2		
bird	Artamidae	*Cracticus quoyi*	black butcherbird		3	0		1	0	0	5	1	2	
bird	Corvidae	*Corvus coronoides*	Australian raven				0			0	0			
bird	Ptilonorhynchidae	*Ptilonorhynchus nuchalis*	great bowerbird							1				

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	MUNA01	MUNA02	MUNA03	MUNA04	MUNA05	MUNA06	MUNA07	MUNA08	MUNA09	MUNA10	INC
bird	Estrildidae	*Neochmia phaeton*	crimson finch			4	2							
bird	Estrildidae	*Neochmia temporalis*	red-browed finch			2		3					3	
bird	Estrildidae	*Lonchura punctulata*	nutmeg manikin*	7		2								
bird	Estrildidae	*Lonchura castaneothorax*	chestnut-breasted mannikin				2							
bird	Nectariniidae	*Nectarinia jugularis*	olive-backed sunbird			1	1	3	1		6	4	3	
bird	Dicaeidae	*Dicaeum hirundinaceum*	mistletoebird	3		6	1	2	0		7	3	5	
bird	Timaliidae	*Zosterops lateralis*	silvereye	7	6	7	8	5	3	10	2	5	4	
rept	Crocodylidae	*Crocodylus porosus*	estuarine crocodile											1
rept	Gekkonidae	*Gehyra dubia*	tree gecko											12
rept	Gekkonidae	*Hemidactylus frenatus*	Asian house gecko*	14	3	5	1					6	1	42
rept	Scincidae	*Carlia rubrigularis*	red-throated skink	7	13		4			8	16	7	7	
rept	Scincidae	*Carlia storri*	Storr's skink	2	3	1		1			5	1		
rept	Scincidae	*Cryptoblepharus virgatus*	fence skink			5	2							
rept	Scincidae	*Ctenotus robustus*	robust skink			2	1							
rept	Scincidae	*Ctenotus taeniolatus*	copper-tailed skink			1	1							
rept	Scincidae	*Glaphyromorphus punctulatus*	fine-spotted mulch skink		5	1	1				1			
rept	Agamidae	*Chlamydosaurus kingii*	frilled lizard										1	2
rept	Varanidae	*Varanus panoptes*	yellow-spotted monitor				1				1		2	5
rept	Typhlopidae	*Indotyphlops braminus*	flowerpot snake*		1									
rept	Boidae	*Liasis mackloti*	water python			1								1
rept	Boidae	*Morelia kinghorni*	amethystine python											1
rept	Boidae	*Morelia spilota*	carpet python											1
rept	Colubridae	*Boiga irregularis*	brown tree snake											1
rept	Elapidae	*Cryptophis nigrostriatus*	black-striped snake			1								
rept	Elapidae	*Pseudechis porphyriacus*	red-bellied black snake			2								
amph	Bufonidae	*Rhinella marina*	cane toad*	7	13	10	5	1	5		16	6	6	166
amph	Hylidae	*Litoria caerulea*	common green treefrog									1	1	2
amph	Hylidae	*Litoria fallax*	eastern sedgefrog	13	7	4	2	1		3	2	4	7	24

CLASS	FAMILY	SCIENTIFIC NAME	COMMON NAME	MUNA01	MUNA02	MUNA03	MUNA04	MUNA05	MUNA06	MUNA07	MUNA08	MUNA09	MUNA10	INC
amph	Hylidae	*Litoria infrafrenata*	white-lipped treefrog											3
amph	Hylidae	*Litoria nasuta*	striped rocketfrog	1										7
amph	Hylidae	*Litoria rothii*	northern laughing treefrog	1										3
amph	Hylidae	*Litoria rubella*	ruddy treefrog	5					2		1		1	7
amph	Limnodynastidae	*Limnodynastes convexiusculus*	marbled frog		1		1				1			0
amph	Limnodynastidae	*Limnodynastes peronii*	striped marshfrog		1	1	1							
amph	Limnodynastidae	*Platyplectrum ornatum*	ornate burrowing frog		10	4	11	2					8	34
amph	Myobatrachidae	*Uperoleia mimula*	mimicking gungan			1								

Numbers presented for standardised monitoring sites are cumulative for each 1 hectare site. Zeros (0) in a column means the animal was recorded near the site, but not within the monitoring hectare. INC column is for incidental records, i.e. species that were recorded away from standardised monitoring sites.

