

Ant community structure along an extended rain forest–savanna gradient in tropical Australia

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Abstract: In mixed tropical landscapes, savanna and rain-forest vegetation often support contrasting biotas, and this is the case for ant communities in tropical Australia. Such a contrast is especially pronounced in monsoonal north-western Australia, where boundaries between rain forest and savanna are often extremely abrupt. However, in the humid tropics of north-eastern Queensland there is often an extended gradient between rain forest and savanna through eucalypt-dominated tall open forest. It is not known if ant community structure varies continuously along this gradient, or, if there is a major disjunction, where it occurs. We address this issue by sampling ants at ten sites distributed along a 6-km environmental gradient from rain forest to savanna, encompassing the crest and slopes of Mt. Lewis in North Queensland. Sampling was conducted using ground and baited arboreal pitfall traps, and yielded a total of 95 ant species. Mean trap species richness was identical in rain forest and rain-forest regrowth, somewhat higher in tall open forest, and twice as high again in savanna woodland. The great majority (78%) of the 58 species from savanna woodland were recorded only in this habitat type. MDS ordination of sites based on ant species composition showed a continuum from rain forest through rain-forest regrowth to tall open forest, and then a discontinuity between these habitat types and savanna woodland. These findings indicate that the contrast between rain forest and savanna ant communities in tropical Australia is an extreme manifestation of a broader forest-savanna disjunction.

Key Words: environmental gradient, forest–savanna disjunction, functional groups, Queensland, species richness

INTRODUCTION

Rain forest and savanna are contrasting closed and open vegetation types respectively that dominate the world's tropics, and support contrasting biotas. The boundaries between them are determined primarily by an interaction between moisture availability and fire frequency, and their dynamics are a key issue in tropical biogeography (Bowman 2000, Bullock *et al.* 1995, Furley *et al.* 1992). However, studies of rain forest/savanna dynamics have focused primarily on vegetation, with less attention paid to contrasting rain-forest and savanna faunas (Lacher & Alho 2001).

The rain forests and savannas of tropical northern Australia support remarkably disjunct ant faunas, with rain forests featuring shade-tolerant taxa of Indo-

Malayan origin, and savannas dominated by autochthonous, 'sun-loving' taxa centred on arid Australia (Andersen *et al.* 2007, Reichel & Andersen 1996, Taylor 1972). The faunas also have contrasting functional composition, with rain-forest communities featuring high proportions of litter-dwelling (cryptic) and arboreal species, and savannas featuring ground-nesting behaviourally dominant species of *Iridomyrmex* (belonging to the functional group Dominant Dolichoderinae; Andersen 1995) and highly specialized thermophiles and granivores (Hot-Climates Specialists) (Andersen 2000a). Further, although tropical rain forests generally are regarded as supporting the world's richest ant faunas (Brühl *et al.* 1998, Longino *et al.* 2002, Verhaagh 1990, Wilson 1959), Australia's rain-forest ant fauna is relatively depauperate (Taylor 1972). In contrast, the ant fauna in Australian savannas is exceptionally rich (Andersen 2000b).

This faunistic disjunction is especially pronounced in monsoonal north-western Australia, where rain forest

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occurs as isolated patches within a vast savanna landscape (Bowman 2000). Here, rain forest-savanna boundaries are remarkably abrupt, and the contrasting ant communities occur within a few metres of each other (Andersen & Majer 1991, Andersen & Reichel 1994). However, in the humid tropics of north-eastern Queensland there is often an extended gradient between rain forest and savanna, typically involving a band of eucalypt-dominated tall open forest (Ashton 1981). It is not known if ant community structure varies continuously along this gradient, or, if there is a major disjunction, where it occurs.

Here we address this issue by describing ant community structure along an extended environmental gradient from rain forest to savanna in North Queensland. We examine patterns of ant richness, species composition and functional composition along the gradient, and test three competing hypotheses: (1) there is a continuous gradient between rain-forest and savanna ant communities; (2) a major disjunction occurs between rain forest on one hand, and open eucalypt forests and savanna woodlands on the other (i.e. a mesophyll-sclerophyll disjunction); (3) a major disjunction occurs between forests, both mesophyll (rain forest) and sclerophyll (tall open forest), and savanna woodland (i.e. a forest-savanna disjunction).

