

BIODIVERSITY CONSERVATION ON THE TIWI ISLANDS, NORTHERN TERRITORY:

Part 2. Fauna



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Cover photograph. The False Water-rat *Xeromys myoides*. This Vulnerable species is known in the Northern Territory from six locations, including the Tiwi Islands.
(Photo: Alex Dudley).

SUMMARY

This is the second part of a three part report describing the biodiversity of the Tiwi Islands, and options for its conservation and management. The first part describes the Islands, their environments and plants. This part describes the fauna of the Tiwi Islands, and highlights the conservation values of that fauna. This report is concerned principally with terrestrial vertebrate fauna (frogs, reptiles, birds and mammals), and provides only limited information on fish, freshwater systems, marine systems and invertebrates.

While Tiwi Aboriginal people have long held a deep knowledge of the fauna of their lands, this knowledge has only recently been documented. Scientific knowledge of the Tiwi fauna has improved substantially over the last decade. Until then, the most substantial contributions had come from collections, mostly of birds and mammals, in the period 1910-1920, that had provided a surprisingly thorough inventory of these groups.

In this report we have collated all accessible information on the fauna of these Islands, and describe results from a major study undertaken over the last few years. This study has greatly increased the amount of information on the distribution, abundance, ecology and conservation status of the Tiwi Islands fauna.

The Tiwi invertebrate fauna remains poorly known. However, our work included a major systematic study of the Tiwi Island ants. A total of 151 ant species are now known from the Tiwi Islands. The biogeographical affinities of this ant fauna are unusual, with a far higher proportion of Torresian species than is typical for the Top End mainland.

The Tiwi Islands frog fauna comprises 17 species, not especially rich in comparison to mainland sites of comparable size. The Tiwi Islands reptile fauna comprises 81 species, a moderate richness compared with similar sized mainland areas, but notably lacking in the rich reptile fauna associated with rocky areas across northern Australia. The Tiwi Islands bird fauna comprises 222 species, relatively high compared with mainland areas. There are some strange omissions in this bird fauna, of species common in comparable habitats on the mainland: these include grey butcherbird *Cracticus torquatus*, black-tailed treecreeper *Climacteris melanura*, masked finch *Poephila personata*, rufous owl *Ninox rufa* and barking owl *N. connivens*. The Tiwi Islands mammal fauna comprises 36 native species, relatively low compared with comparably sized areas on the mainland, largely because of the absence on the Tiwi Islands of the rich component of the northern Australian mammal fauna associated with rocky areas. Nonetheless, the number of native mammal species recorded from the Tiwi Islands is exceptional compared to other Australian islands.

Ten animals found on the Tiwi Islands are listed as threatened (endangered or vulnerable) at national level in regulations of the Commonwealth *Environment Protection and Biodiversity Conservation Act*. Those species are green turtle *Chelonia mydas*, hawksbill turtle *Eretmochelys imbricata*, olive ridley *Lepidochelys olivacea*, flatback turtle *Natator depressus*, loggerhead turtle *Caretta caretta*, red goshawk *Erythrotriorchis radiatus*, partridge pigeon *Geophaps smithii smithii*, masked owl *Tyto novaehollandiae melvillensis*, butler's dunnart *Sminthopsis butleri* and false water-rat *Xeromys myoides*.

Eleven animals found on the Tiwi Islands are listed as threatened (endangered or vulnerable) at the Northern Territory level, in regulations of the *Territory Parks and Wildlife Conservation Act*. Only four species are common to both the national and Northern Territory lists (loggerhead turtle, red goshawk, masked owl and butler's dunnart). The other species listed as threatened at Northern Territory level are the snails *Amphidromus cognatus* and *Trochomorpha melvillensis*, Dodd's azure butterfly *Ogyris iphis doddii*, northern grassdart butterfly *Taractrocera ilia ilia*, the Tiwi Islands subspecies of hooded robin *Melanodryas cucullata melvillensis*, northern brush-tailed phascogale *Phascogale (tapoatafa) pirata*, and brush-tailed rabbit-rat *Conilurus penicillatus*. A further 29 species are listed as Data Deficient (with this tally including 16 species that are listed because of possible but uncertain impacts of cane toads across their Northern Territory range).

Threatened animal species occur mostly on the west of Melville Island and on Bathurst Island, but this distribution may be at least partly biased by uneven sampling efforts. Eucalypt open forest is the principal habitat of the most threatened animal species, but all main habitats support at least one threatened animal species.

The number of threatened animal taxa reported from the Tiwi Islands is unusually high compared with other regions studied recently in northern Australia.

As to be expected for a large island, many animal taxa occur only on the Tiwi Islands. Such species may have particular conservation and management leverage because these can be protected only on the Tiwi Islands. The number of these is impossible to calculate for most invertebrates, but systematic assessment is possible for one group, ants. In this case, about 10% of the known Tiwi Islands ant fauna is endemic (or at least not known from any other locations in northern Australia). For invertebrate groups with less dispersal ability than ants (such as landsnails), the level of endemism may be even higher.

No frog or reptile species are restricted to the Tiwi Islands. About eight bird subspecies and two mammal subspecies are considered restricted to the Tiwi Islands.

Fifty-one animal species recorded from the Tiwi Islands are listed under treaties protecting migratory animals. This listing is dominated by 33 species of migratory waders, waterbirds and seabirds.

Many of these species occur on the Tiwi Islands only during part of their life cycle, and their movements link the Tiwi Islands to mainland north Australia, Indonesia and north Asia. The number and complexity of these connections imply that any degradation of habitats on the Tiwi Islands may have impacts upon biodiversity well beyond the Tiwi Islands.

Islands generally have conservation values in offering some protection against factors that may operate extensively across connected mainland areas. This has been demonstrated particularly for Australian islands, which have offered sheltered refuge for many mammal species now extinct on the mainland. As large islands with a substantial fauna, the Tiwi Islands have the potential to provide a major safeguard for north Australian fauna. This role may be greatly enhanced should the spread of cane toads result in reductions of many native predator species, and should the Tiwi Islands be kept free of cane toads.

In addition to threatened species and endemic species, sites on the Tiwi Islands support nationally significant aggregations of some species, particularly colonially breeding seabirds, shorebirds (waders) and marine turtles, and the waters around the north of the islands have national significance for sea-grass beds and dugongs. Seagull Island off the northwestern tip of Melville Island supports a breeding colony of about 60,000 crested tern *Sterna bergii*, the largest known colony of this species in the world.

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1. INTRODUCTION

1.1. Purpose and context of this report

This segment of the report presents information on animals occurring on the Tiwi Islands, Northern Territory. Part 1 of this series discusses the environments and plants of these islands, and part 3 provides a synthesis and describes some management recommendations. This report is based on an intensive field survey and collation of previous documentation. It aims to define and describe conservation values. This assessment is limited mostly to terrestrial vertebrate animals, and provides only minor consideration of invertebrates, and of aquatic and marine species.

This report builds from a previous and related assessment (Woinarski *et al.* 2000a) of the conservation values of the Tiwi Islands, and the extent to which these may be affected by a major forestry development proposal. To that earlier report, this document adds:

- the results from a substantial field survey on Bathurst Island in 2001;
- additional sampling on Melville Island in 2002;
- information on Tiwi ethnoecology presented in Puruntatameri *et al.* (2001);
- natural resource management plans (Tiwi Land Council 2000); and
- also recognises the major review of conservation status of Northern Territory plants and animals completed in 2002 (Anon 2002).

2. HISTORICAL AND RECENT STUDIES ON TIWI ANIMALS

2.1. Previous information

As with plants, documentation of the fauna of the Tiwi Islands has been meagre.

Aspects of the rich traditional knowledge of Tiwi animals have been described recently in Puruntatameri *et al.* (2001), and in less detail in Davis (1983), Fensham and Woinarski (1992) and Anon (1998).

Scientific interest in the Tiwi fauna began with a phase of wildlife collection in the early twentieth century (e.g. J.P. Rogers in 1911-1912 and W.D. Dodd in 1914). These collections fuelled the description of many bird and mammal species, forms considered then to be restricted to the Tiwi Islands (Thomas 1913, 1921; Mathews 1914; Zietz 1914a,b). With more circumspect consideration of taxonomic boundaries, and more knowledge of variation and distribution of species across northern Australia generally, most of these supposed Tiwi-endemic vertebrate species have been relegated to subspecies or dismissed (Walton 1988; Mason and Schodde 1997; Schodde and Mason 1999).

There was little activity in the decades following these somewhat systematic collecting expeditions, other than limited opportunistic collection of “unusual” specimens by Europeans associated with the Nguui mission, and occasional brief notes (Dodd 1935; Goodfellow 1935; Hayman 1936; Harney and Elkin 1943). Much of this early documentation of Tiwi fauna is geographically imprecise (with records typically noting only “Melville Island” as location) and lacks information on habitat or abundance. While these early records now have diminished value, they do provide some context and contribution to the basic inventory of the Islands’ biodiversity.

Until this project, recent studies of the Tiwi fauna have been less comprehensive than for plants. The most broad-based work was sampling of terrestrial vertebrates in 18 Tiwi rainforest patches and adjacent habitat over 10 weeks in 1990-1992, as part of a broader biogeographic study of the mammal (Menkhorst and Woinarski 1992), bird and herpetofauna (reptiles and frogs: Gambold and Woinarski 1993) rainforest communities in the Top End of the Northern Territory generally, and as part of a study of the ecology and management of Tiwi rainforests specifically (Fensham and Woinarski 1992). This survey also included inventory of ants in five of these rainforest patches, again documented as part of a broader Top End rainforest study (Reichel and Andersen 1996).

The next major study was an inventory of some invertebrate groups, freshwater fish, and terrestrial vertebrates at a series of riparian sites on western Melville Island over two weeks in October 1996, by staff of the Museums and Art Galleries of the Northern Territory (Horner 1998) and more broad-scale collection of birds at the same time by CSIRO (Mason and Schodde 1997).

Information from this set of studies was collated in a review of the Tiwi fauna included within Anon (1998).

Proposed forestry expansion prompted a subsequent series of studies leading up to this project. These studies included a brief (4 days) survey in June 1998 of vertebrate fauna for the initial Environmental Impact Assessment of a proposed large-scale plantation of *Acacia mangium* (For Sci 1999) and a 10-day inventory by PWCNT staff of plants and terrestrial vertebrates in a 3,125 ha block of native forest on Melville Island proposed for clearing (Brock *et al.* 2000). A far more substantial survey of terrestrial vertebrate fauna on Melville Island was undertaken between July and October 2000, with results published in Woinarski *et al.* (2000a). This work was extended in 2001 and 2002 to include comparable sampling on Bathurst Island, and results from both major surveys are collated here. The forestry development has also initiated a series of recent studies on particular fauna of conservation significance, most notably on the red goshawk *Erythrotriorchis radiatus* (Baker-Gabb 2001).

Not all fauna records from the Tiwi Islands are credible. Some records appear to be based on supposition, or are otherwise lacking in punctiliousness. For example, in a major text describing Australian mammals, Strahan (1995) listed the following mammal species from the Tiwi Islands, apparently erroneously: northern quoll *Dasyurus hallucatus*, bare-rumped sheath-tail-bat *Saccolaimus saccolaimus*, and diadem horseshoe-bat *Hipposideros diadema inornatus*. Such records persist and percolate through the subsequent literature (e.g. Abbott and Burbidge 1995). For the quoll, surveys on the Tiwi Islands have repeatedly not reported its occurrence, and there are explicit assertions of absence (Harney and Elkins 1942-43; Puruntutameri *et al.* 2001). Accounts of ethnobiology may also introduce some erroneous records if they are not compiled with a detailed zoological expertise. For example, Davis (1983) lists a Tiwi name for olive python *Liasis olivaceus*, and Puruntutameri *et al.* (2001) lists a Tiwi name for rufous owl *Ninox rufa*, but these are more likely to refer to similar species present on the Islands. There are other unusual records that should best be treated as dubious without further confirmation: for example, the naturalist/collector Goodfellow (1935) recorded hooded parrot *Psephotus dissimilis*, a reasonably conspicuous species that has not been reported before or since. In our compilation of species records from the Tiwi Islands, we list all records, but note those that appear unlikely and/or require further confirmation.

2.2. Summary of previous studies for major fauna groups

Invertebrates

Invertebrates in particular have been poorly sampled. The only previous systematic surveys have been brief and relatively localised – Reichel and Andersen (1996) included samples from five Tiwi rainforests within their study of Top End rainforest ants; Watson (in Watson and Theischinger 1984) collected dragonflies and damselflies in June 1981; Suggit (in Anon 1998) collected macroinvertebrates at five freshwater sites on Melville Island as part of a national river health monitoring project; and Brown (1998) collected aquatic insects at 14 sites on Melville Island over a two-week period in 1996. As evidence of the inadequacy of information on Tiwi invertebrates, Brown noted that 26 of the 81 aquatic insect species he collected “were either new or could not be identified to species with certainty”.

A further illustration of the inadequate and unsystematic collecting and knowledge of the invertebrates of the Tiwi Islands is that the cockroach *Platyzysteria baldwinspenceri* is known only from the original collection of seven specimens during a visit to the Tiwi Islands for a few days by Baldwin Spencer in 1912 (Mackerras 1968). No-one has recorded it since. With such little knowledge, it is impossible to assess the distribution (including whether it is

Tiwi-endemic), habitat and conservation status of this species; and the case is evidence of the major lack of any substantial systematic survey of the Tiwi invertebrate fauna generally.

While lacking comprehensive and systematic surveys, there has been some relatively incidental and largely undocumented collecting of some invertebrate groups, particularly butterflies, and recent research has considered possible invertebrate pests to forest plantations (D. McLeod *pers. comm.*). In a broad study of the factors affecting the structure, floristics and dynamics of eucalypt forests on the Tiwi Islands, Fensham (1994*a,b*) investigated the phytophagous (vegetation-consuming) invertebrate community at a series of sites on Melville Island, examining particularly the variation in this invertebrate fauna between different tree species, tree ages, sites and seasons. Invertebrates were collected by sweepnet sampling and by foliage clipping. Invertebrates collected were sorted to morphospecies, but no formal names were applied. The study demonstrated that there was a rich fauna of phytophagous insects, with substantial variation in community composition and diversity across seasons and between tree species.

Fish

Information on freshwater fish on the Tiwi Islands is similarly sparse. Before two weeks of sampling on Melville Island in October 1996, Larson (1998) noted “*almost nothing is known of the freshwater fish fauna of the Tiwi Islands. For example, only three freshwater fishes are recorded in the literature as occurring on Melville Island.*”

Frogs

The frog fauna of Melville Island was described in some detail by Tyler *et al.* (1991), based on 10 days of sampling. Limited additional information was presented in Fensham and Woinarski (1992), Gambold and Woinarski (1993), Woinarski (1998) and Woinarski *et al.* (2000*a*).

Reptiles

The reptile fauna known from the Tiwi Islands is listed in Fensham and Woinarski (1992), Woinarski (1998) and Woinarski *et al.* (2000*a*), although this listing is based on little systematic research, most notably a survey of 18 Tiwi rainforest patches (Gambold and Woinarski 1993) and a two-week survey of freshwater and adjacent areas at four main sites on Melville Island (Horner and Griffiths 1998).

There have also been surveys of the distribution and abundance of saltwater crocodiles *Crocodylus porosus* (Messel *et al.* 1979), and of nesting marine turtles, with results of the latter included within a broad report on the distribution and status of marine turtles generally in the Northern Territory (Chatto 1998). Chatto (1998) has demonstrated that the Tiwi Islands holds regional and national significance for breeding and feeding sites for some marine turtle species.

Birds

The bird fauna of the Tiwi Islands has been reviewed in Mason and Schodde (1997) and Woinarski (1998), based largely on collections in the first two decades of the twentieth century (Mathews 1914; Zietz 1914a,b), more recent sampling of 18 Tiwi rainforest patches and their surrounds (Fensham and Woinarski 1992), and a survey on Melville Island by CSIRO over two weeks in 1996 (Mason and Schodde 1997).

The species composition, distribution and status of waterfowl, seabirds and shorebirds on the Tiwi Islands have been studied in a series of NT-wide aerial surveys by Chatto (2000, 2001, 2003). These have documented the regional, and in some cases national, significance of the Tiwi Islands for the conservation of some of these bird species. Watanabe (1999) provided a more detailed study of the large rookery of crested terns *Sterna bergii* (and smaller colony of silver gulls *Larus novaehollandiae*) on Seagull Island off the northwestern tip of Melville Island.

Forestry development has recently led to more detailed consideration of the status of a setries of threatened bird species on Melville Island (Baker-Gabb 2001), particularly including ongoing studies and monitoring of red goshawk.

Mammals

The mammal fauna of the Tiwi Islands is reported in Fensham and Woinarski (1992), Abbott and Burbidge (1995), Woinarski (1998) and ForSci (1999), although this listing is based on little systematic research, most notably the brief records from early collectors (e.g., Thomas 1913, 1921), a survey of 18 Tiwi rainforest patches and their surrounds (Menkhorst and Woinarski 1992) and a two-week survey of freshwater and adjacent areas at four main sites on Melville Island (Horner and Griffiths 1998). There have also been some recent largely anecdotal accounts of individual mammal species on the Tiwi Islands (Magnusson *et al.* 1976; Kemper and Schmitt 1992; Woinarski *et al.* 1996).

The feral mammals of the Tiwi Islands (pig, water buffalo, horse and cattle) have been surveyed as part of a Territory-wide aerial survey in 1985 (Bayliss 1985). The water buffalo is not present on Bathurst Island, but reaches very high densities (exceeding 10 individuals/km²) on Melville Island, particularly in the south-east. Feral pigs are common on Bathurst island, but absent on Melville Island.

Dugong *Dugong dugon* populations around the Tiwi Islands are currently being studied by Scott Whiting (Northern Territory University).

2.3. This survey

In 2000, fieldwork was undertaken on Melville Island only, over the periods 31 January to 7 February and 1 July to 29 September (for a total of 410 person-days). This survey included sampling of vertebrate animals in 204 quadrats (each sampled over a 3 night period). Sampling was stratified to attempt to cover as much of Melville Island as was accessible (Fig. 2.1), and to sample the environmental range present. Sampling methodology followed now standard practice used for wildlife survey by Parks and Wildlife Commission of the

Northern Territory (see Appendix C). Survey results were reported in Brock *et al.* (2000) for the February fieldwork, and Woinarski *et al.* (2000a) for the subsequent fieldwork.

In 2001, fieldwork was undertaken mainly on Bathurst Island, over the periods 21 April to 9 June 2001 (for a total of 115 sites with 147 person-days). Sampling procedure was as for the 2000 fieldwork on Melville Island.

In the course of fieldwork for the present study, we sampled ants at 224 sites on both Bathurst and Melville Islands, based on collection of specimens in the pitfall traps used for vertebrate sampling. This represents the most thorough examination of any invertebrate group on the Tiwi Islands, and the results are presented in detail in Appendix D.

In addition to this broad-scale inventory sampling, in 2001 we also conducted some baseline monitoring for the forestry development project on Melville Island. This consisted of specific sampling and searches for masked owl *Tyto novaehollandiae melvillensis* and hooded robin *Melanodryas cucullata melvillensis*, and sampling in a set of 32 quadrats in eucalypt forests near or in areas proposed for clearing for forestry plantation.

Together, these 2000-2001 surveys produced 7136 records of vertebrates from 351 quadrats, with a further 857 geo-coded incidental vertebrate records. This survey effort substantially increased the amount of information documented for Tiwi vertebrate animals (Table 2.1), constituting more than 70% of the total number of known geo-coded records of frogs, reptiles, birds and mammals from the Tiwi Islands.

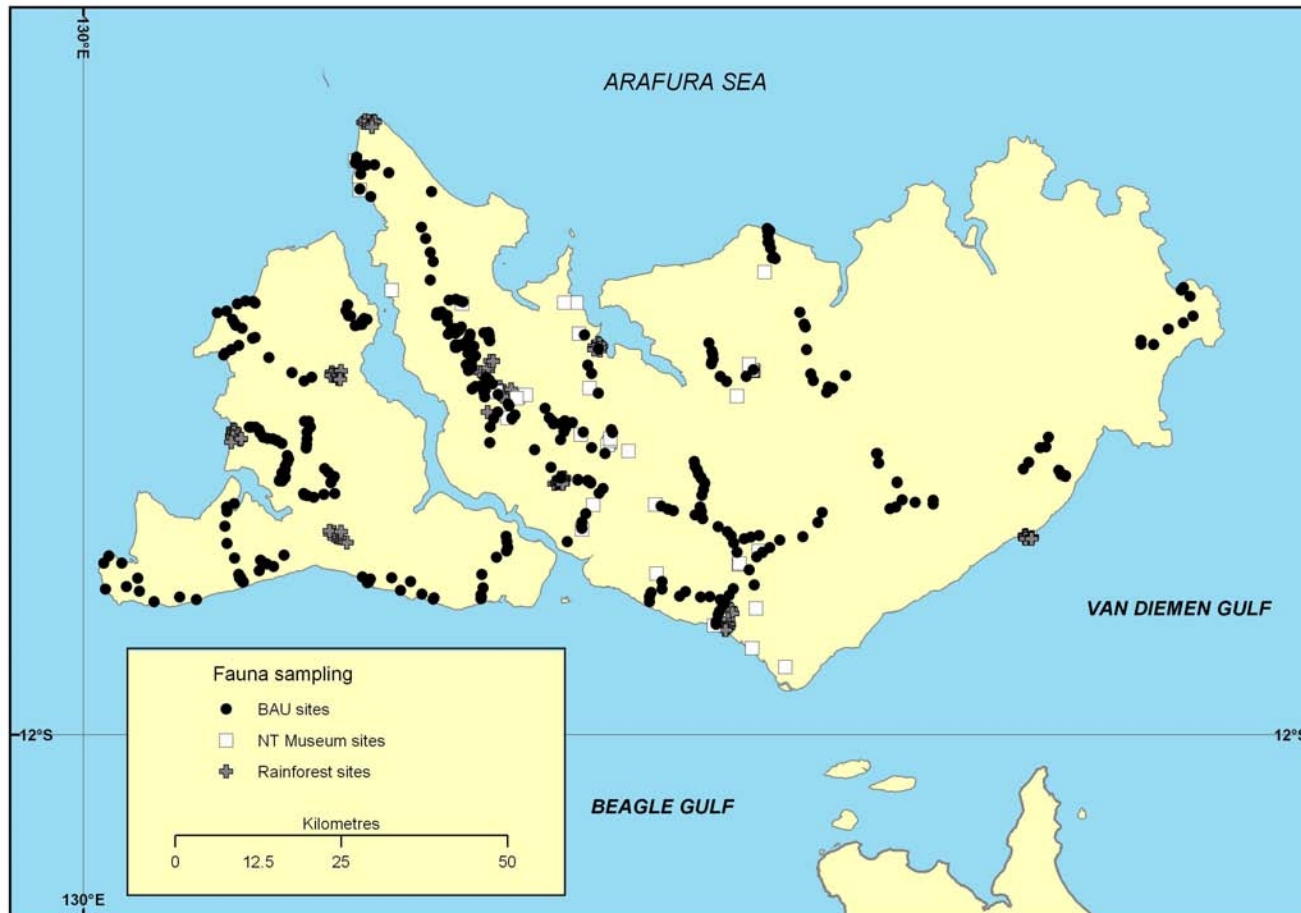


Fig. 2.1. Locations used for plot-based survey of terrestrial vertebrate fauna

Table 2.1. The main fauna data sets available for the Tiwi islands.

data set	no. of sites	no. of records	taxa recorded	quadrat-based?	period	locational precision	reference
rainforest patches (and adjacent habitats)	97	1708	frogs, reptiles, birds, mammals	Y	1990-92	+/- 100 m	Fensham & Woinarski (1992)
aquatic habitats (and adjacent areas)	38	183	reptiles, mammals	Y	October 1996	+/- 10m	Horner & Griffiths (1998)
CSIRO birds	-	268	birds	N	October 1996	+/- 1 km	Mason & Schodde (1997)
this survey - Melville Island 2000-2001	236	5119	frogs, reptiles, birds, mammals	Y	31/1/00 -7/2/00; 1/7/00 - 27/9/00	+/- 10 m	Woinarski <i>et al.</i> (2000).
this survey - Bathurst Island (2001)	115	2017	frogs, reptiles, birds, mammals	Y		+/- 10 m	this report
Birds Australia bird atlas	6	149	birds	Y?	1998-2000	+/- 100 m	-
fauna atlas		1806*	individual records of individual spp.	N	19th century on	variable, from +/- 10 m to +/- 20 km	
Total	492	11250					

* note that this includes some duplication with the other data bases listed (e.g. where animal specimens were collected from sample sites).

3. THE TIWI FAUNA

3.1. *Species richness and composition*

Ants are the only invertebrate group for which systematic inventory has been attempted on the Tiwi Islands. A total of 151 ant species are now known for the Tiwi Islands, however this tally is likely to be very incomplete. Six introduced ants have been recorded on the Tiwi Islands, including currently highly localised records of the big-headed ant *Pheidole megacephala*, a species known to be a major threat to conservation values.

The ant species richness is comparable to that of the Northern Territory mainland, although any comparison is hampered by inconsistencies in survey methodology and effort. Northern Australia generally has one of the world's most diverse ant faunas (Andersen 2000).

The Tiwi ant fauna is unusual in composition, with 68% of the species belonging to Torresian (tropical) species groups, which is considerably higher than the 44% for Australia's monsoonal ant fauna as a whole (Appendix D).

The only substantial study of Tiwi Islands freshwater fish (Larson 1998) documented records for 49 fish species, although this tally included many estuarine species.

The known frog fauna of the Tiwi Islands comprises 17 species (with dubious records of another species) (Appendix A). This is not especially rich compared with other sampled areas in the mainland Northern Territory (Table 3.1).

The reptile fauna of the Tiwi Islands comprises 81 species (with dubious records of another three species), including one crocodile, five marine turtles, two freshwater turtles, five geckoes, three pygopodids (legless lizards), six dragons, six goannas, 21 skinks, three blind-snakes, four pythons, two file snakes, six colubrid snakes, 11 elapid snakes and six sea-snakes. This tally is not atypical of comparably sized areas of mainland northern Australia, though is substantially less rich than sites with more complex topography, most notably the Kakadu area (Table 3.1). The Tiwi Island reptile fauna includes two exotic species - the Asian house gecko and flowerpot blind-snake.

A total of 222 bird species have been recorded from the Tiwi Islands, although six of these species are considered unlikely, and records for four species may require further confirmation. This species richness is comparable to that of other similar-sized regions of mainland northern Australia (Table 3.1). However, the Tiwi bird fauna is notable by the absence of a set of species that are common and widespread in similar habitats of the Top End mainland. These "missing" species include grey butcherbird, black-tailed treecreeper, masked finch, rufous owl and barking owl. The emu is another missing Tiwi species, although it is only patchily common on the Top End mainland. Other Top End species not yet recorded from the Tiwi Islands may signify inadequate sampling in wetland areas (e.g. grey teal, black cormorant, pied cormorant, cattle egret, swamp harrier and clamorous reed-warbler), and species that are typically at very low densities (e.g. crested shrike-tit). There are also no Tiwi records for a range of vagrant species that have been reported in the north of the Northern Territory only intermittently and uncommonly. A suite of species

that are widespread in the Top End, but principally in lower rainfall areas (e.g. around Katherine) are also apparently absent from the Tiwi Islands. These include black-chinned honeyeater, diamond dove, budgerigar, hooded parrot, rufous-throated honeyeater, banded honeyeater, jacky winter and masked wood-swallow). There are remarkably few records on the Tiwi Islands for some species that are common on the adjacent mainland, including magpie-lark, willie wagtail, restless flycatcher, double-barred finch, long-tailed finch and crimson finch. Many of these species absent or at relatively low abundance on the Tiwi Islands are also absent or rare on Groote Eylandt and on other island chains off Arnhem Land (Woinarski *et al.* 2001*a*; Noske and Brennan 2002). In contrast, some bird species appear to be unusually common and widespread on the Tiwi Islands compared with similar habitats on the adjacent mainland. These species include partridge pigeon, masked owl, red goshawk, singing honeyeater and yellow-tinted honeyeater.

The Tiwi Island mammal fauna comprises 36 native species (four dasyurids, one bandicoot, one macropod, two possums, 16 bats, nine rodents, dingo and dugong) and six exotic species (black rat, water buffalo, cattle, pig, horse and cat). This tally is somewhat low relative to comparably sized areas of the mainland Top End (Table 3.1), most notably because of the absence of the rich mammal fauna associated with rocky areas (e.g. sandstone antechinus, short-eared rock-wallaby, black wallaroo, rock ringtail possum, common rock-rat, and many cave-dwelling bats).

Table 3.1. Vertebrate species richness for the Tiwi Islands compared with some other sampled areas in northern Australia. Species tallies are modified from Fisher and Woinarski (2002), Noske and Brennan (2002) (for Groote Eylandt) and Woinarski (1998) (for Wessel and English Company islands).

location	area (km ²)	no. of native species				
		frog	reptile	bird	mammal	total
Tiwi Islands	7481	17	79	216	36	348
Kakadu NP	19800	26	116	269	64	475
Bradshaw (Juliki)	8710	22	77	212	44	355
Litchfield NP	1458	24	61	186	39	310
Nitmiluk NP	2947	21	65	188	34	308
Gurig NP	4505	8	46	194	18	266
Gregory NP	12727	20	74	164	37	295
Purnululu NP (WA)	3193	12	79	146	30	267
Mary River NP (proposed)	1215	21	70	199	29	319
Groote Eylandt	2260			228		
Wessel and English Company Islands	525	8	49	171	18	246

The terrestrial vertebrate fauna of the Tiwi Islands is compared quantitatively with that of the mainland in Table 3.2. This analysis is based on a large series of surveys conducted in a standardised manner by Parks and Wildlife Commission of the Northern Territory over the last decade. To render the comparison most unbiased, we consider here only those sampled quadrats in which *Eucalyptus miniata* and/or *E. tetradonta* was a dominant canopy species. This data set comprised a set of xx quadrats on the Northern Territory mainland and a set of xx quadrats on the Tiwi islands (Fig. 3.1).

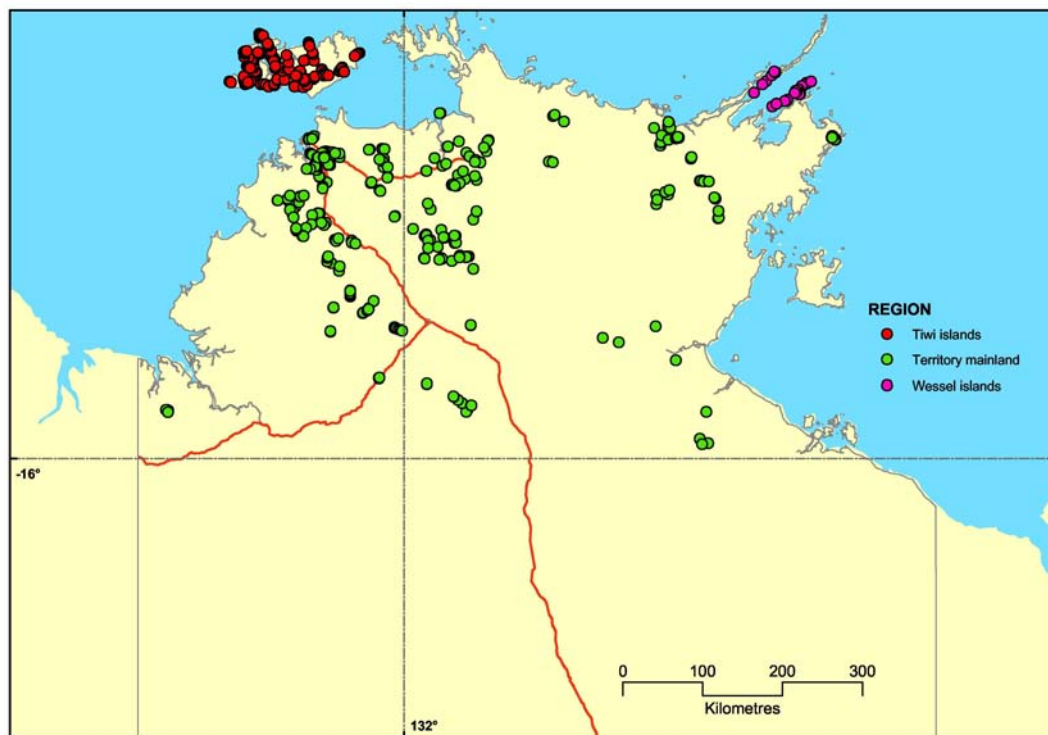


Figure 3.1. Locations of quadrats dominated by *Eucalyptus miniata* and/or *E. tetradonta* that were used to compare the terrestrial vertebrate fauna of the Tiwi Islands with that of the Northern Territory mainland.

The analysis used a Mann-Whitney U-test to compare the abundance of individual species in the set of mainland sites and the set of Tiwi Island sites. Only species that were recorded from 5 or more sites are considered in this analysis.

The results show that the faunal assemblages of the Tiwi Island's eucalypt forests are distinctly different from those in the comparable eucalypt forests sampled on the Northern Territory mainland, with many species far more abundant on the Tiwi Islands and many other species absent or far less abundant there.