* Introduced species

4 Discussion and Recommendations

Because of the variety of land uses and habitat types within Mungalla, it is expected to have a moderately high overall biodiversity. The proximity of some stretches of remnant vegetation to Mungalla is expected to further increase the biodiversity on Mungalla, relative to surrounding areas such as cane farms and the suburban footprint of Forrest Beach. Further, regular visits by Tony Ashton (over 70 visits from 2012 to early 2016) and others (Eremaea, 2016), mean that the bird diversity has been well documented. The sand ridge country is somewhat different to the country normally visited by Tony Ashton and others which is the probable reason an additional five species of birds were recorded during this survey. It is also part of the reason that many of the bird species previously recorded were not recorded, or were recorded only infrequently on this survey. Common wetland and open country species such as cattle egrets, Australian white ibis and royal spoonbills for example, were not observed, despite many previous records.

In contrast the only mammals and reptiles previously recorded, either within Mungalla or within the 5 km buffer, were red-legged pademelons, *Thylogale stigmatica*, striped possums, estuarine crocodiles and the tommy roundhead, *Diporiphora australis* (ALA, 2015). Of these, the striped possum and estuarine crocodile were recorded in this survey. No previous amphibian records exist in the online resources accessed prior to this survey.

Because of its location and its current and historical management, there is excellent potential to increase the biodiversity values of Mungalla. Since there are significant (i.e. threatened) species present or likely to be present on Mungalla, recommendations for retaining or improving habitat for these species are discussed below. A general description of each species' requirements is provided. Potential for creating habitat for some of those "unlikely" species listed in Table 1 is also discussed. Species are discussed in order from those known or inferred to occur on Mungalla through to those thought very unlikely to ever occur in the area.

4.1 Threatened species

4.1.1 Estuarine crocodile, *Crocodylus porosus*

This species is widespread and common across much of northern Australia, and occurs outside Australia in the Indian and Pacific Oceans. It is most commonly associated with estuaries, but also occurs well inland (e.g. > 200 km upstream from river mouths) in freshwater and can traverse thousands of kilometres of open sea. Estuarine crocodile females lay eggs in an earth and vegetation nest which they construct in close proximity to the water's edge, usually in a secluded location, often in a swamp or backwater.

The estuarine crocodile is unique among the threatened species discussed here for two reasons. First, it is common, widespread and likely still increasing in numbers since the instigation of protection in the 1970s. Second, it is a potential predator of humans and as such is subject to management actions, particularly in relation to 'problem crocodiles' in the vicinity of infrastructure. An approximately 2.5 m estuarine crocodile was observed in the Bird Hide Lagoon during this survey, and the species has been previously noted from that area (Brett Abbott, Mike

Nicholas; pers. comm.) and along Palm Creek (Jacob Cassady; pers. comm.). Suitable nesting habitat exists along Palm Creek, and potentially around the Bird Hide Lagoon. With the opening up of the Bird Hide Lagoon to tidal influence, the potential amount of breeding habitat available to estuarine crocodiles may change, though because the vegetation community is still responding to the reinstatement of tidal influence, it is not known whether breeding habitat will increase or decrease.

Although estuarine crocodiles are unlikely to inhabit the actual sand ridge country, they may play some role in helping maintain the sand ridge ecology through predation on pigs and agile wallabies.

4.1.2 Mahogany glider, *Petaurus gracilis*

The mahogany glider is an iconic north Queensland endemic species, known from approximately Clemant State Forest in the south to Hull River National Park in the north, a linear distance of approximately 100 km. It is known only from coastal lowlands and foothills, below about 200 m altitude. Mahogany gliders generally prefer forests and woodlands with a relatively open understorey. Many of the tree species that are significant components of their main habitats are present on the Mungalla sand ridge country, for example large *Corymbia*, *Eucalyptus* and *Melaleuca* spp. However, large examples of these species are not common in the majority of the sand ridge that was previously cleared which is now largely regrowth dominated by *Acacia* spp.

