



Birds of East Trinity Inlet

Acid-Sulphate Remediation Project

Queensland Herbarium

December 2014

Prepared by

Geoffrey C. Smith and Brian L. Venables
Queensland Herbarium
Science Delivery Division
Department of Science, Information Technology, Innovation and the Arts
PO Box 5078
Brisbane QLD 4001

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Citation

Smith, G.C. and Venables, B.L. (2014) Birds of East Trinity Inlet – Acid-Sulphate Remediation Project. Department of Science, Information Technology, Innovation and the Arts.

Acknowledgements

This report has been prepared by the Department of Science, Information Technology, Innovation and the Arts. Acknowledgement is made of Phil Norman, Jim Radford, Murray Haseler, Michael Mathieson, Angus McElnea, Michelle Martens, Paul Fisk and those gallant bird watchers who endured the 'horror bird counts' at East Trinity. Front cover photo of sharp-tailed sandpiper *Calidris acuminata* by Phillip Griffin.

9 December 2014

Executive summary

The impacts of the reclamation at East Trinity and the subsequent rehabilitation of the area on birds and other terrestrial vertebrates have not been previously assessed. Bird observations undertaken during November 2011 to June 2012 and other supplementary observations were used to review the likely importance of East Trinity to bird communities and the likely changes associated with rehabilitation. These studies were not specifically designed to make an assessment of the rehabilitation effort.

A total of 109 bird species were observed at East Trinity 2011-12. An additional 27 species have also been opportunistically recorded at the same location by another observer over an unspecified period since the rehabilitation began, indicating a species richness of some 136 bird species utilising the East Trinity area in recent times.

The species richness of birds at East Trinity was compared to richness estimates from an earlier study of the disturbed wetlands around Cairns International Airport in 1994. That study produced records of some 83 species over a shorter time frame but across a broader range of habitats (that also included beach dune low woodland/shrubland and eucalyptus woodland habitats) than bird surveys of the East Trinity study area. The East Trinity area demonstrated a substantially greater species richness of birds both within habitat and over the entire area compared with the airport area.

The East Trinity area contains important habitat for birds. Changes to the extent and condition of vegetation communities that have been recorded and which are likely to continue changing will affect the diversity of bird species and their abundance across this landscape as these changes occur.

Importantly a number of internationally important shorebird species listed in agreements with China (CAMBA), Japan (JAMBA) and the Republic of Korea (ROKAMBA) are likely to benefit because of vegetation changes associated with rehabilitation of the East Trinity area. Recently a new wader roosting site has emerged in mangroves on the northern boundary of the East Trinity area and it seems this may be significant in the regional context. Observed increase in the amount of mangrove area due to rehabilitation will have a potential positive effect for roosting waders, such as whimbrel *Numenius phaeopus*. The area also serves as a high tide feeding area. Rehabilitation of these higher elevation wetlands will expand and improve habitat for waders feeding in the wet, inundated areas, such as sharp-tailed sandpiper *Calidris acuminata*. Continuing rehabilitation and protection of East Trinity wetlands will be a positive outcome for bird species under pressure elsewhere in their national and global ranges.

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Introduction

East Trinity is a wetland area of some 940 ha adjacent to Trinity Inlet which was drained and cleared in the 1970s and a bund wall constructed around its seaward perimeter in order to develop new agricultural lands. The area contains acid sulphate soils which resulted in the production of acid leachate in and around the area. As a result fish kills were first noted in the vicinity in 1972. Fish kills associated with disturbance of acid-sulphate soils are well known in Australia (Russell and McDougall 2003; Russell *et al.* 2010).

The site was purchased by the Queensland Government in 2000 and a project to neutralise the acidic soils was instigated. This included a program of installing several gates in the bund wall around the site to allow seawater to tidally enter, and the addition of hydrated lime to the incoming tide to help neutralise the acidic soil. Studies have indicated that these remediation works have had a positive effect on marine life (Russell *et al.* 2010) and there have been subsequent changes to vegetation altered by the first reclamation impacts (Newton *et al.* 2014).

The coastal zone in the vicinity of Cairns contains a diverse complex of marine, intertidal, wetland and terrestrial vegetation communities which include mangrove, seagrass, claypan, mudflat, freshwater swamp and woodland habitats for a diverse fauna assemblage (Kutt 1997). The Cairns mudflats, wetlands and mangroves are well known for their role in hosting a significant and diverse array of migratory shorebirds that are of international interest (MacDonald Wagner 1989; Driscoll 1996; Fisk 1996; Pell and Lawler 1996).

The impacts of the reclamation at East Trinity and the subsequent rehabilitation of the area on birds and other terrestrial vertebrates have not been assessed through any designed study. This report sought to address the question as to whether remedial work on acid-sulphate soils has had a positive effect on bird species. We reviewed information available on the birds of East Trinity in order to establish the species richness of the area as a whole and by habitat type; this information came primarily from bird counts undertaken by a number of voluntary and dedicated bird observers. This information was compared with the only available publication on terrestrial vertebrates of Trinity Bay by Kutt (1997), focusing on a disturbed coastal wetland area in Trinity Bay adjacent to Cairns International Airport (Figure 1). Other studies have assessed the shorebirds of Trinity Bay and found it to be of considerable importance (MacDonald Wagner 1989), however only Kutt (1997) has surveyed a variety of terrestrial and marine habitat types adjacent to Trinity Bay. We compared our data with Kutt's study in order to place the East Trinity data in a local context.