Table 3.2. Comparison of the abundance of terrestrial vertebrate species in eucalypt forests on the mainland with that of eucalypt forests on the Tiwi Islands. Species are listed sequentially by their z-scores (column 7), which rank from the most significantly more abundant on the Tiwi Islands (at the head of the Table) to those most significantly more abundant on the mainland (at the bottom of the Table). “p” denotes the probability levels associated with the test results: p values of <0.05 are conventionally regarded as showing significant difference. Species listed in red are significantly more abundant in eucalypt forests on the Tiwi Islands than on the mainland; those listed in blue are significantly more common on the NT mainland.

Species	Scientific name	No sites (mainland)	No sites (Tiwi)	Mean abundance (mainland)	Mean abundance (Tiwi)	Z value	p
Yellow-tinted Honeyeater	<i>Lichenostomus flavescens</i>	12	71	2.1	5.4	-12.8	0.000
Striped Rainbow-skink	<i>Carlia munda</i>	193	140	4.6	6.4	-12.2	0.000
Port Essington Ctenotus	<i>Ctenotus essingtonii</i>	81	97	1.9	3.8	-12.0	0.000
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	48	105	0.9	1.3	-10.0	0.000
Leaden Flycatcher	<i>Myiagra rubecula</i>	75	85	1.4	1.7	-8.5	0.000
Brush-tailed Tree-rat	<i>Conilurus penicillatus</i>	1	23	1.0	2.9	-8.4	0.000
Rufous Whistler	<i>Pachycephala rufiventris</i>	215	131	2.4	3.4	-8.3	0.000
Northern Fantail	<i>Rhipidura rufiventris</i>	95	86	1.7	1.9	-8.0	0.000
Zig-zag Gecko	<i>Oedura rhombifer</i>	48	54	1.3	1.4	-7.3	0.000
Spangled Drongo	<i>Dicrurus bracteatus</i>	44	70	1.0	1.3	-7.3	0.000
Varied Lorikeet	<i>Psitteuteles versicolor</i>	58	76	7.9	7.4	-7.2	0.000
Floodplain Toadlet	<i>Uperoleia inundata</i>	15	32	5.7	4.5	-6.9	0.000
Northern Ctenotus	<i>Ctenotus borealis</i>	6	18	1.2	2.4	-6.0	0.000
Northern Territory Frog	<i>Sphenophryne adelphe</i>	5	15	2.0	1.4	-5.1	0.000
Black-footed Tree-rat	<i>Mesembriomys gouldii</i>	49	39	1.5	1.3	-4.7	0.000
Pied Butcherbird	<i>Cracticus nigrogularis</i>	210	112	1.6	2.0	-4.7	0.000
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	78	59	2.1	1.7	-4.6	0.000
Masked Owl	<i>Tyto novaehollandiae</i>	3	11	0.3	0.8	-4.6	0.000
White-throated Honeyeater	<i>Melithreptus albogularis</i>	292	122	4.9	6.1	-4.4	0.000
Northern Brown Bandicoot	<i>Isoodon macrourus</i>	131	80	2.6	1.8	-4.2	0.000
Arboreal Snake-eyed Skink	<i>Cryptoblepharus plagiocephalus</i>	139	69	1.7	1.7	-3.9	0.000

Species	Scientific name	No sites (mainland)	No sites (Tiwi)	Mean abundance (mainland)	Mean abundance (Tiwi)	Z value	p
Bynoe's Gecko	<i>Heteronotia binoei</i>	187	88	2.0	1.9	-3.7	0.000
Northern Water Dragon	<i>Lophognathus temporalis</i>	16	16	1.0	1.5	-3.6	0.000
Agile Wallaby	<i>Macropus agilis</i>	84	47	1.5	1.1	-3.1	0.002
Red-winged Parrot	<i>Aprosmictus erythropterus</i>	144	84	2.4	1.7	-3.1	0.002
Spotted Nightjar	<i>Eurostopodus argus</i>	7	10	0.7	0.8	-3.1	0.002
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	32	21	0.7	0.9	-3.1	0.002
Brown Tree Snake	<i>Boiga irregularis</i>	3	5	0.7	1.0	-2.9	0.003
Remote Froglet	<i>Crinia remota</i>	2	6	2.5	2.0	-2.9	0.003
Chestnut-backed Button-quail	<i>Turnix castanota</i>	1	5	14.0	2.8	-2.9	0.003
White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>	280	114	2.4	2.4	-2.7	0.007
Douglas Skink	<i>Glaphyromorphus douglasi</i>	38	23	2.4	2.7	-2.6	0.009
Brown Goshawk	<i>Accipiter fasciatus</i>	20	14	0.7	0.9	-2.6	0.010
Hill's Ctenotus	<i>Ctenotus hilli</i>	3	5	1.7	2.2	-2.6	0.011
Little Red Flying-fox	<i>Pteropus scapulatus</i>	18	14	5.1	4.5	-2.5	0.012
Carpet Python	<i>Morelia spilota</i>	1	4	1.0	0.8	-2.4	0.017
Olive-backed Oriole	<i>Oriolus sagittatus</i>	35	19	0.7	1.2	-2.3	0.020
Pheasant Coucal	<i>Centropus phasianinus</i>	50	37	0.6	0.5	-2.3	0.021
Tawny Frogmouth	<i>Podargus strigoides</i>	34	22	0.7	0.9	-2.3	0.024
Horse	<i>Equus caballus</i>	7	10	0.6	0.5	-2.2	0.027
Alana's Menetia	<i>Menetia alanae</i>	18	13	2.0	1.7	-2.1	0.036
Helmeted Friarbird	<i>Philemon buceroides</i>	23	20	2.6	2.0	-2.0	0.049
Green Tree Snake	<i>Dendrelaphis punctulata</i>	2	3	1.0	1.0	-1.9	0.060
Burton's Legless Lizard	<i>Lialis burtonis</i>	4	4	1.0	1.0	-1.7	0.086
Red-tailed Black-Cockatoo	<i>Calyptorhynchus banksii</i>	78	49	1.2	0.9	-1.6	0.108
Silver-crowned Friarbird	<i>Philemon argenticeps</i>	219	91	3.9	3.7	-1.5	0.123
Rainbow Bee-eater	<i>Merops ornatus</i>	168	66	1.9	2.2	-1.5	0.138
Wedge-tailed Eagle	<i>Aquila audax</i>	8	4	0.6	1.3	-1.4	0.150
Brown Falcon	<i>Falco berigora</i>	26	14	0.6	0.9	-1.4	0.151

Species	Scientific name	No sites (mainland)	No sites (Tiwi)	Mean abundance (mainland)	Mean abundance (Tiwi)	Z value	p
Rocket Frog	<i>Litoria nasuta</i>	17	10	4.4	1.5	-1.4	0.160
Striated Pardalote	<i>Pardalotus striatus</i>	290	99	3.7	4.4	-1.4	0.167
Common Bronzewing	<i>Phaps chalcoptera</i>	14	8	1.2	1.4	-1.1	0.271
Storr's Snake-eyed Skink	<i>Morethia storri</i>	97	37	1.5	1.5	-1.1	0.274
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	101	41	1.3	0.7	-1.0	0.300
Weebill	<i>Smicromnis brevirostris</i>	316	106	6.0	6.2	-0.9	0.360
Dingo	<i>Canis familiaris</i>	24	7	0.4	0.6	-0.9	0.376
Singing Honeyeater	<i>Lichenostomus virescens</i>	4	2	1.3	2.0	-0.8	0.404
Tree Martin	<i>Hirundo nigricans</i>	14	6	3.5	2.2	-0.8	0.413
Bush Stone-curlew	<i>Burhinus grallarius</i>	18	16	0.6	0.3	-0.7	0.458
Northern Rosella	<i>Platycercus venustus</i>	137	54	2.5	2.8	-0.7	0.480
Gilbert's Dragon	<i>Lophognathus gilberti</i>	12	5	1.0	1.4	-0.7	0.491
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	88	31	1.5	2.9	-0.7	0.513
Partridge Pigeon	<i>Geophaps smithii</i>	20	10	2.1	3.5	-0.6	0.524
Northern Dwarf Tree-frog	<i>Litoria bicolor</i>	10	6	2.4	3.0	-0.6	0.568
Torresian Crow	<i>Corvus orru</i>	91	36	1.2	0.8	-0.5	0.597
Northern Pipistrelle	<i>Pipistrellus westralis</i>	4	2	1.3	1.0	-0.5	0.599
Cicadabird	<i>Coracina tenuirostris</i>	6	4	1.0	0.5	-0.5	0.599
Brsuh-tailed Phsacogale	<i>Phascogale tapoatafa</i>	4	2	1.5	1.0	-0.5	0.601
Grey's Menetia	<i>Menetia greyii</i>	68	25	2.5	1.4	-0.4	0.656
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	5	2	1.4	1.0	-0.3	0.787
Darwin Skink	<i>Glaphyromorphus darwiniensis</i>	48	17	1.4	1.5	-0.2	0.821
Varied Sittella	<i>Daphoenositta chrysoptera</i>	27	12	4.0	3.3	-0.1	0.900
Sugar Glider	<i>Petaurus breviceps</i>	13	4	1.1	1.3	-0.1	0.932
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>	7	1	0.4	1.0	-0.0	0.968
Little Corella	<i>Cacatua sanguinea</i>	9	1	0.7	2.0	-0.0	0.968
Rufous-banded Honeyeater	<i>Conopophila albogularis</i>	5	1	2.2	2.0	-0.0	0.969
Southern Boobook	<i>Ninox novaeseelandiae</i>	45	28	0.7	0.4	-0.0	0.980

Species	Scientific name	No sites (mainland)	No sites (Tiwi)	Mean abundance (mainland)	Mean abundance (Tiwi)	Z value	p
Pig	<i>Sus scrofa</i>	10	3	0.7	0.7	0.1	0.893
Northern Blind-snake	<i>Ramphotyphlops diversus</i>	7	2	1.1	1.0	0.1	0.891
Yellow-throated Miner	<i>Manorina flavigula</i>	146	44	5.2	7.9	0.2	0.870
Black Flying-fox	<i>Pteropus alecto</i>	16	4	2.4	5.3	0.3	0.765
Western Chestnut Mouse	<i>Pseudomys nanus</i>	22	6	1.5	1.5	0.3	0.742
Dusky Honeyeater	<i>Myzomela obscura</i>	55	16	3.3	1.8	0.4	0.707
Roth's Tree-frog	<i>Litoria rothii</i>	8	2	0.6	2.0	0.4	0.673
Pied Imperial Pigeon	<i>Ducula bicolor</i>	15	4	0.7	0.8	0.4	0.671
Orange-naped Snake	<i>Furina ornata</i>	5	1	1.2	1.0	0.4	0.667
Bar-shouldered Dove	<i>Geopelia humeralis</i>	154	48	2.4	1.4	0.5	0.599
Short-eared Rock-wallaby	<i>Petrogale brachyotis</i>	5	0	0.4	0.0	0.6	0.573
Radjah Shelduck	<i>Tadorna radjah</i>	5	0	1.4	0.0	0.6	0.573
Little Bronze-Cuckoo	<i>Chrysococcyx minutillus</i>	6	2	0.2	0.0	0.6	0.573
Tornier's Frog	<i>Litoria tornieri</i>	10	2	1.1	7.0	0.6	0.556
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	6	4	2.7	1.0	0.6	0.543
Bar-breasted Honeyeater	<i>Ramsayornis fasciatus</i>	7	1	3.4	1.0	0.6	0.536
Blue-winged Kookaburra	<i>Dacelo leachii</i>	164	59	1.1	0.9	0.6	0.524
Water Buffalo	<i>Bubalus bubalis</i>	31	20	0.8	0.2	0.6	0.522
Two-lined Dragon	<i>Diporiphora bilineata</i>	149	42	1.9	1.8	0.7	0.482
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	2	3	1.0	0.0	0.8	0.425
Rusty-topped Delma	<i>Delma borea</i>	23	6	1.2	0.8	0.8	0.420
Mistletoebird	<i>Dicaeum hirundinaceum</i>	249	85	2.5	1.6	0.9	0.365
Cockatiel	<i>Nymphicus hollandicus</i>	7	0	1.0	0.0	1.0	0.328
Frilled Lizard	<i>Chlamydosaurus kingii</i>	19	3	0.7	0.7	1.0	0.323
Grassland Melomys	<i>Melomys burtoni</i>	33	7	2.1	1.6	1.0	0.305
Varied Triller	<i>Lalage leucomela</i>	27	5	1.2	2.6	1.1	0.293
Floodplain Monitor	<i>Varanus panoptes</i>	11	1	0.8	1.0	1.1	0.293
Green-backed Gerygone	<i>Gerygone chloronotus</i>	4	2	1.5	0.0	1.1	0.258

Species	Scientific name	No sites (mainland)	No sites (Tiwi)	Mean abundance (mainland)	Mean abundance (Tiwi)	Z value	p
Crimson Finch	<i>Neochmia phaeton</i>	5	0	2.4	0.0	1.1	0.258
Giant Frog	<i>Cyclorana australis</i>	5	0	1.0	0.0	1.1	0.258
Pallid Cuckoo	<i>Cuculus pallidus</i>	7	0	0.9	0.0	1.1	0.258
Feral Cattle	<i>Bos taurus</i>	11	0	0.6	0.0	1.1	0.258
Red-tailed Snake-eyed Skink	<i>Morethia ruficauda</i>	28	5	1.3	1.4	1.1	0.254
Red Tree-frog	<i>Litoria rubella</i>	12	1	1.0	1.0	1.2	0.240
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	119	48	3.4	1.8	1.2	0.232
Red-cheeked Dunnart	<i>Sminthopsis virginiae</i>	15	2	1.7	1.0	1.2	0.224
Robust Rainbow-skink	<i>Carlia longipes</i>	5	0	3.8	0.0	1.3	0.206
Cane Toad	<i>Bufo marinus</i>	5	0	1.4	0.0	1.3	0.206
Spiny-tailed Gecko	<i>Diplodactylus ciliaris</i>	5	0	1.4	0.0	1.3	0.206
Dwarf Ctenotus	<i>Ctenotus tantillus</i>	5	0	1.2	0.0	1.3	0.206
Robust Dragon	<i>Diporiphora bennettii</i>	5	0	1.2	0.0	1.3	0.206
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>	7	0	0.9	0.0	1.3	0.206
Grey Fantail	<i>Rhipidura fuliginosa</i>	7	0	0.9	0.0	1.3	0.206
Common Koel	<i>Eudynamys scolopacea</i>	10	0	0.6	0.0	1.3	0.206
Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>	128	42	2.8	2.1	1.3	0.204
Little Woodswallow	<i>Artamus minor</i>	20	3	3.0	3.3	1.3	0.203
Restless Flycatcher	<i>Myiagra inquieta</i>	16	1	0.8	1.0	1.3	0.197
White-lined Honeyeater	<i>Meliphaga albilineata</i>	9	0	1.9	0.0	1.4	0.166
Pale Frog	<i>Litoria pallida</i>	6	1	5.2	0.0	1.4	0.166
Grey-fronted Honeyeater	<i>Lichenostomus plumulus</i>	6	0	3.2	0.0	1.4	0.166
Carnaby's Snake-eyed Skink	<i>Cryptoblepharus carnabyi</i>	6	0	1.2	0.0	1.4	0.166
Beccari's Free-tail Bat	<i>Mormopterus beccarii</i>	6	0	1.2	0.0	1.4	0.166
Common Bent-winged Bat	<i>Miniopterus schreibersii</i>	6	0	1.0	0.0	1.4	0.166
Half-girdled Snake	<i>Simoselaps semifasciatus</i>	6	0	1.0	0.0	1.4	0.166
Common Blue-tongued Lizard	<i>Tiliqua scincoides</i>	7	0	0.9	0.0	1.4	0.166
Sand Monitor	<i>Varanus gouldii</i>	26	3	0.9	1.3	1.4	0.153

Species	Scientific name	No sites (mainland)	No sites (Tiwi)	Mean abundance (mainland)	Mean abundance (Tiwi)	Z value	p
Little Friarbird	<i>Philemon citreogularis</i>	196	51	5.0	2.4	1.4	0.152
Black-tailed Monitor	<i>Varanus tristis</i>	23	3	1.0	1.0	1.4	0.149
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	255	80	5.9	3.2	1.5	0.143
Lemon-bellied Flycatcher	<i>Microeca flavigaster</i>	20	2	1.5	2.5	1.5	0.139
Masked Woodswallow	<i>Artamus personatus</i>	8	0	8.0	0.0	1.5	0.134
Diamond Dove	<i>Geopelia cuneata</i>	8	0	4.5	0.0	1.5	0.134
Antilopine Wallaroo	<i>Macropus antilopinus</i>	13	0	0.9	0.0	1.5	0.134
Sandstone Shrike-thrush	<i>Colluricincla woodwardi</i>	9	0	1.1	0.0	1.5	0.134
Marbled Velvet Gecko	<i>Oedura marmorata</i>	7	0	1.3	0.0	1.5	0.134
White-gaped Honeyeater	<i>Lichenostomus unicolor</i>	66	16	2.1	1.6	1.5	0.124
Red-backed Kingfisher	<i>Todiramphus pyrrhopygia</i>	15	1	1.3	1.0	1.6	0.109
Northern Free-tail Bat	<i>Chaerophon jobensis</i>	14	1	1.4	1.0	1.6	0.109
Cogger's Ctenotus	<i>Ctenotus coggeri</i>	8	0	3.9	0.0	1.6	0.109
Dusky Rat	<i>Rattus colletti</i>	8	0	3.3	0.0	1.6	0.109
Little Broad-nosed Bat	<i>Scotorepens greyii</i>	9	0	2.8	0.0	1.7	0.089
White-lipped Dragon	<i>Diporiphora albilabris</i>	10	0	1.0	0.0	1.7	0.089
Spotted Tree Monitor	<i>Varanus timorensis</i>	52	11	1.1	0.8	1.7	0.083
Sacred Kingfisher	<i>Todiramphus sanctus</i>	23	4	1.0	0.3	1.8	0.074
Black Kite	<i>Milvus migrans</i>	18	0	1.4	0.0	1.8	0.073
Figbird	<i>Sphecotheres viridis</i>	15	0	0.9	0.0	1.8	0.073
Common Planigale	<i>Planigale maculata</i>	11	0	1.0	0.0	1.8	0.073
Masked Finch	<i>Poephila personata</i>	13	0	2.6	0.0	1.9	0.059
Echidna	<i>Tachyglossus aculeatus</i>	12	0	0.9	0.0	1.9	0.059
Golden-headed Cisticola	<i>Cisticola exilis</i>	18	0	2.2	0.0	2.0	0.049
Bilingual Froglet	<i>Crinia bilingua</i>	14	0	1.6	0.0	2.0	0.049
Spalding's Ctenotus	<i>Ctenotus spaldingi</i>	14	0	1.6	0.0	2.0	0.049
Crowned Gecko	<i>Diplodactylus stenodactylus</i>	12	0	1.3	0.0	2.0	0.049
Kakadu Pebble-mound Mouse	<i>Pseudomys calabyi</i>	13	0	2.5	0.0	2.1	0.040

Species	Scientific name	No sites (mainland)	No sites (Tiwi)	Mean abundance (mainland)	Mean abundance (Tiwi)	Z value	p
Magnificent Dragon	<i>Diporiphora magna</i>	13	0	1.2	0.0	2.1	0.040
Peaceful Dove	<i>Geopelia striata</i>	224	62	2.6	2.0	2.1	0.037
Yellow Oriole	<i>Oriolus flavocinctus</i>	55	14	1.7	0.4	2.1	0.036
Wotjulum Frog	<i>Litoria wotjulumensis</i>	14	0	2.4	0.0	2.1	0.033
Euro	<i>Macropus robustus</i>	21	0	0.9	0.0	2.1	0.033
Karl Schmidt's Lerista	<i>Lerista karlschmidti</i>	14	0	1.1	0.0	2.1	0.033
Storr's Ctenotus	<i>Ctenotus storri</i>	16	0	1.9	0.0	2.2	0.027
Robust Ctenotus	<i>Ctenotus robustus</i>	15	0	1.3	0.0	2.2	0.027
Slender Snake-eyed Skink	<i>Proablepharus tenuis</i>	15	0	1.1	0.0	2.2	0.027
Black-faced Woodswallow	<i>Artamus cinereus</i>	21	0	3.8	0.0	2.3	0.023
Eastern Ierista	<i>Lerista orientalis</i>	16	0	1.1	0.0	2.3	0.022
Delicate Mouse	<i>Pseudomys delicatulus</i>	62	9	1.9	1.7	2.3	0.022
Brown Quail	<i>Coturnix ypsilophora</i>	19	1	3.1	0.0	2.4	0.019
Rufous-throated Honeyeater	<i>Conopophila rufogularis</i>	17	0	3.2	0.0	2.4	0.019
Red-sided Rainbow-skink	<i>Carlia rufilatus</i>	17	0	3.3	0.0	2.4	0.019
Pale Field-rat	<i>Rattus tunneyi</i>	79	14	3.4	1.4	2.4	0.017
Great Bowerbird	<i>Chlamydera nuchalis</i>	76	10	0.8	1.0	2.4	0.015
Jacky Winter	<i>Microeca fascinans</i>	20	0	2.7	0.0	2.5	0.013
Green Tree-frog	<i>Litoria caerulea</i>	29	2	1.0	0.5	2.5	0.011
Whistling Kite	<i>Haliastur sphenurus</i>	59	4	0.5	0.3	2.5	0.011
Smooth-tailed Skink	<i>Glaphyromorphus isolepis</i>	26	1	1.4	1.0	2.5	0.011
Marbled Frog	<i>Limnodynastes convexiusculus</i>	28	2	2.0	0.5	2.6	0.009
Forest Kingfisher	<i>Todiramphus macleayii</i>	82	16	1.4	0.7	2.6	0.009
Northern Spotted Rock Dtella	<i>Gehyra nana</i>	23	0	1.8	0.0	2.7	0.007
Dollarbird	<i>Eurystomus orientalis</i>	40	0	1.0	0.0	2.8	0.006
Three-spined Rainbow-skink	<i>Carlia triacantha</i>	25	0	1.8	0.0	2.8	0.005
White-throated Gerygone	<i>Gerygone olivacea</i>	33	0	1.2	0.0	2.8	0.005
Main's Menetia	<i>Menetia maini</i>	26	0	1.2	0.0	2.9	0.003

Species	Scientific name	No sites (mainland)	No sites (Tiwi)	Mean abundance (mainland)	Mean abundance (Tiwi)	Z value	p
Double-barred Finch	<i>Taeniopygia bichenovii</i>	37	0	2.8	0.0	3.2	0.002
Brown Honeyeater	<i>Lichmera indistincta</i>	206	50	5.7	3.9	3.2	0.002
Northern Dtella	<i>Gehyra australis</i>	78	9	1.4	1.4	3.2	0.001
Galah	<i>Cacatua roseicapilla</i>	45	0	3.7	0.0	3.3	0.001
Long-tailed Finch	<i>Poephila acuticauda</i>	34	0	2.2	0.0	3.3	0.001
Brush Cuckoo	<i>Cacomantis variolosus</i>	61	7	0.7	0.0	3.3	0.001
White-winged Triller	<i>Lalage sueurii</i>	47	1	2.8	1.0	3.4	0.001
Red-backed Fairy-wren	<i>Malurus melanocephalus</i>	107	17	4.3	3.1	3.5	0.001
Stonemason Toadlet	<i>Uperoleia lithomoda</i>	61	4	2.3	2.3	3.5	0.000
Plain Ctenotus	<i>Ctenotus inornatus</i>	39	0	1.5	0.0	3.6	0.000
Slender Rainbow-skink	<i>Carlia gracilis</i>	43	0	6.6	0.0	3.8	0.000
Banded Honeyeater	<i>Certhionyx pectoralis</i>	47	0	17.5	0.0	3.8	0.000
Fawn Antechinus	<i>Antechinus bellus</i>	49	0	2.3	0.0	4.0	0.000
Common Rock-rat	<i>Zyzomys argurus</i>	52	0	4.7	0.0	4.1	0.000
Magpie-lark	<i>Grallina cyanoleuca</i>	89	1	3.1	0.0	4.5	0.000
Ornate Burrowing-frog	<i>Limnodynastes ornatus</i>	69	1	3.6	1.0	4.6	0.000
Willie Wagtail	<i>Rhipidura leucophrys</i>	91	1	1.6	2.0	4.7	0.000
Black-tailed Treecreeper	<i>Climacteris melanura</i>	92	1	2.0	0.0	4.7	0.000
Ornate Snake-eyed Skink	<i>Notoscincus ornatus</i>	73	0	2.5	0.0	4.9	0.000
Scant-striped Ctenotus	<i>Ctenotus vertebralis</i>	84	0	3.4	0.0	5.3	0.000
Northern Quoll	<i>Dasyurus hallucatus</i>	86	0	2.0	0.0	5.5	0.000
Grey Butcherbird	<i>Cracticus torquatus</i>	167	1	2.9	2.0	7.2	0.000
Two-spined Rainbow-skink	<i>Carlia amax</i>	189	1	6.4	1.0	8.8	0.000

3.2. Comparison of the Tiwi fauna with that of other Australian islands

Abbott and Burbidge (1995) provide lists of mammal fauna for all Australian islands. With the revised list for the Tiwi Islands presented here, this collation shows that Melville Island has more extant native mammal species than any other island in Australia other than Tasmania (which has the same number), and the richness of the Bathurst Island mammal fauna is surpassed only by Melville Island, Tasmania, Groote Eylandt and Fraser Island (Table 3.3). Comparable listings are not available for birds, reptiles and frogs of Australian islands.

Table 3.3. Comparison of richness of native mammals on Australian islands. Note that these tallies exclude extinct species, dingo, marine species, translocated species and exotic species. Tallies are taken from Abbott and Burbidge, with updates for the Tiwi Islands based on material presented in this report. Only islands for which 10 or more species have been recorded are listed.

Island	area (km ²)	no. of native species
Melville	5788	33
Tasmania	62000	33
Groote Eylandt, NT	2258	27
Fraser, Qld	1654	22
Bathurst	1693	19
Hinchinbrook, Qld	318	17
North Stradbroke, Qld	263	17
Rotamah, Vic	3	17
Kangaroo, SA	4500	16
Flinders, Tas	1347	15
Phillip, Vic	101	15
Burrup, WA	118	14
Bruny, Tas	367	14
North (Pellew), NT	58	13
Barrow, WA	236	13
King, Tas	1100	13
Bribie, Qld	175	11
Augustus, WA	190	10
Centre (Pellew), NT	92	10
Vanderlin, NT	277	10

3.3. Listed threatened animals

There have been many reviews of the conservation status of Australian wildlife. Such categorisation provides a measure of priorities for management and for the assessment of impacts of proposed land uses. Where these lists are annexed to legislation (such as in the federal *Environment Protection and Biodiversity Conservation Act 1999* and the *Territory Parks and Wildlife Conservation Amendment Act 2000*), they provide an explicit linkage for triggering particular actions or assessment. Lists are updated regularly to reflect increased knowledge, changes in conservation security, and trends in abundance. Here we collate current listings for Tiwi terrestrial vertebrate species. We include the conservation status recognised nationally, under regulations of the *Environmental Protection and Biodiversity Conservation Act 1999*; and also that recognised at Northern Territory level, under regulations of the *Territory Parks and Wildlife Conservation Act 2000* (Anon 2002, and subsequent updates).

In addition we include the classifications given in the recent national revision of *The Action Plan for Australian Birds* (Garnett and Crowley 2000) and *The Action Plan for Australian Bats* (Duncan *et al.* 1999), which may be expected to be used for ongoing revisions to the above listings. Note that all four of these lists use the assessment protocol recommended as the international standard by IUCN (2000), which involves a series of at least semi-quantitative criteria. This protocol includes the classes:

- **Critically Endangered**, when the taxon “is facing an extremely high risk of extinction in the wild in the immediate future”;
- **Endangered**, when the taxon “is facing a very high risk of extinction in the wild in the near future”;
- **Vulnerable**, when the taxon “is facing a high risk of extinction in the wild in the medium-term future”;
- **Lower Risk**, and
- **Data Deficient**, when there is “inadequate information to make a direct, or indirect, assessment of its risk to extinction based on its distribution and/or population status ... listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate”.

Of these categories, only Endangered and Vulnerable are included in the EPBCA lists.

Animal species that have been recorded from the Tiwi Islands and which are listed as threatened are given in Table 3.4.

Ten Tiwi species are listed nationally as threatened. These comprise five marine turtles, the partridge pigeon, Tiwi subspecies of masked owl, false water-rat, red goshawk and butler’s dunnart: all except loggerhead turtle and olive ridley (which are both categorised as Endangered nationally) are Vulnerable. There is a high probability that the Tiwi subspecies of hooded robin will be added to this list, given its rating as Vulnerable in the most recent national overview of the conservation status of Australian birds (Garnett and Crowley 2000).

Table 3.4. List of Tiwi animals that have been classified as threatened.

Listings: EPBCA=annexes to the *Environment Protection and Biodiversity Conservation Act 1999*; TPWCA=listings (revised 2002-03) under Section 29 of the *Territory Parks and Wildlife Conservation Act 2000*; Bird plan=Garnett and Crowley (2000); Bat plan=Duncan *et al.* (1999).

Threatened category: CR=critically endangered; EN=endangered; V=vulnerable; DD=data deficient; lr=lower risk (near threatened).