It is likely that mahogany gliders use the sand ridge sporadically, probably moving in from the adjacent *Melaleuca* forest and woodland to the east, which in turn is connected to relatively contiguous woodlands to the north of Mungalla, where mahogany gliders have been reported (2013).

Forrest Beach Road probably forms the most serious barrier to dispersal into and out of Mungalla for mahogany gliders. In addition, small scale clearing of forest to the north of Mungalla may pose a threat to mahogany gliders in the area. It is likely that with appropriate management Mungalla could be improved with respect to mahogany glider habitat, and this could occur within existing management aspirations for the property. Encouraging large tree regrowth in the sand ridge country is likely to favour them in the future – as tree hollows develop, mahogany gliders are likely to become more permanently resident, if they are not already. Discouraging fires which kill emergent tree seedlings is likely to help these large trees develop and then persist. Existing tree planting projects elsewhere on Mungalla are also likely to favour mahogany gliders in the long term, provided care is taken with species selection, and connectivity to potential source populations to the north. If habitat improvement for mahogany gliders is ultimately seen as a goal for Mungalla, then discussion and cooperation with neighbouring landholders about riparian tree management and connectivity are likely to be more beneficial than Mungalla operating individually. Enhancing and maintaining tree corridors that already exist is likely to strongly favour dispersal and survival of mahogany gliders

4.1.3 Bare-rumped sheathtail bat, *Saccolaimus Saccolaimus nudicluniatus*

This species is poorly known; in Queensland, it is known from eastern Cape York Peninsula, south to approximately Mackay, with a 280+ km gap from near Townsville to Mackay that has no

records. In Australia, bare-rumped sheathtail bats are thought to roost communally, exclusively in large tree hollows. Within the Wet Tropics and northern Brigalow Belt bioregions roosts are known from large *Melaleuca leucadendra*, *Corymbia tessellaris* and *Eucalyptus platyphylla* (author's observation, Cairns; Compton & Johnson, 1983; Reside *et al.*, 2015), but any large tree hollows are likely to be suitable. All known roosts in the region are near-coastal.

Proximity to coastal areas, especially mangroves and probably riparian forests such as gallery rainforest and *Melaleuca* woodlands is thought to favour bare-rumped sheathtail bats. They are a fast, high-flying species that is known to forage over mangroves, and it may be this tendency which has led to so little information being known about them. Mangroves are difficult to sample, and obtaining reference calls for using with ultrasonic detection is still in its infancy with this species. Nevertheless, there have been recent improvements in this respect and the use of targeted ultrasonic detectors for this species would be useful to help confirm their presence on Mungalla.

Habitat improvement activities prescribed for mahogany gliders would likely also benefit this species, especially the retention, protection and promotion of large hollow-bearing trees, and smaller trees that may develop hollows in the future. This is particularly important for large *Corymbia tessellaris* and *Melaleuca* spp., as well as *Eucalyptus* spp., especially *E. platyphylla* and *E. tereticornis* which readily form hollows. Retention of large numbers of trees will help ensure continuity of roosting habitat for bare-rumped sheathtail bats in the event of losses from cyclones in the future. Mungalla is ideally situated to provide protection of roosting habitat and feeding opportunities for this species, and such protection is likely to fit comfortably with existing land management aspirations for the property.

4.1.4 Large-eared horseshoe bat, *Rhinolophus robertsi*

This species is relatively poorly known. Until recently it was generally considered to be a large variant within the species *Rhinolophus philippinensis*, (Churchill, 1998; Woinarski *et al.*, 2014) and some references still refer to it as such (Van Dyck *et al.*, 2011), but *R. robertsi* is generally accepted. It is known to occur sparsely from eastern Cape York Peninsula, south to approximately Townsville (Van Dyck & Strahan, 2008; ALA, 2016). Its preferred habitats a variety of woodlands, forests and rainforests. It is generally a slow flying species "fluttering" species of the sub-canopy, in "cluttered environments. Roost sites include hollow trees, and probably cave, culverts and overhangs where available. There may be suitable roosting culverts in the vicinity of Mungalla, but there are likely to be few natural roost locations apart from hollow trees on Mungalla itself.

