

The ant fauna of the remote Mitchell Falls area of tropical north-western Australia: biogeography, environmental relationships and conservation significance

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Abstract This paper presents the first systematic description of the ant fauna of the dominant savanna landscapes of the remote northern Kimberley region of far northwestern Australia, an area of extremely high conservation value for other taxa. These conservation values are threatened by inappropriate fire regimes and invasion by the introduced cane toad *Bufo marinus*. Ants were sampled at 16 sites in the Mitchell Falls area, eight each on laterite and sandstone substrates, representing the two regionally dominant landforms. At each site, ants were sampled using 40 pitfall traps during the middle of the dry season (June/July) 2007, and a wide range of environmental variables was measured, covering vegetation and ground-layer structure, soil texture and chemistry, and time since fire. A total of 166 species from 33 genera were collected, with sample species richness ranging from 35 to 59 (mean 45.5) across the sites. The richest genera were *Camponotus* (21 species), *Monomorium* (20), *Pheidole* (14), *Melophorus* (14), *Rhytidoponera* (13), *Meranoplus* (12), *Iridomyrmex* (12), *Polyrhachis* (10) and *Tetramorium* (9). The dominant functional groups were Dominant Dolichoderinae (mostly species of *Iridomyrmex*) and Generalised Myrmicinae (mostly species of *Monomorium* and *Pheidole*), which

together represented a relatively constant 80% of all ants at each site. The regional fauna is composed primarily of Torresian (tropical) and Eyrean (arid) taxa, which each contributed 42% of total species. The distributional range of individual species showed a strongly bimodal pattern, with about a third of total species known only from the Mitchell Falls area, and another third occurring throughout monsoonal northern Australia. Laterite and sandstone sites supported markedly different ant faunas. Ant distributions were only weakly related to time since fire. The overall functional group and biogeographical structure of the northern Kimberley ant fauna is similar to that of climatically comparable regions elsewhere in monsoonal northern Australia. However, the fauna is an especially significant one due to a high degree of regional endemism, which is attributed to the region's unusually high rainfall. Our findings indicate that the high conservation values attributed to the flora and vertebrate fauna of the northern Kimberley also apply to the region's insect fauna.

Keywords Ants · Australian Kimberley region · Endemism · Environmental relationships · Tropical savanna

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Introduction

The tropical savanna landscapes of monsoonal northern Australia, covering the northern third of the continent, are widely considered to have exceptional conservation values because they support a largely intact biota (Woinarski et al. 2007). However, its insect fauna remains poorly known. Ants are an ecologically dominant faunal group throughout the region, and as such are one of the better-known insect taxa. The monsoonal ant fauna is estimated to comprise

about 1500 species, and includes many diverse species-groups that are endemic to Australian savannas, such as the *insolescens* and *carinatum* groups of *Monomorium*, the *spininode* group of *Tetramorium*, the *pellax* group of *Camponotus*, and the *mjobergi*, *testudineus* and other groups of *Meranoplus* (Andersen 2000a, 2006). Species diversity is high at all spatial scales, with up to 100 or more occurring within a single hectare (Andersen 1992a, 2000a).

The Australian savanna zone has a strong gradient of decreasing rainfall from north to south, and this is matched by a gradient in the biogeographic affinities of local ant faunas. The majority of species occurring in regions of higher rainfall (>1,000 mm/year) have Torresian (tropical) affinities (e.g. Andersen et al. 2004), with Eyrean (arid) elements becoming increasingly important as rainfall decreases to the south (Andersen 1993; Barrow et al. 2006). However, functional composition is relatively consistent throughout, with local communities being dominated by highly active and aggressive species of *Iridomyrmex*, and also including numerous sub-dominant species of *Monomorium* (*nigrius*, *laeve*, *carinatum* and *sordidum* groups). Globally, such a functional group profile is characteristic of the most productive ant communities (Andersen 1995, 2000b), and occurs throughout arid and semi-arid Australia (Andersen 2003).

The Kimberley region of far north-western Australia supports a particularly noteworthy ant fauna. One genus (*Steromyrmex*, previously referred to as *Willowskiella*) is known in Australia only from this region, and there are remarkable radiations of species-groups within widespread genera, such as the *insolescens* group of *Monomorium*, the *testudineus* group of *Meranoplus*, and an undescribed species-group of *Tetramorium* (Andersen 2000a). However, although the overall composition of the regional fauna is relatively well known, there have been no detailed studies of savanna ants anywhere in the northern Kimberley. Indeed, the ants of the small and restricted rain forest patches that are embedded in the savanna matrix have been far better documented than those of the savannas themselves (Andersen and Majer 1991; Andersen 1992b).

This paper examines the ant fauna of the remote Mitchell Falls area of the northern Kimberley, an area of especially high biodiversity value for several nationally threatened faunal groups. This is especially the case for granivorous birds and small mammals, which have undergone dramatic population declines elsewhere in northern Australia. (Franklin et al. 2005; McKenzie et al. 2007; Woinarski et al. 2010). These values are threatened by inappropriate fire regimes, especially by an increased incidence of extensive, high intensity fires late in the dry season (Russell-Smith and Yates 2007; Murphy et al. 2010). They are also threatened by the exotic cane toad *Bufo marinus*, which was introduced into Queensland in

1935 and has since invaded most of northern Australia. It has had a marked impact on native predators due to its toxicity, but is also a particular threat to ants because they are its predominant prey (Shine in press). The cane toad invasion front has recently reached the eastern Kimberley region.

The specific aims of our paper are to: (1) Document the diversity and composition of the ant fauna of the Mitchell Falls region; (2) Identify factors determining the local distribution of species, through an analysis of relationships with environmental variables; and (3) Assess the level of endemism and therefore conservation significance of the fauna.

Methods

Study sites

The study was conducted in and around Mitchell River National Park in the Mitchell Falls (14°48'S, 125°41'E) area of the northern Kimberley (Fig. 1). The region experiences a tropical monsoonal climate, with temperatures being high year round (daily mean maximum 29.6–36.0°C), and most of the 1550 mm mean annual rainfall occurring during the summer wet season (November–April). The Mitchell Falls area is dominated by two landforms: the lateritic Mitchell plateau, supporting eucalypt-dominated open forest on red loams; and sandstone outcrops and associated sandy soils around the base of the plateau, supporting eucalypt-dominated woodland and shrubland (Fig. 2).

Ants were sampled at 16 sites, eight each on laterite and sandstone substrates (Table 1; Fig. 1). The laterite sites were located along a 30 km stretch of the Port Warrender Rd., which runs parallel to, approximately 15 km east of, the Mitchell River. Due to very limited vehicular access to sandstone habitats in the region, the spatial separation of sandstone sites was restricted such that all were located within three kilometres of each other, immediately to the east of Mitchell Falls. The sites were selected to represent the range of vegetation types and recent fire histories in the region. Recent fire history was described as time since last fire, as determined by analysis of satellite images and discussions with Park rangers, and ranged from 2–24 months.