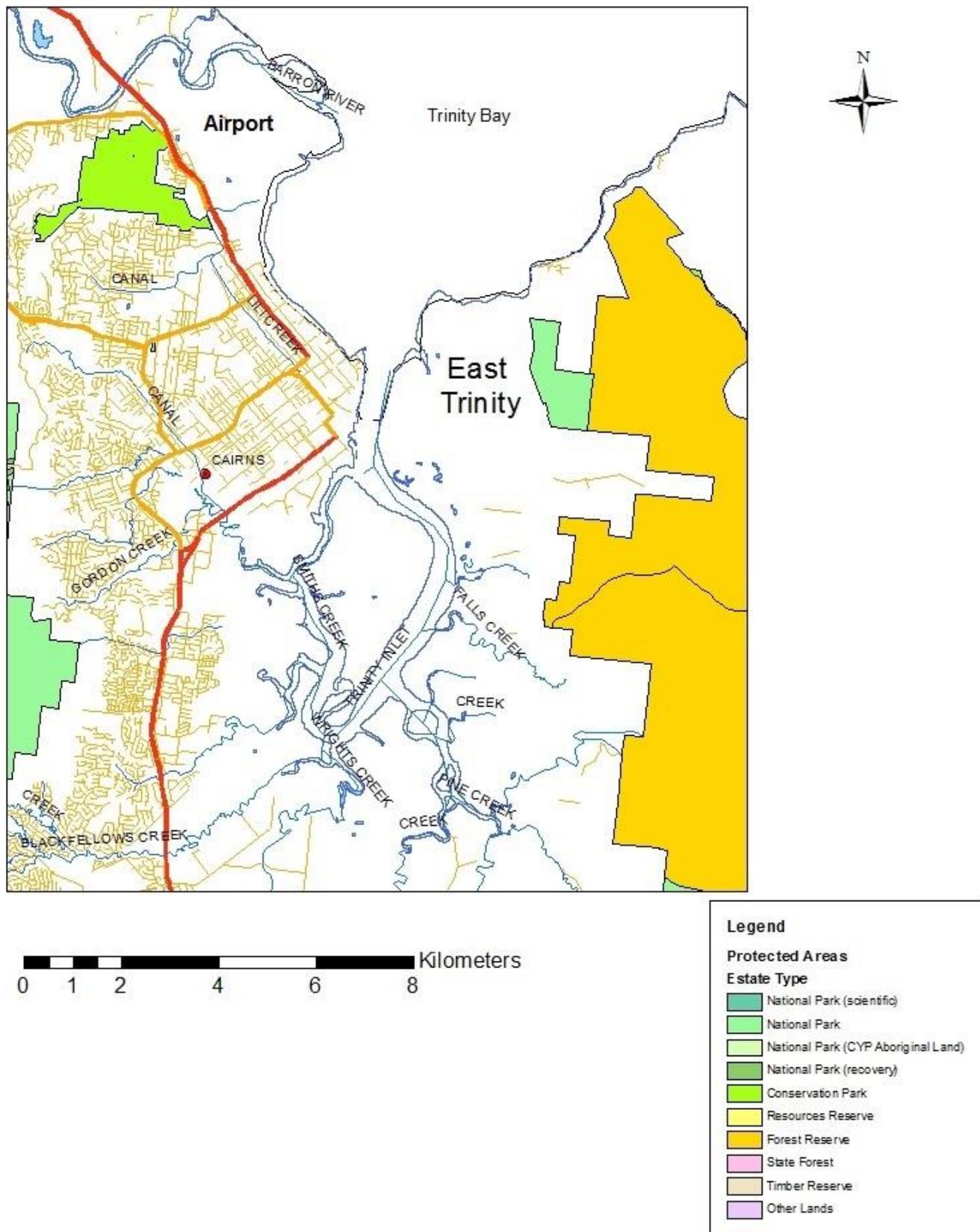


Figure 1 General location of the East Trinity area adjacent to Cairns, north Queensland.

Study Area

East Trinity (16° 56' S, 145° 48' E) is located approximately 2 km east of Cairns CBD across Trinity Inlet and is a part of the coastal strip that borders the broader Trinity Bay, which extends from the mouth of the Barron River down to False Cape. Access to East Trinity by road is along the Pine Creek-Yarrabah Rd, off Warner Rd from the Bruce Highway. Hill's Creek dissects the site and flows into Trinity Inlet (Figure 1).

The vegetation of the East Trinity site is very diverse. It has also changed considerably from the original communities, firstly because of the reclamation of land for agriculture and then subsequently the flooding with seawater associated with remediation. The vegetation communities at East Trinity consist largely of secondary communities with little resemblance to original vegetation composition and structure. However, the mosaic of forest types mapped in the north-east of the site, remain unaffected by the remediation. In general, the communities are still very dynamic and complex.

There has been an expansion of the tidal zones within East Trinity and this has meant expansion of mangrove fern lands and mangrove communities into former halophytic forblands, mixed forbland-grassland-fermland communities and areas of former and recent *Melaleuca leucadendra* (weeping paperbark) dieback. There has been an increase in *M. leucadendra* shrublands, particularly into former grasslands. Grasslands have been reduced in area most significantly, particularly those dominated by exotic species and *Imperata cylindrica*. There has been some dieback of open forests of *M. leucadendra* impacted by the tidal areas with some stands that were healthy in 2009 now in decline.

Change in management regime is undoubtedly influencing the direction and speed of changes to the vegetation. A detailed map of vegetation (Figure 2) has been recently produced by Newton *et al.* (2014).

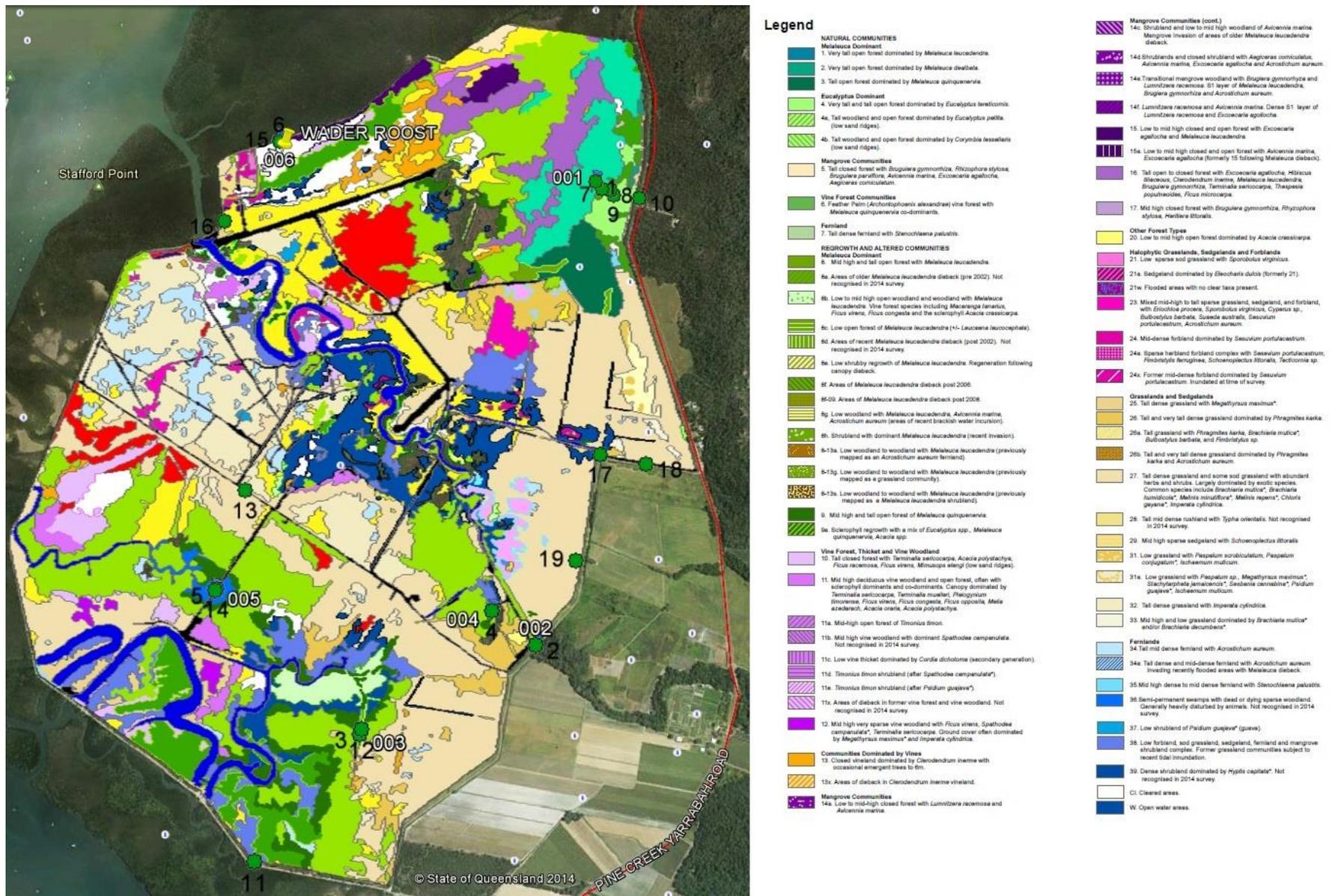


Figure 2 The vegetation communities of East Trinity as mapped by Newton *et al.* (2014). The position of bird survey sites are shown as follows: numbered green dots with black numbering indicate opportunistic sites and numbered green dots with white numbering indicate regularly sampled sites.