Island: B=Bathurst, M=Melville.

taxonomic group	species	EPBCA	TPWCA	Bird action plan	Bat action plan	principal habitat(s)	notes	island
snails	<i>Amphidromus cognatus</i>		V			rainforest		BM
	<i>Trochomorpha melvillensis</i>		V			rainforest		M
ants	<i>Bothroponera</i> sp. (<i>sublaevis</i> grp)		DD			rainforest		M
	<i>Camponotus</i> sp. (<i>vitreus</i> grp)		DD			rainforest		M
butterflies	Dodd's Azure butterfly <i>Ogyris iphis doddi</i>		EN			eucalypt woodland; eucalypt open forest		M
	northern grassdart butterfly <i>Taractrocera ilia ilia</i>		V			open forest		M
frogs	ornate burrowing frog <i>Limnodynastes ornatus</i>		DD*			eucalypt open forest; eucalypt woodland		BM
	giant frog <i>Cyclorana australis</i>		DD*			eucalypt open forest; eucalypt woodland; paperbark forest; swamp		BM
reptiles	green turtle <i>Chelonia mydas</i>	V	DD			coastal		
	hawksbill turtle <i>Eretmochelys imbricata</i>	V	DD			coastal		
	olive ridley <i>Lepidochelys olivacea</i>	EN	DD			coastal		
	flatback turtle <i>Natator depressus</i>	V	DD			coastal		
	loggerhead turtle <i>Caretta caretta</i>	EN	EN			coastal		
	ridge-tailed monitor <i>Varanus acanthurnus</i>		DD*			rocky areas	record dubious	M
	mangrove monitor <i>Varanus indicus</i>		DD*			mangroves		M
	merten's water monitor <i>Varanus mertensi</i>		DD*			rivers		BM
	spotted tree monitor <i>Varanus scalaris</i>		DD*			eucalypt open forest; eucalypt woodlands		BM
	black-tailed monitor <i>Varanus tristis</i>		DD*			eucalypt open forest; eucalypt woodlands		BM

	common blue-tongued lizard <i>Tiliqua scincoides</i>		DD*			eucalypt woodlands; treeless plains		BM
	Macleay's water snake <i>Enhydryis polylepis</i>		DD*			rivers; swamps		M
	northern death adder <i>Acanthophis praelongus</i>		DD*			eucalypt open forest; eucalypt woodlands		BM
	olive whip snake <i>Demansia olivacea</i>		DD*			eucalypt open forest; eucalypt woodlands		BM
	Papuan whip snake <i>Demansia papuensis</i>		DD*			eucalypt open forest; eucalypt woodlands		M
	black whip snake <i>Demansia vestigiata</i>		DD*			eucalypt open forest; eucalypt woodlands		BM
	taipan <i>Oxyuranus scutellatus</i>		DD			eucalypt open forest; eucalypt woodlands		BM
	king brown snake <i>Pseudechis australis</i>		DD*			eucalypt open forest; eucalypt woodlands; swamps; treeless plains		BM
	western brown snake <i>Pseudonaja nuchalis</i>		DD*			eucalypt open forest; eucalypt woodlands; swamps; treeless plains		BM
	northern bandy-bandy <i>Vermicella multifasciata</i>		DD			eucalypt open forest; eucalypt woodlands		M
birds	chestnut-backed button-quail <i>Turnix castanota</i>		DD	lr		eucalypt open forest; eucalypt woodlands		BM
	pin-tailed snipe <i>Gallinago stenura</i>		DD			swamps		BM
	Swinhoe's snipe <i>Gallinago megala</i>		DD			swamps		BM
	broad-billed sandpiper <i>Limicola falcinellus</i>		DD			coastal; swamps		M
	red goshawk <i>Erythrotriorchis radiatus</i>	V	V	V		eucalypt open forest		BM
	partridge pigeon (eastern subspecies) <i>Geophaps smithii smithii</i>	V	lr	lr		eucalypt open forest; eucalypt woodlands		BM
	masked owl (Melville Island subspecies) <i>Tyto novaehollandiae melvillensis</i>	V	EN	EN		eucalypt open forest; eucalypt woodlands; rainforest		BM
	hooded robin (Tiwi Islands subspecies) <i>Melanodryas cucullata melvillensis</i>		EN	V		eucalypt open forest; eucalypt woodlands; treeless plains		BM

mammals	butler's dunnart <i>Sminthopsis butleri</i>	V	V			eucalypt open forest; eucalypt woodlands		BM
	red-cheeked dunnart <i>Sminthopsis virginiae</i>		DD*			eucalypt open forest; swamps		M
	fawn antechinus <i>Antechinus bellus</i>		DD*			eucalypt open forest		M
	northern brush-tailed phascogale <i>Phascogale (tapoatafa) pirata</i>		V			eucalypt open forest		M
	bare-rumped sheath-tail-bat <i>Saccolaimus saccolaimus nudicluniatus</i>		DD		CR	eucalypt open forest; eucalypt woodlands; grasslands	record dubious	M
	little north-western freetail bat <i>Mormopterus loriae cobourgiana</i>		lr		DD	mangroves; rainforest; coastal		M
	brush-tailed rabbit-rat <i>Conilurus penicillatus</i>		V			eucalypt open forest		BM
	false water-rat <i>Xeromys myoides</i>	V	DD			mangroves; swamps		M

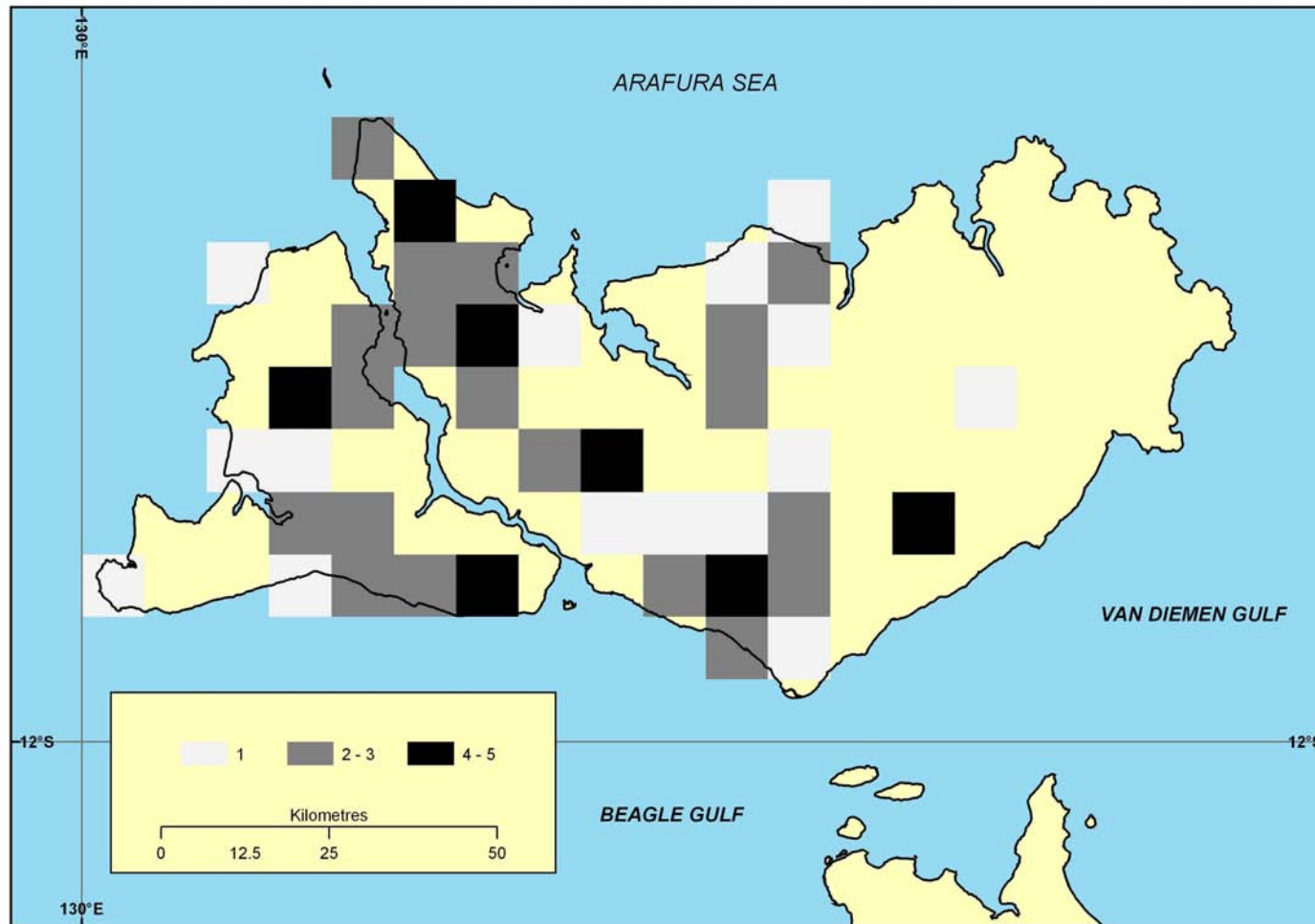


Figure 3.2. The number of threatened (endangered and vulnerable) terrestrial vertebrate species recorded in 5' x 5' cells on the Tiwi Islands. Note that the mapping excludes data deficient species, marine species, and invertebrates.

Eleven Tiwi species are listed as threatened (Endangered or Vulnerable) at the Northern Territory level, but this listing is notably dissimilar to that at the national level. The NT listing includes two snails, two butterflies, only one marine turtle, red goshawk, Tiwi subspecies of hooded robin and masked owl, butler's dunnart, brush-tailed rabbit-rat, and northern brush-tailed phascogale. Excluding two species for which the Tiwi records are dubious, a further 29 species are listed as Data Deficient (with this tally including 16 species listed as such in the Northern Territory largely because of uncertain impacts of cane toads).

The number of threatened animal taxa occurring on the Tiwi Islands is very high relative to that of other recently studied regions in the Top End of the Northern Territory (Table 3.5).

Table 3.5. Comparison of the number of threatened animal taxa on the Tiwi Islands relative to other recently studied regions in the Top End of the Northern Territory. Note that (for all regions listed) where taxa are listed at different categories on national and NT lists, the more threatened category only is listed in this Table. Values in body of table are numbers of threatened vertebrate taxa: for the Tiwi Islands alone the number of threatened invertebrate taxa is given in brackets - this information was not reported for the other regions considered. Species listed as Data Deficient because of possible impacts of cane toads are excluded from this listing, because these were not reported for the other regions considered.

region	area (km ²)	no. threatened animals			source
		<i>endangered and/or critically endangered</i>	<i>vulnerable</i>	<i>data deficient</i>	
Tiwi Islands	7,481	4 (+1)	9 (+3)	6 (+2)	this report
Coomalie Shire	1,507	0	2	1	Price and Baker (2003)
Mary River catchment	8,602	2	6	5	Armstrong <i>et al.</i> (2002)
Arafura Swamp catchment	10,365	2	5	3	Brennan <i>et al.</i> (2003)
Daly Basin bioregion	20,800	2	3	6	Price <i>et al.</i> (2000)

More detailed information on each species listed as threatened (endangered or vulnerable) at national and/or Northern Territory level is provided in Appendix B. The threats to, and management requirements and implications for, these species are discussed in part 3 of this report.

On the Tiwi Islands, threatened species are known mainly from the western half of Melville Island and Bathurst Island (Fig. 3.2), although this distribution may at least partly reflect sampling biases (Fig. 2.1).

The Tiwi threatened (vulnerable and endangered) animals occur principally in eucalypt open forests, but there are at least some species in most other broad habitat types (Fig. 3.3a), with the notable occurrence of five marine turtles obviously in coastal habitat. Data deficient species show a less pronounced association with eucalypt open forests, and a more equitable distribution across broad habitat types, other than treeless plains (Fig. 3.3b). Species listed as data deficient because of possible but uncertain impacts of cane toads occur principally in eucalypt open forests and woodlands (Fig. 3.3c).

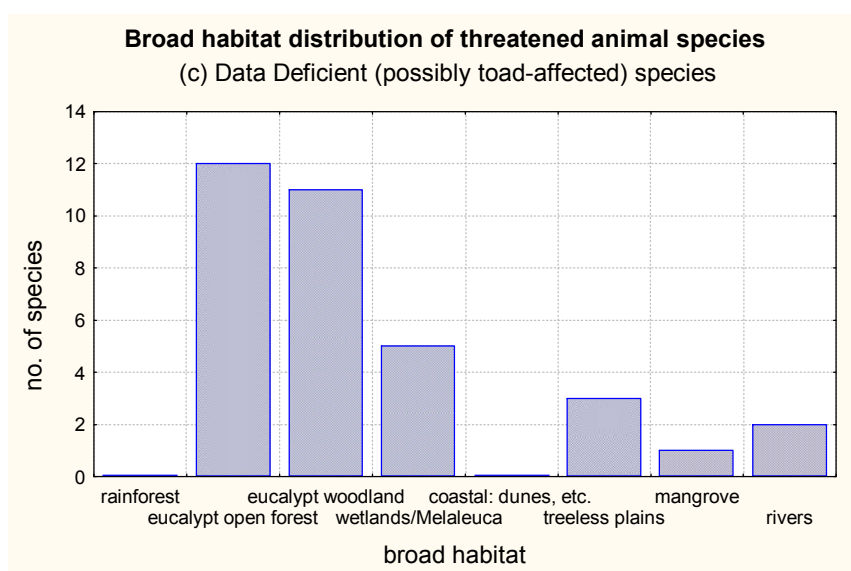
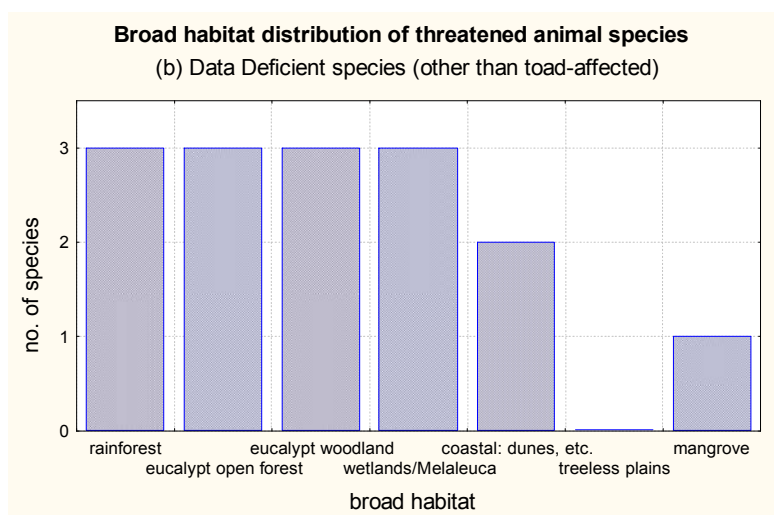
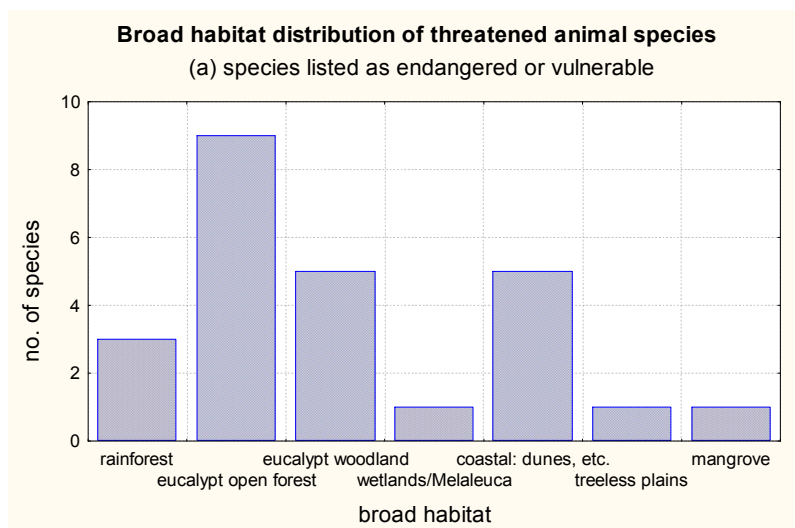


Figure 3.3. Broad habitat distribution of threatened animal taxa on the Tiwi Islands.

3.4. *Tiwi-endemic animals*

For any land mass (such as the Tiwi Islands), isolation over a period of around 10,000 years (with many periods of isolation preceding that) will have contributed to genetic divergence from mainland populations among resident plants and animals. The extent of this divergence is related to the island size, population size, generation time, environmental factors, and random processes. Divergence between populations on the Tiwi Islands and mainland is likely to have been promoted further by the location of the Tiwi Islands at the extreme north of the continent, and in an area with appreciably higher rainfall than the mainland. For some Tiwi plants and animals, the extent of this divergence is sufficient to recognise the Tiwi populations as taxonomically distinct.

However, as noted in Section 2.1 above, taxonomic inconstancy has led to very variable assessments of the number of vertebrate taxa that are considered endemic to the Tiwi Islands. For invertebrate taxa, lack of collecting has led to very uncertain distributional bounds, and hence difficulties in judging the extent of endemism.

Species, or subspecies, that occur nowhere else than on the Tiwi Islands require some special consideration in this conservation plan, because these have no options for protection elsewhere, and are totally reliant on appropriate management on the Tiwi Islands.

We cannot provide a comprehensive listing of invertebrate species that occur only on the Tiwi Islands, because there is simply not enough inventory and distribution information available for most invertebrate groups (either for the Tiwi Islands themselves or for mainland Northern Territory, from which to assess endemism).

Ants are the only invertebrate group for which such information is available in a reasonably systematic manner. Fifteen species of ant found on the Tiwi Islands have not been recorded from the Northern Territory mainland. These include a species of *Anonychomyrma*, which is the only record of the genus in monsoonal Australia, *Polyrhachis debilis*, the only representative of the sub-genus *Cyrtomyrma* known from northwestern Australia, and the only species of the *araneoides* group of *Rhytidoponera* in the Northern Territory.

Some of these species are known from only one location, such as *Rhytidoponera* sp. (*araneoides* group) which has been collected only from Jump-Up Jungle on Melville Island. Such restriction may partly reflect limited collecting, but many invertebrate species may actually have highly localised ranges.

The proportion of endemic species among the known Tiwi ant fauna is 10%, and this relatively high level may be a reasonable approximation for many other invertebrate groups, depending upon their level of vagility (ability to disperse).

Land-snails provide an example of a group with very low vagility, and consequently these probably have a much higher degree of endemism. In the far more comprehensively studied rainforest patches of the Kimberley, nearly every rainforest patch has its own endemic land snail species, and extraordinarily localised distribution is the norm for most species (Solem and McKenzie 1991). Land snails have not been systematically nor comprehensively sampled on the Tiwi Islands, but relatively incidental collecting suggests

that there may be substantial levels of endemism. For example, Anon (2002) notes that the threatened land snail *Trochomorpha melvillensis* is known only from Melville Island, and the threatened snail *Amphidromus cognatus* may also now be restricted to the Tiwi Islands.

In contrast to the landsnails, butterflies are a relatively vagile group, and their distribution is relatively well known. Only one taxon is thought to be restricted to the Tiwi Islands, the skipper *Sumiana lascivia lasus* (Common and Waterhouse 1982), known only from Bathurst Island.

Less systematically, recent sampling (Brown 1998) has identified two dragonfly species that appear to be restricted to the Tiwi Islands, *Huonia melvillensis* (recorded only from one riparian area near Pickertaramoor) and *Nososticta taracumbi* (known only from riparian areas near Taracumbie Falls) (Watson and Theischinger 1984; Brown and Theischinger 1998).



Figure 3.4. The dragonfly *Huonia melvillensis*, known only from Melville Island (from Brown and Theischinger 1998).

Of the vertebrate groups, no fish, frog or reptile species are known to be restricted to the Tiwi Islands. Likewise no mammal or bird species is considered endemic to the Tiwi Islands, however several mammal and bird subspecies are endemic.

Mason and Schodde (1997) list about 90 subspecies of birds that have been described from, and considered probably endemic to, the Tiwi Islands, mostly by Mathews (1914) and Zietz (1914*a,b*). Changing taxonomic standards have resulted in the current lack of recognition of most of these subspecies. Only five subspecies of birds were accepted as restricted to the Tiwi Islands by Mason and Schodde (1997) – of masked owl *Tyto novaehollandiae melvillensis*, striated pardalote *Pardalotus striatus melvillensis*, weebill *Smicrornis brevirostris melvillensis*, yellow-tinted honeyeater *Lichenostomus flavescens melvillensis* and brown honeyeater *Lichmera indistincta melvillensis*. Subsequently, in a major review of the taxonomic status of all Australian passerine birds, Schodde and Mason (1999) recognised the distinctiveness of the Tiwi-endemic subspecies of striated pardalote, yellow-tinted honeyeater, brown honeyeater and hooded robin *Melanodryas cucullata melvillensis*. The taxonomic treatment of non-passerine birds has not yet been completed, but this is likely to recognise the distinctiveness of the Tiwi-endemic masked owl, blue-winged kookaburra *Dacelo leachii nana*, partridge pigeon *Geophaps smithii ceciliae* and orange-footed scrubfowl *Megapodius reinwardt melvillensis* (I. Mason *pers. comm.*).

As with birds, many mammal taxa have been described as restricted to the Tiwi Islands, although most are no longer recognised as such. Only two valid mammal taxa are now considered to be endemic – subspecies of brush-tailed rabbit-rat *Conilurus penicillatus melibius* and black-footed tree-rat *Mesembriomys gouldii melvillensis*.

3.5. Animals listed under other treaties

Australia has formal obligations for the protection of migratory species listed under a number of international conventions and bilateral treaties, the most significant of which are the Japan-Australia Migratory Bird Agreement (JAMBA, 1974); the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979); and the China- Australia Migratory Bird Agreement (CAMBA, 1986). The protection of these listed species is regarded as a matter of national significance under the *Environment Protection and Biodiversity Conservation Act 1999*.

Fifty-one animal species recorded from the Tiwi Islands are listed under one or more of these treaties (Table 3.6). Thirty-three of these species are migratory seabirds, waterbirds or shorebirds (waders).

Table 3.6. Animal species which occur on the Tiwi Islands and are listed under international conventions or bilateral agreements.

<i>species</i>	name	CAMBA	JAMBA	BONN
<i>Crocodylus porosus</i>	Saltwater Crocodile	0	0	1
<i>Caretta caretta</i>	Loggerhead Turtle	0	0	1
<i>Chelonia mydas</i>	Green Turtle	0	0	1
<i>Natator depressus</i>	Flatback Turtle	0	0	1
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle	0	0	1
<i>Eretmochelys imbricata</i>	Hawksbill Turtle	0	0	1
<i>Sula leucogaster</i>	Brown Booby	1	1	0
<i>Fregata ariel</i>	Lesser Frigatebird	1	1	0
<i>Egretta sacra</i>	Eastern Reef Egret	1	0	0
<i>Ardea alba</i>	Great Egret	1	1	0
<i>Plegadis falcinellus</i>	Glossy Ibis	1	0	0
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	1	0	0
<i>Gallinago stenura</i>	Pin-tailed Snipe	1	1	0
<i>Gallinago megala</i>	Swinhoe's Snipe	1	1	1
<i>Limosa limosa</i>	Black-tailed Godwit	1	1	1
<i>Limosa lapponica</i>	Bar-tailed Godwit	1	1	1
<i>Numenius minutus</i>	Little Curlew	1	1	1
<i>Numenius phaeopus</i>	Whimbrel	1	1	1
<i>Numenius madagascariensis</i>	Eastern Curlew	1	1	1
<i>Tringa stagnatilis</i>	Marsh Sandpiper	1	1	1
<i>Tringa nebularia</i>	Common Greenshank	1	1	1
<i>Xenus cinereus</i>	Terek Sandpiper	1	1	1
<i>Actitis hypoleucos</i>	Common Sandpiper	1	1	1
<i>Heteroscelus brevipes</i>	Grey-tailed Tattler	1	1	1
<i>Arenaria interpres</i>	Ruddy Turnstone	1	1	1
<i>Limnodromus semipalmatus</i>	Asian Dowitcher	1	1	1

<i>Calidris canutus</i>	Red Knot	1	1	1
<i>Calidris tenuirostris</i>	Great Knot	1	1	1
<i>Calidris ruficollis</i>	Red-necked Stint	1	1	1
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	1	1	1
<i>Calidris ferruginea</i>	Curlew Sandpiper	1	1	1
<i>Calidris alba</i>	Sanderling	1	1	1
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	1	1	1
<i>Pluvialis squatarola</i>	Grey Plover	1	1	1
<i>Pluvialis fulva</i>	Pacific Golden Plover	1	1	1
<i>Charadrius mongolus</i>	Lesser Sand Plover	1	1	1
<i>Charadrius leschenaultii</i>	Greater Sand Plover	1	1	1
<i>Sterna caspia</i>	Caspian Tern	1	1	0
<i>Sterna bengalensis</i>	Lesser Crested Tern	1	0	0
<i>Sterna albifrons</i>	Little Tern	1	1	0
<i>Sterna hirundo</i>	Common Tern	1	1	0
<i>Chlidonias leucopterus</i>	White-winged Black Tern	1	1	0
<i>Cuculus saturatus</i>	Oriental Cuckoo	1	1	0
<i>Hirundapus caudacutus</i>	White-throated Needletail	1	1	0
<i>Apus pacificus</i>	Fork-tailed Swift	1	1	0
<i>Merops ornatus</i>	Rainbow Bee-eater	0	1	0
<i>Myiagra rubecula</i>	Leaden Flycatcher	0	0	1
<i>Myiagra inquieta</i>	Restless Flycatcher	0	0	1
<i>Rhipidura rufifrons</i>	Rufous Fantail	0	0	1
<i>Acrocephalus orientalis</i>	Oriental Reed-warbler	1	0	0
<i>Dugong dugon</i>	Dugong	0	0	1

3.6. Regional context

The previous section described many species that use the Tiwi Islands during part of their life cycle. The fate of these species, and many others, depends upon linkages across the landscape, and on maintaining habitat quality across widely-dispersed sites. The condition of Tiwi environments may affect animals that spend much of the year elsewhere, in mainland northern Australia, in the Indonesian archipelago, or even in northern Asia (for many of the shorebirds). Conversely, Tiwi environments may be maintained as suitable, but some animal species may nonetheless decline because places used elsewhere at some time of the year may be lost or degraded.

A recent radio-tracking study provides one example of this interconnectedness of the Tiwi Islands with other areas, for at least some elements of the Tiwi fauna. In this study (Palmer 1997), a radio-tracked black flying-fox made repeated movements to and from the Tiwi Islands from the mainland Northern Territory (Fig. 3.5). This pattern, and many variants on it, is probably a feature of the ecology of flying-foxes, honeyeaters, pigeons, waterbirds, marine turtles, dugongs, cuckoos, shorebirds, raptors, bustards, butterflies, and many other animal groups (Price *et al.* 1999; Woinarski *et al.* 2000*b*). The characteristic means that the management and conservation on the Tiwi islands cannot be divorced or isolated from that of its regional context.

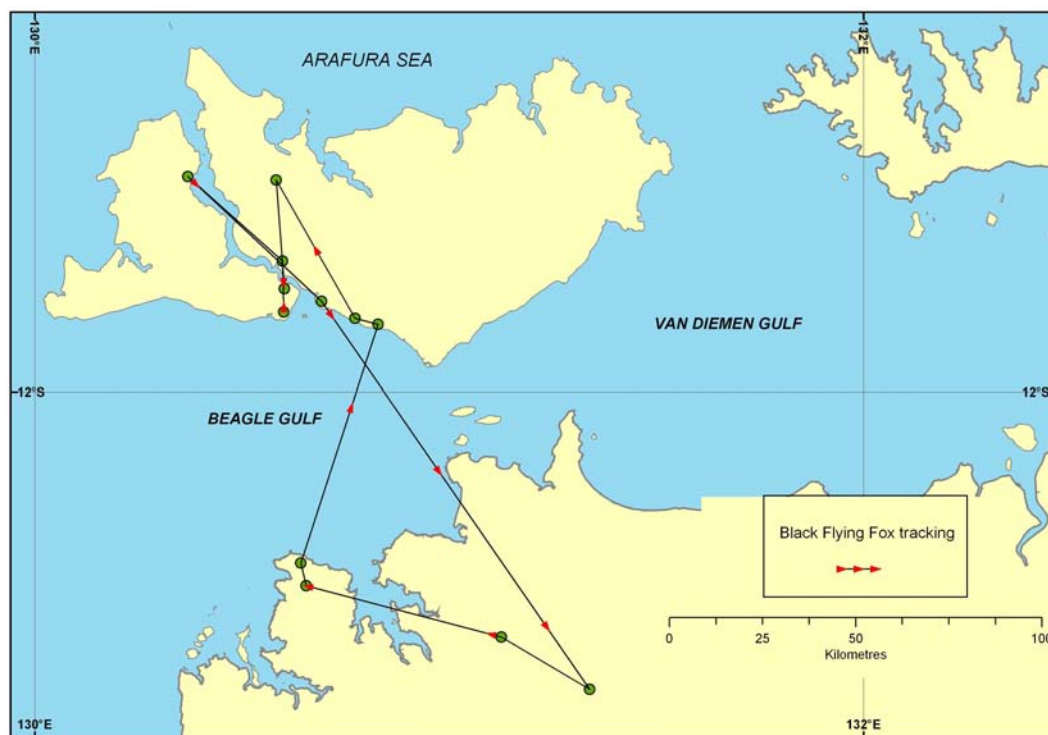


Figure 3.5. Movement patterns of a single black flying-fox, taken at monthly intervals over one year, illustrating the linkages between the Tiwi Islands and mainland (from Palmer 1997).

There are other important components of regional context that are the opposite of this connectedness through movements to and from the Tiwi Islands. Isolation provides the Tiwi Islands, and their biota, with some protection from processes that degrade mainland areas. Currently, such factors include exotic pasture grasses, mimosa, and other weeds, and cane toads. There is now increasing evidence that large components of the vertebrate fauna of mainland northern Australia are declining (or indeed disappearing across large regions) in the face of this cocktail of threats (Franklin 1999; Woinarski *et al.* 2001*b*). In contrast, the fauna of many Australian islands has persisted, and there are now many cases where islands maintain the only populations of species that formerly were distributed widely across mainland areas (Burbidge 1989; Abbott and Burbidge 1995; Burbidge *et al.* 1997; Burbidge 1999). This characteristic substantially increases the conservation value and potential of islands. As larger islands typically contain a more complete set of the mainland fauna, larger islands (such as the Tiwi Islands) have the greatest potential to maintain relatively complete faunas. The very recent invasion of cane toads to the Top End mainland may well result in a substantial increase in the conservation significance of the Tiwi Islands, as populations of many species of goannas, snakes and other predator species will probably decline, at least temporarily, on the mainland (van Dam *et al.* 2002), leaving the Tiwi islands with an increased proportion of the total populations of these species.

3.7. *Significant colonies and aggregations*

Some sites are important for biodiversity conservation not because they hold unusually high species richness, threatened species or endemic species, but rather because they support unusually high abundances of one or more species. Colonial breeding sites may be the most important of such congregations, but major feeding and roosting sites are also important. These sites are critical because at any one time they may support a particularly high proportion of the regional or world population of a particular species. Hence the degradation or loss of such sites may have an impact far greater than apparent from the size of the site alone. Almost by definition, these aggregation sites are significant because they provide particular or important resources that are otherwise not widely available, at least at some time of year.

In the Northern Territory, such sites typically include major cave systems (used as maternity colonies by many bats), wetlands, extensive mudflats (used as foraging sites by shorebirds), islands and beaches. The Tiwi Islands have no major waterbird breeding colonies (Chatto 2000) and no wetlands considered important at national or Northern Territory scale (ANCA 1996). However, aggregations (of up to 6,000 birds) and breeding colonies of magpie geese (in the floodplain area of Andranangoo Creek) are at least of local significance, for biodiversity conservation and for the Tiwi lifestyle (Anon 1998).

There are at least five seabird breeding colonies on the Tiwi Islands, of which one is regarded as of international significance (Chatto 2001). The location of these sites is given in Fig. 3.8. Seagull Island (Fig. 3.7), north-west of Cape van Diemen, Melville Island, has the world's largest breeding colony of crested terns (with an estimated 60,000 birds). Other Tiwi seabird colonies are smaller (Fig. 3.6), but important for less common seabirds, most notably including the little tern (e.g. a colony of 80 little tern on Buchanan Island at the south of Apsley Strait).



Figure 3.6. Islet off northwest Bathurst Island, containing a significant breeding colony of Little Tern. This colony contains at least 30 breeding pairs, one of the largest colonies for this species in north Australia. Photo: R. Chatto, from Chatto (2001).



Figure 3.7. Seagull Island off the north-west tip of Melville Island supports the largest colony of breeding crested terns in the world. (photo K. Saalfeld, from Chatto 2001).

The coastline of the Tiwi Islands provides important feeding and roosting sites for migratory shorebirds (waders) and nesting sites for marine turtles. The largest congregations of shorebirds are along the southeastern shore of Melville Island and the south of Apsley Strait near Buchanan Island (Fig. 3.9). These are areas where extensive mudflats are exposed at low tide, and which are flanked by mangrove systems that provide roosting sites at high tide. Tens of thousands of shorebirds use these sites (Chatto 2003). In contrast, the most important sites for turtle nesting are on the broad sandy beaches of the north of Melville Island (Fig. 3.10). These sites are of at least national significance, in holding a relatively high proportion of the populations of flatback turtle *Natator depressus* and olive ridley *Lepidochelys olivacea*. (Chatto 1998).

This report does not explicitly consider marine issues, but we note here that the seas around the northern coast of Bathurst and Melville Islands are also important feeding areas for marine turtles and dugongs, and are thought to hold some of the Northern Territory's most important sea-grass beds (Parks and Wildlife Service 2003) (Fig. 3.11).

There are breeding and non-breeding colonies of flying-foxes on the Tiwi Islands, but there has been no systematic count of the size of these aggregations, nor of the populations here relative to mainland sites.

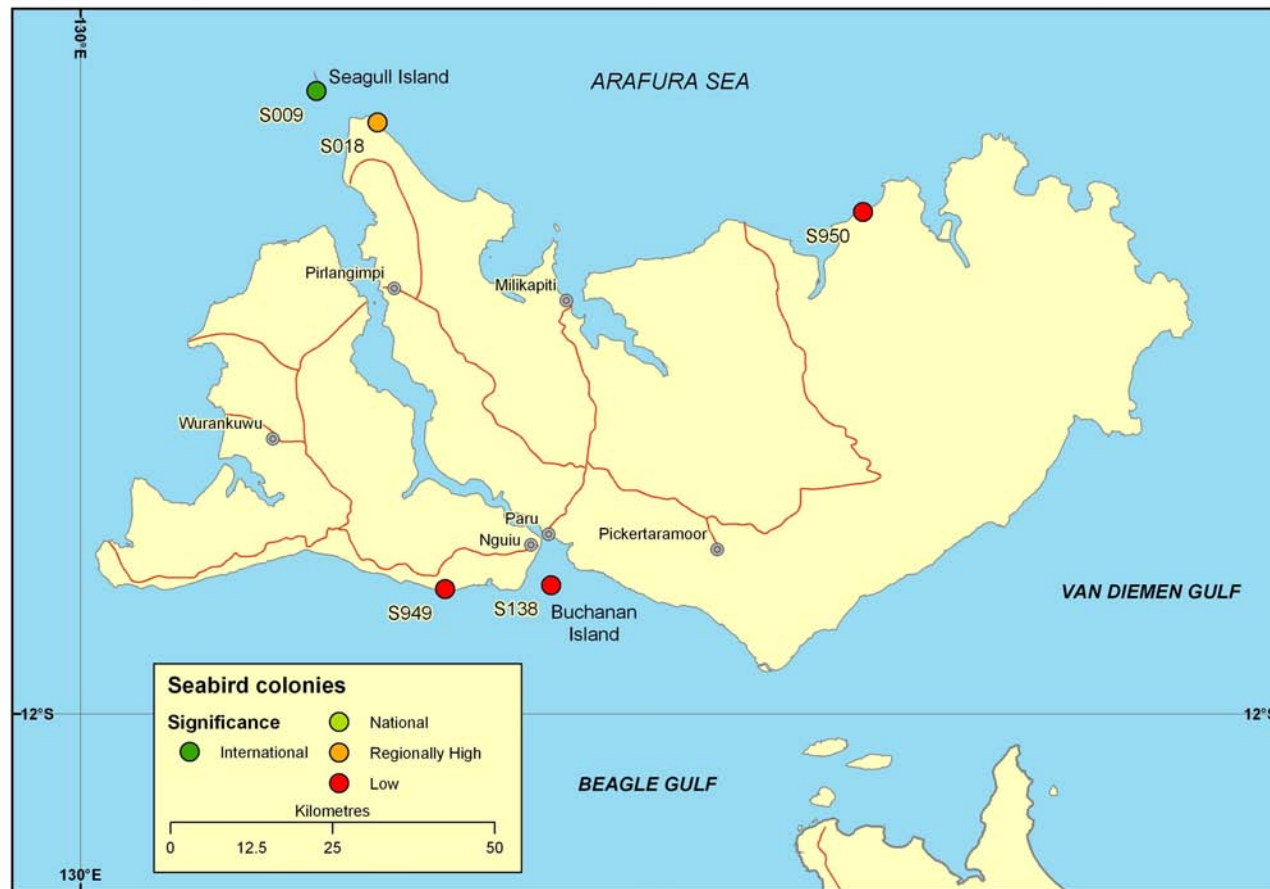


Figure 3.8. Known seabird colonies around the Tiwi Islands (modified from Chatto 2001).