Sampling

Ants were sampled using 40 pitfall traps (7 cm diam; partly filled with ethylene glycol as a preservative) at each site. Australia's savanna fauna contains very few cryptic (litter-dwelling) and specialist arboreal species (Andersen 2000a), and pitfall trapping has been shown to provide a reliable representation of the ground-active fauna (Andersen

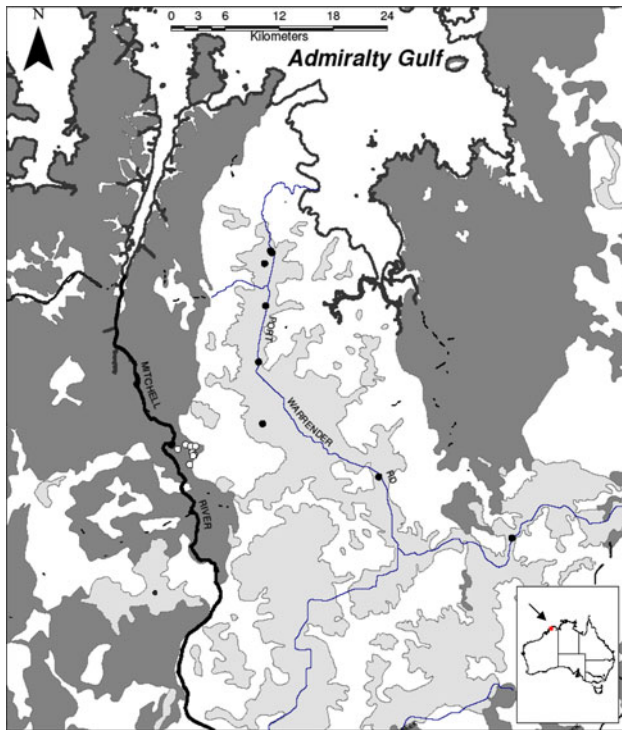


Fig. 1 Location of laterite (*closed circles*) and sandstone (*open circles*) study sites in the Mitchell Falls area of the northern Kimberley region of far north-western Australia. The dominant laterite and sandstone landforms are represented by *light* and *dark shading* respectively

1991a). Thirty-six traps were placed at 5 m intervals along the perimeter of a 50 m × 40 m plot, with the remaining four at the corners of a 20 m × 20 m square within the centre of the plot. This configuration was used to coordinate with mammal trapping at the sites. Traps were operated for 4-day periods in June (sandstone sites) and July (laterite sites) 2007.

A wide range of environmental attributes was measured at each site. The following ground-level structural attributes were recorded in four randomly selected 1 × 1 m quadrats at each site: dominant herbaceous species; percentage ground cover, tree litter ground cover, bare soil cover, rock cover, charcoal cover and number of invertebrate macropores; and biomass of herbaceous and tree leaf litter (not including branches >2 mm diameter), which was harvested and dry weighed. Pooled samples from five 10 cm-deep soil cores from four quadrats were used to assess soil texture, available nitrogen (nitrate and ammonium), total and available phosphate (P), potassium (K), sulphur (S), total carbon (C), organic C, iron (Fe), soil conductivity, pH, aluminium (Al), total microbial biomass, fungal microbial biomass, bacterial microbial biomass, and the unknown component of microbial biomass. Woody vegetation was assessed in four randomly placed 20 × 20 m quadrats located within and immediately surrounding the 50 × 40 m ant sampling plot. Within each quadrat all trees and shrubs were classified into species and

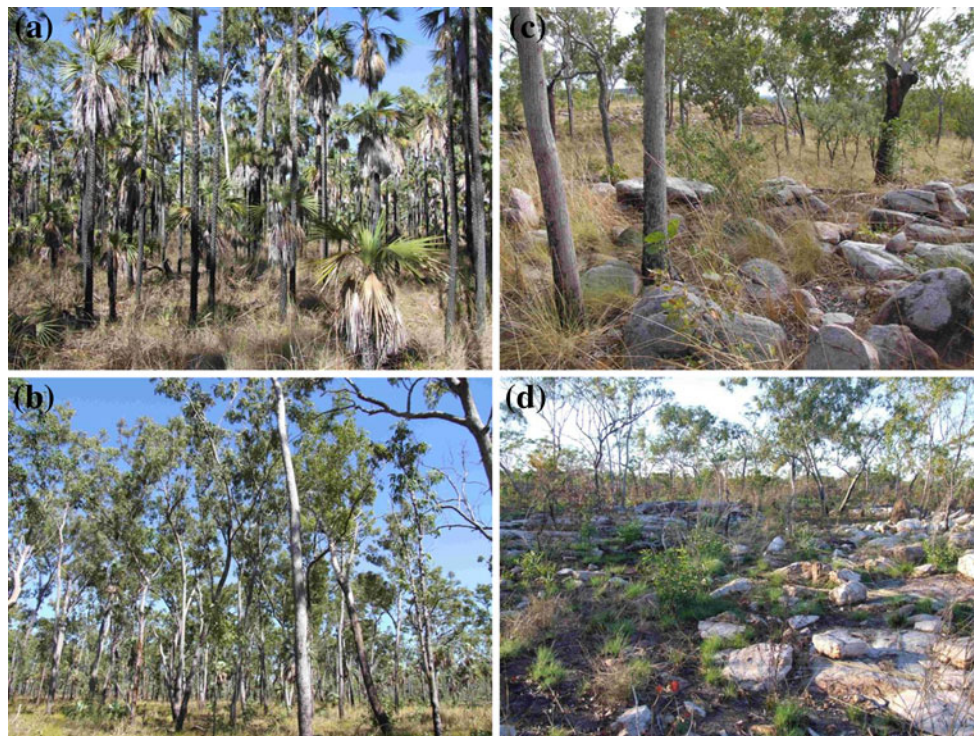


Fig. 2 Photographs of representative habitats in the region: open forest on laterite (**a, b**), and sandstone shrubland (**c**) and woodland (**d**)

Table 1 Summary descriptions of the 16 study sites

Site	Vegetation type	Dominant canopy species	Months since last fire
<i>Laterite</i>			
L1	Open forest	<i>Corymbia polycarpa</i> , <i>Erythrophleum chlorostachys</i> , <i>Eucalyptus miniata</i>	24
L2	Open forest	<i>Corymbia polycarpa</i> , <i>Eucalyptus miniata</i> , <i>Livistona eastonii</i>	2
L3	Open forest	<i>Corymbia polycarpa</i> , <i>Eucalyptus miniata</i> , <i>Livistona eastonii</i>	24
L4	Open forest	<i>Corymbia polycarpa</i> , <i>Eucalyptus miniata</i> , <i>Eucalyptus tetrodonta</i> , <i>Livistona eastonii</i>	7
L5	Open forest	<i>Corymbia bleeseri</i> , <i>Corymbia polycarpa</i> , <i>Eucalyptus miniata</i> , <i>Eucalyptus tetrodonta</i> , <i>Livistona eastonii</i>	24
L6	Open forest	<i>Corymbia polycarpa</i> , <i>Eucalyptus miniata</i> , <i>Eucalyptus tetrodonta</i> , <i>Livistona eastonii</i>	7
L7	Open forest	<i>Eucalyptus miniata</i> , <i>Eucalyptus tetrodonta</i> , <i>Livistona eastonii</i>	7
L8	Open forest	<i>Corymbia polycarpa</i> , <i>Eucalyptus miniata</i> , <i>Eucalyptus tetrodonta</i>	24
<i>Sandstone</i>			
S1	Shrubland	<i>Corymbia grandiflora</i> , <i>Acacia tumida</i>	24
S2	Woodland	<i>Eucalyptus miniata</i> , <i>Eucalyptus tetrodonta</i>	18
S3	Woodland	<i>Eucalyptus tetrodonta</i> , <i>Corymbia bella</i> , <i>Corymbia grandiflora</i> , <i>Erythrophleum chlorostachys</i>	18
S4	Woodland	<i>Corymbia grandiflora</i> , <i>Corymbia polycarpa</i> , <i>Eucalyptus tetrodonta</i> , <i>Terminalia hadleyana</i> ssp <i>hadleyana</i>	7
S5	Woodland	<i>Corymbia bleeseri</i> , <i>Eucalyptus miniata</i> , <i>Eucalyptus tetrodonta</i>	7
S6	Open woodland	<i>Corymbia grandiflora</i> , <i>Terminalia hadleyana</i> ssp <i>hadleyana</i> , <i>Terminalia canescens</i>	2
S7	Woodland	<i>Corymbia bleeseri</i> , <i>Eucalyptus miniata</i> , <i>Eucalyptus tectifera</i> , <i>Erythrophleum chlorostachys</i> , <i>Owenia vernicosa</i>	2
S8	Woodland	<i>Corymbia bleeseri</i> , <i>Eucalyptus miniata</i> , <i>Eucalyptus tetrodonta</i> , <i>Erythrophleum chlorostachys</i>	2

For both laterite and sandstone, sites are numbered according to their north–south distribution

size class, and counted to give estimates of basal area and plant density. Standing dead timber and logs were assessed for size and number. Projected tree canopy cover (height >4 m), shrub canopy cover (height 1–4 m) and shrub cover at 0–1 m height were visually estimated.