METHODS

Study sites

The study was conducted at ten sites (Table 1) distributed along a 6-km environmental gradient encompassing the crest and slopes of Mt. Lewis, in the Australian Wildlife Conservancy's Brooklyn wildlife sanctuary (16°59'S, 145°25'E) 100 km north-west of Cairns. The sanctuary

covers 600 km², and is remarkably diverse biologically, providing habitat for about 40% and 30% of all Australian bird and mammal species respectively (http://www.iucn.org/themes/wcpa/pubs/pdfs/Figgis_Parks2006.pdf). Previous studies of its ant fauna have been limited to opportunistic collections, but it includes one species that is known only from Mt. Lewis (*Monomorium draculai*; Heterick 2001).

The study sites varied in altitude from 640 to 1060 m asl, with mean annual rainfall ranging from <900 mm at the lowest site to about 4000 mm at the top of Mt. Lewis (http://www.iucn.org/themes/wcpa/pubs/pdfs/Figgis_Parks2006.pdf). Vegetation ranged from savanna woodland (canopy cover <30%) dominated by eucalypt species at low elevation, through tall open forest (canopy cover about 50%) dominated by other eucalypt species at mid-elevation, to complex notophyll vine forest (rain forest) at highest elevations (vegetation nomenclature follows Groves 1981). Some of the rain forest at lower elevation is regrowth from extensive historical logging that ceased 30 y previously (S. McKenna, pers. comm.), so that we recognized four vegetation types: rain forest (RF, three sites); rain-forest regrowth (RFR, two sites); tall open forest (TOF, three sites); and savanna woodland (SW, two sites) (Table 1, Figure 1).

Sampling

Ants were sampled during April (late wet season) 2007 using pitfall traps located in the ground (for ground-active species) and on the trunks of trees (for arboreal species). Sampling of leaf litter for cryptic species was also attempted using Winkler sacs (Agosti *et al.* 2000); however, there was insufficient leaf litter for collection at the tall-open-forest and savanna sites, and so this was abandoned.

Table 1. Summary descriptions of the ten study sites. Habitat type follows Groves (1981), and plant species nomenclature follows the Australian Plant Name Index (<http://www.anbg.gov.au/cpbr/databases/apni-search-full.html>).

Site code	Habitat type	Altitude (m)	Vegetation description
RF1	Rain forest	1017	Complex notophyll vine forest of cloudy wet uplands, with dominant species including <i>Argyrodendron</i> sp., <i>Cardwellia sublimis</i> , <i>Athertonia diversifolia</i> and <i>Hylandia dockrillii</i>
RF2	Rain forest	1060	Complex notophyll vine forest of cloudy wet uplands, dominated by species of <i>Cryptocarya</i> and <i>Beilschmiedia</i>
RF3	Rain forest	1066	Complex notophyll vine forest of cloudy wet uplands
RFR1	Rain-forest Regrowth	1010	Vine forest regrowth, with many slender vines
RFR2	Rain-forest Regrowth	1016	Vine forest regrowth, with vines and climbing palms (<i>Calamus</i> sp.) prominent
TOF1	Tall open forest	938	<i>Eucalyptus grandis</i> open forest over the sub-canopy trees <i>Syncarpia glomulifera</i> , <i>Allocasuarina torulosa</i> and <i>Banksia aquilonia</i>
TOF2	Tall open forest	911	<i>Syncarpia glomulifera</i> open forest over <i>Allocasuarina torulosa</i> and <i>Banksia aquilonia</i>
TOF3	Tall open forest	851	<i>Eucalyptus resinifera</i> and <i>E. reducta</i> open forest over <i>Allocasuarina torulosa</i> and <i>Syncarpia glomulifera</i>
SW1	Savanna woodland	720	<i>Eucalyptus portuensis</i> woodland with <i>Corymbia</i> spp., <i>E. citriodora</i> and <i>E. tereticornis</i> , over dense grass dominated by <i>Themeda triandra</i>
SW2	Savanna woodland	641	<i>Eucalyptus granitica</i> woodland with <i>Corymbia hylandii</i> , over dense grass dominated by <i>Themeda triandra</i>



Figure 1. Photographs of the four habitat types occurring along the study gradient: Rain forest (site RF1) (a), Rain-forest regrowth (site RFR1) (b), Tall open forest (site TOF3) (c) and Savanna woodland (site SW2) (d).

Pitfall traps were 4-cm-diameter plastic containers partly filled with ethylene-glycol as a preservative. At each site, 15 ground traps were established in a 5×3 grid with 5-m spacing, buried in the soil with their rims flush with the soil surface. An arboreal trap was taped to the tree nearest to each ground trap at 1.7 m height, following Andersen *et al.* (2006). Arboreal traps had their inner rims smeared with fish paste as an ant attractant, whereas ground traps were not baited. Each trap was opened for a single 48-h period. There was no substantial rain during the sampling period.