Figure 3.9. Known occurrences and aggregations of shorebirds around the Tiwi Islands (modified from Chatto 2003).

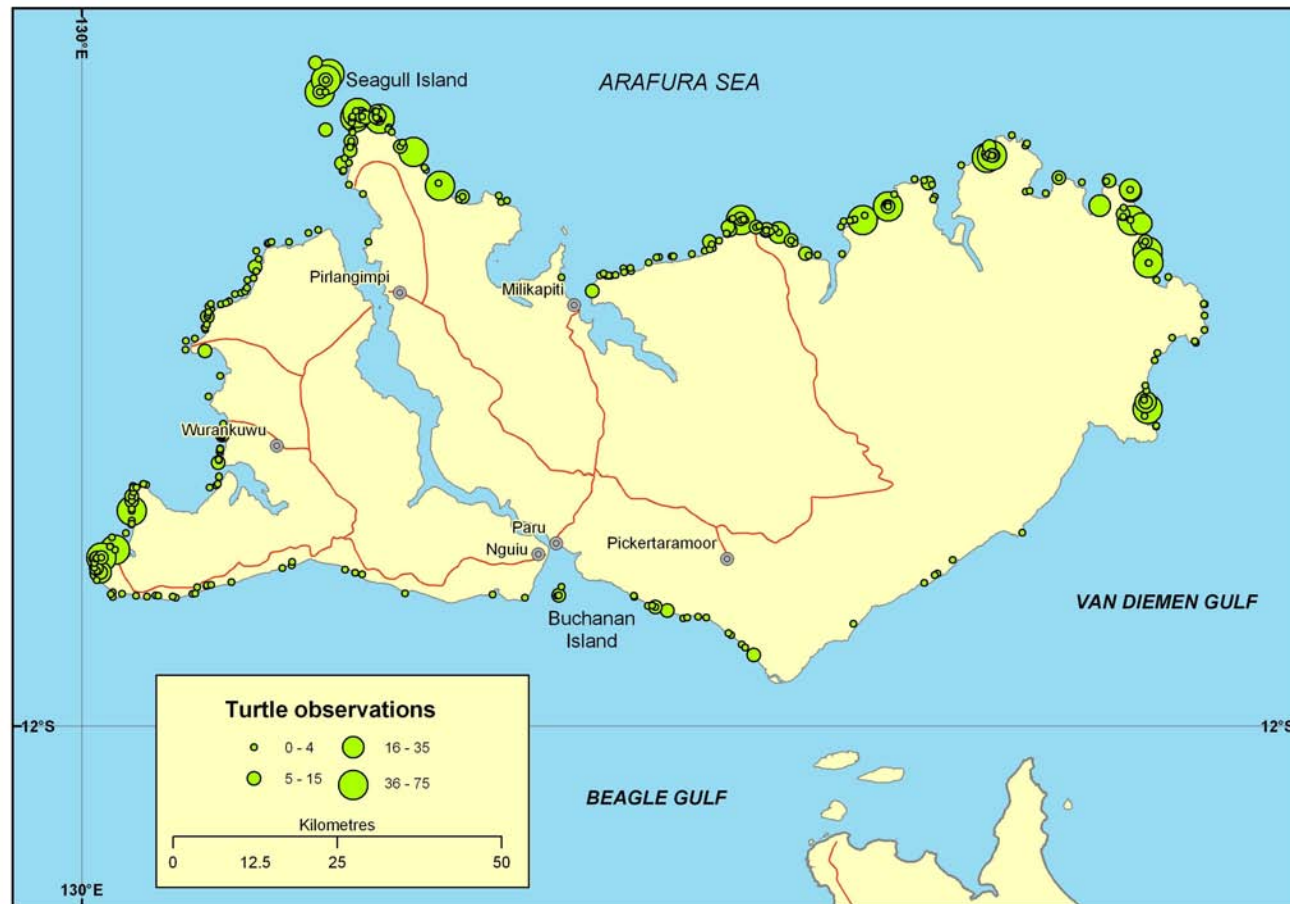


Figure 3.10. Known locations of marine turtles around the Tiwi Islands, with most aggregations of observations denoting major breeding sites (modified from Chatto 1998 and unpublished data).

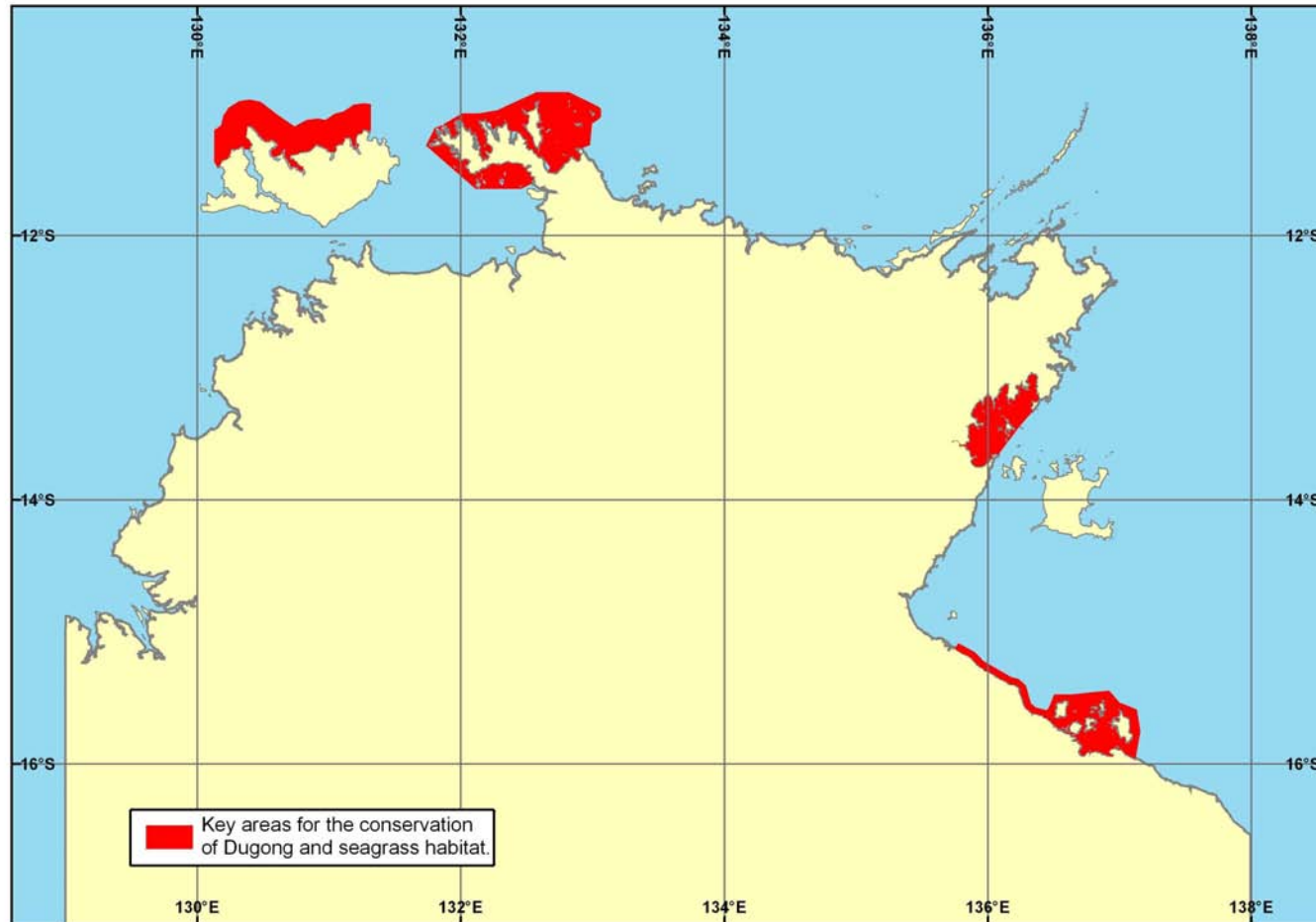


Figure 3.11. The most significant sites for dugong and seagrass on the Northern Territory coast (from Parks and Wildlife Service 2003).

4. SYNTHESIS OF VALUES

This report collates and interprets information on the fauna of the Tiwi Islands and its value. The terrestrial vertebrate fauna is now relatively well known, and this study also provides a reasonably comprehensive account of one invertebrate group, ants. Other invertebrate groups, and aquatic and marine faunas, remain less well known.

The Tiwi Islands have outstanding values for fauna conservation.

The Tiwi Island fauna is reasonably rich compared to similar-sized areas on the north Australian mainland, although notably it lacks the distinctive component of species associated with rocky environments in many other areas of the mainland. Notably, the mammal fauna of the Tiwi Islands is exceptionally rich compared with other Australian Islands, with Melville Island surpassing all other Australian islands (including Tasmania) in the number of extant native mammal species present. This is a major conservation value, given the widely-recognised importance of islands for the conservation of Australian mammals. There are no collations of island inventories for other faunal groups than mammals, so it is not possible to provide a comparable ranking of the richness of the Tiwi Islands for any other fauna group, but it is likely that the Tiwi Islands are amongst the richest in Australia for almost all other fauna groups.

This review shows that they hold an unusually high number of threatened animals: 17 taxa are recognised as endangered or vulnerable at either national level or Northern Territory level. Of these threatened taxa, three (Tiwi Islands subspecies of hooded robin and masked owl, and the landsnail *Trochomorpha melvillensis*) occur nowhere else than on the Tiwi Islands, and the Tiwi Islands holds a high proportion of the total known population of many others. Most of the threatened animals occur primarily in eucalypt open forests, but all main habitat types present on the Tiwi Islands support at least one threatened animal taxon. National and Northern Territory legislation guides and affects the management of these threatened taxa..

In addition to the three recognised threatened endemic taxa, the Tiwi Islands support many other endemic taxa. About 10% of the ant species known from the Tiwi Islands have been reported nowhere else in the Northern Territory. No other invertebrate group has been so well documented on the Tiwi Islands, but this level of endemism is probably reasonably general for most invertebrate groups, with higher levels likely for groups with low dispersal ability (such as landsnails) and lower levels likely for groups with higher dispersal ability (such as butterflies). In vertebrates, endemism occurs only at the subspecific level. Subspecies restricted to the Tiwi Islands are recognised for eight bird and two mammal species. Endemic taxa are particularly important for conservation planning and management because these cannot be protected anywhere else.

A total of 51 species recorded from the Tiwi Islands are listed under international conventions for the protection of migratory species (the Japan-Australia Migratory Bird Agreement; the Convention on the Conservation of Migratory Species of Wild Animals; and the China- Australia Migratory Bird Agreement). These treaties include obligations for the protection and management of these listed species.

Many animal species use the Tiwi Islands for only part of their life-cycle, moving to and from the Tiwi Islands, mainland northern Australia and overseas to Asia. These linkages complicate the conservation fate of these animals. Loss or degradation of habitat on the Tiwi Islands may have repercussions to fauna that occurs (in at least part of the year) tens, hundred, and thousands of kilometres away. Somewhat conversely, for more sedentary groups of animals, the isolation of the Tiwi Islands is a major conservation asset, as they can be spared from threatening processes that occur extensively across mainland areas. This value may be especially evident for predators susceptible to impacts from cane toads (such as goannas, some snakes and some carnivorous mammals), now spreading across the north Australian mainland. If the Tiwi Islands can be kept free of cane toads, then the Tiwi Island populations of these species may become extremely significant.

In addition to the threatened and endemic taxa, the Tiwi Islands support internationally and nationally significant congregations of colonially breeding seabirds, shorebirds (waders), nesting marine turtles and dugongs.

Together with a comparable set of values for Tiwi Islands plants (Part 1 of this report), this is a very substantial array of conservation assets. Along with the western Arnhem Land Plateau and the ranges of central Australia, the Tiwi Islands are one of the Northern Territory's most important areas for biodiversity conservation.

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Appendix A. List of vertebrate species recorded from Tiwi Islands.

This Table lists all species for which we could locate published and unpublished records. In some cases, where indicated in “Notes” column, these records may be dubious or require further confirmation. Also listed are the islands from which recorded, either BI (Bathurst) or MI (Melville). In a few cases, the island from which the record derives is uncertain.

The surveys and geo-coded records referred to are *this survey* (PWCNT studies from 2000 to 2002 (Woinarski *et al.* 2000, and this report), *rainf survey* (=fauna survey of Tiwi rainforests: Fensham and Woinarski 1992; Menkhorst and Woinarski 1992; Gambold and Woinarski 1993), *NTM* (=survey by Museums and Art Galleries of the Northern Territory: Horner 1998), *CSIRO* (=survey of birds by Mason and Schodde 1997), *other A* (=other data bases, such as the Atlas of Australian Birds and historical museum records), *other B* (=geo-coded records from PWCNT surveys, other than associated with our systematic survey plots).

Other published records. These mostly refer to literature records, often without precise localities. In general, listing is for primary sources only. Codes for sources are: A = Tyler *et al.* (1991); B = Horner (1998); C = Puruntatameri *et al.* (2001); D = Chatto (1998); E = Chatto (2003); F = Davis (1983); G = Fensham and Woinarski (1992); H = Mathews (1914); I = Zietz (1914*a,b*); J = Mason and Schodde (1997); K = Osborne (1974); L = Storr (1977); M = Chatto (2001); N = Goodfellow (1935); O = Dodd (1935); P = Parker (1973); Q = ForSci (1999); R = Thomson (1989); S = Thomas (1921); T = Thomas (1913); U = Watts and Aslin (1981); V = Magnusson *et al.* (1976); W = Abbott and Burbidge (1995).

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>FROGS</i>												
<i>Crinia bilinea</i>	Bilingual Froglet	*	*	6	1					7		Records unlikely: need confirmation - probably should be <i>C. remota</i> .
<i>Crinia remota</i>	Remote Froglet	*	*	31	5	3		3		42	A; B	
<i>Limnodynastes convexiusculus</i>	Marbled Frog	*	*	18	9			5	1	33	A	
<i>Limnodynastes ornatus</i>	Ornate Burrowing Frog	*	*	7	22	4		9	1	43	A; B	
<i>Notaden melanoscaphus</i>	Northern Soadefoot Toad		*					2		2	A	
<i>Uperoleia inundata</i>	Floodplain Toadlet	*	*	57	9			8		74	A	

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Uperoleia lithomoda</i>	Stonemason Toadlet	*	*	8						8		Records may need confirmation
<i>Cyclorana australis</i>	Giant Frog	*	*		2			8		10	A	
<i>Litoria bicolor</i>	Northern Dwarf Tree-frog	*	*	16	12	2		18	1	49	A; B	
<i>Litoria caerulea</i>	Green Tree-frog	*	*	6	10			4		20	A	
<i>Litoria inermis</i>	Peter's Frog		*	1	2	2		2		7	B	
<i>Litoria microbelos</i>	Javelin Frog	*	*	3	4	2		19		28	A; B	
<i>Litoria nasuta</i>	Rocket Frog	*	*	44	14	4		16	2	80	A; B	
<i>Litoria pallida</i>	Pale Frog		*	3		1		7		11	A; B	
<i>Litoria rothii</i>	Roth's Tree-frog	*	*	5	7	1		9	1	23	A; B	
<i>Litoria rubella</i>	Desert Tree-frog	*	*	6	5			6		17		
<i>Litoria tornieri</i>	Tornier's Tree-frog		*	6	5	3		19		33	A; B	
<i>Sphenophryne adelphe</i>	Northern Territory Frog	*	*	36	31	10		22		99	A; B	
REPTILES												
<i>Crocodylus porosus</i>	Saltwater Crocodile	*	*	1				1		2	C	
<i>Caretta caretta</i>	Loggerhead Turtle										C	
<i>Chelonia mydas</i>	Green Turtle										D; C	
<i>Natator depressus</i>	Flatback Turtle										D; C	
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle										D	
<i>Eretmochelys imbricata</i>	Hawksbill Turtle										D; C	
<i>Chelodina rugosa</i>	Northern Snake-necked Turtle		*								F; B; C	
<i>Emydura victoriae</i>	Northern Short-necked Turtle		*			1		1		2	F; B	
<i>Diplodactylus ciliaris</i>	Spiny-tailed Gecko		*	1						1		
<i>Gebyra australis</i>	Northern Dtella	*	*	13	5	3		10		31	B	
<i>Hemidactylus frenatus</i>	Asian House Gecko	*	*	3	7	3		3		16	B	
<i>Heteronotia binoei</i>	Bynoe's Gecko	*	*	142	36	9		53		240	B	
<i>Oedura rhombifer</i>	Zig-zag Velvet Gecko	*	*	72	21	2		19		114	B	

species	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Delma borea</i>	Rusty-topped Delma	*	*	8	2			5		15		
<i>Delma tincta</i>	Black-necked Snake-lizard		*	1						1		
<i>Lialis burtonis</i>	Burton's Legless Lizard	*	*	6		1		21		28	B; C	
<i>Chlamydosaurus kingii</i>	Frillneck Lizard	*	*	16		2		4	4	26	B; C	
<i>Diporiphora albilabris</i>	White-lipped Two-line Dragon		*					3		3		Records may need confirmation
<i>Diporiphora bilineata</i>	Two-lined Dragon	*	*	73	6	5		8		92	B	
<i>Diporiphora magna</i>	Yellow-sided Two-line Dragon		*	1				2		3		Records may need confirmation
<i>Lophognathus gilberti</i>	Gilbert's Dragon	*	*	10				1		11		
<i>Lophognathus temporalis</i>	Northern Water-dragon	*	*	36	37	9		25	1	108	B	
<i>Varanus acanthurus</i>	Ridge-tailed Monitor		*					1		1		Record unlikely: needs confirmation
<i>Varanus gouldii</i>	Sand Goanna	*	*	13	4	1		5	3	26	B; C	
<i>Varanus indicus</i>	Mangrove Monitor		*	1						1	F	
<i>Varanus mertensi</i>	Merten's Water Monitor	*	*	3		3		2	2	10	B; C	
<i>Varanus panoptes</i>	Floodplain Monitor	*		1						1		Record may need confirmation
<i>Varanus scalaris</i>	Spotted Tree Monitor	*	*	16	9	1		12		38	B	
<i>Varanus tristis</i>	Black-tailed Monitor	*	*	5	1			6		12		
<i>Carlia amax</i>	Two-spined Rainbow Skink		*	1	1					2		Records unlikely: needs confirmation
<i>Carlia gracilis</i>	Slender Rainbow Skink	*	*	17	8	12		9		46	B	
<i>Lygisaurus macfarlanei</i>	MacFarlane's Skink	*	*	1	23	3		14		41	B	
<i>Carlia munda</i>	Striped Rainbow Skink	*	*	252	52	4		51	2	361	B	
<i>Carlia rufilatus</i>	Red-sided Rainbow Skink	*	*	6	3	8		1		18	B	
<i>Carlia triacantha</i>	Three-spined Rainbow Skink	*	*	8	2	4		2		16	B	
<i>Cryptoblepharus plagiocephalus</i>	Arboreal Snake-eyed Skink	*	*	144	38	13		29	1	225	B	
<i>Ctenotus borealis</i>	Northern Ctenotus	*	*	39	6	3		5		53	B	
<i>Ctenotus essingtonii</i>	Port Essington Ctenotus	*	*	179	30	6		41		253	B	

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Ctenotus hilli</i>	Hill's Ctenotus	*	*	10				1		11		
<i>Ctenotus inornatus</i>	Ctenotus inornatus	*		1						1		Record may need confirmation
<i>Ctenotus robustus</i>	Ctenotus robustus	*	*	1				6		7		
<i>Ctenotus storri</i>	Storr's Ctenotus	*						1		1		
<i>Glaphyromorphus darwiniensis</i>	Darwin Skink	*	*	53	16	4		13		86	B	
<i>Glaphyromorphus douglasi</i>	Douglas Skink	*	*	54	34	8		41		137	B	
<i>Glaphyromorphus isolepis</i>	Smooth-scaled Skink	*	*	9				2		11		
<i>Menetia alanae</i>	Alana's Menetia	*	*	26	3			1		30		
<i>Menetia greyii</i>	Grey's Menetia	*	*	41	5			2		48		
<i>Morethia ruficauda</i>	Red-tailed Snake-eyed Skink	*	*	6				2		8		
<i>Morethia storri</i>	Storr's Snake-eyed Skink	*	*	76	7	1		2		86	B	
<i>Proablepharus tenuis</i>	Slender Snake-eyed Skink	*	*		2			2		4		
<i>Tiliqua scincoides</i>	Common Blue-tongue Lizard	*	*	1	2	1		2		6	B; C	
<i>Ramphotyphlops braminus</i>	Flowerpot Snake	*	*		2	3		1		6	B	
<i>Ramphotyphlops diversus</i>	Northern Blind-snake	*	*	4				1		5		
<i>Ramphotyphlops torelli</i>	Darwin Blind-snake		*		2			2		4		
<i>Aspidites melanocephalus</i>	Black-headed Python	*	*	1					1	2	C	
<i>Liasis childreni</i>	Children's Python	*	*	4	2	1		1		8	B	
<i>Liasis fuscus</i>	Water Python	*	*	1				3		4	C	
<i>Liasis olivaceus</i>	Olive Python		*	1						1	F	Records unlikely: needs confirmation
<i>Morelia spilota</i>	Carpet Python	*	*	5	1	1		6	2	15	B; C	
<i>Acrochordus granulatus</i>	Little File Snake		*					1		1		
<i>Acrochordus arafurae</i>	Javan File Snake	*	*								F	Records may need confirmation
<i>Boiga irregularis</i>	Brown Tree Snake	*	*	6	1	1		2	1	11	B; C	
<i>Cerberus rhynchops</i>	Bockadam		*					5		5		
<i>Dendrelaphis punctulata</i>	Green Tree Snake	*	*	8	5	1		8	1	23	B; C	
<i>Enhydryis polylepis</i>	Macleay's Water Snake		*		1			1		2		

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Stegonotus cucullatus</i>	Slaty-grey Snake	*									G	
<i>Tropidonophis mairii</i>	Keelback	*	*	4	2	2		2		10	B	
<i>Acanthophis praelongus</i>	Northern Death Adder	*	*								C	
<i>Demansia olivacea</i>	Olive Whip Snake	*	*					2		2		
<i>Demansia papuensis</i>	Papuan Whip Snake		*						1	1		
<i>Demansia simplex</i>	Grey Whip Snake		*	1						1		
<i>Demansia vestigiata</i>	Black Whip Snake	*	*	2	1			2		5	C	
<i>Furina ornata</i>	Moon Snake	*	*	3	2			1		6		
<i>Oxyuranus scutellatus</i>	Taipan	*	*					4		4	C	
<i>Pseudechis australis</i>	King Brown Snake	*	*	4	2	1		7	2	16	B; C	
<i>Pseudonaja nuchalis</i>	Western Brown Snake	*	*					2		2	C	
<i>Simoselaps semifasciatus</i>	Shovel-nosed Snake		*					1		1		
<i>Vermicella multifasciata</i>	Northern Bandy-bandy		*					1		1		
<i>Astrotia stokesii</i>	Stokes' Sea-snake		*					1		1		
<i>Disteira major</i>	Olive-headed Sea-snake		*					6		6		
<i>Hydrophis atriceps</i>	Black-headed Sea-snake		*					1		1		
<i>Hydrophis elegans</i>	Elegant Sea-snake		*					2		2		
<i>Hydrophis ornatus</i>	Ornate Sea-snake		*					1		1		
<i>Lapemis hardwickii</i>	Spine-bellied Sea-snake		*					6		6		
BIRDS												
<i>Megapodius reinwardt</i>	Orange-footed Scrubfowl	*	*	9	17		4	13	3	46	H; I; J; C	
<i>Coturnix ypsilophora</i>	Brown Quail	*	*	10			2	1		13	H; I; J	
<i>Coturnix chinensis</i>	King Quail	*	*	1	2			1		4		
<i>Anseranas semipalmata</i>	Magpie Goose		*				1	1		2	H; I; J; C	
<i>Dendrocygna arcuata</i>	Wandering Whistling-Duck	*	*	1				2	1	4	H	
<i>Dendrocygna eytoni</i>	Plumed Whistling-duck		*								H	
<i>Tadorna radjab</i>	Radjab Shelduck	*	*				2	3	3	8	J; C	
<i>Nettapus pulchellus</i>	Green Pygmy-goose	*	*				1	1	3	5	H; J	

species	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Anas superciliosa</i>	Pacific Black Duck		*	1			1			2	J	
<i>Aythya australis</i>	Hardhead		*								H	
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	*		1						1		
<i>Sula leucogaster</i>	Brown Booby	*							1	1		
<i>Anhinga melanogaster</i>	Darter	*	*				2	2		4	H; J; C	
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	*	*				3	2		5	H; I; J	
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant		*					1		1		
<i>Pelecanus conspicillatus</i>	Australian Pelican		*				1	3		4	H; J; C	
<i>Fregata ariel</i>	Lesser Frigatebird	*	*					2		2	C	
<i>Egretta novaehollandiae</i>	White-faced Heron		*				1	1		2	J	
<i>Egretta garzetta</i>	Little Egret		*				1	3	1	5	H; J	
<i>Egretta sacra</i>	Eastern Reef Egret	*	*					3	5	8	H	
<i>Ardea sumatrana</i>	Great-billed Heron		*	2					2	4	H	
<i>Ardea picata</i>	Pied Heron		*				1	1		2	H; J	
<i>Ardea alba</i>	Great Egret		*		1		2	3		6	H; J; C	
<i>Ardea intermedia</i>	Intermediate Egret	*	*				2	2	1	5	J	
<i>Ardea pacifica</i>	White-necked Heron	*	*								K	
<i>Butorides striatus</i>	Striated Heron		*		1		2	3	5	11	H; I; J; C	
<i>Nycticorax caledonicus</i>	Nankeen Night Heron	*	*	1	3		2	7		13	H; J; C	
<i>Ixobrychus flavicollis</i>	Black Bittern	*	*		1		2	1	3	7	H; I; J	
<i>Plegadis falcinellus</i>	Glossy Ibis		*				1			1	J	
<i>Threskiornis molucca</i>	Australian White Ibis	*	*	1	2		1	3	1	8	H; J	
<i>Threskiornis spinicollis</i>	Straw-necked Ibis		*					1		1	C	
<i>Platalea regia</i>	Royal Spoonbill		*					1		1	H; C	
<i>Platalea flavipes</i>	Yellow-billed Spoonbill		*				1	1		2	J	
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	*	*	2			2	2	1	7	H; J; C	
<i>Pandion haliaetus</i>	Osprey	*	*	3			1	3	3	10	H; I; J; C	
<i>Aviceda subcristata</i>	Pacific Baza		*	1						1		
<i>Elanus axillaris</i>	Black-shouldered Kite	*	*					1	1	2	C	

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Hamirostra melanostemon</i>	Black-breasted Buzzard		*					2		2		
<i>Mihus migrans</i>	Black Kite		*					2		2	H; C	
<i>Haliastur sphenurus</i>	Whistling Kite	*	*	10	1		6	8	3	28	H; I; J	
<i>Haliastur indus</i>	Brahminy Kite	*	*	4	3		1	8	2	18	H; J; C	
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	*	*	8			3	5	6	22	H; I; J; C	
<i>Circus assimilis</i>	Spotted Harrier		*								H	
<i>Accipiter fasciatus</i>	Brown Goshawk	*	*	26	6		3	6	1	42	H; I; J	
<i>Accipiter novaebollandiae</i>	Grey Goshawk		*				1	2		3	H; I; J	
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk	*	*	3						3	L	
<i>Erythrotriorchis radiatus</i>	Red Goshawk	*	*	1	1		1	1	5	9	L; J	
<i>Aquila audax</i>	Wedge-tailed Eagle	*	*	12			2	1	1	16	J; C	
<i>Hieraaetus morphnoides</i>	Little Eagle		*	1						1	C	
<i>Falco berigora</i>	Brown Falcon	*	*	31			3	3	1	38	H; I; J	
<i>Falco cenchroides</i>	Nankeen Kestrel		*								H	
<i>Falco longipennis</i>	Australian Hobby		*				1	1		2	H; I; J	
<i>Falco hypoleucos</i>	Grey Falcon	*		1						1		
<i>Falco peregrinus</i>	Peregrine Falcon	*		1						1		
<i>Grus rubicunda</i>	Brolga		*				1	2	1	4	H; J; C	
<i>Porzana tabuensis</i>	Spotless Crane		*		1			1		2		
<i>Porzana cinerea</i>	White-browed Crane	*	*					1	1	2	H	
<i>Eulabeornis castaneoventris</i>	Chestnut Rail	*	*	4	1		2	5	1	13	H; I; J	
<i>Ardeotis australis</i>	Australian Bustard		*								H; C	
<i>Turnix maculosa</i>	Red-backed Button-quail	*	*		2			1		3	H	
<i>Turnix pyrrhoborax</i>	Red-chested Button-quail		*	1						1		
<i>Turnix castanota</i>	Chestnut-backed Button-quail	*	*	8	1		2	3	1	15	H; I; J	
<i>Gallinago stenura</i>	Pin-tailed Snipe	*	*		2					2		Records may need confirmation
<i>Gallinago megala</i>	Swinhoe's Snipe	*	*					2		2	H	
<i>Limosa limosa</i>	Black-tailed Godwit	*						1		1	E	
<i>Limosa lapponica</i>	Bar-tailed Godwit	*							1	1	H; E	

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Vanellus miles</i>	Masked Lapwing	*	*	1			3	6	4	14	H; J; C	
<i>Stiltia isabella</i>	Australian Pratincole		*								H; I	
<i>Larus novaehollandiae</i>	Silver Gull	*	*					1	2	3	H; J; M; C	
<i>Sterna nilotica</i>	Gull-billed Tern	*	*					1		1		
<i>Sterna caspia</i>	Caspian Tern	*	*					1		1		
<i>Sterna bengalensis</i>	Lesser Crested Tern	*	*						1	1		
<i>Sterna bergii</i>	Crested Tern	*	*					3		3	H; M; C	
<i>Sterna albifrons</i>	Little Tern	*	*					1		1	H; M	
<i>Sterna hirundo</i>	Common Tern		*								M	
<i>Chlidonias hybridus</i>	Whiskered Tern		*								M	
<i>Chlidonias leucopterus</i>	White-winged Black Tern	*	*								M	
<i>Chalcophaps indica</i>	Emerald Dove	*	*	7	12		4	11	1	35	H; I; J; C	
<i>Phaps chalcoptera</i>	Common Bronzewing	*	*	12	3			4	1	20	H; I; J	
<i>Geophaps smithii</i>	Partridge Pigeon	*	*	21	1		2	2	21	47	H; I; J; C	
<i>Geopelia striata</i>	Peaceful Dove	*	*	127	10			14	7	158	H; I; J; C	
<i>Geopelia humeralis</i>	Bar-shouldered Dove	*	*	121	26			20	13	180	H; I; J; C	
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	*	*	14	18		4	15		51	H; I; J	
<i>Ducula bicolor</i>	Pied Imperial Pigeon	*	*	10	18		3	8	1	40	H; I; J; C	
<i>Calyptorhynchus banksii</i>	Red-tailed Black-Cockatoo	*	*	66			5	5		76	H; I; J; C	
<i>Cacatua sanguinea</i>	Little Corella	*	*	2			2	3	1	8	H; I; J	
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	*	*	65	10		4	12	5	96	H; I; J; C	
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	*	*	117	18			13	5	153	H; I; J; C	
<i>Psittenteles versicolor</i>	Varied Lorikeet	*	*	134	1		2	3	6	146	H; I; J	
<i>Aprosmictus erythropterus</i>	Red-winged Parrot	*	*	147	23			18	4	192	H; I; J; C	
<i>Platycercus venustus</i>	Northern Rosella	*	*	83	11			13		107	H; I; J; C	
<i>Psephotus dissimilis</i>	Hooded Parrot		*								N	Record unlikely
<i>Cuculus saturatus</i>	Oriental Cuckoo		*		2		1	2		5	H; J	
<i>Cuculus pallidus</i>	Pallid Cuckoo	*	*	1	2			2		5	H	
<i>Cacomantis variolosus</i>	Brush Cuckoo	*	*	20	4		4	7	4	39	H; I; J	