Analysis

Species richness

Ants were sorted to species, with a species' abundance within a single trap being capped at 50 to reduce data distortions caused by a small number of exceptionally high captures due to traps being placed very close to nests or foraging trails (see Andersen 1991a). The poor taxonomic state of northern Australian ants meant that only a small proportion could be confidently assigned a species name, and in such cases nomenclature follows Shattuck (1999). Unnamed species were identified to species group following Andersen (2000a), and assigned number codes that follow those published in previous studies in the Top End of the Northern Territory (e.g. Andersen 1991, 1992). The accuracy of species demarcations has been consistently validated by independent chemical and genetic analyses (Jones

et al. 2009; K. Sparks, unpublished data). Voucher specimens of all species are held at the CSIRO Tropical Ecosystems Research Centre in Darwin.

To investigate overall sampling completeness, species site occurrences were used to generate rarefaction (smoothed species accumulation) curves using EstimateS (Colwell 2005). This was done for laterite and sandstone sites separately, and for all sites combined. In each case, EstimateS was also used to calculate Chao2 estimates of total species richness (Colwell and Coddington 1994).

Functional groups

Functional composition of the regional fauna was described by assigning species to functional groups based on global responses to environmental stress and disturbance at the genus and species-group level (Andersen 1995). There are three key functional groups that respectively represent dominant, sub-dominant and ruderal structural components of ant communities: Dominant Dolichoderinae (primarily species of *Iridomyrmex*); Generalised Myrmicinae (species of *Monomorium*, *Pheidole* and *Crematogaster*); and Opportunists (primarily species of *Rhytidoponera*, *Tetramorium* and *Paratrechina*). Two other functional

groups are also very diverse in Australian savannas (Andersen 2000a): Subordinate Camponotini (species of *Camponotus*, *Polyrhachis* and *Opisthopsis*), and Hot-Climature specialists (species of *Melophorus* and *Meranoplus*, and granivorous species of *Monomorium*). The remaining functional groups are: Tropical-Climature Specialists (e.g. *Oecophylla smaragdina*); Cold-Climature Specialists (e.g. *Stigmatocros*); Cryptic Species (e.g. *Solenopsis*, *Hypoponera*); and Specialist Predators (e.g. *Leptogenys*, *Bothroponera*, *Myrmecia*).

Biogeography

The biogeography of the fauna was analysed in two ways. First, each species was designated as having either Torresian (tropical), Eyrean (arid) or Bassian (cool temperate) affinities, or being Widespread, according to the distribution of the species-groups to which they belong. Such designations follow Andersen (2000a). For the total ant fauna of monsoonal northern Australia, it is estimated that 44, 40 and 2% of species have Torresian, Eyrean, and Bassian affinities, respectively, with 13% belonging to widespread species groups (Andersen 2000a).

Second, species were classified according to their known distributional ranges across northern Australia, based on specimens held at the CSIRO Tropical Ecosystems Research Centre in Darwin, which holds by far the largest collection of northern Australian ants. The classifications were: (1). Known only from the Mitchell Falls region (almost all of these recorded for the first time in the present study); (2). Known from elsewhere in the northern Kimberley; (3). Occurring widely in the broader Kimberley region; (4). Occurring also in the Northern Territory; (5). Occurring throughout monsoonal northern Australia (i.e. also in Queensland as well as the Northern Territory).

Environmental relationships

Relationships between ant community composition and environmental attributes were examined using multivariate analysis, using the PC-ORD software package. First, a Bray-Curtis site dissimilarity matrix was constructed based on \log_e transformed ant species abundance data (considering all species), and sites were ordinated using non-multidimensional scaling (NMDS). Relationships between site similarity, and ant species and environmental variables, were represented using joint plots, where relationships are represented as lines of differing length radiating from a centroid, with the length of the line being proportional to the strength of the relationship. For environmental data, percentage cover was $\arcsin(\sqrt{x})$ transformed prior to analysis.

Second, Mantel tests (based on the correlation between comparable cells of two dissimilarity matrices) were used

to determine the direct relationships between ant community composition and various suites of environmental attributes across all sites combined, and for laterite and sandstone sites separately. Environmental attributes tested were combined tree/shrub species (density and basal area), combined herbaceous species (species percentage estimates), combined tree/shrub structural attributes (tree and shrub size classes, total basal area), combined herbaceous layer structural attributes (herbaceous and leaf litter biomass and cover, rock and boulder cover, herbaceous species richness) and soil data (chemical and physical measurements). To ensure normality, percentage cover data were $\arcsin(\sqrt{x})$ transformed, and other quantitative data were \log_e transformed, prior to analysis. All site matrices were based on Bray Curtis dissimilarity, and in all cases sandstone and laterite sites were considered together.

Finally, Spearman correlation coefficients were calculated for the relationships between time-since-fire and ant species richness, total ant abundance and the abundance of the most common species (those occurring at 12 or more of the 16 sites) and functional groups, considering sandstone and laterite sites separately.

Results

The fauna

A total of 21,570 ants (>25,000 when not capped at 50 per trap per species) representing 166 species from 33 genera were collected during the study (Table 2). The fauna included a single exotic species, *Paratrechina longicornis*, which occurred at six (mostly laterite) sites, but represented <0.1% of total ants. A total of 113 species were recorded at each of laterite and sandstone sites, with site species richness ranging from 36 to 59 (mean 45.8) and 35 to 55 (mean 45.1) respectively. Species rarefaction curves (Fig. 3) indicate that a substantial number of additional species were not recorded. Chao2 estimates of total species richness at laterite and sandstone sites were 151 and 147 respectively, and 203 combined.

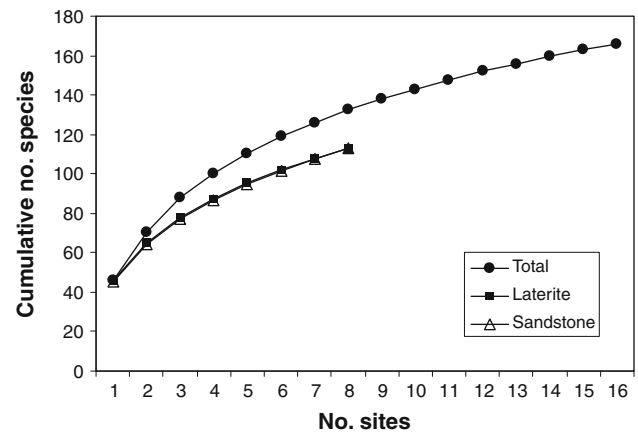
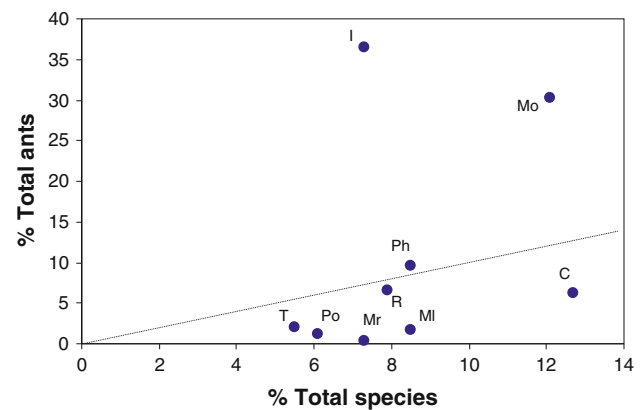
The richest genera were *Camponotus* (21 species), *Monomorium* (20), *Pheidole* (14), *Melophorus* (14), *Rhytidoponera* (13), *Meranoplus* (12), *Iridomyrmex* (12), *Polyrhachis* (10) and *Tetramorium* (9). *Iridomyrmex* (36.5% of total ants) and *Monomorium* (30.2%) were by far the most abundant genera (Appendix 1). The most speciose genera varied markedly in terms of their contribution to total ant abundance, with *Monomorium* and especially *Iridomyrmex* contributing disproportionately high numbers, and *Polyrhachis*, *Melophorus* and especially *Meranoplus* disproportionately low (Fig. 4).