Melaleuca woodlands and regrowth *Acacia* areas of the sand ridge country are likely habitats for this species on Mungalla. Targeted searching ultrasonic detection would be useful to increase knowledge of large-eared horseshoe bats in the area. Habitat improvement activities prescribed for mahogany gliders would likely also benefit this species.

4.1.5 Masked owl, *Tyto novaehollandiae kimberli*

Masked owls belonging to the vulnerable subspecies *kimberli* are known from across the north of the continent, and, on the east coast, south to approximately Townsville (ALA, 2016). Masked owls in the vicinity of Mungalla are likely to be this *Tyto novaehollandiae kimberli*.

Masked owls use a wide variety of woodland and forest habitats, generally where there are moderately tall forests, with open areas in close proximity (author's observations; Higgins, 1999). Scattered large trees in paddocks with nearby uncleared forest should provide good habitat for this species on Mungalla. Large, hollow-bearing trees are required for roosting and it is likely that some of the large *Melaleuca* trees scattered throughout the property could contain suitable nesting and roosting hollows for this species. Two barn owls were observed along one of the boundary fences of Mungalla in this survey, and they were probably roosting in large Melaleuca trees just off the property. Barn owls and masked owls often roost in similar sorts of hollows, which suggests there should be suitable habitat for masked owls on Mungalla.

Retention, protection and promotion of large hollow-bearing trees, including existing paddock trees, should favour masked owls in the area. Retention of large numbers of trees will help ensure continuity of potential nesting and roosting habitat masked owls in the event of losses from cyclones in the future. Protection of potential masked owl habitat is likely to fit comfortably with existing land management aspirations for Mungalla.

4.1.6 Spectacled flying-fox, *Pteropus conspicillatus*

Spectacled flying-foxes are generally restricted to the Wet Tropics and parts of Cape York Peninsula. In the vicinity of Mungalla, they are likely to be rare and sporadic users of local habitats. Since Cyclone Yasi in 2011, spectacled flying-foxes have generally been absent south of approximately Cardwell. However, like all flying-foxes they are capable of long flights and a single individual was observed in Townsville in 2013 (author's observation), although the possibility that this was a rehabilitated and released animal cannot be discounted.

Spectacled flying-foxes are most likely to use areas of Mungalla after being displaced from 'camps' elsewhere. In the future this is most likely to result from destruction of camps by cyclones, and, potentially, tree clearing and camp dispersal activities.

Spectacled flying-foxes are very useful pollinators and seed dispersers, but may also come into conflict with humans where there are orchards planted and where camps are located in close proximity to humans. Habitat for spectacled flying-foxes is likely to be improved by land management activities discussed above relating to other threatened species on Mungalla.

4.1.7 Red goshawk, *Erythrotriorchis radiatus*

Red goshawks are widespread but sparsely distributed across northern and eastern Australia, where they generally inhabit very large territories. Their prey is primarily birds, especially both species of kookaburra, and rainbow lorikeets. They are likely to be occasional users of woodlands and forests on Mungalla and its surrounds, although there is probably insufficient habitat currently to support breeding on Mungalla. Young birds that are dispersing from their nests are the most likely to be encountered on Mungalla.

As with most other threatened species in the area, current land management activities on Mungalla that involve forest and woodland regeneration and retention and help maintain and improve tree corridors, are likely to favour red goshawks.

4.1.8 Squatter pigeon, *Geophaps scripta scripta*

Squatter pigeons generally favour open woodlands with a grassy ground cover, usually with bare patches of ground interspersed. They are most likely to favour open areas of Mungalla. Management of sand ridge country for squatter pigeons should probably not be seen as a significant priority because they are likely to be absent generally, and if they do use Mungalla then existing management would probably not exclude them. With the possible exception of the estuarine crocodile, they are the least threatened of the species discussed here, the existing habitat is probably broadly unfavourable, and management activities that may be conducted to promote other threatened species on Mungalla are not likely to impact on squatter pigeons.

4.1.9 Northern quoll, false water-rat and black-throated finch

These last three species are briefly discussed together because all are unlikely to occur on Mungalla.