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo	*	*	2			1	1		4	H; J	
<i>Chrysococcyx minutillus</i>	Little Bronze-Cuckoo	*	*	9	1		6	5	5	26	H; I; J	
<i>Eudynamys scolopacea</i>	Common Koel	*	*		13		6	12		31	H; J; C	
<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	*	*								H	
<i>Centropus phasianinus</i>	Pheasant Coucal	*	*	76	16			10	1	103	H; I; J	
<i>Ninox connivens</i>	Barking Owl		*					1		1		Record unlikely: needs confirmation
<i>Ninox novaeseelandiae</i>	Southern Boobook	*	*	45	6		5	7	2	65	H; I; J	
<i>Ninox rufa</i>	Rufous Owl		*								C	Record unlikely: needs confirmation
<i>Tyto novaehollandiae</i>	Masked Owl	*	*	44	1		6	2		68	H; J	
<i>Tyto alba</i>	Barn Owl		*		1			1		2	C	Record may need confirmation
<i>Podargus strigoides</i>	Tawny Frogmouth	*	*	34	1			4	10	49	H; J; C	
<i>Eurostopodus argus</i>	Spotted Nightjar	*	*	20	1		5	1	1	28	J	
<i>Caprimulgus macrurus</i>	Large-tailed Nightjar	*	*	12	3		4	5	1	25	H; I; J	
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	*	*	32	3		3	3	5	46	H; J	
<i>Hirundapus caudacutus</i>	White-throated Needletail		*				1			1	J	
<i>Apus pacificus</i>	Fork-tailed Swift	*	*	1				1		2	H	
<i>Alcedo azurea</i>	Azure Kingfisher	*	*	3				4	3	10	H; I; J; C	
<i>Alcedo pusilla</i>	Little Kingfisher		*	1			2	2		5	H; I; J	
<i>Dacelo leachii</i>	Blue-winged Kookaburra	*	*	112	18			15	5	150	H; I; J; C	
<i>Todiramphus macleayii</i>	Forest Kingfisher	*	*	47	13		1	13	7	81	H; I; J	
<i>Todiramphus pyrrhopygia</i>	Red-backed Kingfisher		*	1					2	3		
<i>Todiramphus sanctus</i>	Sacred Kingfisher	*	*	11	2		3	6	3	25	H; I; J	
<i>Todiramphus chloris</i>	Collared Kingfisher	*	*	3	2		2	2	1	10	H; I; J; C	
<i>Merops ornatus</i>	Rainbow Bee-eater	*	*	136	2		2	4	11	155	H; I; J; C	
<i>Eurystomus orientalis</i>	Dollarbird		*	1			1	1	1	4	H; J	
<i>Pitta iris</i>	Rainbow Pitta	*	*	1	9		5	8	1	24	H; J	

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Climacteris melanura</i>	Black-tailed Treecreeper		*	1						1		Record unlikely: needs confirmation
<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	*	*	38	5			4	2	49	H; I; J	
<i>Pardalotus striatus</i>	Striated Pardalote	*	*	201	8		3	6	7	225	H; I; J	
<i>Smicromis brevirostris</i>	Weebill	*	*	155	9		2	6	5	177	H; I; J	
<i>Gerygone levigaster</i>	Mangrove Gerygone	*	*	4	2			3	2	11		
<i>Gerygone magnirostris</i>	Large-billed Gerygone	*	*	4	3		5	4	2	18	H; I; J	
<i>Gerygone chloronotus</i>	Green-backed Gerygone	*	*	32	32		3	16	7	90	H; I; J	
<i>Philemon buceroides</i>	Helmeted Friarbird	*	*	29	16		4	11	1	61	H; I; J	
<i>Philemon argenticeps</i>	Silver-crowned Friarbird	*	*	142	15			10	5	172	H; I; J; C	
<i>Philemon citreogularis</i>	Little Friarbird	*	*	101	7		2	6	1	117	H; I; J	
<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	*	*	66	3			6		75	H; I; J	
<i>Manorina flavigula</i>	Yellow-throated Miner	*	*	76	6		4	2		88	H; I; J	
<i>Lichenostomus virescens</i>	Singing Honeyeater	*	*	20	3		1	2		26	H; I; J	
<i>Lichenostomus unicolor</i>	White-gaped Honeyeater	*	*	55	21		3	16	9	104	H; I; J	
<i>Lichenostomus flavescens</i>	Yellow-tinted Honeyeater	*	*	119	12		3	6	1	141	H; I; J	
<i>Melithreptus albogularis</i>	White-throated Honeyeater	*	*	220	54			17	10	301	H; I; J	
<i>Lichmera indistincta</i>	Brown Honeyeater	*	*	139	21		5	15	12	192	H; I; J	
<i>Ramsayornis fasciatus</i>	Bar-breasted Honeyeater	*	*	15	1			4	6	26	H; I	
<i>Conopophila albogularis</i>	Rufous-banded Honeyeater	*	*	4	8		2	5	8	27	H; J	
<i>Myzomela obscura</i>	Dusky Honeyeater	*	*	59	40		6	17	3	125	H; I; J	
<i>Myzomela erythrocephala</i>	Red-headed Honeyeater	*	*	13	12		3	7	2	37	H; I; J	
<i>Microeca flavigaster</i>	Lemon-bellied Flycatcher		*	12	4		1	2	6	25	H; I; J	
<i>Eopsaltria pulverulenta</i>	Mangrove Robin	*	*	2	2		5	2	1	12	H; I; J	
<i>Melanodryas cucullata</i>	Hooded Robin	*	*		1			1		2	H; I	
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	*	*	75	4			5	1	85	H; I; J	
<i>Daphoenositta chrysoptera</i>	Varied Sittella	*	*	31	1				1	33	H; I	
<i>Pachycephala melanura</i>	Mangrove Golden Whistler	*	*	1	4		2	3	1	11	H; I; J	
<i>Pachycephala simplex</i>	Grey Whistler	*	*	28	23		8	14	10	83	H; I; J	
<i>Pachycephala rufiventris</i>	Rufous Whistler	*	*	234	31			19	6	290	H; I; J	

species	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Pachycephala lanioides</i>	White-breasted Whistler		*				1	2		3	H; I; J	
<i>Colluricincla megarhyncha</i>	Little Shrike-thrush	*	*	27	36		6	15	9	93	H; I; J	
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	*	*	164	12			8	3	187	H; I; J	
<i>Myiagra ruficollis</i>	Broad-billed Flycatcher	*	*	1	5		4	5		15	H; I; J	
<i>Myiagra rubecula</i>	Leaden Flycatcher	*	*	153	22			16	4	195	H; I; J	
<i>Myiagra alecto</i>	Shining Flycatcher	*	*	16	10		5	7	9	47	H; I; J	
<i>Myiagra inquieta</i>	Restless Flycatcher		*	1				1	1	3		
<i>Grallina cyanoleuca</i>	Magpie-lark	*	*	1			3	2		6	H; J; C	
<i>Rhipidura rufifrons</i>	Rufous Fantail	*	*	1	1		2	1	2	7	H; I; J	
<i>Rhipidura phasiana</i>	Mangrove Fantail		*					1		1	H	
<i>Rhipidura rufiventris</i>	Northern Fantail	*	*	182	65			21	14	282	H; I; J	
<i>Rhipidura leucophrys</i>	Willie Wagtail		*	1				1		2	H	
<i>Dicrurus bracteatus</i>	Spangled Drongo	*	*	128	27			17	5	177	H; I; J	
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	*	*	65	1			6		72	H; I; J; C	
<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	*	*	187	19			14	9	229	H; I; J	
<i>Coracina tenuirostris</i>	Cicadabird	*	*	8	1		1	1	1	12	H; I; J	
<i>Lalage sueurii</i>	White-winged Triller	*	*	1			1			2	H; I; J	
<i>Lalage leucomela</i>	Varied Triller	*	*	40	39		4	17	11	111	H; J	
<i>Oriolus flavocinctus</i>	Yellow Oriole	*	*	36	38		2	20	10	106	H; I; J	
<i>Oriolus sagittatus</i>	Olive-backed Oriole	*	*	31	1			2	2	36	H; I; J	
<i>Sphecothebes viridis</i>	Figbird	*	*	2	1		3	4	1	11	H; J	
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	*	*	6	1		3	5	1	16	H; I; J	
<i>Artamus personatus</i>	Masked Woodswallow		*					1		1		Record unlikely: needs confirmation
<i>Artamus minor</i>	Little Woodswallow	*		4						4		
<i>Cracticus quoyi</i>	Black Butcherbird	*	*	13	5		4	7	5	34	H; I; J	
<i>Cracticus torquatus</i>	Grey Butcherbird	*	*	1						1		Record unlikely: needs confirmation
<i>Cracticus nigrogularis</i>	Pied Butcherbird	*	*	175	6			7		188	H; I; J	
<i>Corvus orru</i>	Torresian Crow	*	*	85	3		3	9	5	105	H; I; J; C	

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Chlamydera nuchalis</i>	Great Bowerbird	*	*	34	14		3	17	6	74	H; I; J	
<i>Anthus novaeseelandiae</i>	Richard's Pipit		*								H; I	
<i>Mirafra javanica</i>	Singing Bushlark		*	2	2			2		6	H; I	
<i>Neochmia phaeton</i>	Crimson Finch		*								O	Record may need confirmation
<i>Taeniopygia bichenovii</i>	Double-barred Finch		*					1		1		Record may need confirmation
<i>Poephila acuticauda</i>	Long-tailed Finch	*									G	
<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin	*	*	1			2			3	H; I; J	
<i>Dicaeum hirundinaceum</i>	Mistletoebird	*	*	165	41			18	9	233	H; I; J	
<i>Hirundo nigricans</i>	Tree Martin	*	*	13	3		1	6	2	25	H; J; C	
<i>Hirundo ariel</i>	Fairy Martin	*	*	2			1	1	2	6	J	
<i>Acrocephalus orientalis</i>	Oriental Reed-warbler		*								H; I	
<i>Megalurus timoriensis</i>	Tawny Grassbird		*	1						1	H; I	
<i>Cinchoramphus matthewsi</i>	Rufous Songlark		*	1						1	H	
<i>Cisticola exilis</i>	Golden-headed Cisticola		*	1	4		2	1		8	H; I; J	
<i>Zosterops luteus</i>	Yellow White-eye	*	*	3	8		3	7	1	22	H; J	
MAMMALS												
<i>Tachyglossus aculeatus</i>	Echidna		*								W	Record unlikely
<i>Antechinus bellus</i>	Fawn Antechinus		*			1				1	B	
<i>Dasyurus hallucatus</i>	Northern Quoll	*	*								W	Records unlikely
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale		*	2						2	C	
<i>Sminthopsis butleri</i>	Butler's Dunnart	*	*	3	2	1		2		8	B	
<i>Sminthopsis virginiae</i>	Red-cheeked Dunnart		*	11	2			9		22	P; W	
<i>Isodon macrourus</i>	Northern Brown Bandicoot	*	*	172	10	2		25	5	214	B; C; W	
<i>Macropus agilis</i>	Agile Wallaby	*	*	100	35	3		21	7	166	P; B; C; W	
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	*	*	110	7	4		16	32	169	P; B; C; W	

<i>species</i>	name	Island		no. of sites from which recorded							other published records	notes
		BI	MI	this survey	rainf survey	NTM	CSIRO	other A	other B	Total		
<i>Petaurus breviceps</i>	Sugar Glider	*	*	5	7	1		17	4	34	P; B; C; W	
<i>Macroglossus minimus</i>	Northern Blossom-bat		*			1		3	1	5	P; B; W	
<i>Pteropus alecto</i>	Black Flying-fox	*	*	5	12			6	1	24	C; W	
<i>Pteropus scapulatus</i>	Little Red Flying-fox	*	*	21		1			1	23	B; C	
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat		*	2		1			14	17	B	
<i>Saccolaimus saccolaimus</i>	Bare-rumped Sheath-tail-bat	*	*								Q; W	Record unlikely: needs confirmation
<i>Tapozeugous georgianus</i>	Common Sheath-tail-bat		*								Q	Record unlikely: needs confirmation
<i>Hipposideros diadema</i>	Arnhem Leaf-nosed Bat	*	*								W	Record unlikely
<i>Rhinonictis aurantius</i>	Orange Leaf-nosed Bat	*						1		1		Record unlikely: needs confirmation
<i>Chalinolobus gouldii</i>	Gould's Wattled-bat	*	*	1				3	1	5		
<i>Chalinolobus nigrogriseus</i>	Hoary Bat	*	*					3		3		
<i>Myotis moluccarum</i>	Large-footed Mouse-eared Bat		*						1	1	P; R	
<i>Nyctophilus arnhemensis</i>	Arnhem Long-eared Bat	*	*	2				11	3	16	W	
<i>Nyctophilus bifax</i>	North Queensland Long-eared Bat		*	2						2	P; W	
<i>Pipistrellus adamsi</i>	Cape York Pipistrelle		*	1						1		
<i>Pipistrellus westralis</i>	North-western Pipistrelle		*	6		1				7	B	
<i>Scotorepens greyii</i>	Little Broad-nosed Bat	*	*					4	1	5		
<i>Scotorepens sanborni</i>	Northern Broad-nosed Bat		*								Q	Record unlikely: needs confirmation
<i>Vespadelus caurinus</i>	Western Cave Eptesicus	*	*								G; W	Records may need confirmation
<i>Chaerophon jobensis</i>	Northern Freetail-bat		*	1					5	6		
<i>Mormopterus beccarii</i>	Beccari's Freetail-bat		*	1						1		
<i>Mormopterus loriae</i>	Little Northern Freetail-bat		*						5	5		
<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-rat	*	*	52	15			15		82	S; P; W	

Appendix B.

Dossiers on threatened animal taxa recorded from the Tiwi Islands

These accounts are derived, and where relevant modified, from Anon (2002). *Threatened species of the Northern Territory. Information package*. NT Department of Infrastructure Planning and Environment, Darwin.

Note that distribution maps show NT distributions only: for some of these species, distributions extend beyond the NT. This is indicated for these species in the **Distribution** section of the text.

In two cases (landsnails and marine turtles), accounts are written for groups of related species rather than separately for individual species, although within these accounts, information is presented for those individual species.

LAND SNAILS – two vulnerable species

Families Camaenidae and Zonitidae

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Not listed.

Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Vulnerable.

Description, ecology, distribution

All information that follows is from Vince Kessner (*personal communication 2002*) or Solem (1993) unless otherwise attributed.

Camaenidae

Amphidromus cognatus

Shell diameter: 25-30 mm.

This large snail is known to occur on Bathurst and Melville Islands. It was originally described from Port Essington on Cobourg Peninsula but has not been found there since. It lives in trees in coastal monsoon vine forest thickets.

Zonitidae

Trochomorpha melvillensis

Shell diameter: 10-12 mm.

This species is only found on Melville Island where it occurs under logs and under the bark of trees in coastal monsoon vine thickets.

Conservation assessment

The snail species listed here are relatively restricted in their geographic range and are exposed to processes that may lead to their decline. They all qualify as **Vulnerable** (under criteria B1ab(i,ii,iii)+2ab(i,ii,iii)) based on:

- extent of occurrence <20,000 km²
- area of occupancy <2,000 km²
- known to exist at <10 locations and
- continuing decline observed, inferred or projected.

Threatening processes

There is no direct evidence that any external factors have yet caused a decline in the numbers or distribution of any of these snail species.

1) Land snails are susceptible to the impacts of an increased frequency and intensity of fire. Exotic pastures, such as Gamba grass (*Andropogon gayanus*) and Mission grass (*Pennisetum polystachion*), create more fuel than native grasses. In northern Australia, the destructive fires that result carry into the edges of monsoon vine-forest patches, leading to their shrinkage and eventual disappearance (Panton 1993). Mission grass is established on Melville Island.

2) Overgrazing by livestock and feral animals can impact heavily on land snail habitat by trampling or disturbing aestivation sites and killing the trees on which some species depend.

- 3) Feral predators such as rats, mice and cane toads may have a significant impact on land snail populations.
- 4) Rare extreme events such as major floods or droughts may impact severely upon populations made vulnerable by the above processes.

Conservation objectives and management

There are no existing management programs for the wild populations of these land snail species in the Northern Territory.

Research priorities are:

- (i) to conduct further surveys to determine whether populations occur elsewhere; and
- (ii) to identify specific threats to any of the known populations.

Management priorities are:

- (i) to better safeguard the known populations through encouragement of traditional Aboriginal burning practices, containing the spread of exotic grasses and controlling feral animals.

Compiled by

Colin Wilson

[September 2002]

References

- Panton, W. J. (1993). Changes in post World War II distribution and status of monsoon rainforests in the Darwin area. *Australian Geographer* **24** (2), 50-59.
- Solem, A. (1993). Camaenid land snails from Western and central Australia (Mollusca: Pulmonata: Camaenidae). VI Taxa from the red centre. *Records of the Western Australian Museum Supplement* **43**, 983-1459.

DODD'S AZURE BUTTERFLY

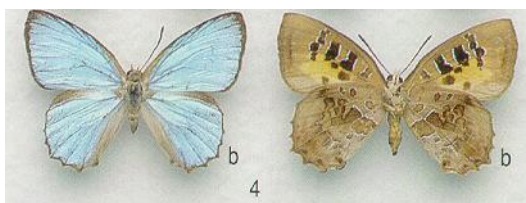
Ogyris iphis doddi

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Not listed.
Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Endangered.

Description

Dodd's Azure is a small, shining, iridescent pale blue butterfly 31-32 mm across the outspread wings. The underside of the wings is brownish and dull orange, with two or three broad brown-black bars edged with iridescent blue under the forewings.



Dodd's Azure butterfly - upper surface of the wings is on the left and the underside is to the right.
 (Reproduced from *Butterflies of Australia Vol 1* (M.F. Braby, 2000) with permission of CSIRO Publishing)

Ecology

Little is known of the ecology of this species. Larvae of the Queensland subspecies feed on mistletoes (family Loranthaceae), and are always attended by ants. They shelter during the day in hollows or cracks in the host tree wherever the attendant ants have established a nest, and pupate in similar situations. They are found in dry eucalypt woodland and open forest on sandstone or sandy soils. The adults fly swiftly among the tree tops and there are probably two or three generations per year (Braby 2000).

Conservation assessment

The Queensland subspecies is highly localised to places where the food plants and attendant ant colonies both occur, but it can be quite abundant in these places (Braby 2000). However, very few specimens of the Northern Territory subspecies, Dodd's Azure, have ever been collected or seen, and it is considered to be extremely rare. Butterflies are eagerly sought by collectors, so the scarcity of specimens of Dodd's Azure in collections almost certainly equates to a genuine restriction in geographic range and rarity in life.

Conservation categorisation is difficult as there is a lack of information on population trends. However, it can be reasonably inferred that this species may be exposed to factors that could lead to its decline from an already tenuous base.

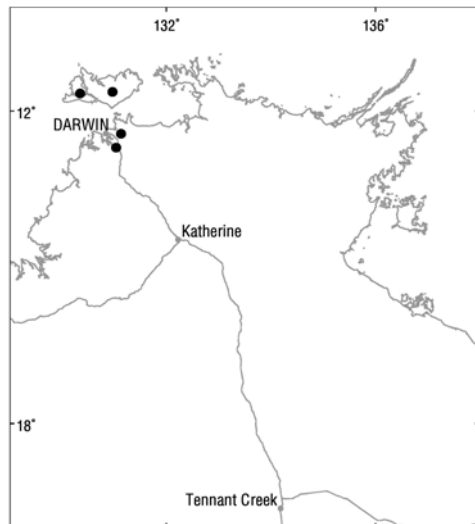
Accordingly, the species qualifies as **Endangered** (under criteria B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)) based on:

- extent of occurrence <5000 km²
- area of occupancy <500 km²

- known to exist at <5 locations and
- continuing decline observed, inferred or projected.

Distribution

Dodd's Azure is endemic to Australia, and has only been collected at Darwin and on Melville Island. It has not been collected at Darwin since 1909, although it was reportedly seen in 1992. A specimen was collected on Melville Island in 1986 (Braby 2000).



Known locations of Dodd's Azure butterfly.

Threatening processes

There is no evidence that any external factors have yet caused a decline in numbers or distribution of Dodd's Azure butterfly. However, there are several factors that could threaten its viability.

- 1) The Top End has seen an increasing frequency and intensity of burning brought about by urban and rural expansion and the uncontrolled spread of introduced perennial pasture grasses.
- 2) Recent incursions by the exotic big-headed and yellow crazy ants may also impact upon populations of the attendant ants which are intimately associated with the butterfly larvae.
- 3) There are plans to clear large areas of savanna woodland on Melville Island for a plantation forestry operation using non-indigenous trees.

Conservation objectives and management

There is no existing management program for the wild population of this species in the Northern Territory.

Research priorities are:

(i) to investigate the ecology of the species so that larval food plants and breeding sites can be identified and protected.

Management priorities are:

(i) to better safeguard the existing population through encouraging traditional Aboriginal burning practices and containing the spread of exotic grasses and ants.

Compiled by

Colin Wilson
[March 2002]

References

Braby, M. F. (2000). *Butterflies of Australia: their identification, biology and distribution*. Vol. 2. CSIRO Publishing, Melbourne, pp. 703-704.

NORTHERN GRASSDART BUTTERFLY

Taractrocera ilia ilia

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Not listed.

Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Vulnerable.

Description

The northern grassdart is a small orange butterfly about 20 mm across the outspread wings. It is similar to many other typical skippers, darters and swifts. The adult has a short, stocky body and the triangular forewings are usually held in a swept-back position like a jet fighter, but vertically over the body. The wings are dark brown with prominent orange markings. When in sunshine or feeding they frequently hold just their hind wings horizontally. The clubs at the end of the antennae are shaped like flattened spoons (Fig. 2).



The northern grassdart. The male is on the left and the female is on the right. The top specimens show the upper side of the wings, and the lower specimens show the underside. (*Reproduced from Butterflies of Australia Vol 1 (M.F. Braby, 2000) with permission of CSIRO Publishing*)

They are difficult for a non-specialist to tell apart from several similar species that are found in the same region.



Clubs at the ends of the antennae of the northern grassdart are shaped like flattened spoons. (Source: Common and Waterhouse 1981)

Ecology

Almost nothing is known of the ecology of this species. Its eggs and larvae are unknown, and adults have only rarely been collected. The larvae of related species are thought to feed almost exclusively on particular grasses (Poaceae). The adults are sometimes found resting in the shade of rock overhangs during the heat of the day (Braby 2000).

Conservation assessment

This species may well be slightly more common than the number of known specimens would suggest. It is very similar in appearance to several related butterflies that are quite common in the same region and collectors may have overlooked it. However, the fact remains that butterflies in general are intensively collected and very few specimens of the northern grassdart have ever been seen.

Conservation categorisation is difficult as there is a lack of information on population trends. There is some evidence that other northern Australian butterflies whose larvae feed on grasses have declined in recent years due to an increase in the frequency and intensity of fires (T.L. Fenner *pers. comm*), and it is reasonable to assume that the northern grassdart will be exposed to the same pressures.

The species qualifies as **vulnerable** (under criterion B1ab(i,ii,iii,iv)) based on:

- extent of occurrence <20,000 km²
- known to exist at <10 locations and
- continuing decline observed, inferred or projected.

Threatening processes

Larvae of this butterfly probably feed almost exclusively on particular species of grass. They are thus likely to be particularly vulnerable to the increased frequency and intensity of fires brought about by a greater density of settlement across their known range, and the uncontrolled spread of giant African perennial pasture grasses.

Conservation objectives and management

There is no existing management program for the northern grassdart butterfly in the Northern Territory. As its host plants and life cycle are unknown, it is difficult to design a management program that will ensure its survival.

Research priorities are:

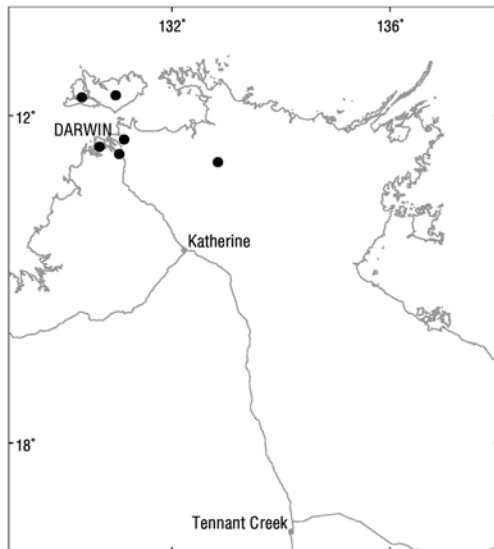
- (i) to investigate the ecology of the species so that larval food plants and breeding sites can be identified and protected.

Management priorities are:

- (i) to better safeguard potential breeding sites through encouraging burning practices that create a mosaic of grassland patches burnt at different frequencies and seasons; and
- (ii) to better safeguard larval foodplants through controlling the spread of exotic perennial pasture grasses.

Distribution

This species is only known from the Northern Territory, where adults have been collected at King River, Darwin, the Alligator Rivers region and Melville Island.



Known locations of the northern grassdart butterfly.

Compiled by

Colin Wilson
[February 2002]

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SEA TURTLES

All of the sea turtles have been classified as threatened at a national level, but not necessarily at the Northern Territory level.

Green turtle *Chelonia mydas*

Listed as *Vulnerable* at the national level.

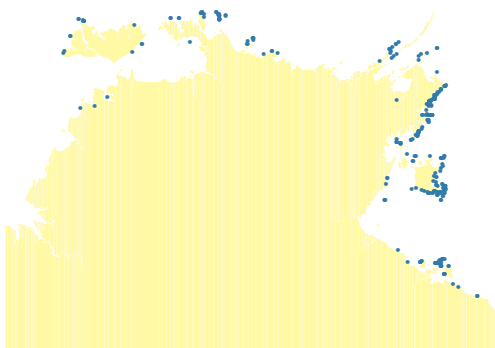
There are no population trend data for the Northern Territory but there is no anecdotal evidence of a decline. Many nesting sites occur in the Northern Territory. Nationally significant nesting beaches occur off the eastern coastline of Arnhem Land and the eastern coast of Groote Eylandt but nesting generally occurs from the western end of Melville Island to near the border with Queensland (Chatto 1998).



Green turtle

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A recent assessment of trends for this species in the southern Great Barrier Reef has shown that the overall population increased by 11% per annum over 8 years (1985-1992) and the female nesting population increased by 3% per annum between 1974 and 1998 (Chaloupka and Limpus 2001).



Recorded locations of nesting by the green turtle. (R. Chatto, unpublished data).

Given the trend data from Queensland the species is best considered as **Least Concern** for the Northern Territory.

Hawksbill turtle *Eretmochelys imbricata*

Listed as *Vulnerable* at the national level.

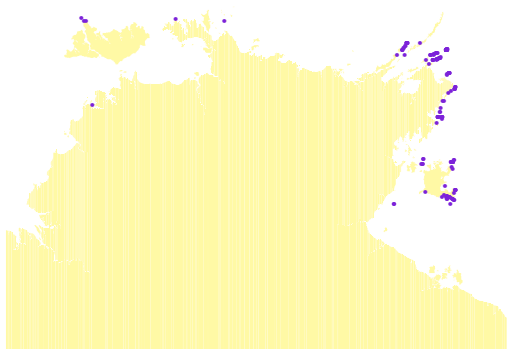


Hawksbill turtle.

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Hawksbill turtles primarily nest on islands with only occasional nesting on mainland beaches. The main breeding sites in the Northern Territory are between north east Arnhem Land and Groote Eylandt (Chatto 1998).

There are no trend data available. As it nests primarily on islands the species should be subject to less collecting of eggs by indigenous people in the Northern Territory. Estimated mortality from fishing nets in the Northern Territory is in the order of 100s (Environment Australia 1998). It is not known whether this would significantly impact on the species. There may also be some mortality of individuals from the Northern Territory due to indigenous harvest in overseas countries.



Recorded locations of nesting by the hawksbill turtle. (R. Chatto, unpublished data).

Given the presence of some threats that cannot be quantified and the lack of trend data the species is best considered as **Data Deficient**.

Olive Ridley *Lepidochelys olivacea*

Listed as *Endangered* at the national level.

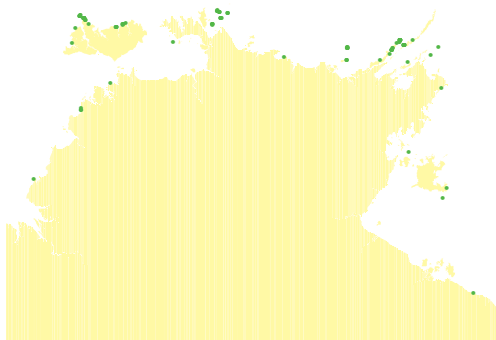
The olive ridley is the smallest sea turtle. They live in shallow protected waters and feed on benthic molluscs, crabs, echinoderms and gastropods. The vast majority of the nesting population in Australian waters occurs in the NT (Environment Australia 1998). Nesting has been recorded from Melville Island to Groote Eylandt, with the highest

nesting occurring on Melville Island, islands to the east of Croker Island and some islands off northeast Arnhem Land (Chatto 1998 and unpublished data). There are no accurate population estimates. The female breeding population in the NT is very roughly estimated to be between 1,000 to 5,000. Mortality of animals does occur due to capture in fishing nets. The worst recorded occurrence was in Fog Bay in 1991 when an estimated 300 turtles were killed in one incident. Of 100 turtles examined from this kill, 85% were olive ridleys. This level of mortality is exceptional and annual bycatch is likely to be normally much lower. Predation of eggs may have increased on Melville Island due to wild dogs. Since a high proportion of the population is thought to nest on Melville Island, it is recommended that action to address this threatening process is given a high priority as a precautionary measure.



Olive ridley turtle.

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Recorded locations of nesting by the olive ridley turtle. (R. Chatto, unpublished data).

To qualify as vulnerable the species with a population the size of the olive ridley needs to have declined by 10% over three generations. Whether a decline has occurred is unknown and the species is best classified as **Data Deficient**.

Flatback turtle *Natator depressus*

Listed as *Vulnerable* at the national level.



Flatback turtle. (Photo: Ray Chatto)

Flatback turtles inhabit shallow, soft bottomed sea beds and feed on soft corals and soft bodied animals such as jellyfish and sea cucumbers. Flatbacks largely occur in Australian continental waters but can be found in low numbers in Indonesia and Papua New Guinea.

Flatback turtles only breed in Australia and breed all around the coastline and offshore Islands of the Northern Territory. Flatbacks probably constitute the highest breeding numbers of any sea turtle in the Northern Territory (Chatto 1998). Mortality due to bycatch in nets and predation of eggs does occur. However, there are no quantitative data on the impacts of this mortality or trends in population size.



Recorded locations of nesting by the flatback turtle. (R. Chatto, unpublished data).

The species is best classified as **Data Deficient** as threatening processes are operating but no data are available to assess their impacts on the species.

Compiled by

Robert Taylor and Ray Chatto
[April 2002]

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LOGGERHEAD TURTLE

Caretta caretta

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*):

Endangered.

Northern Territory (*Territory Parks and Wildlife Conservation Amendment Act 2000*):

Endangered.

Description

Marine turtle with a red-brown to brown shell of ~1 m length and a relatively large head. Usually has five pairs of large scales down each side of the shell. When ashore they move with an alternating gait. Eggs are intermediate in size (mean diameter = 4.1 cm) compared with other species. Hatchlings are dark brown dorsally and light brown ventrally.



Loggerhead turtle. (Copyright: State of Queensland, reproduced with permission of the Environmental Protection Agency)

Ecology

Loggerheads eat shellfish, crabs, sea urchins and jellyfish. Females migrate up to 2600 km from feeding areas to traditional nesting beaches. Females lay up to six clutches of around 125 eggs each season with 3-4 years between breeding. After hatching young turtles take up a drifting existence in surface waters and feed on macro zooplankton. As partially grown immature turtles (shell length of ~75 cm) they move to inshore areas. They settle in one area and do not move large distances, except to breed.

Conservation assessment

The population trends in the western stock are not known but between 1985 and 1992 the population in the southern Great Barrier Reef declined by 20% and between 1985 and 1998 a decline of 65% occurred in the number of loggerheads nesting on Heron Island (Chaloupka and Limpus 2001). No data are available on trends in numbers feeding in Northern Territory waters but as the threatening processes are operating here (see below) it is concluded that a decline is likely.

If it is assumed the same decline is occurring in Northern Territory waters as is occurring in Queensland then the species qualifies as **Endangered** (under criteria A2b) due to:

- population reduction of $\geq 50\%$ over the last 10 years or three generations.

Threatening processes

Simulation models suggest that increased fox predation on eggs and mortality of pelagic juveniles from incidental capture in coastal otter trawl fisheries and oceanic longline fisheries have led to the observed declines (Chaloupka and Limpus 2001). Loggerhead turtles have a greater propensity than other sea turtles to consume baited longline hooks (Witzell 1998)

Conservation objectives and management

There is no existing management program for the wild population of this species in the Northern Territory. The main anthropomorphic mortality factor operating within Territory waters is probably capture of turtles by prawn trawlers (Poiner and Harris 1996). This fishery is under the control of the Commonwealth government and they have put in measures to reduce bycatch of turtles (Environment Australia 1998).

Management priorities are to:

- (i) ensure that measures to reduce bycatch in fisheries are effective.

Distribution

The species has a global distribution. In Australia breeding is centred in the southern Great Barrier Reef and adjacent mainland, on Dirk Hartog Island (Shark Bay) and Muiron Island (North West Cape) in Western Australia. The eastern and western populations are genetically distinct. No breeding is known to occur in the Northern Territory. Loggerheads from Australia migrate to the Pacific Islands and southern Asia. The animals that feed in Northern Territory waters appear to come from both the east and western breeding populations. When feeding in inshore areas they inhabit subtidal and intertidal coral and rocky reefs and seagrass meadows, as well as deeper, soft bottomed habitats. Feeding loggerheads are known to occur in Northern Territory waters but are infrequently encountered.

Compiled by

Robert Taylor and Ray Chatto
[March 2002]

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RED GOSHAWK

Erythrotriorchis radiatus

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Vulnerable.
Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Vulnerable.

Description

A large reddish-brown goshawk, with conspicuous dark streaks from chin to belly, conspicuously barred on the underwing and tail. The head is whitish with dark streaks. The legs and feet are strong and yellowish, with prominent red feathering ("trousers"). Compared with the common Brown Goshawk, the wings are longer and more pointed and the tail is shorter.