Table 2 Summary of the ant fauna collected across all sites combined

	No. species	% abundance
Sub-family Myrmeciinae		
<i>Myrmecia</i>	1	0.2
Sub-family Cerapachyinae		
<i>Cerapachys</i>	2	+
<i>Sphinctomyrmex</i>	1	+
Sub-family Ponerinae		
<i>Anochetus</i>	2	+
<i>Bothroponera</i>	2	+
<i>Brachyponera</i>	1	+
<i>Hypoponera</i>	1	+
<i>Leptogenys</i>	1	+
<i>Odontomachus</i>	3	0.2
Sub-family Ectatomminae		
<i>Rhytidoponera</i>	13	6.6
Sub-family Myrmicinae		
<i>Aphaenogaster</i>	1	1
<i>Cardiocondyla</i>	1	0.7
<i>Crematogaster</i>	4	0.5
<i>Meranoplus</i>	12	0.3
<i>Monomorium</i>	20	30.2
<i>Pheidole</i>	14	9.6
<i>Solenopsis</i>	1	0.2
<i>Strumigenys</i>	1	+
<i>Tetramorium</i>	9	2.1
Sub-family Dolichoderinae		
<i>Froggattella</i>	1	0.4
<i>Iridomyrmex</i>	12	36.5
<i>Ochetellus</i>	2	0.5
<i>Papyrius</i>	2	0.4
<i>Tapinoma</i>	2	0.2
Sub-family Formicinae		
<i>Acropyga</i>	2	+
<i>Camponotus</i>	21	6.3
<i>Melophorus</i>	14	1.6
<i>Oecophylla</i>	1	1
<i>Opisthopsis</i>	2	0.5
<i>Paratrechina</i>	4	0.7
<i>Plagiolepis</i>	1	+
<i>Polyrhachis</i>	11	1.1
<i>Stigmacros</i>	1	+
Total	166	100

Data are number of species and percentage of total ants (+ = < 0.1%) collected for each genus

The most abundant species were *Iridomyrmex sanguineus* (19.2% of total ants), *Iridomyrmex* sp. 1 (*anceps* gp.; 11.4%), *Monomorium* sp. 24 (*laeve* gp.; 9.0%), *Monomorium* sp. P (*sordidum* gp.; 5.7%), *Camponotus* sp. 9 (*novaeollandiae*

**Fig. 3** Species rarefaction curves for laterite and sandstone sites separately and combined**Fig. 4** Relative contribution to total species compared with total abundance for each of the major genera (C *Camponotus*; I *Iridomyrmex*; MI *Melophorus*; Mo *Monomorium*; Mr *Meranoplus*; Ph *Pheidole*; Po *Polyrhachis*; T *Tetramorium*). The dotted line represents the 1:1 ratio

gp.; 4.3%), *Monomorium* sp. 37 (*nigrius* gp.; 4.2%), *Pheidole impressiceps* (3.3%) and *Pheidole* sp. 3 (*variabilis* gp.; 3.3%). *Iridomyrmex sanguineus*, *Monomorium* sp. 24 and *Pheidole* sp. 3 were recorded at all 16 sites, and *Monomorium* sp. 37 at 15 ([Appendix 1](#)).

Functional groups

All nine functional groups were represented in the regional fauna. Four functional groups each contributed about 20% of total species (Fig. 5): Generalised Myrmicinae (mostly species of *Monomorium* and *Pheidole*), Opportunists (mostly species of *Rhytidoponera* and *Tetramorium*), Subordinate Camponotini (mostly species of *Camponotus* and *Polyrhachis*) and Hot Climate Specialists (mostly species of *Melophorus* and *Meranoplus*). In contrast, the functional group profile based on ant abundance was overwhelmingly dominated by Dominant Dolichoderinae

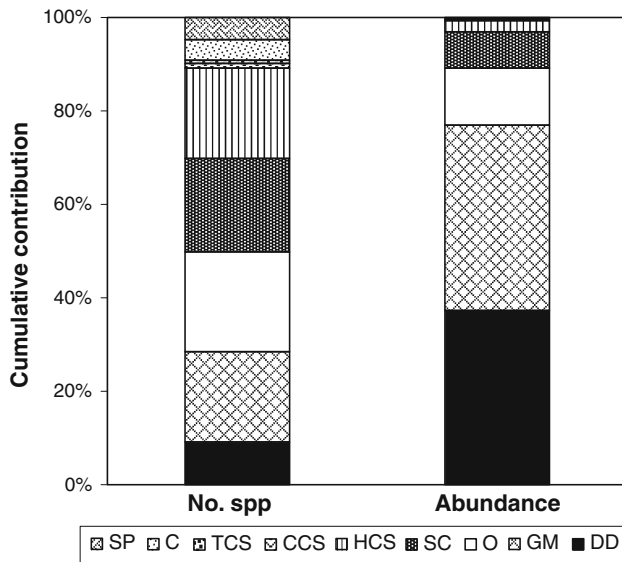


Fig. 5 Functional group profiles of the Mitchell Falls regional ant fauna. Data are relative contributions of each functional group to total species richness ($n = 165$) and to total ant abundance ($n = 21,570$), based on pooled data across all sites. *DD* Dominant Dolichoderinae; *GM* Generalised Myrmicinae; *O* Opportunists; *SC* Subordinate Camponotini; *HCS* Hot Climate Specialists; *CCS* Cold Climate Specialists; *TCS* Tropical Climate Specialists; *C* Cryptic Species; *SP* Specialist Predators

(mostly species of *Iridomyrmex*) and Generalised Myrmicinae, with each contributing nearly 40% of total ants (Fig. 5). There was a very strong negative correlation between the relative abundances of Dominant Dolichoderinae and sub-dominant Generalised Myrmicinae across the 16 sites ($r = 0.904, P < 0.001$), such that their combined abundances represented a relatively constant 80% of all ants at each site. There was a positive relationship between the abundance of Dominant Dolichoderinae and site species richness ($r = 0.50, P < 0.05$).

Biogeography

The Mitchell Falls fauna is dominated by Torresian and Eyrean taxa, which each contributed 42% of total species. Only two of the 165 species (species of *Myrmecia* and *Stigmacros*) have Bassian affinities, with the remaining 14% of species belonging to widespread taxa. The classification of species according to their distributional range across northern Australia shows a strongly bimodal pattern, with about a third of total species known only from the Mitchell Falls area, and another third occurring throughout monsoonal northern Australia (Fig. 6). This distributional pattern varied markedly between genera. For example, 11 of the 12 species of *Iridomyrmex* are known from throughout monsoonal Australia, and the remaining species is also widespread, occurring throughout the Top End of the

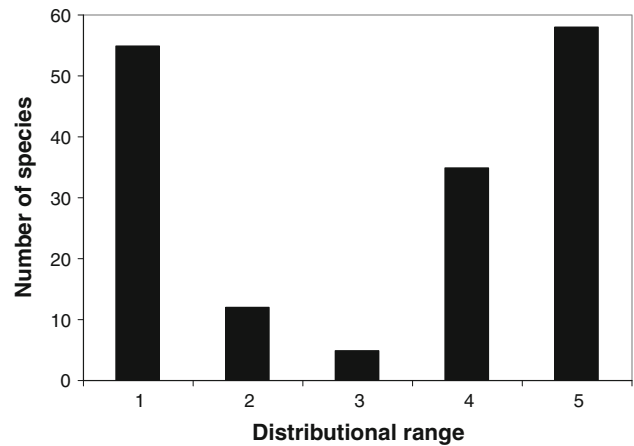


Fig. 6 Species distributions across northern Australia. Data are numbers of species in each of five distributional range classes: 1. Known only from the Mitchell Falls region; 2. Known from elsewhere in the northern Kimberley; 3. Occurring widely in the broader Kimberley region; 4. Occurring also in the Northern Territory; 5. Occurring throughout monsoonal northern Australia

Northern Territory. Species of *Polyrhachis* also tend to be widespread, with eight of the ten species occurring also in the Northern Territory, and six of these also in Queensland. In contrast, seven of the 13 species of *Rhytidoponera* are known only from the Mitchell Falls area, with only two known from the Northern Territory, and none from Queensland. Similarly, 11 of the 21 species of *Camponotus*, and six of the 14 species of *Melophorus*, are known only from the Mitchell Falls area. Such a contrast in distributional patterns also occurred between species groups within a genus. For example, within *Monomorium* nearly all of the 12 species of the *nigrius*, *leave* and *carinatum* groups (Generalised Myrmicinae) are very widespread (with most occurring throughout northern Australia), whereas none of the four species of the *insolescens* group (Hot Climate Specialists) are known from outside the northern Kimberley.