All ants collected in traps were sorted to species, and where possible named, with species nomenclature following Bolton (1995). Species that could not be confidently named were identified to species-group following Andersen (2000b), and assigned number codes (sp. 1, sp. 2, etc.) if they had been recorded as such in published studies from the Top End of the Northern Territory (Andersen *et al.* 2006, 2007). They were otherwise assigned letter codes (sp. A, sp. B, etc.) that apply only to this study. Voucher specimens of all species are held at the CSIRO Tropical Ecosystems Research Centre in Darwin.

Data analysis

Rarefaction curves, plotting the cumulative number of species recorded as a function of sampling effort (Gotelli & Colwell 2001), were used to compare species richness among the four habitat types and to assess sampling completeness. The curves were based on combined ground and arboreal traps from all sites from a particular habitat type (i.e. four curves, derived from either 60 or 90 traps), and were generated using EstimateS ver. 7.5.0 (Colwell & Coddington 1994). Mean species richness and abundance per trap were compared among habitat types using one-way ANOVA, with abundance data square-root transformed to meet the assumption of normality. A Tukey test of post hoc comparison was used to determine statistically significant differences between habitat types (Zar 1999).

Patterns of ant species composition were investigated at the site level using multidimensional scaling (MDS) in two dimensions, on species presence/absence data. MDS was based on a Bray-Curtis dissimilarity matrix, and performed using the software Systat 10. The extent of clustering according to stratum (ground vs arboreal) and

vegetation type was then assessed by analysis of similarity (ANOSIM; Clarke & Warwick 2001), using Primer 5.0 (Clarke & Gorley 2001). Functional composition was examined by assigning species to one of nine functional groups based on global responses of their species-groups to environmental stress and disturbance (Table 2). Finally, the biogeographic affinities of the faunas from each habitat type were examined by assigning species to one of four biogeographic classes based on the distribution of their species-group within Australia, following Andersen (2000b): Torresian – occurring primarily in the tropical north; Bassian – occurring primarily in the cool-temperate south; Eyrean – occurring primarily in the arid zone; and widespread – well-represented throughout Australia.

RESULTS

Species richness and abundance

In total, 3479 individuals representing 95 species, 35 genera and 10 subfamilies were collected in traps (Appendix 1). Seventy-six and 45 species respectively were collected in ground and arboreal traps, with 26 (27%) collected in both. The great majority of species collected in arboreal traps nest in the ground, with only eight known to nest in trees. The richest subfamilies were Formicinae (30 species from 11 genera) and Myrmicinae (30 species from nine genera), and the richest genera were *Pheidole* (11 species), *Rhytidoponera* (10), *Camponotus* (9), *Monomorium* (9) and *Polyrhachis* (7). There was a single record of an introduced species – *Monomorium destructor* from one of the savanna-woodland sites.

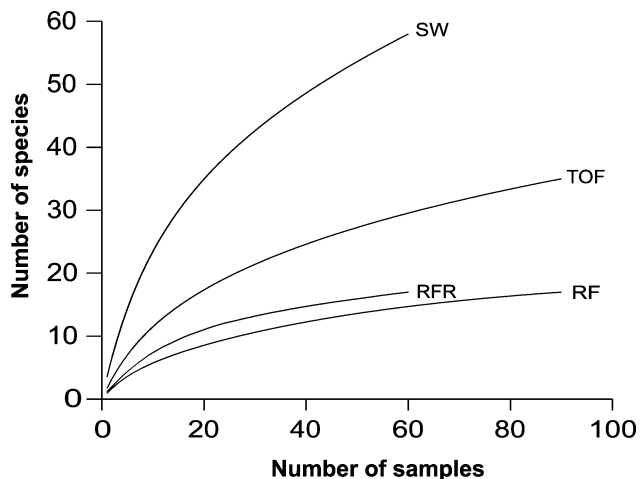


Figure 2. Rarefaction curves for the number of ant species collected in combined ground and arboreal pitfall traps among the four habitats (RF = rain forest, RFR = rain-forest regrowth, TOF = tall open forest and SW = savanna woodland).