Bird surveys were carried out repeatedly at six sites in the East Trinity area. Site 6 in the north of the East Trinity area was identified as an important wader roost (Figures 2 and 3). The vegetation communities surrounding each of these sites are described below.

Site 1 (and including opportunistic sites 7, 8, 9 and 10)

These sites occur in very tall open forest dominated by *Melaleuca leucadendra*.

Site 2

This site is located in mid-high and tall open forest with *Melaleuca leucadendra*, adjacent to a cleared area.

Site 3 (and including opportunistic sites 11 and 12)

These sites are comprised of tall dense and mid-dense fernland with *Acrostichum aureum*, invading recently flooded areas with *Melaleuca* die-back.

Site 4

This site is on the edge of land previously cleared of vegetation, in very tall open forest dominated by *Melaleuca leucadendra* and with nearby sedgeland dominated by *Eleocharis dulcis*.

Site 5 (and including opportunistic site 14)

These sites are in an open water area, which was previously a semi-permanent swamp and contains dead or dying sparse woodland. These sites are generally heavily disturbed by animals and are adjacent to an area cleared of vegetation.

Site 6 (and including opportunistic sites 15 and 16)

These sites occur in low to mid high closed and open forest with *Avicennia marina* and *Excoecaria agallocha*. Formerly low to mid high closed and open forest with *Excoecaria agallocha* and *Melaleuca leucadendra*; *Melaleuca* has suffered die-back. The site is adjacent to an area that undergoes regular inundation on the landward side. It is the site of a shorebird roost.

Other opportunistic sites (sites 13, 17, 18, 19)

These sites were opportunistic sites which were not spatially associated with any of the frequently sampled sites. They occurred in and were adjacent to a mosaic of vegetation types, which included:

- tall dense grassland and some sod grassland with abundant herbs and shrubs and largely dominated by exotic species, but with the native grass *Imperata cylindrica* also common
- cleared areas
- tall mid dense fernland with *Acrostichum aureum*.

For convenience of analysis, Site 13 was included with Site 5 and Sites 17, 18, 19 were included with Site 2.

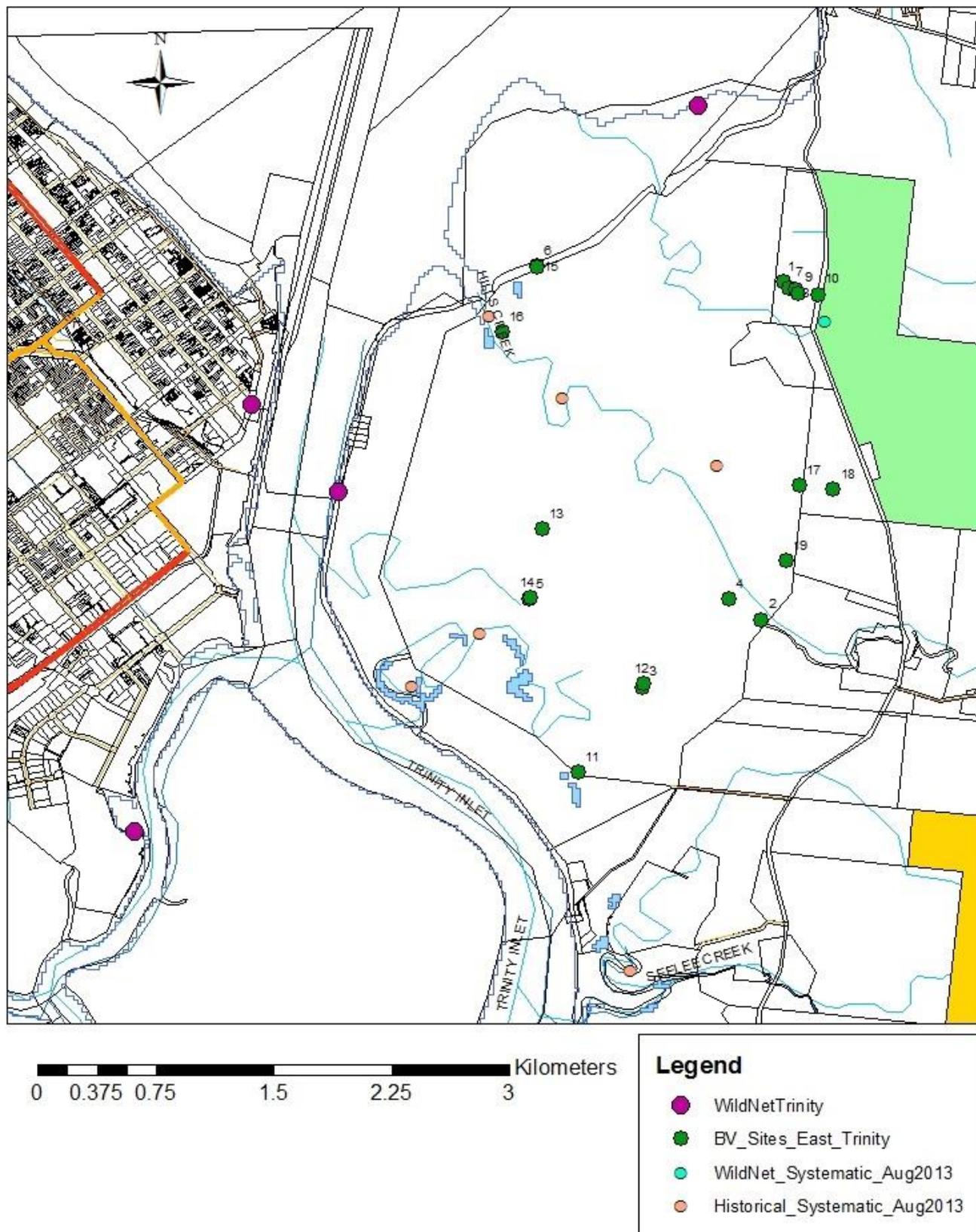


Figure 3 Detailed map of East Trinity showing location of current and past survey sites.

Methods

Birds were surveyed in (1) November 2011 by Brian Venables, J. Grant, S. Murphy, I. Blackman; (2) February 2012 by J. Grant, I. Blackman, D. Chaplin, Ota Yu, Brian Venables, Jeff Arneth and Steve Wilbraham; and (3) June 2012 by I. Blackman, D. Chaplin, J. Grant, Jun Matsui, Brian Venables and Yu Ota. The counting method was undertaken according to one of Australian Bush Heritage's standard bird survey methods, called 'bird-minutes' (A. Gilmore in prep.; J. Radford pers. comm.). This method enables several useful indicators to be calculated for each species. Detailed analyses according to the 'bird-minutes' methodology was beyond the scope of this report but may be undertaken at a future time.

Each bird-minute survey consisted of 20 one-minute point-counts, during which the number and distance of all birds detected from a central survey point was estimated. The unique aspect of bird-minutes is that the count is 'reset' every minute, such that each survey consists of 20 consecutive one-minute surveys. These counts were undertaken at six monitoring sites (Figure 3).

For this report, the maximum count for each species in any one of the 20 bird minutes was noted (Appendix A). Each bird species was assigned a general relative abundance code as follows: 1 = rare, with only a single record of an individual or group, 2= uncommon, recorded infrequently and from up to 10%-50% of site x time surveys and 3 = common, recorded frequently and from between 50-100% of site x time surveys.