Environmental relationships

Ordination analysis revealed that the ant faunas of laterite and sandstone sites were very distinct from each other (ANOSIM Global $R = 1, P = 0.001$; Fig. 7). *Camponotus* sp. 9 (*novaehollandiae* gp.), *Cardiocondyla atalanta*, *Iridomyrmex* sp. 1 (*anceps* gp.), *Iridomyrmex* sp. 7 (*bicknelli* gp.), *Melophorus* sp. 36 (*mjobergi* gp.), *Monomorium anderseni*, *Monomorium* sp. 24 (*leave* gp.), *Monomorium* sp. 33 (*leave* gp.), *Polyrhachis gab* and *Tetramorium* sp. 1 (*striolatum* gp.) were significantly associated with laterite sites, and *Camponotus crozieri*, *Pheidole* sp. 1 (*mjobergi* gp.), *Pheidole* sp. G (*ampla* gp.) and *Rhytidoponera* sp. C (*reticulata* gp.) were significantly associated with sandstone sites (Fig. 7a). Laterite and sandstone sites were

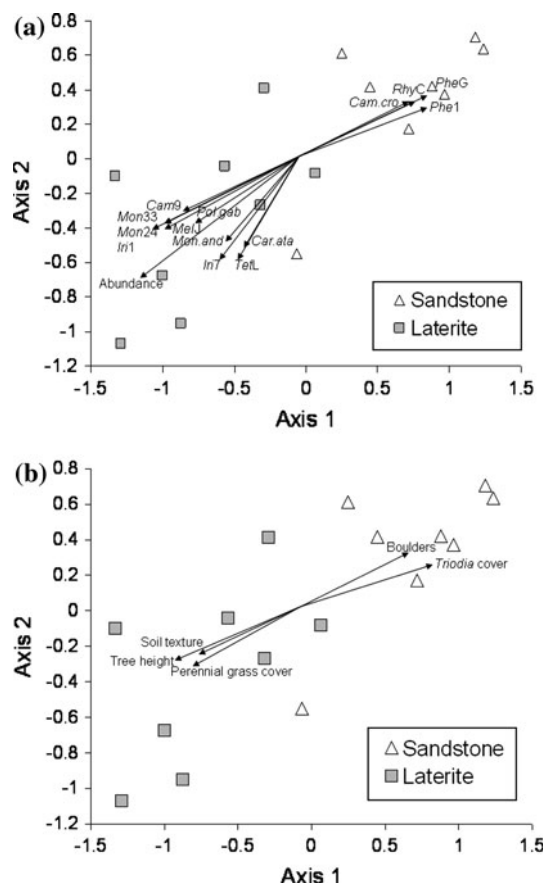


Fig. 7 Non-metric multidimensional scaling ordination of study sites according to ant species composition, showing significant associations (Pearson's $r > 0.621$; $P < 0.05$) for ant species [*Cam.cro*–*Camponotus crozieri*; *Camp9*–*Camponotus* sp. 9 (*novaeollandiae* gp.); *Car.ata*–*Cardiocondyla atalanta*; *Irid1*–*Iridomyrmex* sp. 1 (*anceps* gp.); *Irid7*–*Iridomyrmex* sp. 7 (*bicknelli* gp.); *Mel1*–*Melophorus* sp. 36 (*mjobergi* gp.); *Mon.and*–*Monomorium anderseni*; *Mon24*–*Monomorium* sp. 24 (*leave* gp.); *Mon33*–*Monomorium* sp. 33 (*leave* gp.); *Phe1*–*Pheidole* sp. 1 (*mjobergi* gp.), *PheG*–*Pheidole* sp. G (*ampla* gp.) *Pol.gab*–*Polyrhachis gab*; *RhyC*–*Rhytidoponera* sp. C (*reticulata* gp.) and *Tet1*–*Tetramorium* sp. 1 (*striolatum* gp.)] and (b) environmental attributes

distinguished by soil texture, tree height, and the cover of perennial grasses, the hummock grass *Triodia*, and boulders (Fig. 7b). Based on Mantel tests, overall ant community composition was significantly correlated with all the sets of environmental variables examined when all sites were considered together (Table 3). However, when laterite and sandstone sites were considered separately there was only one significant correlation—with soil physico-chemical attributes at laterite sites. This indicates that all the correlations with other environmental attributes were driven by variation between and not within laterite and sandstone sites.

Neither ant species richness nor overall ant abundance were significantly related to time-since-fire in either sandstone ($r = -0.575$ and -0.597 respectively; $P > 0.05$ in both cases) or laterite ($r = -0.360$ and -0.061 respectively; $P > 0.05$ in both cases) habitats. Considering the 14 most common species (those occurring at 12 or more of the 16 sites), there were only three cases of a significant relationship between abundance and time-since-fire: positive relationships for *Rhytidoponera* sp. 2 (*aurata* gp.) ($r = 0.687$, $P < 0.05$) and *Polyrhachis gab* ($r = 0.702$, $P < 0.05$) at sandstone sites, and a negative relationship ($r = -0.788$, $P < 0.05$) for *Rhytidoponera cersastes* at laterite sites. The abundance of Dominant Dolichoderinae significantly decreased with time-since-fire ($r = -0.769$, $P > 0.05$), but there was no fire relationship with the other common functional groups.

Discussion

The Mitchell Falls area supports a rich and noteworthy ant fauna, with a total of 166 species recorded during this study, and total species richness in the area estimated to be more than 200. Approximately a third of the recorded species are known only from the Mitchell Falls area, and,

Table 3 Mantel tests for the relationships between ant community composition (based on species abundances) and environmental attribute data across all sites combined, and for laterite and sandstone sites separately

Environmental attributes	All sites combined	Laterite sites	Sandstone sites
Herbaceous plant composition	0.790**	−0.053	−0.106
Ground-layer structure	0.195*	−0.267	−0.114
Woody plant composition	0.546**	0.307	−0.389
Woody vegetation structure	0.290**	0.263	−0.203
Tree basal area	0.426**	−0.266	−0.277
Soil chemical ($n = 19$) and physical attributes ($n = 2$)	0.549**	−0.108	0.659*

Compositional plant attributes are based on abundance or percentage data for each plant species. Ground-layer structural information encompasses herbaceous and leaf litter biomass, ground vegetation cover, leaf litter cover and rock cover, herbaceous species richness and proportion of site with boulders. Structural data for woody vegetation encompasses size class information for both live and dead trees and shrubs. Data were transformed for numerical abundance data (\log_e) and percentage data (arcsin square root). * $P < 0.05$; ** $P < 0.0001$

although this figure is undoubtedly very strongly influenced by limited sampling elsewhere in the Kimberley region, it is suggestive of a very significant level of local endemism. Moreover, the figure of about 50% of the species being restricted to the broader Kimberley region is likely to be reasonably robust, given the very high sampling effort in the climatically comparable Top End of the Northern Territory (e.g. Andersen 1991a, 1991b; Andersen et al. 2004, 2007). A further 30% of the species recorded are known from right across northern Australia; such a combination of highly localised and highly widespread species seems to be characteristic of the Australian savanna zone (Andersen 2000a). Interestingly, the eight most abundant species in the Mitchell Falls area are all common throughout monsoonal northern Australia, which conforms to a common macro-ecological tendency for numerically dominant species to be very widely distributed (Gaston 1994).