Red goshawk

Ecology

The red goshawk hunts mainly for medium-sized birds (up to the size of kookaburras and black cockatoos). Territory size is typically very large (up to 200 km²) (Debus and Czechura 1988; Czechura and Hobson 2000). The preferred habitat is tall open eucalypt forest and riparian areas (including paperbark forest and gallery forests). The conspicuous basket-shaped stick nest is typically placed in large trees near watercourses (Aumann and Baker-Gabb 1991).

Conservation assessment

Based on a series of surveys across northern Australia (Debus and Czechura 1988; Aumann and Baker-Gabb 1991; Czechura and Hobson 2000), there is now reasonably reliable information available on distribution and total population. Garnett and Crowley (2000) collated these surveys to estimate the population size as 1000 breeding birds, and considered it to be vulnerable at the national level, on the IUCN 1994 criterion of D1 (<1000 mature individuals).

Based on the proportion of the known distribution, the Northern Territory population probably accounts for about one-third of the total population (that is, about 330 mature individuals). Of this tally, about 120 live on Melville Island (Woinarski *et al.* 2000). Proposed forestry operations are likely to reduce this Melville Island population by about 10%. Given these figures, the red goshawk qualifies as **Endangered** in the Northern Territory (under criteria C2a(i)) due to:

- population size estimated to number <2500 mature individuals;
- a continuing decline (observed, projected or inferred); and
- population structure with no subpopulation containing more than 250 mature individuals.

Threatening processes

Nationally, the red goshawk has been threatened chiefly by clearance of preferred habitat for agriculture, with some localised problems related to illegal egg-collection, shooting, and fire (Garnett and Crowley 2000). In the Northern Territory, the most immediate threat is clearing of prime habitat on Melville Island for short rotation plantations of exotic pulpwood.

Conservation objectives and management

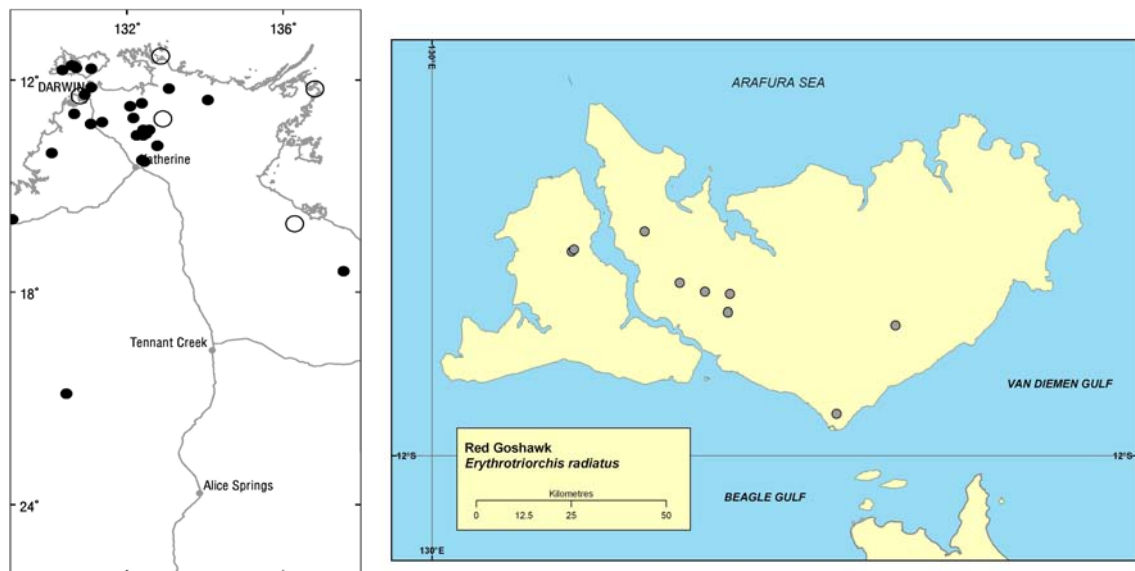
The management priorities are:

- (i) to minimise the impact of the proposed Melville Island forestry development, through retention of adequate habitat especially around known nest sites, and
- (ii) the establishment of an appropriate monitoring program.

Distribution

The red goshawk occurs across much of northern Australia, from near Broome in the south-west Kimberley to south-eastern Queensland. Within this range it generally occurs in taller forests characteristic of higher rainfall areas, but there are some isolated recent records from central Australia. It appears to be unusually common on the Tiwi Islands (Bathurst and Melville).

It has been recorded from Kakadu, Litchfield, Nitmiluk and Garig Gunak Barlu National Parks.



Known locations of the red goshawk. o = pre 1970; • = post 1970.

Compiled by

John Woinarski
[May 2002]

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PARTRIDGE PIGEON (eastern subspecies) *Geophaps smithii smithii*

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Vulnerable.
Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Lower Risk (near threatened).

Description

The partridge pigeon is an unmistakable ground-dwelling pigeon. It is medium-sized (slightly smaller than the feral pigeon *Columbia livia*: weights about 220g cf. 300g respectively), grey-brown bird with conspicuous white leading edge to the wing and red bare skin on the face. It forages entirely on the ground, and, except when flushed in alarm, rarely flies. The subspecies occurring in the Northern Territory *G. smithii smithii* differs from the other subspecies *G. s. blawii* (of the Kimberley) in colour of the bare skin around the face.



Partridge pigeon

Ecology

The diet of the partridge pigeon comprises seeds, mostly of grasses but also from *Acacia* and other woody plants (Higgins and Davies 1996). It is largely sedentary, although may make local-scale movements (up to 5-10km) in response to seasonal variations in water and food availability (Fraser 2001). It typically occurs singly or in small family groups, but larger aggregations may occur, especially in the late dry season, around water sources. It nests on the ground, mostly in the early dry season (Fraser 2001), with "nest" location preferentially in sites with relatively dense grass cover. Such sites contrast to the relatively open (typically burnt) areas preferred for feeding, and suggest that the species may be much affected by fire regimes. Small, patchy fires have been recommended for the management of this species (Fraser 2001).

Partridge pigeons occur principally in lowland eucalypt open forests and woodlands, with grassy understoreys; but also occur in some other vegetation types including paperbark woodlands and around plantation edges.

Conservation assessment

The partridge pigeon has declined substantially in the Northern Territory, and probably also in the Kimberley (Johnstone 1981; Garnett and Crowley 2000; Fraser 2001), although is still abundant in some locations (e.g. parts of Kakadu NP, Litchfield NP and Tiwi Islands: Woinarski *et al.* 2000). The timing and currency of this decline is poorly resolved, but may have occurred gradually over the last century (Franklin 1999). Neither the extent nor the recency of this decline quite meets the IUCN criteria for vulnerable status. However, it is likely that declines will continue and possibly escalate, given the recent rapid spread of exotic grasses and their consequential impact of increasing the intensity, extent and severity of fires.

Threatening processes

Partridge pigeons face a number of threats, whose relative impacts have not been well established. As they forage, nest and roost on the ground, partridge pigeons are highly susceptible to predation by feral cats. Partridge pigeons are also dependent upon daily access to water for drinking, so are likely to do poorly in relatively dry years, and will be affected by any manipulation of water sources.

But probably the most important threats are the inter-related changes in grass composition and fire regimes. Across much of the Top End (and including parts of the Tiwi Islands), exotic grasses (including mission grass *Pennisetum polystachion*, gamba grass *Andropogon gayanus* and/or other African and South American grasses) have spread rapidly over recent decades (e.g. Kean and Price 2003), and, where now present, have greatly reduced the diversity of native grasses. This will change the diversity, timing and abundance of seeds available as food to the partridge pigeon. Fire regimes have also changed appreciably over the Top End (and Tiwi islands) over the last century, and continue to change. Traditional Aboriginal fire regimes were probably far more patchy and fine-scale than the regimes now prevailing. The partridge pigeon was probably greatly advantaged by a regime of frequent, patchy but localised fire, and is probably disadvantaged by the current regime of fewer but more extensive fires. That current regime is now being made even more disadvantageous by the high fuel loads associated with exotic grasses, that make for hotter and more extensive fire.

Partridge pigeons may also be affected by the change in vegetation composition and structure caused by livestock and feral animals, although the direction and magnitude of this impact is uncertain. In some cases, grazing by stock may create the more open and patchy ground layer preferred by partridge pigeons (Fraser 2001).

Partridge pigeons occur principally in tall eucalypt open forest, and their population will be reduced wherever these areas are cleared. This habitat is that currently most subjected to conversion for horticulture or forest plantation.

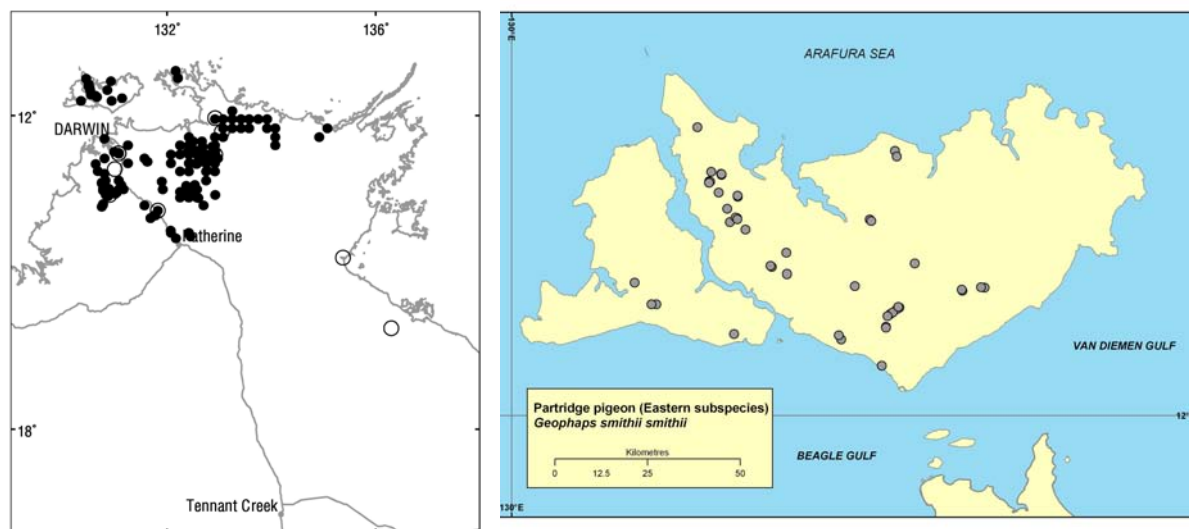
Conservation objectives and management

The major conservation management objective is to maintain extensive areas of eucalypt open forest with intact native grass species composition, and exposed to a fine-scale relatively frequent fire regime.

Distribution

The partridge pigeon occurs across the Top End of the Northern Territory and Kimberley. However it has declined or disappeared from much of the lower rainfall parts of this range over the last century.

In the Northern Territory, it has been recorded from Kakadu, Litchfield, Nitmiluk and Garig Gunak Barlu National Parks.



Known locations of the partridge pigeon. o = pre 1970; • = post 1970.

Compiled by

John Woinarski
(May 2003)

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HOODED ROBIN (Tiwi subspecies) *Melanodryas cucullata melvillensis*

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Not listed.

Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Endangered.

Description

The hooded robin is a small woodland bird with black head, white belly and black and white wings, tail and back. It typically perches quietly on low branches, and pounces on prey on the ground.

This subspecies is only weakly differentiated in morphology from those of the Australian mainland (Schodde and Mason 1999).



Hooded robin (male on left)

(© Graeme Chapman)

Ecology

On the Tiwi Islands, it has been reported from eucalypt tall open forests and treeless plains.

Its diet comprises mostly a range of ground-dwelling invertebrates. Other subspecies forage preferentially in areas where the ground vegetation is sparse (such as in burnt areas or in thickets where a dense canopy limits the cover of grasses: Woinarski and Fisher 1995).

Conservation assessment

There are extraordinarily few records of this taxon, despite recent unusually comprehensive and systematic general wildlife surveys within its range, and the generally reasonably conspicuous nature of hooded robins (Woinarski *et al.* 2000). The last known record was in 1992.

There is insufficient information to provide a reasonably precise estimate of total population or trends in that population, but its total population appears to be substantially less than 2,500 individuals, and it is highly probable that this is declining.

This trend may be exacerbated by a developing plantation forestry program on Melville Island that will transform 300-1000 km² of tall eucalypt open forest to short-rotation plantations of exotic species.

Based on this information, Garnett and Crowley categorised the Tiwi hooded robin as vulnerable, under the IUCN (1994) set of criteria C2b. Under the latest (2000) revision, the species is considered **Endangered** in the Northern Territory (under criteria C2a) due to:

- population size estimated at fewer than 2,500 mature individuals;
- an inferred or projected decline in numbers of mature individuals; and
- at least 95% of mature individuals within one subpopulation.

The fit to the latter criterion assumes that there is no subpopulation structure within and between Bathurst and Melville Islands.

Threatening processes

There is no detailed information on factors that may have contributed to the apparent decline of this taxon. The most likely is change in fire regime, from an intricate fine-scaled mosaic imposed by Aboriginal management to a more polarised regime now characterised by extensive areas burnt by larger hotter fires around more accessible areas, and a low frequency in the more remote areas (Woinarski *et al.* 2000). Low frequency of fires probably disadvantages this taxon, because the resulting dense grass cover leads to reduced foraging efficiency. A high frequency of extensive hot fires may also be disadvantageous.

The proposed transformation of large areas of eucalypt open forest to exotic plantations will also probably affect this taxon detrimentally.

Over much of their range elsewhere, hooded robins have also declined or become locally extinct, possibly due to predation by feral cats, vegetation change or changes in the abundance of some invertebrate prey.

Conservation objectives and management

Research priorities are to:

- (i) determine population size, distribution, habitat relationships and threats (especially relationship to fire).

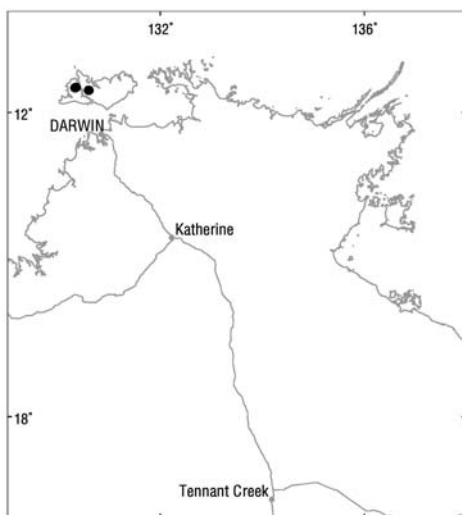
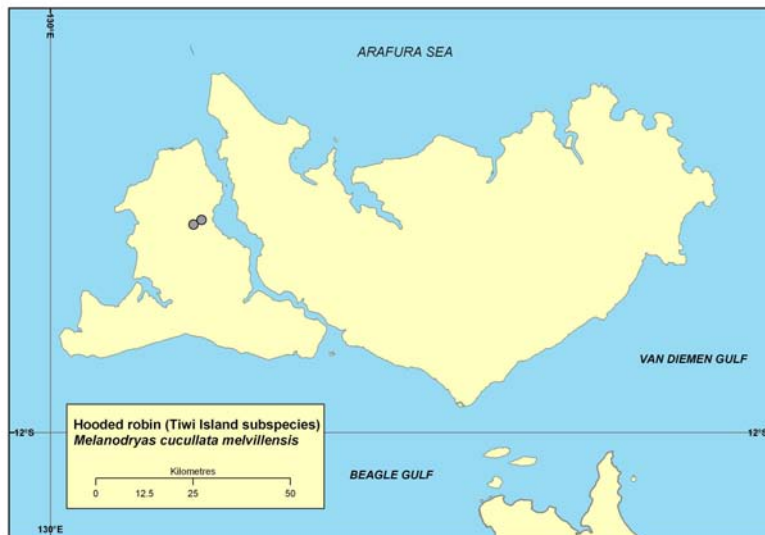
Management priorities are to:

- (i) ensure that forestry developments are associated with retention of adequate areas of habitat and populations;
- (ii) develop fire management programs, with the collaboration of Aboriginal land owners, that are not detrimental to this taxon.

Distribution

The Tiwi hooded robin is restricted to the Tiwi Islands (Bathurst and Melville). Within this range there are precise records from fewer than 10 localities.

It is not found in any conservation reserves.



Known locations of the Tiwi hooded robin.

Compiled by
John Woinarski
[February 2002]

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MASKED OWL (Tiwi subspecies)

Tyto novaehollandiae melvillensis

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*):

Vulnerable.

Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Endangered.

Description

The Tiwi masked owl is a large dark owl, most likely to be confused with the barn owl *Tyto alba*, which is noticeably smaller and paler, with far weaker legs and feet and with far less feathering on the legs. It is most likely to be detected from its loud call, which comprises a highly varied set of shrieks and complex whistles.

The Tiwi subspecies is only weakly differentiated from the subspecies occurring on mainland northern Australia. Both are appreciably smaller than the two other subspecies from south-eastern and south-western Australia.

Ecology

The Tiwi masked owl occurs mainly in eucalypt tall open forests (especially those dominated by *Eucalyptus miniata* Darwin woollybutt, *E. tetradonta* Darwin stringybark and *Corymbia nesophila* Melville Island bloodwood), but also commonly roosts in monsoon rainforests, and forages also in more open vegetation types, including grasslands and “treeless plains” (shrublands dominated by *Grevillea pteridifolia*, *Melaleuca* spp., *Acacia* spp., *Banksia dentata*, and other species) (Woinarski *et al.* 2000).

Although it may roost in dense foliage, it more typically roosts, and nests, in tree hollows. Mammals, up to the size of possums, constitute the bulk of its diet.

Although there is no detailed information for this subspecies, masked owls of other subspecies occupy large home ranges, estimated at 5-10km² (Kavanagh and Murray 1996).

Conservation assessment

Based on extrapolation of densities and home range size from other subspecies, Garnett and Crowley (2000) estimated the total population at about 1000 breeding pairs, within a total area of about 7400 km² on the Tiwi Islands.

Although there are no data available to assess trends in this population size, recently approved proposals for a plantation forestry project centred on probably the highest quality habitat for this species, would reduce this habitat by between 300 and 1000 km², resulting in a population decline of about 5-15% (depending upon the actual area committed for forestry and whether the owls used the commercial plantations).

On the basis of the total population size and this projected decline, Garnett and Crowley categorised the Tiwi masked owl as **Endangered**. It qualifies (under criteria C2a) due to:

- population size estimated at fewer than 2,500 mature individuals;
- an inferred or projected decline in numbers of mature individuals; and
- at least 95% of mature individuals within one subpopulation.

The fit to the latter criterion assumes that there is no subpopulation structure within and between Bathurst and Melville Islands.

Threatening processes

The most acute threatening process is conversion of large areas of its optimum habitat (eucalypt tall open forest) to short-rotation plantations of exotic timber species.

It may also be affected more pervasively by altered fire regimes, producing changed vegetation composition and then changes in the abundance of native mammals.

Conservation objectives and management

The main research priority is to:

- (i) derive more precise information on population size, home range, habitat requirements, etc., and using these to develop a usable population viability model.

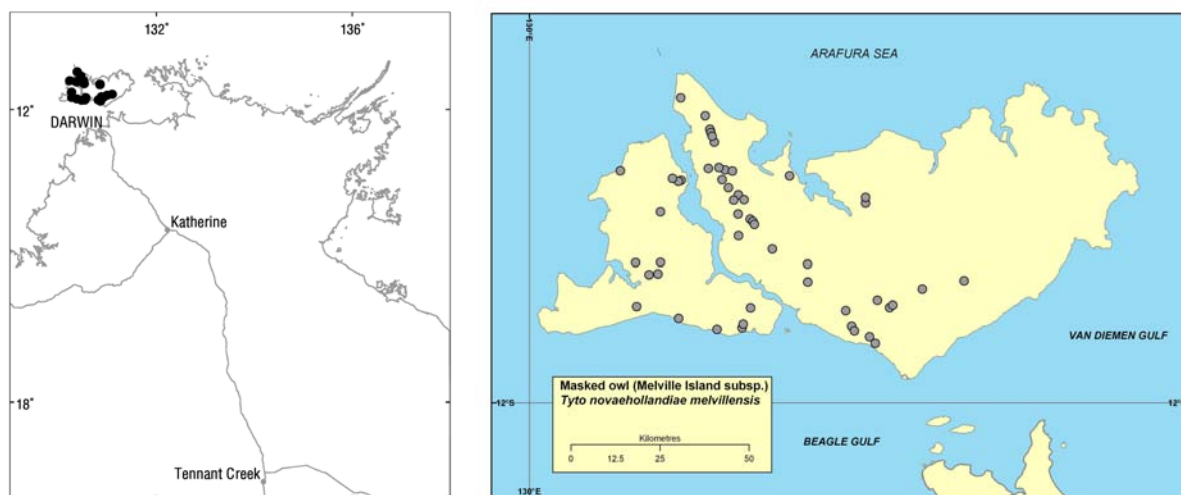
The main management priorities are:

- (i) ensuring the retention of adequate areas of prime habitat within a forestry management program;
- (ii) establishment of a monitoring program to assess the impacts of forestry development.

Distribution

This subspecies of masked owl is restricted to Bathurst and Melville Islands (the Tiwi group).

It is not known from any conservation reserve.



Known locations of the Tiwi masked owl.

Compiled by

John Woinarski
[February 2002]

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BRUSH-TAILED TREE-RAT (Brush-tailed rabbit-rat)

Conilurus penicillatus

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Not listed.

Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Vulnerable.

Description

A moderately large (about 150 g) partly arboreal rat, with long brush-tipped tail (with the distal third either black or white), long ears. Fur colour is relatively uniformly coloured brown above, and cream below. It is distinctly smaller than the two other long-tailed tree-rats in the Northern Territory.



Brush-tailed tree-rat

Ecology

Preferred habitat is eucalypt tall open forest, generally with a relatively dense tall shrubby understorey. However, at least on Cobourg Peninsula, it also occurs on coastal grasslands (with scattered large *Casuarina equisetifolia* trees, beaches, and stunted eucalypt woodlands on stony slopes.

It shelters in tree hollows, hollow logs and, less frequently, in the crowns of pandanus or sand-palms. Most foraging is on the ground, but it is also partly arboreal. The diet comprises mainly seeds (especially of grasses), with some fruits, invertebrates and leaves and grass.

Conservation assessment

Conservation assessment is hampered by lack of knowledge concerning the timing, extent and currency of geographic decline, and the lack of a recent assessment of their status on Groote Eylandt and Centre Island. Its range and population size in the

Northern Territory has probably declined by well over 50% since European settlement, but this decline cannot be dated with any assurance. Certainly, its current status no longer matches that reported more than 100 years ago: “in Arnhem Land is everywhere common in the vicinity of water” (Dahl 1897), “numerous all over Arnhem Land, and in great numbers on the rivers of the lowlands” (Collett 1897). There is some suggestion of a decline within the last 20 years at Kakadu National Park, but this is based on very few records (Woinarski *et al.* 2001).

Current research will provide some assessment of the population size (or at least an index of abundance, whose assessment can be consistently repeated) on Bathurst and Melville Islands, Cobourg Peninsula and Kakadu. A recent study (PWCNT 2001) found very high population density (>6 individuals/ha) in at least two locations on Cobourg Peninsula.

Its status best fits **Vulnerable** (under the criteria B1ab(i,ii,iii,iv,v) based on:

- extent of occurrence estimated to be <20,000 km²;
- severely fragmented or known to exist at no more than 10 locations; and
- continuing decline, observed, inferred or projected.

Within this set, the estimate of extent is most arguable, as the islands where it is present are widely scattered. The total area of the islands known to be occupied is 11813 km², and that of Cobourg Peninsula is 2207 km². Elsewhere on the Territory mainland it is known to persist only in a small area (<20 km²) within Kakadu National Park.

The Tiwi Island subspecies *C.p. melibius* unequivocally meets this set of criteria (with total extent of occupancy of about 8300 km²). The other subspecies *C.p. penicillatus* would meet the set of criteria B2ab(i,ii,iii,iv,v).

Threatening processes

No single factor has been demonstrated to have caused the decline of brush-tailed rabbit-rats, but the extent of loss on the mainland and the maintenance of some island populations suggests that it is probably not due to land use factors but rather to either disease or exotic predators. The most likely causal factor is predation by feral cats.

However, it is possible that broad-scale habitat change may have contributed to the apparent decline. Changed fire regimes, weeds and grazing by livestock and feral animals may have changed the availability of preferred or vital food resources (e.g. seeds from particular grass species), and more frequent hot fires may have reduced the availability of hollow logs, tree hollows and the tall fruit-bearing understorey shrubs.

The population on the Tiwi Islands will be reduced by a proposed forestry development which aims to clear between 30,000 and 100,000 ha of the preferred habitat (tall eucalypt open forests) and replace this with plantations of fast-growing exotic *Acacia* species.

Conservation objectives and management

Management priorities are to:

- (i) establish a monitoring program in at least two sites, which can also measure responses to management actions. The baseline for this monitoring has now been established, with current studies on Cobourg Peninsula and in Kakadu National Park.
- (ii) maintain effective quarantine actions for island populations, most particularly relating to maintaining at least some of these islands cat-free. Note that all islands occupied are Aboriginal lands.

(iii) develop effective captive population breeding programs, and evaluate the possibility of establishing translocated populations (either to currently uninhabited islands or to appropriately managed conservation reserves).

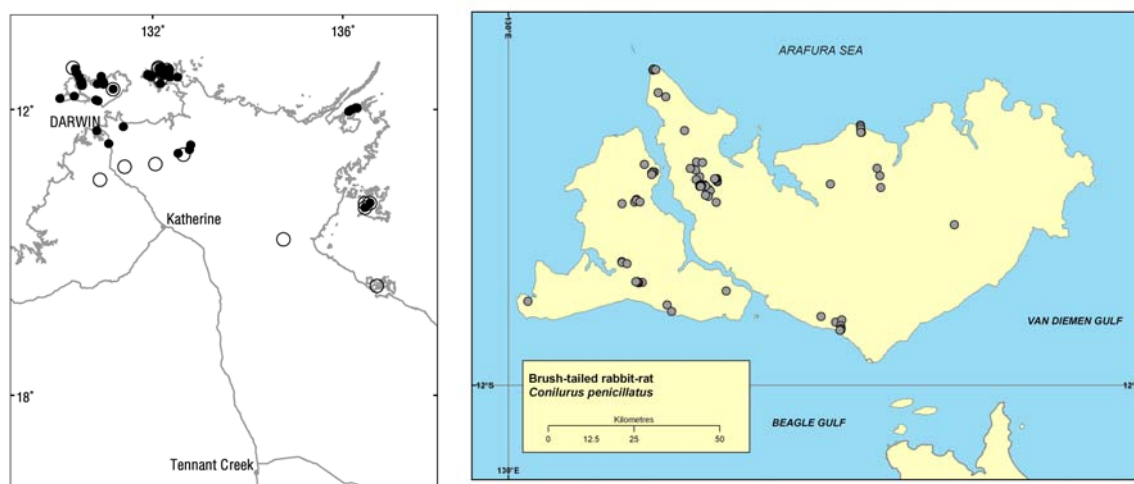
Distribution

In the Northern Territory, this species has been recorded from near-coastal areas from near the mouth of the Victoria River in the west to the Pellew Islands in the east, and including Bathurst, Melville, Inglis and Centre Islands and Groote Eylandt (Parker 1973; Kemper and Schmitt 1992; Woinarski 2000). There are no recent records from much of this historically recorded range, and it is currently known to persist in the Northern Territory only on Cobourg Peninsula, Bathurst, Melville, Inglis and Centre Islands, Groote Eylandt, and a small area within Kakadu National Park.

Two weakly-defined subspecies are recognised from the Northern Territory: *C.p. melibius* from the Tiwi Islands, and *C.p. penicillatus* from all other Australian areas (Kemper and Schmitt 1992).

Beyond the Northern Territory, the species also occurs from higher rainfall, near-coastal areas of the north Kimberley, Bentinck Island (Queensland) and a small area of southern New Guinea.

In the Northern Territory, it is known from two conservation reserves, Kakadu and Garig Gunak Barlu (formerly Gurig) National Park.



Known locations of the brush-tailed tree-rat. o = pre 1970; ● = post 1970.

Compiled by
John Woinarski.
[February 2002]

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NORTHERN BRUSH-TAILED PHASCOGALE

Phascogale (tapoatafa) pirata

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Not listed.
Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Vulnerable.

Description

The northern brush-tailed phascogale is a carnivorous marsupial about midway in size between the larger northern quoll and the small antechinuses and dunnarts. Its most notable feature is the long dark hairs on the tail, which form a distinctive brush. The hairs can be stiffened when alarmed, giving a bottle-brush appearance. The general body colour is dark grey, the snout is notably pointed and the eyes are large. Body weight is about 150-200 g.



Photo: M. Armstrong

Northern brush-tailed phascogale.

Ecology

There have been no detailed studies of the northern brush-tailed phascogale, but its ecology is probably similar to that reported for its temperate relatives (Rhind 1998). The diet is predominantly invertebrates with some small vertebrates. It is a nocturnal mammal, feeding both in trees and on the ground. It shelters in tree hollows during the day. Most records are from tall open forests dominated by *Eucalyptus miniata* (Darwin woollybutt) and *E. tetradonta* (Darwin stringybark).

Conservation assessment

Conservation assessment is hampered by the lack of precise information on range, population size and trends. Decline is evident from variation between historic statements about status and current assessments: most notably Dahl (1897) reported that "*on the rivers Mary and Katherine it was frequently observed. In fact nearly everywhere inland it was very constant, and on a moonlight walk one would generally expect to see this little animal*". This is certainly no longer the case. Surveys by PWCNT across the Top End over the last decade have resulted in fewer than 10 captures of brush-tailed phascogales in more than 350,000 trap-nights. However this meagre tally may also partly reflect some degree of trap-shyness.

It best fits the status of **Vulnerable** (under criteria C2ai) based on:

- population size estimated to number fewer than 10,000 mature individuals;

- a continuing decline, observed, projected or inferred, in numbers of mature individuals; and
- no subpopulations estimated to contain more than 1000 mature individuals.

Threatening processes

There are no data available to evaluate threatening processes. The apparent decline to coastal areas and especially islands suggests either exotic predators (cats) or disease. Other factors potentially involved may include vegetation change due to altered fire regimes and/or pastoralism. As a predator of small vertebrates, this species may be affected by the arrival of cane toads, but there is no relevant information available to assess the likelihood of this potential threat.

Conservation objectives and management priorities

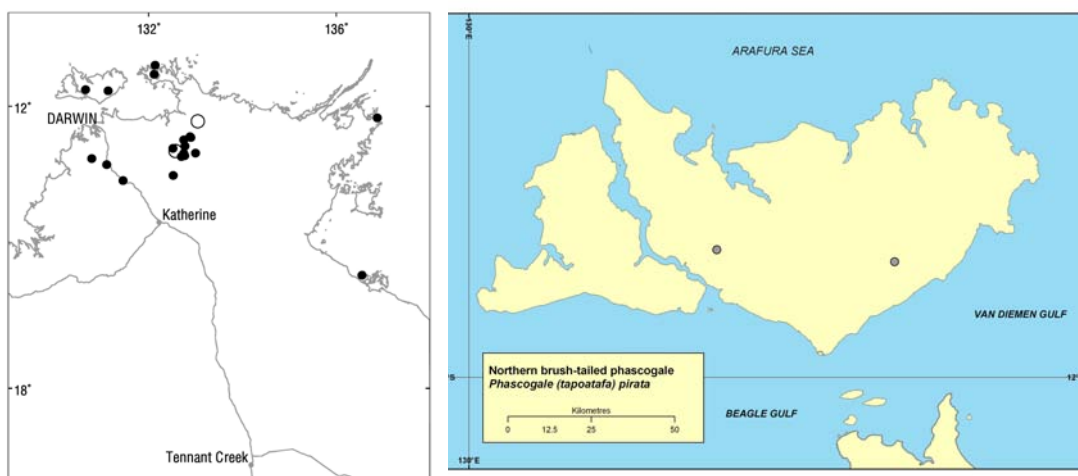
The major priority is to firm up knowledge of the distribution, abundance, habitat requirements and trends for this species. This will require a detailed autecological study and a distributional survey.

Distribution

Recent taxonomic studies (Rhind *et al.* 2001, Spencer *et al.* 2001) have suggested that the northern population of brush-tailed phascogale is specifically distinct from that in south-western and south-eastern Australia. As redefined, the northern brush-tailed phascogale is known from a few records on Cape York Peninsula, the Top End of the Northern Territory, and parts of the north Kimberley.

In the Northern Territory, there are recent (since 1980) records from the Tiwi Islands, Cobourg Peninsula, Groote Eylandt, West Pellew Island, Kakadu National Park (notably around Jabiru and near Jim Jim ranger station), and Litchfield National Park. There are older records from the Gove and Katherine areas.

It is known to still exist in three Northern Territory reserves: Kakadu, Litchfield and Garig Gunak Barlu (formerly Gurig) National Parks.



Known locations of the northern brush-tailed phascogale. ○ = pre 1970; ● = post 1970.

Compiled by
John Woinarski
[March 2002]

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BARE-RUMPED SHEATHTAIL BAT

Saccoilamus saccoilamus

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Not listed. However, listed as critically endangered in the Commonwealth's Bat Action Plan (Duncan *et al.* 1999).

Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Data Deficient.