The data from the bird-minute surveys have been supplemented with observations of shorebirds made by Paul Fisk (pers. comm.) and other birds by Angus McElnea (communicated by Michelle Martens pers. comm.).

Results

A total of 109 bird species were encountered at East Trinity during November 2011 to June 2012 (Appendix A and Table 1). Most species were recorded during the two summer counts in November 2011 and February 2012. Twenty-six of these species (or 24%) were recorded on only one occasion, from a total of 18 possible times x sites. Eighteen species (or 16%) were recorded on more than 50% of site x time occasions.

The most consistently recorded species included Australian swiftlet, bar-shouldered dove, brown honeyeater, eastern great egret, forest kingfisher, helmeted friarbird, large-billed gerygone, leaden flycatcher, masked lapwing, mistletoebird, yellow-bellied sunbird, pied imperial pigeon, shining flycatcher, varied triller, willie wagtail, yellow honeyeater, yellow oriole and yellow-spotted honeyeater. Except for the Australian swiftlet and the eastern great egret, all were bush birds.

Wading shorebird species included nine species within Family Ardeidae (white-faced heron, little egret, great-billed heron, eastern great egret, intermediate egret, cattle egret, striated heron, nankeen night-heron, black bittern), three species within F. Threskiornithidae (Australian white ibis, straw-necked ibis, royal spoonbill), one species within F. Ciconiidae (black-necked stork), six species within the F. Scolopacidae (common greenshank, common sandpiper, eastern curlew, grey-tailed tattler, sharp-tailed sandpiper and whimbrel) and two species within F. Charadriidae (black-fronted dotterel and masked lapwing); see Appendix A.

Some 34 species (or 31%) encountered could be considered to be true wetland species, associating with freshwater pools, mudflat, saltmarsh and mangroves. They included Australasian darter, Australian white ibis, black bittern, black-fronted dotterel, black-necked stork, black-winged stilt, cattle egret, common greenshank, common sandpiper, crested tern, eastern great egret, eastern curlew, eastern osprey, great-billed heron, grey-tailed tattler, intermediate egret, little black cormorant, little egret, little pied cormorant, masked lapwing, nankeen night-heron, Pacific black duck, pale-vented bush-hen, purple swamphen, red-necked crake, royal spoonbill, sharp-tailed sandpiper, straw-necked ibis, striated heron, wandering whistling-duck, whimbrel, white-bellied sea-eagle, white-browed crake and white-faced heron.

A breakdown of species by four broad habitat types is provided in Table 1. Fifty-seven species (or 52%) were associated with counts in Melaleuca forests and woodlands. Nineteen of these species (or 19%) were found only in this habitat, but are not necessarily considered to be Melaleuca forest/woodland habitat specialists; they included barred cuckoo-shrike, black-faced monarch, eastern koel, fairy gerygone, graceful honeyeater, grey fantail, grey whistler, laughing kookaburra, lemon-bellied flycatcher, little shrike-thrush, Macleay's honeyeater, orange-footed scrubfowl, peaceful dove, pheasant coucal, red-necked crake, rufous fantail, spectacled monarch, sulphur-crested cockatoo and superb fruit-dove.

Seventy-five species (or 69%) were associated with claypan/saltmarsh and disturbed habitat observations. Twenty-three (or 21%) of these species were associated only with these habitats. They included azure kingfisher, black bittern, black-faced cuckoo-shrike, black kite, black-shouldered kite, cicadabird, common sandpiper, crimson finch, dusky honeyeater, grey-tailed tattler, helmeted friarbird, leaden flycatcher, magpie-lark, metallic starling, nankeen kestrel, peaceful dove, pheasant coucal, red-browed finch, scaly-breasted lorikeet, sharp-tailed sandpiper, wandering whistling-duck, white-browed crake and white-throated honeyeater.

Some 68 species (or 62%) were associated with mangrove counts. Sixteen species (or 15%) were associated only with mangrove habitat. Mangroves are likely to be of particular importance to Australasian darter, black bittern, collared kingfisher, grey-tailed tattler, intermediate egret, little pied cormorant, mangrove robin, nankeen night-heron, pied imperial pigeon, whimbrel, white-breasted woodswallow and white-faced heron.

Forty species (or 37%) were associated with fernland counts. None of these species were associated only with this habitat. A number of species were associated with this habitat and the claypans; they included crimson finch, nankeen kestrel, red-browed finch and wandering whistling duck, although none of these could be considered claypan/fernland specialists.

Table 1 Bird species recorded from the East Trinity area and adjacent to Cairns International Airport (as derived from Kutt (1997), with their relative abundance and the broad habitat types they occurred within. Relative abundance codes: 1 = single record of individual or group, 2 = uncommon, recorded infrequently and from up to 25-50% of survey times x sites, 3= common, recorded frequently and from between 50-100% of survey times x sites. Habitat codes (after Kutt 1997) are S= sand ridge woodland habitat, C= claypan/saltmarsh habitat, D= disturbed habitat, MI= mangrove-intertidal habitat, F= fernland. * Venables (pers. obs.) considers these species unusual for the Cairns-Trinity Bay area and will be unlikely to be recorded at East Trinity.

Common Name	Species	Relative Abundance East Trinity	Relative Abundance Airport Study	S - East Trinity Study	S - Cairns Airport Study	C + D - East Trinity Study	D - Cairns Airport Study	MI - East Trinity Study	MI - Cairns Airport Study	F - East Trinity Study
Orange-footed scrubfowl	<i>Megapodius reinwardt</i>	2	1	+	+				+	
Wandering whistling-duck	<i>Dendrocygna arcuata</i>	2				+				+
Pacific black duck	<i>Anas superciliosa</i>	2						+		
Australian darter	<i>Anhinga novaehollandiae</i>	2				+		+		+
Little pied cormorant	<i>Phalacrocorax melanoleucos</i>	2				+		+		
Little black cormorant	<i>Phalacrocorax</i>	1						+		

	<i>sulcirostris</i>									
Australian pelican	<i>Pelecanus conspicillatus</i>		2						+	
White-faced heron	<i>Egretta novaehollandiae</i>	2	2			+		+	+	+
Little egret	<i>Egretta garzetta</i>	2				+		+		
Great-billed heron	<i>Ardea sumatrana</i>	2				+		+		+
Eastern great egret	<i>Ardea modesta</i>	3		+		+		+		+
Intermediate egret	<i>Ardea intermedia</i>	2	2			+		+	+	
Cattle egret	<i>Ardea ibis</i>	1		+						
Striated heron	<i>Butorides striatus</i>	2	1			+		+	+	
Nankeen night-heron	<i>Nycticorax caledonicus</i>	2				+		+		
Black bittern	<i>Ixobrychus flavicollis</i>	1	1			+			+	
Australian white ibis	<i>Threskiornis molucca</i>	2	3			+	+	+	+	+
Straw-necked ibis	<i>Threskiornis spinicollis</i>	1						+		