Species regional distributions varied dramatically between ant genera and between species groups within a genus. Species of *Rhytidoponera*, *Camponotus*, *Melophorus* and the *insolescens* group of *Monomorium* tended to have restricted distributions, with many if not most being endemic to the Kimberley region. In contrast, many if not most of the species of *Iridomyrmex*, *Polyrhachis* and other species-groups within *Monomorium* are widespread across northern Australia. Such inter-taxon variability in regional turnover of species has been noted previously in the Australian savanna zone (e.g. unusually high turnover in *Melophorus*, Andersen 2007). The processes driving such variability are unclear, but it highlights the need to consider a range of taxa when analysing patterns of speciation and regional endemism.

Sandstone and laterite sites supported distinct ant communities. There is a statistical issue of lack of spatial interspersed of sandstone and laterite sites, given that the two landforms are geographically separated. However the distance between sandstone and laterite sites (8–20 km) was similar to distances between laterite sites, so that we are confident that the distinct ant communities are directly associated with the different landforms. We were able to identify a range of ant species and environmental variables relating to vegetation, soils and ground-layer structure that differentiated laterite and sandstone sites. The ecology of individual species is too poorly known to provide mechanistic explanations for their environmental associations, but such environmental variables are generally known to be important in structuring ant communities (Greenslade 1979; Andersen 1995; Ríos-Casanova et al. 2006; Vasconcelos et al. 2008). Except for soil physico-chemical characteristics at laterite sites, we were unable to identify environmental attributes associated with variation within laterite or sandstone sites. We also found little association

between ant communities and time-since-fire, though the important Dominant Dolichoderinae group did significantly decline with time-since-fire. The weak association between ant communities and fire history in this study is consistent with the overall resilience of savanna ant communities to individual fire events (Parr and Andersen 2008). In contrast, ant communities respond strongly to variation in vegetation structure wrought by variation in long-term fire regimes (Andersen 1991b; Parr et al. 2004).

The Mitchell Falls fauna is equally dominated by Torresian and Eyrean elements (42% of total species in each case), with only 2% of species having Bassian affinities. This mirrors almost exactly the biogeographic profile of the entire ant fauna of monsoonal Australia, which is estimated to consist of 44, 40 and 2% of Torresian, Eyrean and Bassian species, respectively, (Andersen 2000a). This profile shows a strong north–south gradient, with the representation of Torresian and Eyrean elements decreasing and increasing, respectively, with decreasing rainfall. Highest rainfall (up to 2,000 mm/year) in monsoonal Australia occurs in the Tiwi Islands north of Darwin, where 66% of ant species have Torresian affinities, and 20% Eyrean (Andersen et al. 2004). These figures are 61 and 23%, respectively for Kakadu National Park, where rainfall ranges from about 1,200–1,600 mm/year (Barrow et al. 2006). At the arid end of the savanna rainfall gradient, these figures are 33 and 50%, respectively, in Purnululu National Park in the southern Kimberley (600 mm annual rainfall; Barrow et al. 2006), and 20 and 70%, respectively, in the Lawn Hill region of far northwestern Queensland (540 mm mean annual rainfall; Andersen 1993).

These biogeographic patterns are mirrored by patterns of functional group composition, with the proportion of species belonging to Dominant Dolichoderinae and Hot-Climax Specialists, both comprised primarily of Eyrean taxa, increasing with decreasing rainfall (Barrow et al. 2006). In the Mitchell Falls region these functional groups, respectively, represented 9 and 19% of total species, which is similar to climatically comparable Kakadu National Park in the Northern Territory (Press et al. 1995). The most abundant functional groups were Dominant Dolichoderinae and (subdominant) Generalised Myrmicinae, which together contributed 80% of all ants, a figure that was very uniform across sites. This is very similar to the figure of 75% in the climatically comparable Darwin region of the Northern Territory (Andersen and Patel (1994), but higher than in the semi-arid tropics where the abundance of *Monomorium* is considerably lower (Andersen 1993; Barrow et al. 2006). There was a positive correlation between the site abundance of Dominant Dolichoderinae on one hand, and both the site abundance of Generalised Myrmicinae and site species richness on the other. Such a pattern occurs at a continental scale, and suggests that all three variables

are co-responding to increased site favourability for ants, and that increased site favourability over-rides any negative effects of increased competition from Dominant Dolichoderinae (Andersen 1995).

In conclusion, the diversity, functional group composition and biogeographical structure of the northern Kimberley ant fauna are all similar to that of climatically comparable regions elsewhere in monsoonal northern Australia, and are consistent with previously documented patterns of Australia's broader savanna fauna in relation to rainfall. However, the high degree of regional endemism makes the fauna an especially significant one. Such endemism can be attributed to the northern Kimberley's unusually high rainfall, which declines dramatically to the south and makes the region geographically isolated from the nearest region of similarly high rainfall in subcoastal Northern Territory. Our findings indicate that the high

conservation values attributed to the flora and vertebrate fauna of the northern Kimberley also apply to the region's insect fauna.

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Appendix 1

Ant species collected from the Mitchell Falls region of far northern Western Australia

	Funct. group	Biogeogr.		Abundance					
				Laterite		Sandstone		Total	
		I	II	A	B	A	B	A	B
Subfamily Myrmeciinae									
<i>Myrmecia</i> sp. nr. <i>desertorum</i>	SP	B	4	4	49			4	49
Subfamily Cerapachyiinae									
<i>Cerapachys</i> sp. 4 (<i>singularis</i> gp.)	SP	E	5			2	3	2	3
<i>Cerapachys</i> ? <i>fervidus</i>	SP	E	4			1	2	1	2
<i>Sphinctomyrmex</i> sp. 5	CS	T	5			1	1	1	1
Subfamily Ponerinae									
<i>Anochetus</i> sp. A (<i>rectangularis</i> gp.)	SP	T	2			1	1	1	1
<i>Anochetus</i> sp. B (<i>rectangularis</i> gp.)	SP	T	1			1	1	1	1
<i>Bothroponera</i> sp. B (<i>sublaevis</i> gp.)	SP	T	1			1	1	1	1
<i>Bothroponera</i> sp. C (<i>sublaevis</i> gp.)	SP	T	1			1	1	1	1
<i>Brachyponera lutea</i>	CS	W	5	3	6	3	7	6	13
<i>Hypoponera</i> sp. A	CS	W	5	1	1			1	1
<i>Leptogenys exigua</i>	SP	T	5			1	3	1	3
<i>Odontomachus</i> sp. nr. <i>turneri</i>	OPP	T	5	7	24			7	24
<i>Odontomachus</i> ? <i>ruficeps</i>	OPP	T	1	2	3			2	3
<i>Odontomachus</i> sp. A (<i>ruficeps</i> sp.)	OPP	T	4			6	10	6	10
Subfamily Ectatomminae									
<i>Rythidoponera aurata</i>	OPP	T	4	1	17	2	2	3	19
<i>R. cerastes</i>	OPP	T	2	6	257	7	377	13	634
<i>Rythidoponera</i> sp. 2 (<i>aurata</i> sp.)	OPP	T	4	6	207	6	156	12	363
<i>Rythidoponera</i> sp. A (<i>tenuis</i> sp.)	OPP	T	1			1	6	1	6
<i>Rythidoponera</i> sp. C (<i>reticulata</i> sp.)	OPP	T	3			8	253	8	253
<i>Rythidoponera</i> sp. D (<i>tenuis</i> sp.)	OPP	T	3	3	22	2	23	5	45
<i>Rythidoponera</i> sp. E (<i>reticulata</i> gp.)	OPP	T	1			5	21	5	21
<i>Rythidoponera</i> sp. F (<i>borealis</i> complex)	OPP	W	1			2	3	2	3