Description

The bare-rumped sheathtail bat is a large (50 g) insectivorous bat. As with other sheathtail bats, the tip of the tail is free of the tail membrane. The fur is dark red-brown to almost black, with white speckles, and this fur doesn't extend to the rump.

Ecology

This is a high-flying insectivorous bat. The Kakadu specimens were collected from open *Pandanus* woodland fringing the sedgeland of the South Alligator River (Friend and Braithwaite 1986). In the Northern Territory, it has also been recorded from eucalypt tall open forests (Churchill 1998). In Queensland, it is known mainly from coastal lowlands, including eucalypt woodlands and rainforests (Duncan *et al.* 1999).

It roosts in tree hollows and caves (Duncan *et al.* 1999).

Conservation assessment

The national assessment of Critically Endangered was based on the apparent absence of recent records from its relatively small known historic range in north-eastern Queensland, associated with substantial vegetation clearance there.

Its status in the Northern Territory is very difficult to assign, given the remarkably few records. One problem is that there is no record of a diagnostic call assigned to this species that can be used for detection (Duncan *et al.* 1999).

In the Northern Territory, there is no information from which to consider trends in status, and no obvious threatening process. While the known range is currently very limited, this largely may reflect sampling problems. Given this lack of critical information, the taxon is best considered **Data Deficient**.

Threatening processes

There are no obvious threatening processes. Hollow availability may be reduced by increasing levels of clearing in the Darwin-Mary River area, but this will not affect populations within Kakadu National Park.

Vegetation change associated with saltwater intrusion and/or invasion by exotic species (such as *Mimosa pigra*) may affect habitat suitability.

Conservation objectives and management

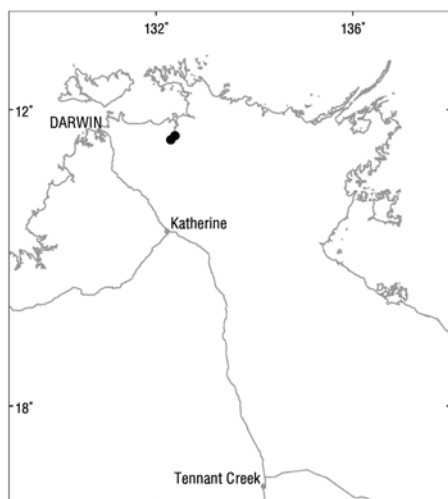
Research priorities are to:

- (i) undertake a targeted study to better define habitat, distribution, population size, and status, and to develop more effective detection techniques.
- (ii) resolve the taxonomic status of the Northern Territory population relative to that in north-eastern Queensland.

Distribution

This species has a wide distribution from India through south-eastern Asia to the Solomon Islands, and including north-eastern Queensland and the Northern Territory. The north-eastern Australian populations are described as the subspecies *S. s. nudicluniatum*, although it is not clear whether this should be applied to the Northern Territory population (Duncan *et al.* 1999).

It was first recorded in the Northern Territory in 1979, and there have been very few (<5 confirmed) records since (McKean *et al.* 1981; Thomson 1991). Its presence here in listing of Tiwi Island threatened species is based on one unconfirmed record from Melville Island (ForSci 1999). All confirmed records have been from the Kakadu lowlands. However, it is likely to be more widespread (McKean *et al.* 1981).



Known locations of the bare-rumped sheathtail bat. • = post 1970.

Compiled by

John Woinarski and Damian Milne
[February 2002]

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BUTLER'S DUNNART

Sminthopsis butleri

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*):

Vulnerable.

Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Vulnerable.

Description

A small (about 15 g) dunnart ("marsupial mouse"), distinguished from other dunnarts of the Top End by a combination of lack of rufous markings on the face, relatively small size, and the patterning on the soles of the hindfeet (relatively hairy, with the interdigital pads fused at the base and with conspicuously enlarged unstriated apical granules) (van Dyck *et al.* 1994).



Butler's dunnart is a mouse-sized insectivorous marsupial.

Ecology

Very little is known of the ecology of this species. The few records are associated with a range of habitats (Woinarski *et al.* 1996, 2000), including eucalypt open forest (dominated by *Eucalyptus tetradonta* and *E. miniata*), *Melaleuca* woodland, and "blacksoil sandplain ... heavily vegetated with eucalypt and grass" (Archer 1979). It is terrestrial, and shelters under logs and other cover.

As with other dunnarts, the diet of this species probably comprises invertebrates, and possibly some small vertebrates.



Habitats of known locations on the Tiwi Islands includes eucalypt open forest

Conservation assessment

The status of Butler's dunnart is difficult to evaluate, given the few records and lack of any information on trends in abundance. We can reasonably infer that it is uncommon in its only known Northern Territory location, the Tiwi Islands. These have now been subject to a substantial biodiversity survey effort since 1991, but this sampling has produced only five individuals. This population can be considered to be likely to decline based on loss of large areas of suitable habitat (300-1000 km² from a total Tiwi Islands area of about 7400 km²) associated with an approved forestry plantation project. It may also decline with increasing abundance of feral cats on the Tiwi Islands.

Consequently, Butler's dunnart fits the status **Vulnerable** based on:

- extent of occurrence estimated to be <20,000 km² ;
- severely fragmented or known to exist at no more than 10 locations; and
- continuing decline, observed, inferred or projected (criteria B1ab)

Threatening processes

The immediate threat to the population is the proposed loss of large areas of suitable habitat on Melville Island because of vegetation clearance for plantation forestry.

Butler's dunnart may also be affected by predation from feral cats, and vegetation change associated with altered fire regimes, weeds and/or feral animals.

Conservation objectives and management

Research priorities are to:

- (i) undertake sampling to more precisely define the range and status;
- (ii) undertake a specific study to provide more information on the ecological requirements of, and threatening factors affecting, this species.

Management priorities are to:

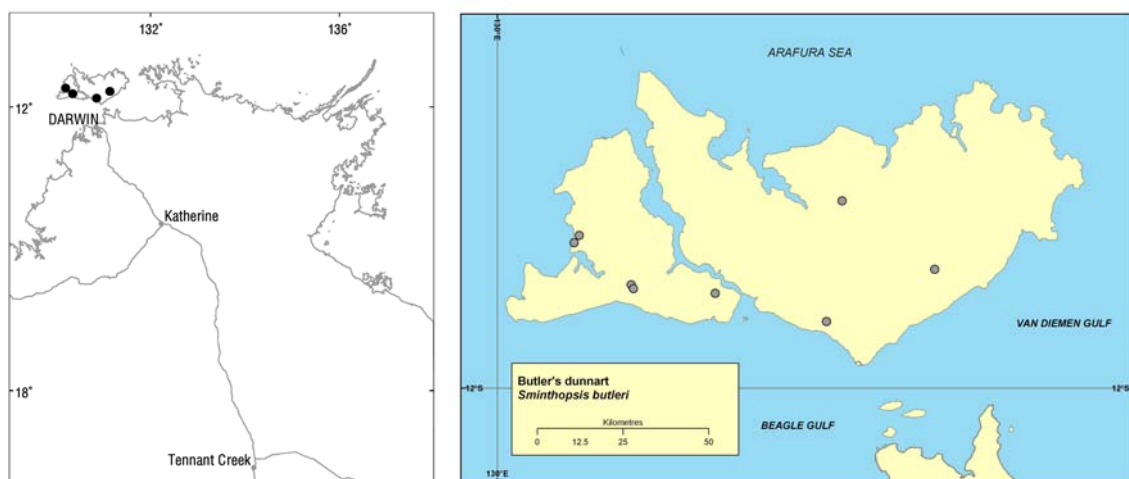
- (i) ensure the retention of sufficient areas of preferred habitat on the Tiwi Islands, especially around the few sites of known occurrence

Distribution

There are remarkably few records of Butler's Dunnart. It was described from three specimens collected at Kalumburu (north Kimberley) between 1965 and 1966. It has not been recorded from Western Australia since. Subsequently, five individuals have been caught from Bathurst and Melville Islands, and a previously-misidentified record from Melville Island in 1913 has been re-assigned to this species (Woinarski *et al.* 1996, 2000).

This species has not been recorded from any conservation reserves.

When first described (in 1979) this species was considered to extend to Cape York Peninsula and New Guinea, and hence named as the "carpentarian dunnart". Subsequently, specimens from those areas have been split off, as *S. archeri* (the chestnut dunnart).



Known locations of the Butler's dunnart.

Compiled by

John Woinarski.
[February 2002]

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FALSE WATER-RAT

Xeromys myoides

Conservation status

Australia (*Environment Protection and Biodiversity Conservation Act 1999*): Vulnerable.
Northern Territory (*Territory Parks and Wildlife Conservation Act 2000*): Data deficient.

Description

The false water-rat is a small (35-50g) rodent of unmistakable appearance. The most distinctive external features are a broad relatively short face, and very short sleek fur. Fur colour is pale grey above and white below. Eyes and ears are relatively small.



False water-rat

Ecology

The ecology of the species is reasonably well known from a detailed study on North Stradbroke Island, Queensland (Van Dyck 1996). The false water-rat is a nocturnal predator eating mainly marine and freshwater invertebrates, especially including crabs, pulmonates and molluscs. It forages entirely on the ground, and is an adept swimmer. It builds and shelters in either burrows or substantial earthen mounds.

Its habitats comprise mangrove forests, freshwater swamps and floodplain saline grasslands (Woinarski *et al.* 2000).

Conservation assessment

Conservation assessment is hampered by the lack of precise information on range, population size and trends, to such an extent that it may qualify best as *data deficient*. However, in the Northern Territory, it can be assigned the status of **vulnerable** on the set of criteria B2ab (area of occupancy estimated to be less than 2000km²; severely fragmented or known to exist at no more than 10 locations; and continuing decline, observed, inferred or projected in area of occupancy, area, extent and/or quality of habitat, and number of locations or subpopulations).

This assignment rests on a presumption that only a small proportion of the Territory's mangroves and floodplains is suitable for (and/or occupied by) the species, and that a range of factors (including saltwater intrusion, spread of weeds, especially *Mimosa*

pigra, and grazing of the floodplains by domestic and feral water buffalo and cattle) are operating to reduce habitat quality.

Threatening processes

There is insufficient information available to assess the impacts of possible threatening processes. There may be some predation by feral cats. However, the most plausible threatening processes relate to broad-scale habitat changes, especially those due to saltwater intrusion, spread of weeds and impacts of grazing. However, it is not clear that these changes necessarily reduce habitat quality for this species, and they are unlikely to diminish the extent of mangrove communities.

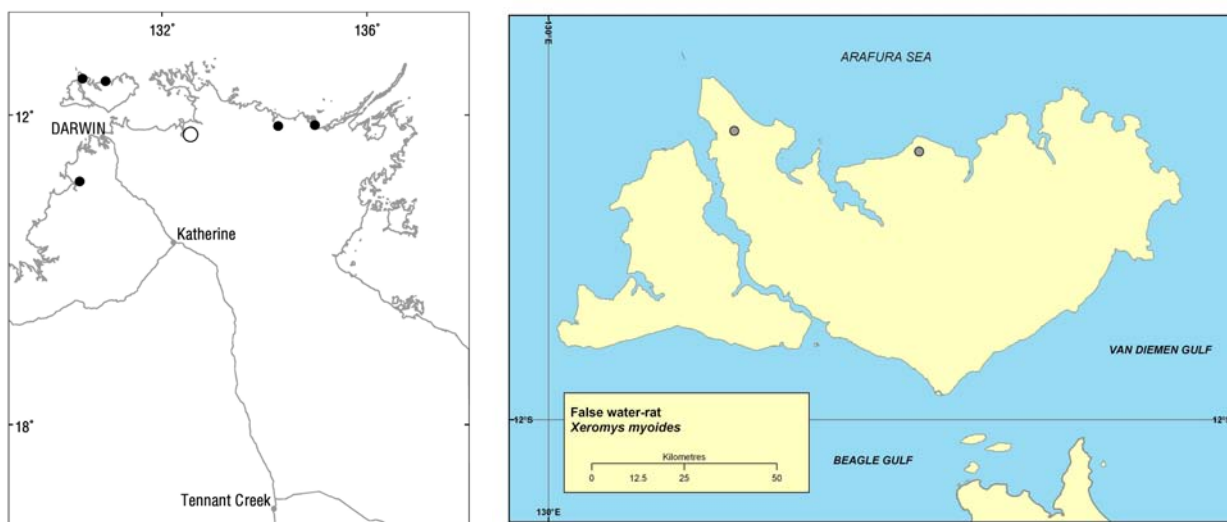
Conservation objectives and management priorities

The main priorities are to better define the distribution and status of this species and to assess the impacts of a range of putative threatening processes. Such information is needed before management prescriptions can be formulated appropriately.

Distribution

In the Northern Territory, it is known from only 10 records at 6 sites (South Alligator River in 1903, Daly River floodplain in 1972, two sites on the Tomkinson River in 1975, Melville Island in 1975 and Glyde River floodplain in 1998 and 1999) (Redhead and McKean 1975; Magnusson *et al.* 1976; Woinarski *et al.* 2000). Beyond the Northern Territory, it is also known from three sites in coastal south-eastern Queensland and one site in New Guinea.

It is known to occur in only one Northern Territory reserve (Kakadu National Park), but this record is from 1903.



Known locations of the false water-rat.

Compiler

John Woinarski
[March 2002]

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Appendix C:

Summary of standard wildlife survey methods (Parks & Wildlife Commission of the Northern Territory).

FAUNA SURVEY

Fauna sampling (and habitat and vegetation description) is based on quadrats. Some incidental observations are made outside quadrats, and some special methodologies may be adopted in particular projects.

Quadrats

In the Top End, the quadrats used are 50m x 50m but rectangular quadrats, with an equivalent area, may be used to sample narrow patches e.g. riparian strips. Birds are sampled in a 100m x 100m quadrat centred on the core 50m x 50m quadrat.

Quadrats are located within substantial areas of relatively homogeneous vegetation and landform, and not near boundaries, e.g. fences or roads. The exception is when a deliberate decision is made to sample a small patch, edge or ecotone. Quadrats should be well separated (i.e. 500m + apart) except where sampling adjacent contrasting land types.

Survey sites are selected to represent land units, vegetation types and land condition in the project area, along with a geographic spread. The number of habitats sampled and the number of quadrats sampled per habitat depend on the size and diversity of the study area and the time and resources available, as well as the aims of the study.

The location of each quadrat is determined as precisely as possible, preferably using averaged GPS reading.

Traps

Each quadrat is sampled using:

- 4 cage traps – one in each corner
- 20 Elliott traps around the perimeter – 5 on each side, c. 8m apart
- 4 pit traps scattered within the quadrat. Two pits are 20 litre plastic buckets and two are 10 litre plastic buckets, and each pit has 10m of drift-fence. Pits are located in different microhabitats in the quadrat e.g. in open ground; in dense grass; close to trees; in rocky areas.

All traps are marked clearly with flagging tape so they can be easily located and are opened for 3 nights. Traps are checked early each morning and rechecked at midday. Elliott and cage traps are rebaited each afternoon. The bait is a mixture of oats, peanut butter & honey. Vanilla essence, cat biscuits and tuna can be added. Cage traps may be baited with fruit or meat scraps. Trapped animals are identified and released near the capture point, or retained for as short a time as possible for identification or for taking measurements.

Bird counts

Eight daylight bird counts are carried out in each quadrat. In addition, birds are recorded during two nocturnal visits – see below. The majority of bird counts are done in the early morning, with a few spread through the day.

Each bird count is theoretically an instantaneous count of all the birds within the quadrat. In practice this involves briefly walking through the quadrat but it is not a count over an extended period of time. The number of individuals of each species is recorded for each count. Only birds that are using the quadrat are recorded – birds merely flying across overhead are not included. Raptors, wood-swallows, etc are included if they are observed hunting overhead.

Searches

Each quadrat is actively searched five times for reptiles, amphibians, mammals, scats and signs. Three searches are carried out during the day (morning, midday, late afternoon) and two searches at night using spotlights. Each search takes about 10 minutes and involves turning rocks and logs, raking through leaf litter, looking under bark or in rock crevices. The number of individuals of each species seen is recorded. Scats, bones and other signs are recorded where these can confidently be attributed to species. Carnivore scats are collected for hair analysis.

Incidental records

Species that are seen in the vicinity of the quadrat and in the sampled environment are recorded as incidental records for that site, with an abundance of zero to indicate they were not within the quadrat

Other species seen in the general area are recorded on a separate list for the general area. Where possible, the exact location and brief habitat details for the species are noted. This is most important for species that have some significance (e.g. rare or vulnerable species or species for which the record may be a range extension)

Data recording

Each species from the quadrat is recorded on a proforma, along with a total abundance (the sum of all records from captures, searches, bird counts). Incidental records adjacent to the quadrat are given an abundance of zero. Data are transferred from proformas to electronic databases (primarily FoxPro).

Specimens

For all species that cannot be positively identified in the field, an individual is euthanased and preserved for later identification.

Bat Sampling

A systematic method for censusing bats includes timed recordings using Anabat equipment in each quadrat.

Bats are also opportunistically sampled using harp traps and mist nets, by sightings or captures in caves, and identification of audible calls for a few species. For each record the location and brief habitat description are noted. When traps are used the trapping time is also recorded. It is usual procedure to take basic measurements of all bats trapped. Reference calls on Anabat may be recorded from captured individuals.

HABITAT DESCRIPTION

The proforma is designed to collect ecologically meaningful data about the sample sites. Self-evident cells are not explained below.

Environmental variables

<i>quad</i>	unique label for each quadrat e.g. TIPP1
<i>survey</i>	bioregional survey e.g. Daly Basin
<i>region/ station</i>	usually park name, station name or sample region
<i>observer</i>	the person deciding what data values go onto the sheet (not necessarily the scribe)
<i>location</i>	explicit details about the site location – in relation to roads, tracks, creeks, landscape features etc – sufficient for someone else to relocate it
<i>lat/ long</i>	precise location from GPS. Use averaged readings from large Magellans if possible
<i>x/y</i>	AMG easting and northings – alternative reading from GPS
<i>landscape position</i>	brief description of landscape setting of site. Use the format of the "Yellow Book" e.g. narrow valley in sandstone plateau; midslope on low hills
<i>landunit</i>	where available, from land unit mapping
<i>run on/ off</i>	<u>run off</u> sites shed rainfall (e.g. hill crests, upper slopes); <u>run-on</u> sites receive run-off e.g. swamps, base of hills; plains are extensive flat areas
<i>patch size</i>	contiguous area of sampled habitat type. Most relevant for restricted habitats e.g. rainforest, lancewood, rock outcrop.
<i>slope</i>	measured in degrees using a clinometer – estimate a mean slope for heterogeneous quadrats
<i>aspect</i>	the direction the slope faces – leave blank for zero slope
<i>altitude</i>	from topo map
<i>perm water</i>	estimated distance to nearest permanent water (including artificial sources)
<i>curr water</i>	distance to nearest water at time of survey
<i>disturbance</i>	various disturbance are scored on a scale of zero to 5, for major impact affecting all of quadrat. This will be somewhat subjective. 1 should mean that the disturbance is present but has had virtually no effect, 3 that there is a low level of disturbance throughout the quadrat, or a moderate effect concentrated in patches
<i>last fire</i>	estimate from fire scars and regeneration whether the site was burnt during the current year; the previous year; fire scars present but apparently old; or no sign of fire or its effects

<i>rock cover</i>	the total cover of rocks within the quadrat is estimated using cover classes for different size classes of rocks (see the "Yellow Book" for examples). Rock sizes refer to the longest dimension on the rock. ** includes rock cover underneath vegetation or litter**
<i>rock type</i>	broad classifications of the principal rock types – add others if you can determine them
<i>lithology</i>	an optional field for the underlying lithology from a geological map
<i>soil texture</i>	broad texture classes relating to the amount of clay in the soil – see Yellow Book
<i>termite mounds</i>	estimate the total number in the quadrat, the maximum height and whether they are tall & thin, squat & wide or magnetic mounds
<i>ground cover</i>	** these variables are quantified by stretching out a 100m tape through the quadrat (use a V-shape). Walk along the tape, looking vertically down and at each 1m score which feature is directly below the mark. The measures should add to 100%, so a piece of grass above litter or rocks would be scored only as grass**.
<u>hummock grass</u> is spinifex (<i>Triodia</i> or <i>Plectrachne</i>)	
<u>annual grasses</u> can easily be pulled out and have very short root systems; <u>perennial grasses</u> are more firmly rooted in the ground and mostly form distinct tussocks	
<u>other forbs</u> are herbs, ferns and small shrubs	
** only score vegetation in the ground layer i.e. below c. 50cm tall	

Vegetation structure

<i>canopy height</i>	mode height of canopy trees (not the tallest), using a clinometer
<i>canopy cover</i>	estimation of projective foliage cover of canopy. Best done objectively, using a device which we will try out shortly
<i>veg profile</i>	estimate the cover of vegetation (using cover classes) in different height zones. The same plant could contribute cover to more than one zone
<i>structural formation</i>	classification of the upper storey (in the quadrat and the surrounding vegetation it represents) as closed forest, open forest, woodland, open woodland, scattered trees or none. Canopy cover and crown separation are given as guides. A crown separation of 0.25 means the mean distance between the crowns of adjacent trees is one-quarter of the mean crown width
<i>Bitterlich sweeps.</i>	Basal area is estimated using sweeps with a Bitterlich measure. The number of sweeps is ideally four, from the 4 corners of the quadrat – fewer sweeps could be used in very open homogeneous vegetation. Unless the tree layer is very dense or trees are very large, use the smallest slot (multiplier = 0.25). ** record the number of sweeps and the slot size (multiplier) used ** For each individual tree scored, visually estimated the DBH class it falls into. All tree species registering a hit are scored separately. The total is the number of hits for each species over all the sweeps
<i>Dominant species</i>	Record the species with at least 5% cover in the three strata of the vegetation in decreasing order of cover. Only enter a max. of 5 species per strata. If there is a tall shrub layer and no tree layer, regard this as the mid layer. ** except in monsoon forests, few species have >5% cover in a 50m quadrat **

Floristic data

The aim is that all quadrats used in bioregional surveys will also have a full floristic inventory done. This will usually be done by a botanist, concurrently with the fauna survey or on a separate trip. The botanist should record the following:

- all plant species present in the 50x50m quadrat
- for each species, an estimate of cover (projective foliage cover) as <1%, 1%, 2%, 5%, 10% or to the nearest 10%. It is recommended that a point-intercept or wheel-point measure is used for the ground layer species

If the floristic inventory is to be done separately, the quadrat must be marked in such a way that the botanist can find both the location and at least approximately the boundaries.

PWCNT Bioregional Surveys quadrat environmental description pro-forma

QUAD:	survey:		quad. size: 50x50 100x100 other:	
region / station:		date:		observer
location details:				
lat:	long:	x:	y:	
landscape position:			photo ref. no.	
land unit:	run: on off plain	patch size (ha): <1 1-5 5-50 50-500 500+		
edge: ecotone or distance:		adj. unit:		
slope (°):	aspect: N NE E SE S SW W NW		herbarium plot ref. no.	
perm water: 0 <50m 50-500m 0.5-5km >5km		curr water: 0 <50m 50-500m 0.5-5km >5km		
disturbance 0=no visible impact -> 5= major impact affecting all of quadrat				
fire impact: 0 1 2 3 4 5		last fire: this year last year 2+ years ago long unburnt		
pig damage: 0 1 2 3 4 5		cow/horse/donkey: 0 1 2 3 4 5		weeds: 0 1 2 3 4 5
other: 0 1 2 3 4 5 describe:				
rock cover (%) pebbles (<0.6cm): 0 <2 2-10 10-20 20-50 50-90 >90 small stones (0.6-2cm): 0 <2 2-10 10-20 20-50 50-90 >90 stones (2-6cm): 0 <2 2-10 10-20 20-50 50-90 >90 small rocks (6-20cm): 0 <2 2-10 10-20 20-50 50-90 >90 rocks (20-60cm): 0 <2 2-10 10-20 20-50 50-90 >90 big rocks (60cm-2m) 0 <2 2-10 10-20 20-50 50-90 >90 boulders (>2m): 0 <2 2-10 10-20 20-50 50-90 >90 outcrop: 0 <2 2-10 10-20 20-50 50-90 >90				rock type sandstone laterite limestone basalt other: lithology:
soil texture: sand sandy-loam loam clay-loam clay cracking clay peat rock				
soil depth (cm): 0 <10 10-40 >40		soil colour:		
termite mounds - no:		max ht (m):	profile: tower dome magnetic	
ground cover (measured along 100m point-intercept tape)				total
bare ground				
rock				
litter				
hummock grass				
perennial grass				
annual grass				
sedge				
other forbs				
logs >5cm				

QUAD:	canopy ht (m):	canopy cover (%):
veg. profile (% cover in height classes) >10m: 0 <5 5-10 10-25 25-50 50-75 >75 5-10m: 0 <5 5-10 10-25 25-50 50-75 >75 3-5m: 0 <5 5-10 10-25 25-50 50-75 >75 1-3m: 0 <5 5-10 10-25 25-50 50-75 >75 0.5-1m: 0 <5 5-10 10-25 25-50 50-75 >75 0-0.5: 0 <5 5-10 10-25 25-50 50-75 >75		structural formation (upper storey) <div style="display: flex; justify-content: space-between;"> <div></div> <div><i>cover</i></div> <div><i>crown separation</i></div> </div> CF 70-100% overlapping OF 30-70% 0 - 0.25 W 10-30% 0.25 - 1 OW <10% > 1 ST scattered isolated trees none ground layer only

Bitterlich sweeps		number: 1 2 3 4				multiplier: 0.25 0.5 0.75 1.0				
species	flower-fruit (0->5)*	<5cm	Σ	5-20cm	Σ	20-50cm	Σ	>50cm	Σ	Total
dead tree										
totals										
total basal area	(=sum total) x width of wedge hole used/no. of sweeps made =									

Dominant species (>5% cover only)		
upper	mid	ground

* for flowers (FL): 0=no plants in flower (FL) or fruit (FR); 1=isolated plants with few flowers; 2=isolated plants with moderate no. of flowers *or* most plants with few flowers; 3=many plants with moderate no. flowers; 4=most plants with many flowers; 5=all plants with many flowers. Comparable score for fruit (FR).

Appendix D: The ant fauna of the Tiwi Islands.

Biogeography of the Ant Fauna of the Tiwi Islands, in northern Australia's monsoonal tropics.

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Abstract

This paper describes the biogeography at the species level of ants from the Tiwi Islands, and represents the first such analysis for any region in Australia. The Tiwi Islands are located 20 km off the mainland coast near Darwin in the Top End of the Northern Territory, and include Australia's second largest island landmass after Tasmania. The islands receive the highest mean annual rainfall (up to 2000 mm) in monsoonal northern Australia, and they are the closest part of the Australian landmass to South-East Asia. Based on about 1300 species records, we list 151 species (including 6 introduced) from 33 genera. The richest genera are *Polyrhachis* (20 species), *Camponotus* (14), *Monomorium* (14), *Pheidole* (12), and *Iridomyrmex* (11). Sixty-eight percent of the Tiwi species belong to Torresian (tropical) species groups, which is considerably higher than the 44% for Australia's monsoonal ant fauna as a whole. Fifteen Tiwi ant species are not known from mainland Australia. These include a species of *Anonychomyrma*, which is the only record of the genus in monsoonal Australia, *Polyrhachis debilis*, the only representative of the sub-genus *Cyrtomyrma* known from northwestern Australia, and the only species of the *araneoides* group of *Rhytidoponera* in the NT. Unfortunately, the Tiwi ant fauna also includes the introduced pest species *Pheidole megacephala*, which represents a serious conservation threat.

Introduction

Island faunas have long captured the attention of biogeographers, and the Tiwi Islands, lying 20 km off the central northern Australian coast near Darwin, are particularly noteworthy from a biogeographical perspective. First, they are large enough to be reasonably expected to support endemic taxa. The Islands consist primarily of two closely abutting land masses, Melville and Bathurst Islands, and at 5788 km² Melville Island is Australia's second largest island after Tasmania. Second, the islands receive the highest rainfall in monsoonal northern Australia, with annual rainfall averaging up to 2000 mm, compared with a maximum of 1700 mm on the mainland coast. Third, the islands are the closest part of the Australian landmass to South-East Asia, lying approximately 350 km south of Tanimbar and 450 km southeast of Timor.

The Tiwi Islands are known to support a distinctive biota, including a range of endemic plant and animal taxa (Woinarski *et al.* 2000). The endemic fauna includes five sub-species of birds (Schodde and Mason 1999) and two of mammals (Woinarski *et al.* 2000). The Tiwi insect fauna has been extremely poorly documented, but is known to include two endemic dragonfly species (Brown and Theischinger 1998).

As for other insect groups, the ant fauna of the Tiwi Islands remains largely undocumented. Indeed, we are aware of only two references to Tiwi ants in the primary literature. The first is Clark's (1936) description of *Rhytidoponera reflexa*, which is based on specimens from Bathurst Island as well as on the mainland near Darwin. It is now clear that Clark had confused two very similar species, with *R. reflexa* being restricted to the Tiwi Islands and an undescribed sibling species occurring both on the Tiwi Islands and mainland of the Darwin region (Andersen 2000). Second, six rainforest patches on Melville Island were included in a survey of the rainforest ant fauna of the Northern Territory (Reichel and Andersen 1996). The Melville Island species were not specified, although it was noted that they included a species of the *Polyrhachis* sub-genus *Cyrtomyrma*, the only known occurrence of the subgenus in the NT. The species was identified at the time as *P. ?rastellata*, but is now considered to be the New Guinea species *P. debilis* (R. Kohout, personal communication).

This paper documents the known ant fauna of the Tiwi Islands, and presents a biogeographical analysis at the species level. It is the first such analysis of an ant fauna at the species-level for any region in Australia. We focus on the following key questions. First, to what extent are Tiwi ant species shared with other biogeographical regions in northern Australia? Second, what is the level of (apparent) endemism of the Tiwi ant fauna? Third, do the Tiwi Islands support any disjunct populations of species known from higher rainfall regions of North Queensland or the Kimberley region of Western Australia, but absent from the Top End mainland? We are able to address these questions with reasonable confidence because the ants of mainland monsoonal Australia have been extensively documented (Andersen 2000). We also ask whether the Tiwi Islands support species from elsewhere in the South-East Asian region that do not occur on mainland Australia. However, our ability to address this question is severely constrained by the very poor documentation of the South-East Asian ant fauna.

Methods

The Tiwi Islands

The Tiwi Islands are relatively low (maximum altitude approximately 100 m), topographically simple landmasses that have been isolated from mainland Australia for about 10,000 years (Woodroffe *et al.* 1992). Temperatures are high throughout the year (mean maximum daily temperatures exceeding 30°C in all months), and rainfall is heavily concentrated into a summer wet season. The vegetation is dominated by eucalypt woodlands and open forests with a grassy understorey, but also includes significant patches of monsoon rainforest, grasslands, *Melaleuca* swamps, mangroves and tidal flats (Woinarski *et al.* 2000).

The entire Tiwi islands are sparsely populated, Aboriginal freehold lands. The population of about 2000 is overwhelmingly comprised of indigenous Tiwi people, most of who live in one of three small towns (Forrest 1998). Aside from the clearing of about 80 km² for plantation forestry (primarily *Callitris intratropica* and *Acacia mangium*), the Tiwi Islands are largely undeveloped, and much of the area remains inaccessible by road.

Ant species records

Tiwi ants have never been comprehensively surveyed, but sufficient records are nevertheless available for meaningful biogeographical analysis. Our primary source of records were specimens collected during fauna surveys conducted during August/September (late dry season) 2000 (Melville Island) and May/June (early dry season) 2001 (Bathurst Island) by the Biodiversity Unit of the NT Department of Infrastructure, Planning and Environment (Woinarski *et al.* 2000). During the surveys, ants were collected from 224 sites distributed across 24 locations, representing the full range of Tiwi habitats, including plantation forests. Most sites occurred in eucalypt open forest, by far the most extensive vegetation type on the islands. At each site, ants were collected from two large (20 l) vertebrate pitfall traps over a 72 hr period. Sampling intensity was therefore very low at each site, but this was compensated by the very large number of sites, which in total yielded 987 ant species records. The survey data were supplemented by records from the six rainforest patches included in the ant survey of NT rainforests (Reichel and Andersen 1996), as well as by opportunistic collections by CSIRO staff and collaborators from the CSIRO Tropical Ecosystems Research Centre (TERC) in Darwin. These supplementary data represented an additional *ca.* 300 species records, so that our analyses are based on approximately 1300 species records from the Tiwi Islands. Voucher specimens of all species are held at TERC. We are unaware of any additional Tiwi ant species held in other collections.

Analysis

The majority of Tiwi ant species are undescribed, but we were able to match them with sorted species held at TERC, which holds by far the most extensive collection of northern Australian ants. Species that could not be confidently named were assigned codes, and identified to species-group following Andersen (2000), with species nomenclature following Shattuck (2000). Where applicable, species codes were numbers that match published records of species from the Top End (e.g. Andersen and Patel 1994; Reichel and Andersen 1996; Andersen and Morrison 1998; Woinarski *et al.* 1998); otherwise species were assigned letter codes that apply to this study only.