Royal spoonbill	<i>Platalea regia</i>	2				+		+		
Black-necked stork	<i>Ephippiorhynchus asiaticus</i>	2						+		
Eastern osprey	<i>Pandion cristatus</i>	2	2			+	+	+	+	+
Black-shouldered kite	<i>Elanus axillaris</i>	1				+				
Black kite	<i>Milvus migrans</i>	1				+				
Brahminy kite	<i>Haliastur indus</i>	2	2				+	+	+	
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	2	2			+	+	+	+	
Brown goshawk	<i>Accipiter fasciatus</i>	1						+		
Brown falcon	<i>Falco berigora</i>		1		+					
Nankeen kestrel	<i>Falco cenchroides</i>	1				+				+
Red-necked crane	<i>Rallina tricolor</i>	1		+						
Pale-vented bush-hen	<i>Amaurornis moluccana</i>	2		+		+		+		+
White-browed crane	<i>Amaurornis cinerea</i>	2				+				

Purple swamphen	<i>Porphyrio porphyrio</i>	2				+		+		
Bar-tailed godwit	<i>Limosa lapponica</i>		1						+	
Whimbrel	<i>Numenius phaeopus</i>	2	2					+	+	
Eastern curlew	<i>Numenius madagascariensis</i>	1	2					+	+	
Grey-tailed tattler	<i>Tringa brevipes</i>	1				+				
Common greenshank	<i>Tringa nebularia</i>	2						+		
Common sandpiper	<i>Actitis hypoleucos</i>	2				+				
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	1				+				
Bush stone-curlew	<i>Burhinus grallarius</i>		2			+			+	
Beach stone-curlew	<i>Esacus magnirostris</i>		2				+		+	
Pied oystercatcher	<i>Haematopus longirostris</i>		1						+	
Black-winged stilt	<i>Himantopus himantopus</i>	2						+		

Red-capped plover	<i>Charadrius ruficapillus</i>		2						+	
Black-fronted dotterel	<i>Euseyornis melanops</i>	1							+	
Masked lapwing	<i>Vanellus miles</i>	3	3	+		+	+	+		+
Silver gull	<i>Chroicocephalus novaehollandiae</i>		2						+	
Gull-billed tern	<i>Gelochelidon nilotica</i>		2						+	
Caspian tern	<i>Hydroprogne caspia</i>		2				+		+	
Crested tern	<i>Thalasseus bergii</i>	1							+	
Common tern	<i>Sterna hirundo</i>		1						+	
Peaceful dove	<i>Geopelia striata</i>	2	3	+	+	+	+		+	+
Bar-shouldered dove	<i>Geopelia humeralis</i>	3	3	+	+	+		+		+
Superb fruit-dove	<i>Ptilinopus superbus</i>	1	2	+	+					
Rose-crowned fruit-dove	<i>Ptilinopus regina</i>	2	2	+	+	+		+		
Pied imperial-pigeon	<i>Ducula bicolor</i>	3	1	+	+	+		+		+

Sulphur-crested cockatoo	<i>Cacatua galerita</i>	2		+						
Rainbow lorikeet	<i>Trichoglossus haematodus</i>	2	3		+	+		+		+
Scaly-breasted lorikeet	<i>Trichoglossus chlorolepidotus</i>	2		+		+				+
Macleay's fig-parrot	<i>Cyclopsitta diophthalma macleayana</i>	2	2	+	+	+		+		+
Pallid cuckoo	<i>Cacomantis pallidus</i>		2							
Brush cuckoo	<i>Cacomantis variolosus</i>	2	2	+		+		+		
Horsfield's bronze-cuckoo	<i>Chalcites basalis</i>	2	2			+		+	+	
Shining bronze-cuckoo	<i>Chalcites lucidus</i>		2		+				+	
Little bronze-cuckoo	<i>Chalcites minutillus</i>	2	3	+		+		+	+	
Eastern koel	<i>Eudynamys orientalis</i>	2	3	+	+				+	
Channel-billed cuckoo	<i>Scythrops novaehollandiae</i>		2		+					

Pheasant coucal	<i>Centropus phasianinus</i>	2	3	+	+	+	+			+
Papuan frogmouth	<i>Podargus papuensis</i>		1						+	
Australian swiftlet	<i>Aerodramus terraereginae</i>	3	3	+	+	+	+	+	+	+
White-throated needletail	<i>Hirundapus caudacutus</i>		2		+		+		+	
Azure kingfisher	<i>Alcedo azurea</i>	2				+				
Laughing kookaburra	<i>Dacelo novaeguineae</i>	2	3	+	+		+			
Forest kingfisher	<i>Todiramphus macleayi</i>	3	3	+	+	+		+		+
Sacred kingfisher	<i>Todiramphus sanctus</i>	2				+		+		+
Collared kingfisher	<i>Todiramphus chloris</i>	2	2			+		+		+
Rainbow bee-eater	<i>Merops ornatus</i>	2	3	+	+	+	+	+	+	+
Dollarbird	<i>Eurystomus orientalis</i>		3		+					
Lovely fairy-wren	<i>Malurus amabilis</i>	2	2	+	+	+	+	+		+

Red-backed fairy-wren	<i>Malurus melanocephalus</i>	2				+		+		+
Large-billed scrubwren	<i>Sericornis magnirostris</i>		2			+			+	
Brown gerygone	<i>Gerygone mouki</i>		2*			+			+	
Mangrove gerygone	<i>Gerygone levigaster</i>		2*			+	+		+	
Large-billed gerygone	<i>Gerygone magnirostris</i>	3	2	+	+	+		+	+	
Fairy gerygone	<i>Gerygone palpebrosa</i>	1	1	+	+				+	
Helmeted friarbird	<i>Philemon buceroides</i>	3	2	+	+	+			+	+
Macleay's honeyeater	<i>Xanthotis macleayana</i>	1		+						
Yellow-spotted honeyeater	<i>Meliphaga notata</i>	3	3	+	+	+		+	+	
Graceful honeyeater	<i>Meliphaga gracilis</i>	2	2	+	+				+	
Varied honeyeater	<i>Lichenostomus versicolor</i>	2	1					+	+	
Yellow honeyeater	<i>Lichenostomus flavus</i>	3		+		+		+		+

White-throated honeyeater	<i>Melithreptus albogularis</i>	2	2	+	+	+				
Brown honeyeater	<i>Lichmera indistincta</i>	3	3	+		+		+	+	+
Brown-backed honeyeater	<i>Ramsayornis modestus</i>	2		+		+		+		+
Dusky honeyeater	<i>Myzomela obscura</i>	2	2	+	+	+			+	+
Lemon-bellied flycatcher	<i>Microeca flavigaster</i>	1		+						
Mangrove robin	<i>Peneonanthe pulverulenta</i>	2	1					+	+	
Grey whistler	<i>Pachycephala simplex</i>	1		+						
Little shrike-thrush	<i>Colluricincla megarhyncha</i>	1		+						
Black-faced monarch	<i>Monarcha melanopsis</i>	1		+						
Spectacled monarch	<i>Monarcha trivirgatus</i>	2	2	+	+					
Leaden flycatcher	<i>Myiagra rubecula</i>	3		+		+				+
Satin flycatcher	<i>Myiagra cyanoleuca</i>		2		+					