continued

	Funct. group	Biogeogr.		Abundance					
				Laterite		Sandstone		Total	
				I	II	A	B	A	B
<i>Rythidoponera</i> sp. G (<i>reticulata</i> gp.)	OPP	T	1	1	1			1	1
<i>Rythidoponera</i> sp. H (<i>tyloxys</i> gp.)	OPP	E	1			1	1	1	1
<i>Rythidoponera</i> sp. J (<i>taurus</i> gp.)	OPP	T	1	2	23			2	23
<i>Rythidoponera</i> sp. K (<i>borealis</i> complex)	OPP	W	2	7	49			7	49
<i>Rythidoponera</i> sp. L (<i>convexa</i> gp.)	OPP	E	1	2	11			2	11
Subfamily Myrmicinae									
<i>Aphaenogaster kimberleyensis</i>	OPP	W	4	8	219			8	219
<i>Cardiocondyla atalanta</i>	OPP	W	5	8	104	4	47	12	151
<i>Crematogaster queenslandica</i>	GM	W	5	3	7	7	37	10	44
<i>C. sp. nr. queenslandica</i>	GM	W	1	2	54			2	54
<i>Crematogaster</i> sp. 2 (<i>australis</i> complex)	GM	W	5	2	3			2	3
<i>Crematogaster</i> sp. A (<i>queenslandica</i> gp.)	GM	W	5	3	5			3	5
<i>Meranoplus ajax</i>	HCS	E	5			2	6	2	6
<i>M. sp. nr. ajax</i>	HCS	E	1			1	1	1	1
<i>M. berrimah</i>	HCS	E	4	1	6	1	5	2	11
<i>Meranoplus</i> sp. 13 (<i>aureolus</i> complex)	HCS	E	4	1	1			1	1
<i>Meranoplus</i> sp. 14 (<i>aureolus</i> complex)	HCS	E	4			2	4	2	4
<i>Meranoplus</i> sp. C (Group F)	HCS	T	2			1	1	1	1
<i>Meranoplus</i> sp. E (<i>excavatus</i> gp.)	HCS	E	1			2	3	2	3
<i>Meranoplus</i> sp. F	HCS	E	1			2	29	2	29
<i>Meranoplus</i> sp. G	HCS	E	4	1	1			1	1
<i>Meranoplus</i> sp. I (Group C)	HCS	T	2			1	2	1	2
<i>Meranoplus</i> sp. J	HCS	E	1	2	2			2	2
<i>Meranoplus</i> sp. K (Group C)	HCS	T	4	2	4			2	4
<i>Monomorium andersini</i>	GM	E	4	4	496			4	496
<i>M. ?fieldi</i>	GM	T	5	6	392	7	62	13	454
<i>Monomorium</i> sp. 8 (<i>carinatum</i> gp.)	GM	T	5	3	50	6	35	9	85
<i>Monomorium</i> sp. 13 (<i>nigrius</i> gp.)	GM	T	5	1	1			1	1
<i>Monomorium</i> sp. 14 (<i>nigrius</i> gp.)	GM	T	5	8	409	5	28	13	437
<i>Monomorium</i> sp. 22 (<i>laeve</i> gp.)	GM	E	4	4	49	1	1	5	50
<i>Monomorium</i> sp. 24 (<i>laeve</i> gp.)	GM	E	5	8	1866	8	271	16	2137
<i>Monomorium</i> sp. 33 (<i>laeve</i> gp.)	GM	E	5	8	577	5	17	13	594
<i>Monomorium</i> sp. 35 (<i>rothsteini</i> gp.)	HCS	E	5	4	81	3	29	7	110
<i>Monomorium</i> sp. 37 (<i>nigrius</i> gp.)	GM	T	4	7	640	8	351	15	991
<i>Monomorium</i> sp. E (<i>insolescens</i> gp.)	HCS	T	1	3	22			3	22
<i>Monomorium</i> sp. F (<i>laeve</i> gp.)	GM	E	1	1	17	6	109	7	126
<i>Monomorium</i> sp. L (<i>insolescens</i> gp.)	HCS	T	1			2	3	2	3
<i>Monomorium</i> sp. K (<i>insolescens</i> gp.)	HCS	T	1			4	10	4	10
<i>Monomorium</i> sp. M (<i>nigrius</i> gp.)	GM	T	1			5	67	5	67
<i>Monomorium</i> sp. P (<i>sordidum</i> gp.)	GM	E	5	5	2424			5	2424
<i>Monomorium</i> sp. R (<i>carinatum</i> gp.)	GM	T	4	1	2			1	2
<i>Monomorium</i> sp. S (<i>bifidum</i> complex)	HCS	T	1	1	1			1	1
<i>Monomorium</i> sp. T (<i>insolescens</i> gp.)	HCS	T	2	1	4			1	4
<i>Monomorium</i> sp. U (<i>sordidum</i> gp.)	GM	E	4	1	11			1	11
<i>Pheidole impressiceps</i>	GM	T	5	4	723	2	6	6	729
<i>Pheidole</i> sp. 1 (<i>Mjobergi</i> gp.)	GM	E	4			8	236	8	236

continued

	Funct. group	Biogeogr.		Abundance					
				Laterite		Sandstone		Total	
				I	II	A	B	A	B
<i>Pheidole</i> sp. 3 (<i>variabilis</i> gp.)	GM	W	4	8	176	8	539	16	715
<i>Pheidole</i> sp. 24 (Group A)	GM	T	4			1	8	1	8
<i>Pheidole</i> sp. B (Group F)	GM	T	4	2	4	1	2	3	6
<i>Pheidole</i> sp. F (Group B)	GM	E	1	1	1	2	81	3	82
<i>Pheidole</i> sp. G (<i>ampla</i> gp.)	GM	T	1	1	1	8	155	9	156
<i>Pheidole</i> sp. I (Group C)	GM	W	4			2	5	2	5
<i>Pheidole</i> sp. J (Group K)	GM	T	1	1	1	6	102	7	103
<i>Pheidole</i> sp. K (<i>variabilis</i> gp.)	GM	W	1	1	11			1	11
<i>Pheidole</i> sp. L (Group K)	GM	T	1			1	2	1	2
<i>Pheidole</i> sp. M (Group C)	GM	W	3	1	1	1	22	2	23
<i>Pheidole</i> sp. N (<i>mjobergi</i> gp.)	GM	E	1			1	12	1	12
<i>Pheidole</i> sp. O (<i>longiceps</i> gp.)	GM	T	1	1	18			1	18
<i>Solenopsis</i> sp. 1	CS	W	5	6	21	7	20	13	41
<i>Strumigenys sutrix</i>	CS	T	4	1	5	1	2	2	7
<i>Tetramorium lanuginosum</i>	OPP	T	5	1	1			1	1
<i>T.</i> sp. nr. <i>sjostedti</i>	OPP	T	4			4	14	4	14
<i>Tetramorium</i> sp. 1 (<i>striolatum</i> gp.)	OPP	E	5	8	83	8	223	16	306
<i>Tetramorium</i> sp. 2 (<i>striolatum</i> gp.)	OPP	E	4	1	1	6	39	7	40
<i>Tetramorium</i> sp. F (<i>striolatum</i> gp.)	OPP	E	1	4	62	2	5	6	67
<i>Tetramorium</i> sp. G (<i>striolatum</i> gp.)	OPP	E	1			3	4	3	4
<i>Tetramorium</i> sp. H (Group A)	OPP	T	1			3	5	3	5
<i>Tetramorium</i> sp. I (<i>striolatum</i> gp.)	OPP	E	1			1	7	1	7
<i>Tetramorium</i> sp. L (Group A)	OPP	T	2	3	10			3	10
Subfamily Dolichoderinae									
<i>Froggattella kirbii</i>	DD	W	5	6	76			6	76
<i>Iridomyrmex sanguineus</i>	DD	E	5	8	4079	8	1871	16	5950
<i>I. pallidus</i>	DD	E	5	3	12	7	220	10	232
<i>I. reburrus</i>	DD	E	5	1	9			1	9
<i>Iridomyrmex</i> sp. 1 (<i>anceps</i> gp.)	DD	E	5	8	2424	6	103	14	2527
<i>Iridomyrmex</i> sp. 2 (<i>mjobergi</i> gp.)	DD	E	5			6	60	6	60
<i>Iridomyrmex</i> sp. 3 (<i>mjobergi</i> gp.)	DD	E	5	1	2	3	47	4	49
<i>Iridomyrmex</i> sp. 4 (<i>coeruleus</i> gp.)	DD	E	5	4	36	1	1	5	37
<i>Iridomyrmex</i> sp. 7 (<i>bicknelli</i> gp.)	DD	E	5	7	83			7	83
<i>Iridomyrmex</i> sp. 8 (<i>bicknelli</i> gp.)	DD	E	5	1	10	4	13	5	23
<i>Iridomyrmex</i> sp. 12 (<i>pallidus</i> gp.)	DD	E	4	2	2	5	10	7	12
<i>Iridomyrmex</i> sp. 17 (<i>pallidus</i> gp.)	DD	E	5			8	261	8	261
<i>Iridomyrmex</i> sp. 21 (<i>gracilis</i> gp.)	DD	E	5			7	622	7	622
<i>Ochetellus flavipes</i>	HCS	E	5			1	1	1	1
<i>Ochetellus</i> sp. 1 (<i>glaber</i> gp.)	OPP	W	4	7	113			7	113
<i>Papyrius</i> sp. 1 (<i>nitidus</i> gp.)	DD	W	5	1	1	4	55	5	56
<i>Papyrius</i> sp. A (<i>nitidus</i> gp.)	DD	W	3			1	40	1	40
<i>Tapinoma</i> sp. A (<i>minutum</i> gp.)	OPP	W	5	1	3	3	8	4	11
<i>Tapinoma</i> sp. B (<i>minutum</i> gp.)	OPP	W	5	5	22	3	7	8	29
Subfamily Formicinae									
<i>Acropyga</i> sp. A	CS	W	1	1	1			1	1
<i>Acropyga</i> sp. B	CS	W	1	1	2			1	2