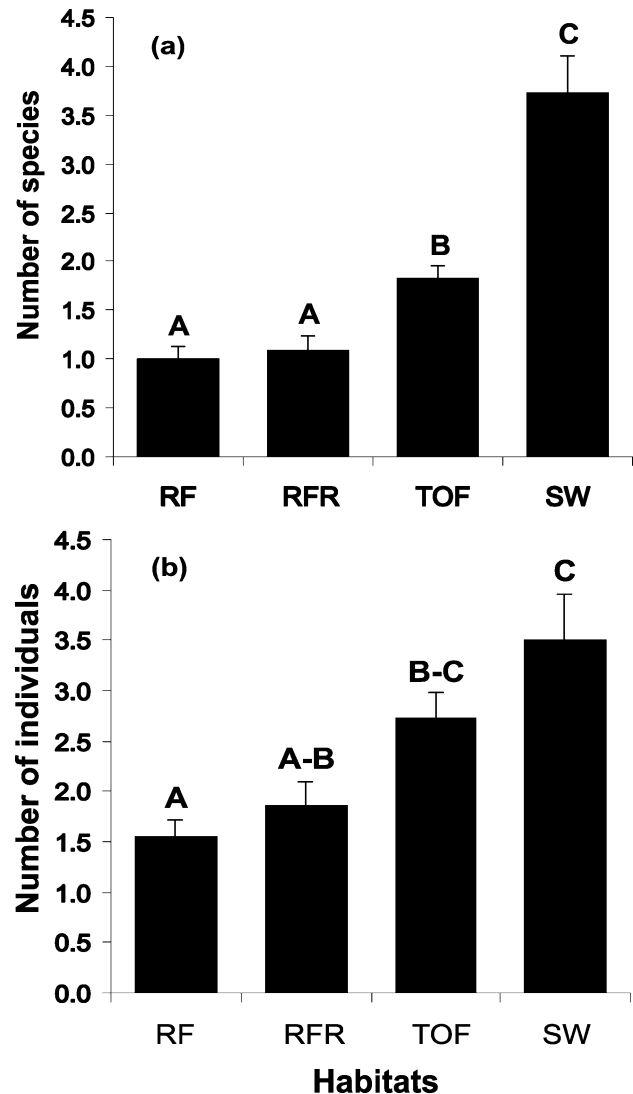


Figure 3. Mean (\pm SE) number of species (a) and square root-transformed abundance (b) per pitfall trap within rain forest (RF), rain-forest regrowth (RFR), tall open forest (TOF) and savanna woodland (SW) habitats. In each case, different letters indicate significant differences ($P < 0.05$) between habitat types according to the post hoc Tukey test.

Total species richness per habitat was 17 each for rain forest ($n = 3$ sites) and rain forest-regrowth ($n = 2$), 35 for tall open forest ($n = 3$), and 58 for savanna woodland ($n = 2$). These differences in species richness were reflected in rarefaction analysis (Figure 2). Rarefaction curves approached asymptotes for rain forest, rain-forest regrowth and tall open forest, but not for savanna woodland. Mean species richness per trap also differed significantly between habitat types (ANOVA; $F_{(3, 296)} = 38.8$, $P \ll 0.01$); it was identical in rain forest and rain-forest regrowth, somewhat higher in tall open forest, and twice as high again in savanna woodland (Figure 3a). Ant abundance showed a similar pattern, although there was more of a continuum between habitat types (Figure 3b). Both site species richness and

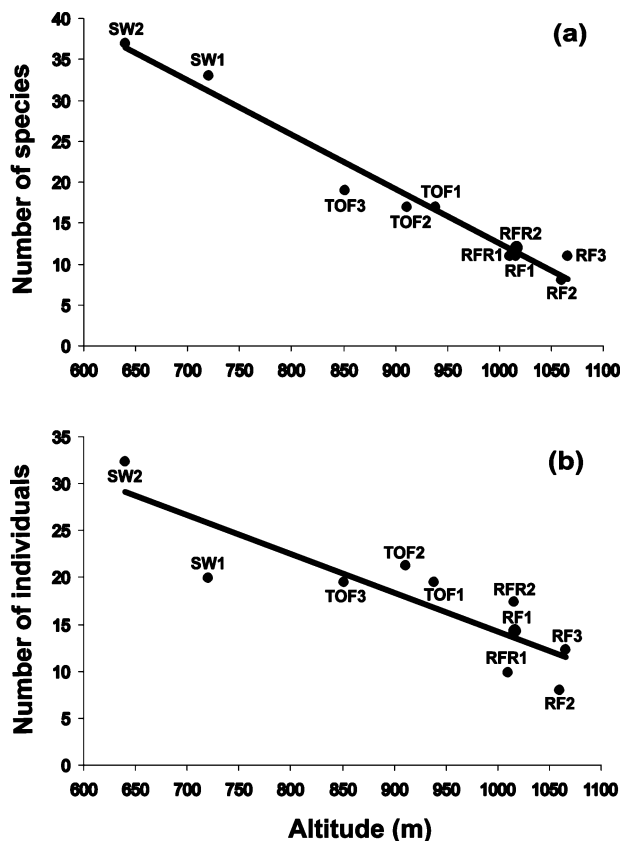


Figure 4. Relationships between altitude and site species richness (a) and square root-transformed abundance (b). RF = rain forest, RFG = rain-forest regrowth, TOF = tall open forest, SW = savanna woodland.

abundance showed very strong negative relationships with altitude (Figure 4).