Shining Flycatcher	<i>Myiagra alecto</i>	3	1	+	+	+		+	+	+
Restless flycatcher	<i>Myiagra inquieta</i>		2*							
Magpie-lark	<i>Grallina cyanoleuca</i>	2	2	+		+	+			
Spangled drongo	<i>Dicrurus bracteatus</i>	2	2	+	+	+		+	+	+
Rufous fantail	<i>Rhipidura rufifrons</i>	2		+						
Grey fantail	<i>Rhipidura fuliginosa</i>	1		+						
Willie wagtail	<i>Rhipidura leucophrys</i>	3	2	+		+	+	+		+
Black-faced cuckoo-shrike	<i>Coracina novaehollandiae</i>	1	2			+	+			
Barred cuckoo-shrike	<i>Coracina lineata</i>	2		+						
White-bellied cuckoo-shrike	<i>Coracina papuensis</i>	2	2	+	+	+		+		+
Cicadabird	<i>Coracina tenuirostris</i>	2	2			+	+			
Varied triller	<i>Lalage leucomela</i>	3	2	+		+		+	+	+
Yellow oriole	<i>Oriolus flavocinctus</i>	3	2	+	+	+		+		+

Olive-backed oriole	<i>Oriolus sagittatus</i>		2		+					
Australasian figbird	<i>Sphecotheres vieilloti</i>	2	2	+	+	+		+	+	
White-breasted wood-swallow	<i>Artamus leucorhynchus</i>	2	2		+	+	+	+		+
Black butcherbird	<i>Cracticus quoyi</i>	2	2	+		+		+	+	+
Australasian pipit	<i>Anthus novaeseelandiae</i>	1						+		
Double-barred finch	<i>Taeniopygia bichenovii</i>		2		+		+			
Crimson finch	<i>Neochmia phaeton</i>	2				+				+
Red-browed finch	<i>Neochmia temporalis</i>	2				+				+
Nutmeg mannikin	<i>Lonchura punctulata</i>	2				+		+		
Chestnut-breasted mannikin	<i>Lonchura castaneothorax</i>	2		+		+		+		
Yellow-bellied sunbird	<i>Nectarinia jugularis</i>	3	3	+	+	+		+	+	+
Mistletoebird	<i>Dicaeum</i>	3	2	+	+	+		+		+

	<i>hirundinaceum</i>									
Welcome swallow	<i>Hirundo neoxena</i>	2	2		+	+	+	+	+	
Fairy martin	<i>Petrochelidon ariel</i>	1						+		
Tawny grassbird	<i>Megalurus timoriensis</i>	1						+		
Golden-headed cisticola	<i>Cisticola exilis</i>	2		+		+		+		
Silvereeye	<i>Zosterops lateralis</i>		2						+	
Metallic starling	<i>Aplonis metallica</i>	2	1	+	+	+				
Common myna	<i>Acridotheres tristis</i>		2				+			
Total Species				57 spp.	47 spp.	75 spp.	20 spp.	68 spp.	50 spp.	42 spp.

Discussion

The bird surveys undertaken by Venables and associates (this study) recorded a diverse assemblage of birds (109 species). A further 27 species have been recorded through casual observation in the area by Angus McElnea, although there are no details available on the locations or times of these sightings (Appendix B, unpublished data; Michelle Martens pers. comm.).

The numbers of species reported from this study substantially exceeds the 83 species reported for the area adjacent to Cairns International Airport during 1994 (Kutt 1997), bearing in mind that the airport surveys were carried out over a shorter time frame than the East Trinity studies. We are also aware of the ecological dissimilarities between these areas (P. Fisk pers. comm.).

Although species richness at East Trinity was higher than near the airport, the surveys in 1994 (Kutt 1997) recorded 25 species which were not seen on the more recent surveys of this study, including: Australian pelican, brown falcon, bar-tailed godwit, bush stone-curlew, beach stone-curlew, pied oystercatcher, red-capped plover, silver gull, gull-billed tern, Caspian tern, common tern, pallid cuckoo, shining bronze-cuckoo, channel-billed cuckoo, Papuan frogmouth, white-throated needletail, dollarbird, large-billed scrub-wren, brown gerygone, mangrove gerygone, satin flycatcher, restless flycatcher, silvereye, double-barred finch and common myna. The absence of these species from East Trinity could be attributed to the fewer types of habitat surveyed in this study compared with the earlier Kutt (1997) study and are not likely to be due to any effects of habitat degradation. Venables (pers. obs.) considers occurrences of the brown gerygone, mangrove gerygone and restless flycatcher to be unusual for Cairns-Trinity Bay area and thinks it unlikely they would occur at East Trinity. The airport study did not appear to record large wader and tern roosts that occur at the mouth of the Barron River, and sharp-tailed sandpipers and eastern golden plover which can both be very common during the summer, depending on the tide (MacDonald and Wagner 1989; P. Fisk pers. comm.), were not recorded by Kutt (1997).

Surveys were conducted in four main habitat types at East Trinity that included Melaleuca forest and woodland (Sites 1 and 2), fern and sedge lands (Site 3 and 4), semi-permanent swamp/clay pan (Site 5), mangrove (Site 6) and some disturbed habitat (Site 5). Clay pan and disturbed habitat (Site 5) were lumped together within the one habitat grouping. Table 1 provides a breakdown of the species observed in each habitat class in the recent study compared with three of the habitats of Kutt (1997). The earlier study by Kutt (1997) was undertaken in six discrete habitat types that included sand ridge woodland, beach dune low woodland/shrubland, mangrove-intertidal, eucalyptus woodland and clay pan/saltmarsh and disturbed habitats. Sites 1 and 2 of this study corresponded at best to the sand ridge woodland habitat featuring *Melaleuca leucadendra* of Kutt (1997); Sites 3, 4 and 5 to the clay pan/saltmarsh and disturbed; and Site 6 corresponded to the mangrove-intertidal habitat of Kutt (1997). Unfortunately Kutt (1997) did not record the species associated with claypan habitat and provided only species for disturbed habitat; therefore the claypan/disturbed habitat observations of this study were not a match for the disturbed only habitat of Kutt (1997). The numbers of species observed in 2011 and 2012 in each of the two habitats compared with those of Kutt's (1997) study indicate that a higher number of species were observed more recently. The shorter time frame of Kutt's (1997) study could explain these shortfalls: 47 compared to 57 species in Melaleuca woodland and 50 compared to 68 species in mangrove-intertidal habitat (Table 1).

The richness of bird species in each of the East Trinity habitats in decreasing order was 75 spp. in claypan/saltmarsh/disturbed habitat, 68 spp. in mangrove-intertidal, 57 spp. in *Melaleuca* woodland and 42 spp. in fernlands. In addition, clay pan/disturbed habitats contributed 23 species that were only associated with these habitats to landscape diversity, *Melaleuca* woodland some 19 species, mangroves 16 species and fernlands no species.

Changes to vegetation and possible effects on bird assemblages

As communities associated with the incursion of seawater and the tidal zones within the East Trinity site expand, there will be as a consequence, changes in the composition and diversity of bird species at the landscape scale (γ -diversity). Birds associated with increases to *Melaleuca leucadendra* will benefit through expansion of these habitats into previously mapped grassland, but also because of maturing shrublands of this species. Grasslands, particularly those dominated by exotics and *Imperata cylindrica* are in decline because of this expansion, but also because of increases in native *Phragmites karka* in association with mangrove ferns *A. aureum*. However, while there are increases in *M. leucadendra* there is also dieback due to tidal impact, which is being replaced by fernland (Newton *et al.* 2014).

The area of mangrove fern (*Acrostichum aureum*) has more than quadrupled in recent times (Newton *et al.* 2014). The mangrove fern grows in mangrove swamps and other wet locations and appears to occupy areas of slight elevation which are occasionally inundated, although it also occupies freshwater areas. The effect an increase in the area of this habitat will have on increasing landscape diversity of birds in the East Trinity area is not clear, as the fewest number of species appear to have associated with this habitat type.