Northern quolls have gone extinct from vast areas of their previous northern Australian range, probably as a result of a combination of factors including land clearing, cattle grazing and the introduction of cane toads (Woinarski *et al.*, 2014). Generally, where cane toads are present, northern quolls are extinct. Rocky hills are the main exception to this, with northern quolls still being present in a few parts of the Great Dividing Range and some coastal hills in Queensland. Quolls may return to areas such as Mungalla in the future, but at present are unlikely to be able to disperse from the hills of the Great Dividing Range to the coast. It is unlikely that there would be sufficient suitable habitat present on Mungalla to maintain a northern quoll population if they did colonise the area.

False water-rats occur in northern and eastern Australia in mangrove communities with adjacent sedgeland and *Melaleuca* forests (author's observations; Van Dyck, 1996; Van Dyck *et al.*, 2011). However, they are not known to occur along a vast stretch of the northern Australian coastline, from approximately Cape Upstart, to the Arafura Swamp in the Northern Territory (ALA, 2016). They are included here because mangroves with adjacent suitable habitat are present, and their potential presence should be flagged. They are not known from much larger areas of seemingly suitable habitat both south and north of Mungalla, though the reason or reasons for this apparent absence are unknown.

Black-throated finches favour habitat similar to that of squatter pigeons, that is, generally open woodland with a mixed grass understory and some patches of bare ground (Higgins *et al.*, 2006; BTFRT, 2007). They are probably now absent, or nearly so, from the Ingham coastal plains. Restoration of black-throated finch habitat has not been attempted in the past, but if it were attempted would probably involve establishing a mix of largely native species of grass, with an open tree and shrub layer present. Black-throated finches are unlikely to disperse great distances (many 10s of km, Vanderduys *et al.*, 2016) and are thus unlikely to disperse from the known existing populations on the Townsville coastal plains roughly 60 km to the south or from drier areas within and to the west of the Great Dividing Range some 70 – 100 km west of Mungalla.

4.1 Weeds

Excellent progress has been made on combatting wetland weeds on Mungalla, primarily through re-instatement of tidal flow by removing two bund walls restricting tidal ingress. This action has primarily been focussed on controlling olive hymenachne (*Hymenachne amplexicaulis*), para grass (*Urochloa mutica*), salvinia (*Salvinia molesta*) and water hyacinth (*Eichhornia crassipes*) (Brett Abbott; pers. comm.). Other weed control using physical and chemical (primarily Glyphosate) means, is in progress along Palm Creek. This has been accompanied by tree planting on riparian banks with excellent progress being made.

In the sand ridge country of Mungalla, there are a suite of weeds that are typical of many areas that have been disturbed in the past that are now regenerating. Examples include guinea grass, (*Megathyrsus maximus*), stylos, (*Stylosanthes* spp.) and mint weed (*Hyptis suaveolens*). One emerging weed, the African tulip tree (*Spathodea campanulata*) can present a significant threat to low lying areas such as parts of Mungalla, and is present, but not yet a serious problem, in areas that were surveyed in this study. At least one mature tree is present in remnant *Melaleuca* dominated vegetation near the north east boundary of Mungalla. There are numerous seedlings present in the area, but prospects for relatively simple control of African tulip trees in the area are strong. It is recommended that attempts be made to eradicate this tree species from Mungalla before it increases significantly.

Guinea grass poses a potential threat to regeneration of dune woodlands on the sand ridge country of Mungalla. It does this because of the high fuel load it creates, such that fires can be hot enough to kill regenerating trees, and "re-set" the regeneration of the woodlands. For this reason it is recommended that guinea grass control be implemented, particularly along the existing north south track along the sand ridge, so that fires spread is inhibited.

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Cover page photos, representative species of each class of vertebrates recorded during Mungalla survey, left to right: mammals – grassland melomys (*Melomys burtoni*): bird – barking owl (*Ninox connivens*); reptiles – frilled lizard (*Chlamydosaurus kingii*); amphibians – striped marshfrog (*Limnodynastes peronii*). All photos from Mungalla, Eric Vanderduys.

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