All species were assigned to one of four broad biogeographical categories based on the distribution of the species-group to which they belong, following Andersen (2000). These categories are Torresian (tropical), Eyrean (arid), Bassian (cool-temperate) and Widespread. Based on TERC specimens and published records (e.g. Taylor and Brown 1985; Shattuck 2000), the occurrence of each species was noted for each of five major regions of far northern Australia: North Queensland, the Gulf region, The Top End (north of Katherine) of the NT, the Victoria River District of northwestern NT (southwest of Katherine), and the Kimberley region of far northern Western Australia (Fig. 1).

Results

The fauna

Our Tiwi Island records comprise 151 species from 33 genera, including the six introduced species *Monomorium floricolor*, *M. pharaonis*, *Paratrechina longicornis*, *Pheidole megacephala*, *Tapinoma melanocephala* and *Tetramorium simillimum* (Appendix A). The majority (118, or 78%) of these Tiwi species were recorded during the fauna surveys. Virtually all the species recorded during these surveys occurred on Melville Island, and the species accumulation curve indicates that the great majority of species susceptible to such trapping were

recorded (Fig. 2). According to our records, the richest genera are *Polyrhachis* (20 species), *Camponotus* (14), *Monomorium* (14), *Pheidole* (12), *Iridomyrmex* (11), *Meranoplus* (9), *Rhytidoponera* (8), and *Cerapachys* (7). Eighteen (12%) species can be considered rainforest specialists in that they occur exclusively or primarily in such habitats (Reichel & Andersen 1996), and four (3%) species can similarly be considered mangrove specialists (Clay & Andersen 1996).

The most commonly recorded species (those recorded from more than 20 sites) during the fauna surveys were *Rhytidoponera aurata* (103 sites), *Iridomyrmex pallidus* (66), *Opisthosopsis haddoni* (54), *Odontomachus* sp. nr. *turneri* (53), *I. sanguineus* (43), *Camponotus* sp. 9 (*novaehollandiae* gp.) (37), *Polyrhachis senilis* (41), *Rhytidoponera reflexa* (32), *Polyrhachis creusa* (31), *Iridomyrmex* sp. 1 (*anceps* gp.) (27), *Papyrius* sp. A (26), *Melophorus* sp. 10 (25), *Polyrhachis inconspicua* (24), and *Rhytidoponera* sp. nr. *reflexa* (22). These 14 (12%) species represented 60% of ant species records from the survey.

Average species richness for fauna survey sites was only about five, which attests to the very low sampling intensity at each site. Highest sample richness occurred in *Eucalyptus bleeseri* woodlands, and lowest in *Melaleuca* swamps and *Callitris* plantations (Table 1). Site sampling intensity was too low for meaningful comment about species distributions across habitat types based on survey data.

Biogeography

One hundred and two (68%) of the Tiwi species belong to Torresian species groups, 29 (19%) Eyrean, and 19 (13%) Widespread. A single species (*Anonychomyrma* sp. A) has Bassian affinities. These figures compare with estimates of 44%, 40%, 13% and 2% respectively for the entire fauna of monsoonal Australia (Andersen 2000).

Six Tiwi species belong to species complexes that are too poorly resolved to comment on their species-level distributions, leaving 139 native species for distributional analysis (Table 2). Fifteen (11%) of these species are not known from mainland Australia: *Anonychomyrma* sp. A (*nitidiceps* group), *Bothroponera* sp. A (*sublaevis* group), *Camponotus* sp. B (*vitreus* group), *Camponotus* sp. E (*janeti* group), *Iridomyrmex* sp. B (*rufoniger* group), *Leptogenys* sp. A (*clarki* group), *Melophorus* sp. B (Group A, Andersen 2000), *Melophorus* sp. C (*aeneovirens* group), *Meranoplus* sp. A, *Pheidole* sp. C (*longiceps* group), *Polyrhachis debilis*, *Polyrhachis* sp. A (*ammon* group), *Rhytidoponera reflexa*, *Rhytidoponera* sp. A (*araneoides* group) and *Tetramorium* sp. A (*ornatum* group). Thirty-two (23%) species are shared with the Top End mainland but are not known to occur elsewhere in Australia (Table 2). Including those species restricted to the Tiwi Islands, this makes 34% of the species known in Australia only from the Top End. A further seven species are restricted to the central monsoonal zone (Gulf, Top End, VRD), mostly shared with the VRD.

Thirteen (9%) species occur across the eastern monsoonal zone, but are not known from west of the Top End. Interestingly, all of these occur in the Top End and Queensland, but have not been recorded in the Gulf region (Table 2). Eighteen (13%) species occur across the western monsoonal zone, but have not been recorded east of the Top End. Most of these are known from the Top End and the Kimberley, but appear to be absent from the VRD (Table 2). The remaining 54 (39%) species occur very widely across Australia's monsoonal zone. More than half of these are known from all the five major regions, while most of the others appear to be restricted to the three regions of higher rainfall (North Queensland, Top End and Kimberley).

An unusually high proportion of the 14 most common species listed above have widespread distributions. Nine (64%) of these common species occur from North Queensland to the Kimberley, which is a substantially higher figure than for the other Tiwi species (36%). This conforms to a general macroecological tendency for locally common species to have widespread distributions (Gaston 1994). In contrast, Tiwi ponerines have disproportionately narrow distributions. Of the 21 ponerine species, 14 (67%) are known only from the Top End (including the Tiwi Islands), compared with 31% for the entire fauna. The Top End ponerine endemics include three of the most commonly recorded species on the Tiwi Islands, *Rhytidoponera aurata*, *R. reflexa* and *R. sp. nr. reflexa*, so this pattern is not just an artefact of

ponerine rarity. Only 2 (10%) Tiwi ponerine species also occur in North Queensland, compared with 47% for the entire Tiwi ant fauna.

All of the 124 native Tiwi species known from the Australian mainland occur in the Top End. Just over half of the Tiwi species also occur in the Kimberley, and a slightly smaller number are shared with North Queensland (Fig. 2). Far fewer species are shared with the two driest regions (Gulf and VRD), despite their closer proximity.

Discussion

The 151 species documented here undoubtedly represent a substantial under-estimate of total ant species richness on the Tiwi Islands. However, these documented species are still likely to provide a reasonable indication of the biogeography of the Tiwi fauna. On one hand, our data might be judged to over-estimate the predominance of widely distributed species, given the likely under-representation of rare species, which have a tendency to be more locally distributed (Gaston 1994). On the other hand, some of the species are likely to be more widely distributed than indicated, given that records from the northern Australian mainland are also incomplete. Despite a lack of completeness, the known Tiwi species still represent about 10% of the estimated entire ant fauna of monsoonal Australia (Andersen 2000).

More than two-thirds of the Tiwi species belong to Torresian species groups, a figure that is considerably higher than for the monsoonal fauna as a whole (44%; Andersen 2000). Similarly, 12% of the known Tiwi species are rainforest specialists, compared with <1% for the entire monsoonal fauna. These figures reflect the location of the Tiwi Islands on the northern, high rainfall fringe of the monsoonal zone. This also explains why many more Tiwi species are shared with North Queensland and the Kimberley than with The Gulf or VRD. The latter are closer, but experience far lower rainfall (maximum of about 800 mm, compared with over 1200 mm in the other regions; Fig. 1).

Over ten percent of the known Tiwi ant species have not been recorded on the Australian mainland. This is in marked contrast to the ant fauna of the Wessel and English Company Islands off the eastern Arnhem Land coast, which consists almost entirely of widespread mainland species (Woinarski *et al.* 1998). Compared with the Tiwi Islands, the Wessel and English Company Islands are far smaller (mostly <10 km²), and receive only about 1350 mean annual rainfall (which is comparable with much of the Top End).

Several of the Tiwi species that are unknown from mainland Australia are of broader biogeographical significance. For example, *Anonychomyrma* sp. is the only record of the genus in monsoonal Australia. In Australia, the genus is otherwise restricted to the southern and eastern seaboard (Shattuck 1992). Similarly, *Polyrhachis debilis* is the only representative of the sub-genus *Cyrtomyrma* known from northwestern Australia. *Rhytidoponera* sp. A is the only record of the *araneoides* group in the NT, which in Australia is otherwise restricted to North Queensland (Andersen 2000), and *Iridomyrmex* sp. B is the only record of the *rufoniger* group of *Iridomyrmex* from the Top End.

None of the Tiwi species have disjunct distributions to the extent that they are absent from mainland Top End but occur in higher rainfall regions of North Queensland or the Kimberley. This is also true for other faunal groups, but contrasts with the situation with plants, where the NT populations of at least seven North Queensland species are restricted to the Tiwi Islands (Woinarski *et al.* 2002). Interestingly, one Tiwi ant species - *Polyrhachis debilis*, is a New Guinean species that is otherwise unknown from mainland Australia. This parallels the distribution of *Tarennoidea wallichii* (Rubiaceae), a South-East Asian tree whose only Australian records are on the Tiwi Islands (Woinarski *et al.* 2002). None of the remaining 14 Tiwi ant species that are unknown from mainland Australia are known to occur elsewhere in the South-East Asian region, and therefore can provisionally be considered endemic to the Tiwi Islands.

The Tiwi ant fauna includes six introduced species. Five of these are relatively innocuous ants that are unlikely to pose a significant environmental threat. However the other, *Pheidole megacephala*, is one of the world's worst invasive ant species. It has infested all the

larger towns in the Top End, and has had a major ecological impact in at least one rainforest patch near Darwin (Hoffmann *et al.* 1999). It was not recorded during the Tiwi fauna surveys, so does not appear yet to have spread out from the towns. Another serious pest ant species, the Yellow crazy ant (*Anoplolepis gracilipes*), occurs in eastern Arnhem Land in the Top End (Young *et al.* 2001), and is at high risk of being introduced to the Tiwi Islands. *Anoplolepis gracilipes* has achieved notoriety in Australia for its dramatic impact on rainforest ecosystems on Christmas Island in the Indian Ocean (O'Dowd *et al.* 2001), where it is currently the subject of a multi-million dollar control programme. Both these pest ant species strongly prefer rainforest over open sclerophyll habitats, and such habitats support a disproportionately large number of noteworthy ant (this study) and plant (Russell Smith 1991; Woinarski *et al.* 2002) species. These pest ants therefore represent extremely serious conservation threats to the Tiwi Islands.

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Table 1. Variation in ant species richness across Tiwi habitat types, based on fauna survey collections from Melville Island.

Habitat type	No. sites	Mean no. species per site
<i>Calitris</i> plantation	7	3.0
<i>Acacia</i> plantation	6	4.0
Treeless plain	23	3.5
<i>Eucalyptus</i> tall open forest	107	4.9
<i>Eucalyptus oligantha</i> / <i>E. bella</i> woodland	9	3.8
<i>E. bleeseri</i> woodland	7	7.0
Dry rainforest	4	4
Wet rainforest	2	5.0
Melaleuca swamp	2	2.5
Mangroves/strand	5	3.4

Table 2. Summary biogeographical distributions of 139 native Tiwi ant species.

Distribution	No. species
<i>Unknown from mainland Australia</i>	15
<i>Central monsoonal zone</i>	39
TE	32
TE, VRD	6
G, TE	0
G, TE, VRD	1
<i>Eastern monsoonal zone</i>	13
NQ, G, TE	0
NQ, TE	13
<i>Western monsoonal zone</i>	18
TE, VRD, K	4
TE, K	14
<i>Widespread</i>	54
NQ, G, TE, VRD, K	29
NQ, TE, K	19
NQ, TE, VRD, K	2
NQ, G, TE, K	2
G, TE, VRD, K	2

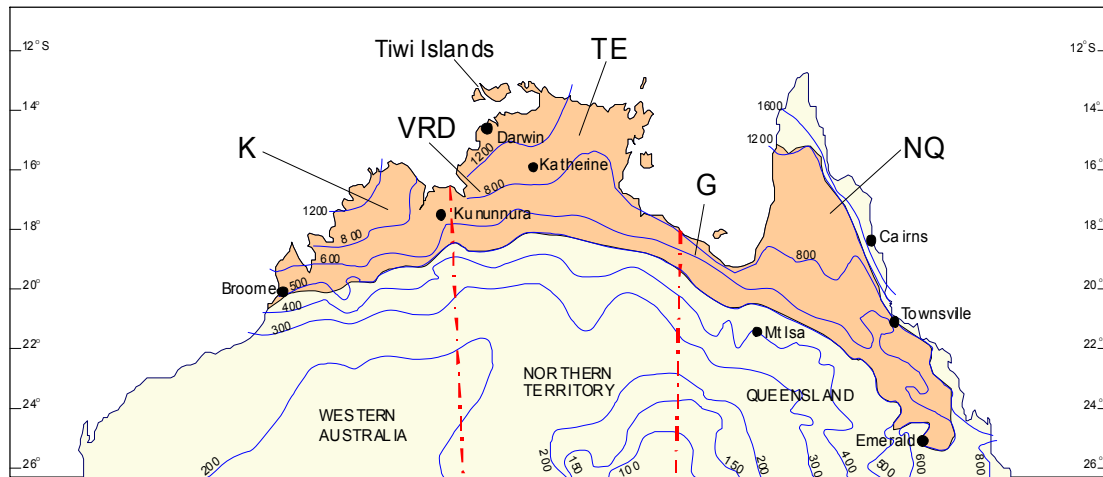


Fig. 1. Monsoonal northern Australia (shaded), showing locations of the Tiwi Islands and major biogeographical regions (NQ – North Queensland; G – Gulf region; TE – Top End; VRD – Victoria River District; K – Kimberley). Modified from Andersen (2000).

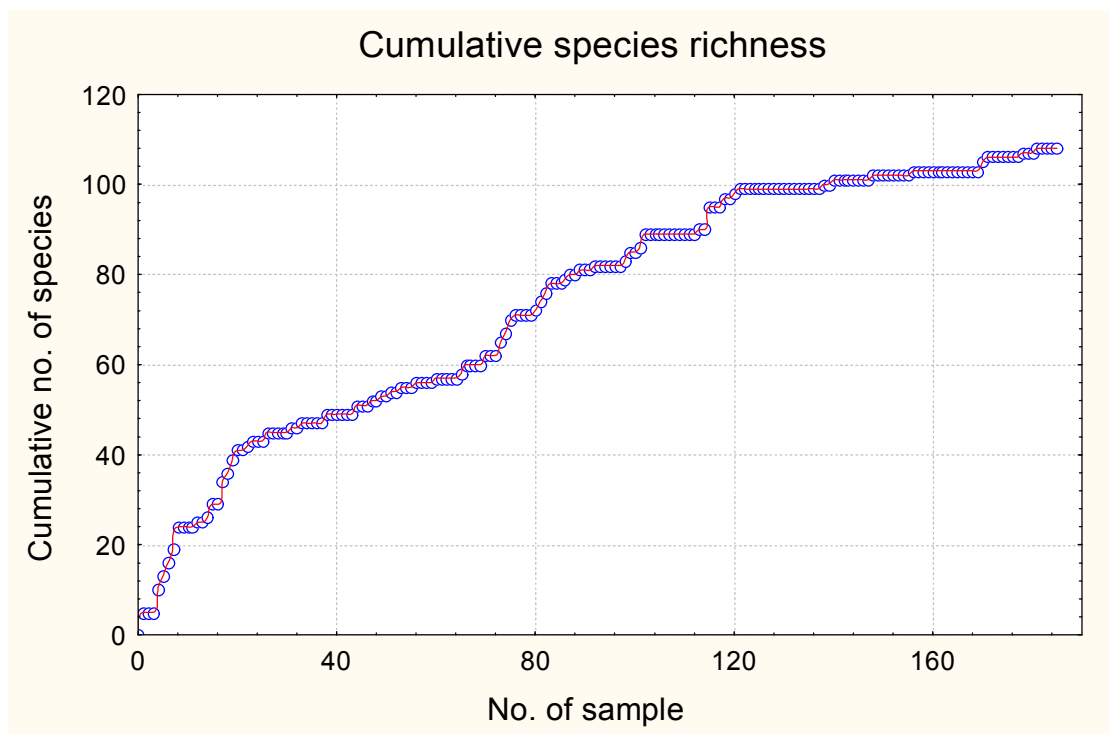


Fig. 2. Accumulation of ant species in samples from the 2000 Melville Island fauna survey.

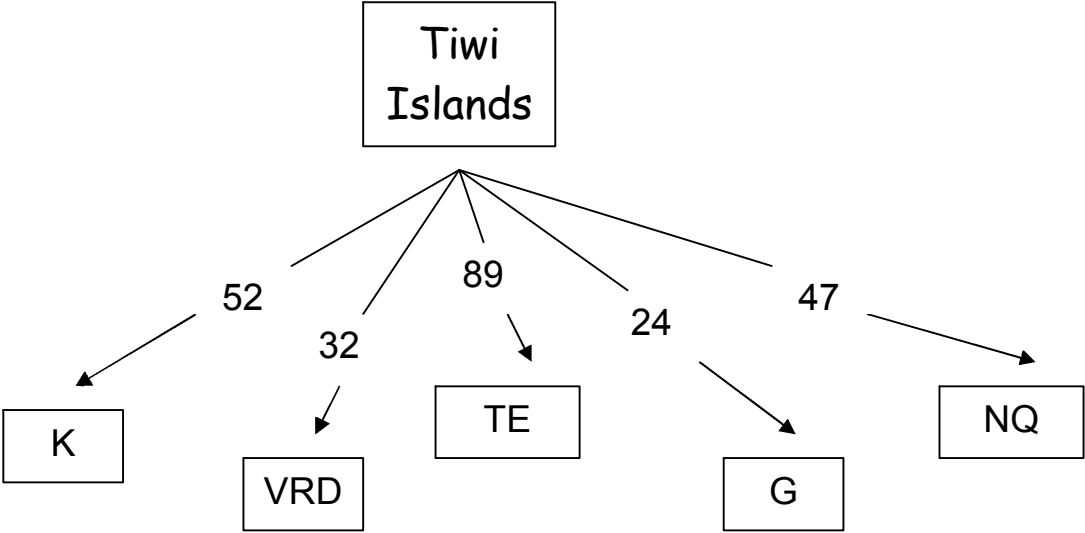


Fig. 3. Percentages of Tiwi ant species (n = 139; not including introduced species, or those from poorly resolved species-groups) known to be shared with each of the five major biogeographical regions of northern Australia (see Fig. 1). Eleven percent of Tiwi species are not known to occur on mainland Australia.

Appendix A. Ant species recorded from the Tiwi Islands, along with their occurrence at 224 fauna survey sites across 24 locations, their broad biogeographical affinities (T – Torresian; E – Eyrean; B – Bassian; W – widespread), and their distributions in monsoonal Australia (NQ – North Queensland; G – Gulf region; TE – Top End; VRD – Victoria River District; K – Kimberley; * known only from the Tiwi Islands). Rainforest specialists are denoted by a superscript r.

	No. Locations (n = 24)	No. sites (n = 224)	Biogeography	Distribution in Monsoonal Australia
Aenictinae				
<i>Aenictus aratus</i> ^r	0	0	T	NQ, TE
<i>Aenictus</i> sp. A (<i>ceylonicus</i> gp.)	1	3	T	TE, K
Cerapachyinae				
<i>Cerapachys</i> ? <i>brevis</i>	1	1	T	NQ, G, TE, VRD, K
<i>C. turneri</i> ^r	1	1	T	NQ, TE, K
<i>Cerapachys</i> sp. 2 (<i>singularis</i> gp.)	1	1	E	NQ, TE
<i>Cerapachys</i> sp. 4 (<i>singularis</i> gp.)	3	3	E	NQ, G, TE, VRD, K
<i>Cerapachys</i> sp. 8 (<i>clarki</i> gp.)	1	1	E	G, TE, VRD
<i>Cerapachys</i> sp. A (<i>fervidus</i> gp.)	1	1	E	TE
<i>Cerapachys</i> sp. B (<i>singularis</i> gp.)	1	1	E	NQ, TE
Dolichoderinae				
<i>Anonychomyrma</i> sp. A (<i>nitidiceps</i> gp.)	2	2	B	*
<i>Froggattella kirbii</i>	2	2	W	NQ, TE, K
<i>Iridomyrmex pallidus</i>	20	66	E	NQ, G, TE, VRD, K
<i>I. reburrus</i>	1	2	E	NQ, G, TE, VRD, K
<i>I. rufoinclinus</i>	1	1	E	NQ, G, TE, K
<i>I. sanguineus</i>	22	43	E	NQ, G, TE, VRD, K

<i>Iridomyrmex</i> sp. 1 (<i>anceps</i> gp.)	11	27	T	NQ, G, TE, VRD, K
<i>Iridomyrmex</i> sp. 2 (<i>mattiolo</i> gp.)	5	6	W	NQ, G, TE, VRD, K
<i>Iridomyrmex</i> sp. 3 (<i>mattiolo</i> gp.)	5	6	W	TE, K
<i>Iridomyrmex</i> sp. 7 (<i>bicknelli</i> gp.)	3	3	E	NQ, TE, K
<i>Iridomyrmex</i> sp. 16 (<i>pallidus</i> gp.)	0	0	E	TE, K
<i>Iridomyrmex</i> sp. A (<i>anceps</i> gp.)	2	6	T	TE
<i>Iridomyrmex</i> sp. B (<i>rufoniger</i> gp.)	1	1	E	*
<i>Papyrius</i> sp. 1	7	11	W	NQ, G, TE, VRD, K
<i>Papyrius</i> sp. A	12	26	W	TE, VRD
<i>Tapinoma melanocephalum</i>	0	0	W	introduced
<i>Tapinoma</i> sp. 1	1	1	W	?
<i>Technomyrmex</i> sp. 1 ^r	1	2	T	NQ, TE
Formicinae				
<i>Acropyga acutiventris</i>	0	0	W	NQ, TE
<i>Calomyrmex impavidus</i>	6	8	T	NQ, TE
<i>Camponotus confusus</i>	5	6	T	NQ, TE
<i>C. dromas</i>	1	1	E	NQ, G, TE, VRD, K
<i>Camponotus</i> sp. 1 (<i>reticulatus</i> gp.) ^r	1	1	T	NQ, TE
<i>Camponotus</i> sp. 4 (<i>pellax</i> gp.)	1	1	T	TE
<i>Camponotus</i> sp. 7 (<i>subnitidus</i> gp.)	11	18	E	G, TE, VRD, K
<i>Camponotus</i> sp. 8 (<i>discors</i> gp.)	6	8	W	TE
<i>Camponotus</i> sp. 9 (<i>novaehollandiae</i> gp.)	17	37	T	NQ, TE, VRD, K
<i>Camponotus</i> sp. 11 (<i>novaehollandiae</i> gp.)	12	17	T	NQ, G, TE, VRD, K
<i>Camponotus</i> sp. 13 (<i>novaehollandiae</i> gp.)	4	12	T	NQ, G, TE, VRD, K
<i>Camponotus</i> sp. A (<i>discors</i> gp.)	4	5	W	TE
<i>Camponotus</i> sp. B (<i>vitreus</i> gp.) ^r	1	1	T	*
<i>Camponotus</i> sp. C (<i>rubiginosus</i> gp.)	3	3	W	TE, VRD
<i>Camponotus</i> sp. D (<i>denticulatus</i> gp.)	1	1	E	TE, VRD, K
<i>Camponotus</i> sp. E (<i>janeti</i> gp.)	0	0	T	*
<i>Melophorus</i> sp. 10 (Group D, Andersen 2000)	14	25	E	TE, VRD
<i>Melophorus</i> sp. 13 (<i>mjobergi</i> gp.)	0	0	E	TE
<i>Melophorus</i> sp. A (Group A, Andersen 2000)	6	6	E	TE, VRD
<i>Melophorus</i> sp. B (Group A, Andersen 2000)	1	1	E	*
<i>Melophorus</i> sp. C (<i>aeneovirens</i> gp.)	9	10	E	*
<i>Oecophylla smaragdina</i>	7	10	T	NQ, G, TE, VRD, K
<i>Opisthopsis haddoni</i>	21	54	T	NQ, G, TE, VRD, K

<i>O. major</i>	5	5	T	NQ, TE, K
<i>O. rufoniger</i>	4	4	T	NQ, G, TE, VRD, K
<i>Opisthopsis</i> sp. A (<i>haddon</i> gp.)	4	6	T	TE
<i>Paratrechina longicornis</i>	1	1	T	Introduced
<i>Paratrechina</i> sp. 3 (<i>obscura</i> gp.)	1	1	W	NQ, G, TE, VRD, K
<i>Paratrechina</i> sp. 4 (<i>vaga</i> gp.)	10	15	T	NQ, TE, K
<i>Paratrechina</i> sp. 5 (<i>vaga</i> gp.)	2	3	T	NQ, TE, K
<i>Polyrhachis (Myrmhopla) bicolor</i> ^r	0	0	T	TE
<i>Polyrhachis (Charioomyrma) constricta</i> ^m	0	0	T	NQ, TE
<i>Polyrhachis (Campomyrma) creusa</i>	15	31	T	NQ, TE, K
<i>P. (Cyrtomyrma) debilis</i> ^r	0	0	T	*
<i>P. (Mrymothrinx) delicata</i> ^r	1	1	T	TE
<i>P. (Campomyrma) inconspicua</i>	14	24	T	NQ, G, TE, VRD, K
<i>Polyrhachis (Charioomyrma) sp. nr. obtusa</i>	0	0	T	NQ, G, TE, VRD, K
<i>P. (Campomyrma) prometheus</i>	1	1	T	NQ, G, TE, VRD, K
<i>P. (Hagiomyrma) schenkii</i>	7	8	T	NQ, TE, K
<i>P. (Chariomyrma) senilis</i>	18	41	T	NQ, G, TE, VRD, K
<i>P. (Chariomyrma) sokolova</i> ^m	0	0	T	NQ, G, TE, K
<i>P. (Chariomyrma) cyrus</i>	1	1	T	NQ, TE
<i>Polyrhachis (Hagiomyrma) sp. 3 (ammon gp.)</i>	9	13	T	NQ, TE, VRD, K
<i>Polyrhachis (Hedomyrma) sp. 6 (cupreata gp.)</i> ^r	1	1	T	TE, K
<i>Polyrhachis (Chariomyrma) sp. 12 (obtusa gp.)</i>	6	7	T	TE
<i>Polyrhachis (Chariomyrma) sp. 16 (gab gp.)</i>	1	1	T	TE
<i>Polyrhachis (Hagiomyrma) sp. A (ammon gp.)</i>	1	1	T	*
<i>Polyrhachis (Campomyrma) sp. B (micans gp.)</i>	0	0	T	TE
<i>Polyrhachis (Hedomyrma) sp. C (euterpe gp.)</i> ^m	0	0	T	TE
<i>Polyrhachis (Hedomyrma) sp. D (euterpe gp.)</i> ^m	0	0	T	TE
Myrmicinae				
<i>Cardiocondyla</i> sp. A (<i>nuda</i> gp.)	2	3	T	NQ, G, TE, VRD, K
<i>Cardiocondyla</i> sp. B (<i>nuda</i> gp.)	0	0	T	NQ, TE
<i>Crematogaster</i> sp. 1 (<i>laeviceps</i> gp.)	1	2	W	NQ, TE, K
<i>Crematogaster</i> sp. 3 (Group A, Andersen 2000) ^r	0	0	T	NQ, TE, K
<i>Crematogaster</i> sp. 5 (<i>cornigera</i> gp.)	0	0	T	NQ, TE
<i>Crematogaster</i> sp. A (Group C, Andersen 2000) ^r	3	3	T	TE
<i>Crematogaster</i> sp. B (<i>laeviceps</i> gp.)	2	2	W	TE
<i>Meranoplus ?unicolor</i>	2	2	E	TE, K

<i>Meranoplus</i> sp. 2 (<i>diversus</i> gp.)	2	2	E	TE, K
<i>Meranoplus</i> sp. 4 (<i>mjobergi</i> gp.)	1	2	T	TE, K
<i>Meranoplus</i> sp. 5 (<i>mjobergi</i> gp.)	2	2	T	TE, VRD
<i>Meranoplus</i> sp. 8 (Group F, Andersen 2000)	1	1	T	TE
<i>Meranoplus</i> sp. 10 (Group E, Andersen 2000)	2	2	T	TE, K
<i>Meranoplus</i> sp. 13	0	0	T	TE
<i>Meranoplus</i> sp. 16	2	2	W	TE
<i>Meranoplus</i> sp. A	1	1	W	*
<i>Monomorium disetigerum</i>	2	2	E	NQ, G, TE, VRD, K
<i>M. donisthorpei</i>	1	2	T	TE
<i>M. fieldi</i>	1	2	T	NQ, G, TE, VRD, K
<i>M. floricola</i>	1	1	T	Introduced
<i>M. ?nigrum</i>	0	0	T	NQ, TE, K
<i>M. pharaonis</i>	0	0	T	introduced
<i>Monomorium</i> sp. 4 (<i>bifidum</i> gp.)	3	3	T	TE, K
<i>Monomorium</i> sp. 7 (<i>insolescens</i> gp.)	1	1	T	TE
<i>Monomorium</i> sp. 8 (<i>carinatum</i> gp.)	0	0	T	NQ, TE, K
<i>Monomorium</i> sp. 14 (<i>nigrum</i> gp.)	0	0	T	NQ, TE, K
<i>Monomorium</i> sp. 23 (<i>laeve</i> gp.)	0	0	E	TE, K
<i>Monomorium</i> sp. 24 (<i>laeve</i> gp.)	5	6	E	NQ, G, TE, VRD, K
<i>Monomorium</i> sp. A (<i>rothsteni</i> gp.)	1	1	E	?
<i>Monomorium</i> sp. B (<i>laeve</i> gp.)	1	1	E	NQ, G, TE, VRD, K
<i>Pheidole impressiceps</i>	3	4	T	NQ, G, TE, VRD, K
<i>P. megacephala</i>	0	0	T	introduced
<i>Pheidole</i> sp. 3 (Group A, Andersen 2000)	5	6	W	TE, K
<i>Pheidole</i> sp. 8 (Group F, Andersen 2000)	1	1	T	?
<i>Pheidole</i> sp. 9 (Group K, Andersen 2000)	0	0	T	?
<i>Pheidole</i> sp. 11 (Group K, Andersen 2000)	3	3	T	TE, K
<i>Pheidole</i> sp. 13 (Group G, Andersen 2000)	0	0	T	NQ, TE, K
<i>Pheidole</i> sp. 14 (Group G, Andersen 2000)	1	1	T	NQ, TE, K
<i>Pheidole</i> sp. A (Group E, Andersen 2000)	1	1	T	?
<i>Pheidole</i> sp. B (Group E, Andersen 2000)	0	0	T	?
<i>Pheidole</i> sp. C (<i>longiceps</i> gp.)	0	0	T	*
<i>Pheidole</i> sp. D (Group E, Andersen 2000)	7	15	T	TE, VRD, K
<i>Pheidologeton affinis</i>	1	1	T	NQ, TE, K
<i>Podomyrma tricolor</i>	1	1	T	NQ, TE, K
<i>Strumigenys</i> sp. nr. <i>radix</i>	0	0	T	TE

<i>Tetramorium lanuginosum</i>	1	1	T	NQ, TE, K
<i>T. ornatum</i> ^r	1	1	T	NQ, TE
<i>T. simillimum</i>	0	0	T	introduced
<i>Tetramorium</i> sp. 1 (<i>striolatum</i> gp.)	3	4	E	NQ, G, TE, VRD, K
<i>Tetramorium</i> sp. 2 (<i>striolatum</i> gp.)	2	2	E	TE, VRD, K
<i>Tetramorium</i> sp. A (<i>ornatum</i> gp.) ^r	0	0	T	*
Ponerinae				
<i>Anochetus parapungens</i>	2	2	T	TE
<i>Bothroponera</i> sp. 7 (<i>sublaevis</i> gp.)	5	5	T	TE, VRD
<i>Bothroponera</i> sp. A (<i>sublaevis</i> gp.)	3	3	T	*
<i>Bothroponera</i> sp. B (<i>sublaevis</i> gp.)	1	2	T	TE
<i>Bothroponera</i> sp. C (<i>sublaevis</i> group) ^r	8	9	T	TE
<i>Diacamma levis</i>	1	1	T	TE
<i>Hypoponera</i> sp. 1	1	1	W	NQ, G, TE, VRD, K
<i>Leptogenys adlerzi</i>	2	3	T	NQ, G, TE, VRD, K
<i>L. exigua</i>	4	4	T	TE, K
<i>Leptogenys</i> sp. nr. <i>conigera</i>	2	2	T	TE
<i>Leptogenys</i> sp. A (<i>clarki</i> gp.)	1	2	T	*
<i>Odontomachus ruficeps</i>	7	10	T	TE
<i>Odontomachus</i> sp. nr. <i>turneri</i>	19	53	T	G, TE, VRD, K
<i>Rhytidoponera aurata</i>	23	103	T	TE
<i>R. borealis</i>	8	9	W	TE, VRD, K
<i>R. foreli</i>	8	10	T	TE
<i>R. reflexa</i>	16	32	T	*
<i>Rhytidoponera</i> sp. nr. <i>reflexa</i>	14	22	T	TE
<i>R. reticulata</i>	10	15	T	TE, K
<i>Rhytidoponera</i> sp. 9 (<i>tenuis</i> gp.)	6	7	T	TE
<i>Rhytidoponera</i> sp. A (<i>araneoides</i> gp.) ^r	0	0	T	*
Pseudomyrmecinae				
<i>Tetraponera nitida</i> ^r	0	0	T	NQ, TE, K
<i>T. punctulata</i>	1	1	T	NQ, G, TE, VRD, K