A four-fold increase in mangrove communities (Newton *et al.* 2014) since the introduction of seawater through the bund wall gates will enhance wetland habitat for a number of important wetland species, including roosting waders. Mangroves are the primary habitat for whimbrels, but eastern curlews, terek sandpipers and common sandpipers also frequent this habitat (MacDonald Wagner 1989).

Wading shorebirds of Trinity Bay and Inlet

The Cairns wetlands and foreshore host a range of migratory shorebirds. Wader densities are generally high from the Barron River to Bessie Point and the Cairns Harbour area also offers good wader habitat in a region relatively short of such conditions (Driscoll 1996). Driscoll (1996) listed the maximum count of shorebirds for the Cairns Esplanade in 1977 as 2125 birds but cautioned that summer values were generally half this number and that winter values were a quarter. In contrast, estimates of some 4750 waders have been recorded in the wetlands around Trinity Bay in 1989 during the southern migration period (MacDonald Wagner 1989; Fisk 1996), while in September and October 1994 the Queensland Wader Study Group recorded some 1600 birds (Driscoll 1996).

Guard and Garnett (1982) noted that waders were more abundant in Trinity Inlet than anywhere else to the north of Cairns until Princess Charlotte Bay. Pell and Lawler (1996) suggested that the large intertidal areas in Trinity Inlet are of significance to shorebirds but that the estuaries and creeks south of Cairns which have moderately extensive mangrove stands have less extensive open tidal flats and thus support only small wader populations. Neither Pell and Lawler (1996) nor Driscoll (1996) recorded any significant roosts at East Trinity. On the other hand, a high number of whimbrels appear to use Trinity Inlet (MacDonald and Wagner 1989; Pell and Lawler 1996; Fisk

1996). Whimbrels and sharp-tailed sandpiper occur in the Cairns area in numbers that are four and five percent of their respective State totals (Driscoll 1996).

Shorebirds were a common feature of the bird assemblage at East Trinity and included some 21 shorebird species (or 19% of species). Many of these species are listed on international agreements with China (CAMBA), Japan (JAMBA) and the Republic of Korea (ROKAMBA), including Caspian tern, cattle egret, common greenshank, common sandpiper, eastern curlew, eastern great egret, grey-tailed tattler, whimbrel and white-bellied sea-eagle.

A major roost of waders has recently been recorded in the NW salt marshes of East Trinity. A couple of counts of over approximately 350 birds have been recorded; mainly sharp-tailed sandpipers and red-necked stints (P. Fisk pers. comm.). These were not recorded at the mangrove site (Site 6) in East Trinity during 2011-12 because the roosting birds were not present at the time of survey. The major roost at East Trinity presently represents some 20-25% of the total estimate for the entire Trinity Bay area that extends from the mouth of the Barron River to False Cape (P. Fisk pers. comm.). This would suggest there are some 1400 waders roosting around Trinity Bay. This number indicates that numbers in total for the Cairns area (Trinity Bay) are down to less than half the total numbers that were being reliably recorded in earlier times (P. Fisk pers. comm.). Records from the Ellie Pt, Mick Creek and Airport/saltmarsh roosts (Barron River mouth) in the late 80's suggest that during the southern migration numbers were as high as 3000 roosting waders (MacDonald Wagner 1989; Fisk 1996).

It is highly likely that changes to both hydrology and vegetation in East Trinity, due to the remediation work that has been carried out over the past 14 years, has had a positive effect for shorebirds. The north-west roost is now considered to be the largest roost currently being used away from the mouth of the Barron River, which has always been a major roost site (Fisk 1996; pers. comm.). Mangrove forests are fundamental not only to providing roosts for waders but to the overall productivity of adjacent feeding areas, and particularly to whimbrels and sharp-tailed sandpipers which feed adjacent to vegetation in higher elevation areas that undergo frequent inundation (MacDonald Wagner 1989; Fisk 1996).

Conclusion

Comparisons suggest that the richness of bird species at East Trinity is high compared with historical data from a different area of Trinity Bay. It could be said that with flux in area of various habitats as the effects of salt water incursion take hold at East Trinity, the effects on bird assemblages will change due to a different composition of habitat within the landscape. A large number of bird species use these wetlands for their daily foraging and roosting requirements and a major wader roost of some regional significance has recently been found in the area. The expansion and improvement in condition of mangrove, clay pan and saltmarsh, and Melaleuca habitats that appears to be in progress will most likely enhance the functionality of East Trinity wetlands and improve general bird diversity and abundance, as well as improve habitat suitability for internationally important wading shorebird species. Continuing rehabilitation and protection of East Trinity wetlands will be a positive outcome for bird species under pressure elsewhere in their range.

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Appendix A — Species observed by sites and times, with the maximum number recorded during a bird minute during the 20 minute survey at each site.

Family	Common Name	Nov-11	Feb-12	Jun-12															
		Site 1	Site 1	Site 1	Site 2	Site 2	Site 2	Site 3	Site 3	Site 3	Site 4	Site 4	Site 4	Site 5	Site 5	Site 5	Site 6	Site 6	Site 6
Megapodiidae	Orange-footed scrubfowl	2	2	1	2														
Anatidae	Wandering whistling-duck							1			1								
Anatidae	Pacific black duck																12		3
Anhingidae	Australasian darter									3			1			1	1	1	1
Phalacrocoracidae	Little pied cormorant										1			1		1			1
Phalacrocoracidae	Little black cormorant																	1	
Ardeidae	White-faced heron							1						1					1
Ardeidae	Little egret														1	2	1	2	5
Ardeidae	Great-billed heron								1						1			1	
Ardeidae	Eastern great egret					1	1	1			1	1	1	1	1	1		3	1
Ardeidae	Intermediate												1					3	

	egret																		
Ardeidae	Cattle egret				1														
Ardeidae	Striated heron											1	1			1			1
Ardeidae	Nankeen night-heron									1									1
Ardeidae	Black bittern										2								
Threskiornithidae	Australian white ibis					2							1	2	4	2	3		4
Threskiornithidae	Straw-necked ibis															1			
Threskiornithidae	Royal spoonbill									1	1				7				13
Ciconiidae	Black-necked stork																	1	2
Accipitridae	Eastern osprey							1					1				1		
Accipitridae	Black-shouldered kite												1						
Accipitridae	Black kite									18									
Accipitridae	Brahminy kite															1	1		2
Accipitridae	White-bellied sea-Eagle						1						1						1
Accipitridae	Brown goshawk																		1
Falconidae	Nankeen kestrel						1												
Rallidae	Red-necked	1																	

	crake																		
Rallidae	Pale-vented bush-hen		1		1				1		1								1
Rallidae	White-browed crake										2	2							
Rallidae	Purple swamphen										1							1	
Scolopacidae	Whimbrel																	26	2
Scolopacidae	Eastern curlew																	1	
Scolopacidae	Grey-tailed tattler												1						
Scolopacidae	Common greenshank																	1	2
Scolopacidae	Common sandpiper												1	1					
Scolopacidae	Sharp-tailed sandpiper													2					
Recurvirostridae	Black-winged stilt																	3	7
Charadriidae	Black-fronted dotterel																		2
Charadriidae	Masked lapwing				1		1	2	1		2		9	2	2			1	
Laridae	Crested tern																		1
Columbidae	Peaceful dove				1				1	1			2	2	1	1			
Columbidae	Bar-shouldered		1		1		1	2	1	1				2		1	1	1	1