continued

	Funct. group	Biogeogr.		Abundance					
				Laterite		Sandstone		Total	
				I	II	A	B	A	B
<i>Camponotus crozieri</i>	SC	T	5	1	1	7	79	8	80
<i>C. dromas</i>	SC	E	5	2	5	2	5	4	10
<i>C. humilior</i>	SC	T	5	3	14	3	17	6	31
<i>C. sp. nr. novaehollandiae</i>	SC	T	1	3	60	1	2	4	62
<i>C. sp. nr. rubiginosus</i>	SC	E	2	5	90			5	90
<i>Camponotus sp. 9 (novaehollandiae gp.)</i>	SC	T	5	8	940			8	940
<i>Camponotus sp. A (pellax gp.)</i>	SC	T	1			1	7	1	7
<i>Camponotus sp. B (rubiginosus gp.)</i>	SC	E	2	1	7	7	28	8	35
<i>Camponotus sp. D (setosus gp.)</i>	SC	E	1			6	15	6	15
<i>Camponotus sp. E (pellax gp.)</i>	SC	T	1			1	2	1	2
<i>Camponotus sp. F (rubiginosus gp.)</i>	SC	E	1			2	3	2	3
<i>Camponotus sp. G (discors gp.)</i>	SC	E	5	5	16	2	6	7	22
<i>Camponotus sp. H (rubiginosus gp.)</i>	SC	E	1			2	17	2	17
<i>Camponotus sp. I (subnitidus gp.)</i>	SC	T	3	3	5			3	5
<i>Camponotus sp. J (pellax gp.)</i>	SC	T	1	2	2	1	1	3	3
<i>Camponotus sp. P (Group D)</i>	SC	E	1	2	2			2	2
<i>Camponotus sp. R (rubiginosus gp.)</i>	SC	E	2	2	5			2	5
<i>Camponotus sp. S (novaehollandiae gp.)</i>	SC	T	2	5	22			5	22
<i>Camponotus sp. U (aureopilus gp.)</i>	SC	T	1	2	5			2	5
<i>Camponotus sp. V (discors gp.)</i>	SC	E	1	1	1			1	1
<i>Camponotus sp. W (pellax gp.)</i>	SC	T	1	2	2			2	2
<i>Melophorus sp. 1 (aeneovirens gp.)</i>	HCS	E	4	8	39	2	47	10	86
<i>Melophorus sp. 12 (mjobergi gp.)</i>	HCS	E	4	3	4			3	4
<i>Melophorus sp. 25 (fieldi gp.)</i>	HCS	E	4	2	3			2	3
<i>Melophorus sp. 30 (fieldi gp.)</i>	HCS	E	5	2	8	2	14	4	22
<i>Melophorus sp. 36 (mjobergi gp.)</i>	HCS	E	4	7	121			7	121
<i>Melophorus sp. 38 (iridescens gp.)</i>	HCS	E	4			1	5	1	5
<i>Melophorus sp. A (Group A)</i>	HCS	E	1	3	4	3	19	6	23
<i>Melophorus sp. B (Group C)</i>	HCS	E	1			2	3	2	3
<i>Melophorus sp. E (froggatti gp.)</i>	HCS	E	2	6	26	1	3	7	29
<i>Melophorus sp. F (Group E)</i>	HCS	E	4			1	44	1	44
<i>Melophorus sp. G (aeneovirens gp.)</i>	HCS	E	1			1	1	1	1
<i>Melophorus sp. M (Group D)</i>	HCS	E	1	2	2			2	2
<i>Melophorus sp. N (mjobergi gp.)</i>	HCS	E	1			1	3	1	3
<i>Melophorus sp. O (Group A)</i>	HCS	E	1	1	1			1	1
<i>Oecophylla smaragdina</i>	TCS	T	5	1	7			1	7
<i>Opisthopsis haddoni</i>	SC	T	5	7	26			7	26
<i>O. rufoniger</i>	SC	T	5	5	68	4	11	9	79
<i>Paratrechina longicornis</i>	OPP	T	5	5	6	1	17	6	23
<i>Paratrechina sp. 4 (vaga gp.)</i>	OPP	T	5	1	1	3	14	4	15
<i>Paratrechina sp. B (minutula gp.)</i>	OPP	W	1	1	29	5	23	6	52
<i>Paratrechina sp. D (vaga gp.)</i>	OPP	W	4	4	48	2	9	6	57
<i>Plagiolepis sp. A (nynganensis gp.)</i>	CCS	W	1			1	1	1	1
<i>Polyrhachis anderseni</i>	SC	T	4			1	1	1	1
<i>P. bohemia</i>	SC	T	5	1	1	1	1	2	2
<i>P. gab</i>	SC	T	5	8	165	6	10	14	175

continued

	Funct. group	Biogeogr.		Abundance					
				Laterite		Sandstone		Total	
		I	II	A	B	A	B	A	B
<i>P. inconspicua</i>	SC	T	5	4	12	6	31	10	43
<i>P. melanura</i>	SC	T	5	1	1	1	1	2	2
<i>P. pseudothrinax</i>	SC	T	5			1	1	1	1
<i>P. schenkii</i>	SC	T	5	1	1			1	1
<i>P. sp. nr. schenkii</i>	SC	T	5	1	1	1	1	2	2
<i>Polyrhachis</i> sp. B (<i>gravis</i> sp.)	SC	E	1			1	2	1	2
<i>Polyrhachis</i> sp. D (<i>schwiedlandi</i> sp.)	SC	E	1			1	1	1	1
<i>Polyrhachis</i> sp. F (<i>schwiedlandi</i> sp.)	SC	E	4	1	1			1	1
<i>Stigmacros aciculata</i>	CCS	B	5	1	1			1	1

For each species, information is provided on its functional group, biogeography (I: *B* Bassian, *E* Eyrean, *W* Widespread; *T* Torresian; II: species distribution across northern Australia, see “Methods”) and abundance (*A* number of sites at which recorded; *B* total number of individuals recorded)

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