	dove																	
Columbidae	Superb fruit-dove	1																
Columbidae	Rose-crowned fruit-dove	1								1						1		
Columbidae	Pied imperial-pigeon		1		2	15		1		2	80		1	2		1	4	
Cacatuidae	Sulphur-crested cockatoo	1			1													
Psittacidae	Rainbow lorikeet	2	1	30	1				2									1
Psittacidae	Scaly-breasted lorikeet	2						2		1			2					
Psittacidae	Macleay's fig-parrot	1			2			1		2						1		
Cuculidae	Brush cuckoo	1			1						1		1			2		
Cuculidae	Horsfield's bronze-cuckoo													1		1		1
Cuculidae	Little bronze-cuckoo	2		1	1					2	1	2				1		
Cuculidae	Eastern koel	2			1													
Cuculidae	Pheasant coucal				1			1		1								
Apodidae	Australian swiftlet	1			1	1	7	2		2	5	10	60	4		50		4
Alcedinidae	Azure kingfisher									1	1							

Halcyonidae	Laughing kookaburra		1			1												
Halcyonidae	Forest kingfisher	1			2			3	2		2	2	2	3	2	2		1
Halcyonidae	Sacred kingfisher								1							1		
Halcyonidae	Collared kingfisher							2	2				2	2	1	1	1	
Meropidae	Rainbow bee-eater			1			2	1	1	1							1	3
Maluridae	Lovely fairy-wren				2				4		1							1
Maluridae	Red-backed fairy-wren							1					1					3
Acanthizidae	Large-billed gerygone(B)				2	1	2				1		1		1	1	1	1
Acanthizidae	Fairy gerygone	1																
Meliphagidae	Helmeted friarbird	2	1	1	1	2		1			1	1		1		1		
Meliphagidae	Macleay's honeyeater	2																
Meliphagidae	Yellow-spotted honeyeater	2	1	2	1	2	2				2			1	1		1	
Meliphagidae	Graceful honeyeater	2	1	1	1	1												
Meliphagidae	Varied honeyeater															2	5	2

Meliphagidae	Yellow honeyeater					1	1	2	1	1	2		1	2	1	1	1	1	
Meliphagidae	White-throated honeyeater		2	1	2	1					1	1							
Meliphagidae	Brown honeyeater		2	2		1	2	3	3	2	2	3	4	2	4	3	1	1	4
Meliphagidae	Brown-backed honeyeater				2			2	2		2	4		1	3		2		
Meliphagidae	Dusky honeyeater	1	1		1	1		1											
Petroicidae	Lemon-bellied flycatcher		1																
Petroicidae	Mangrove robin																1	1	1
Pachycephalidae	Grey whistler	2																	
Pachycephalidae	Little shrike-thrush		1																
Monarchidae	Black-faced monarch		1																
Monarchidae	Spectacled monarch		1	1	1														
Monarchidae	Leaden flycatcher	1	1	2		1	1	1		1	1	2	1	2					
Monarchidae	Shining flycatcher				1			1	2		1	1		3	2	1	1	1	1
Monarchidae	Magpie-lark				1						1								
Dicruridae	Spangled	2	1	2			1			2			1			1			1

	drongo																		
Rhipiduridae	Rufous fantail			1				1											
Rhipiduridae	Grey fantail							2											
Rhipiduridae	Willie wagtail (B)				1	1	1	2	1		1			2	1	1	1	2	1
Campephagidae	Black-faced cuckoo-shrike															1			
Campephagidae	Barred cuckoo-shrike	1			1														
Campephagidae	White-bellied cuckoo-shrike	1							1	2				1	1	1		2	
Campephagidae	Cicadabird	2			2						2								
Campephagidae	Varied triller	1	1	1	1	1	1	1	1	2	1	1		1		1	1	1	
Oriolidae	Yellow oriole	6	3		7	3	1	2	2	1	4	2	2	2		1	2	1	
Oriolidae	Australasian figbird	1			2	1					6				2		1		
Artamidae	White-breasted woodswallow									1							1	1	1
Artamidae	Black butcherbird	1	1	2	1	1			1						1				1
Motacillidae	Australasian pipit																		1
Estrildidae	Crimson finch									2	1		4	4	2				
Estrildidae	Red-browed finch							3	2					4					
Estrildidae	Nutmeg										1							2	20

	mannikin																		
Estrildidae	Chestnut-breasted mannikin					5					1								1
Nectariniidae	Yellow-bellied sunbird	1		1	2	1	1	5	3	2	1	1		2	1	1	2	2	1
Nectariniidae	Mistletoebird	1		1	1	1	1	2	1	1	1	2	2	2	2	1	1	1	1
Hirundinidae	Welcome swallow													1	1		6	6	
Hirundinidae	Fairy martin																		6
Megaluridae	Tawny grassbird																		2
Cisticolidae	Golden-headed cisticola				1							2						1	1
Sturnidae	Metallic starling		1			60					1	12			10				

Appendix B – Additional species observed at East Trinity by Angus McEInea, Senior Scientist, DSITIA (unpublished data via Michelle Martens pers. comm.).

Family	Common Name	Species
Anseranatidae	Magpie goose	<i>Anseranas semipalmata</i>
Anatidae	Radjah shelduck	<i>Tadorna radjah</i>
Anatidae	Grey teal	<i>Anas gracilis</i>
Phalacrocoracidae	Pied cormorant	<i>Phalacrocorax varius</i>
Phalacrocoracidae	Great cormorant	<i>Phalacrocorax carbo</i>
Accipitridae	Whistling kite	<i>Haliastur sphenurus</i>
Accipitridae	Collared sparrowhawk	<i>Accipiter cirrhocephalus</i>
Falconidae	Brown falcon	<i>Falco berigora</i>
Rallidae	Buff-banded rail	<i>Gallirallus philippensis</i>

Scolopacidae	Latham's snipe	<i>Gallinago hardwickii</i>
Scolopacidae	Bar-tailed godwit	<i>Limosa lapponica</i>
Scolopacidae	Great knot	<i>Calidris tenuirostris</i>
Scolopacidae	Red-necked stint	<i>Calidris ruficollis</i>
Scolopacidae	Curlew sandpiper	<i>Calidris ferruginea</i>
Jacaniidae	Comb-crested jacana	<i>Irediparra gallinacea</i>
Burhinidae	Bush stone-curlew	<i>Burhinus grallarius</i>
Columbidae	Emerald dove	<i>Chalcophaps indica</i>
Cuculidae	Shining bronze-cuckoo	<i>Chalcites lucidus</i>
Cuculidae	Channel-billed cuckoo	<i>Scythrops novaehollandiae</i>
Halcyonidae	Blue-winged kookaburra	<i>Dacelo leachii</i>
Coraciidae	Dollarbird	<i>Eurystomus orientalis</i>
Meliphagidae	Noisy friarbird	<i>Philemon corniculatus</i>
Meliphagidae	Lewin's honeyeater	<i>Meliphaga lewinii</i>

Meliphagidae	Black-chinned honeyeater	<i>Melithreptus gularis</i>
Rhipiduridae	Northern fantail	<i>Rhipidura rufiventris</i>
Corvidae	Torresian crow	<i>Corvus orru</i>
Sturnidae	Common myna	<i>Acridotheres tristis</i>