Species composition

The great majority (78%) of the 58 species from savanna woodland were recorded only in this habitat type

(Appendix 1). These savanna specialists were primarily from the cosmopolitan genera *Monomorium* (8 species), *Rhytidoponera* (6), *Camponotus* (4) and *Crematogaster* (3), but also included specialist savanna genera such as *Melophorus* (3), *Opisthopsis* (2) and *Iridomyrmex* (1). At the opposite end of the environmental gradient, a relatively modest 13 species were recorded only at rain-forest or rain-forest-regrowth sites, despite having a combined five sites compared with only two for savanna woodland. The rain-forest specialists included representatives of the specialist rain-forest genera *Discothrea* and *Pristomyrmex*, as well as specialist rain-forest species-groups within *Cerapachys*, *Leptomyrmex*, *Rhytidoponera*, *Monomorium* and *Leptogenys*. Most (65%) species recorded in rain-forest regrowth also occurred in tall open forest. A small number of species (*Rhytidoponera* sp. E (*araneoides* gp.), *Notostigma carazii* and *Meranoplus hirsutus*) were relatively common in tall open forest but not recorded elsewhere, and just two species (*Rhytidoponera victoriae* and *Prolasius* sp. nr. *nitidissimus*) were recorded in all four habitat types.

The MDS plot showed clear separation between habitat types along the primary axis (Global R = 0.67, P << 0.01), and between ground and arboreal strata along the secondary axis (Global R = 0.41, P << 0.01) (Figure 5a). For both ground and arboreal data, there was continuous variation along the first axis from rain forest through rain-forest regrowth to tall open forest, and then a discontinuity between these habitat types and savanna woodland (Figure 5a). This result was confirmed by within-group comparisons in ANOSIM, with the dissimilarity between savanna and tall open forest (R = 0.89, P < 0.01) being far higher than that between tall open forest and rain-forest regrowth (R = 0.41, P = 0.01). The discontinuity between the gradient from rain forest to tall open forest on one hand, and savanna on the other, was particularly marked when ground and arboreal data were pooled (Figure 5b).

Table 2. Ant functional groups based on global responses to environmental stress and disturbance (see Andersen 1995, 1997).

Dominant Dolichoderinae: From a global perspective, dominant ants are those at the top of the dominance hierarchies of the most productive ant communities, and such ants are characteristically dolichoderines.
Generalized Myrmicinae: This group comprises the cosmopolitan genera <i>Pheidole</i> , <i>Monomorium</i> and <i>Crematogaster</i> , which are among the most abundant ants throughout the warmer regions of the world. From a global perspective they can be considered sub-dominant to Dominant Dolichoderinae.
Opportunists: These are unspecialized, poorly competitive species, often with wide habitat distributions. They predominate only at sites where stress or disturbance severely limits ant productivity and diversity, and consequently where behavioural dominance is low.
Subordinate Camponotini: <i>Camponotus</i> and allied genera are ubiquitous in ant communities; they tend to be behaviourally submissive to Dominant Dolichoderinae, and many are ecologically segregated from them due to their large body size, nocturnal foraging, and/or arboreal habits.
Hot-climate specialists: These are taxa occurring primarily or exclusively in arid regions, and exhibit highly specialized behaviour such as granivory or extreme thermophilia.
Cold- and Tropical-Climate Specialists: These are taxa whose distributions are heavily centred on the ground-layer of temperate and tropical forests respectively. The abundance of Dominant Dolichoderinae is generally low in these habitats, and, aside from their habitat tolerances, Cold- and Tropical-Climate Specialists are typically unspecialized ants.
Cryptic Species: These are species of small to minute ants, predominantly myrmicines and ponerines, that nest and forage primarily within soil, litter and rotting logs. They are ecologically removed from the mainstream ant community.
Specialist Predators: This group comprises medium-sized to large, highly active predators with well-developed sight, and most have powerful stings.

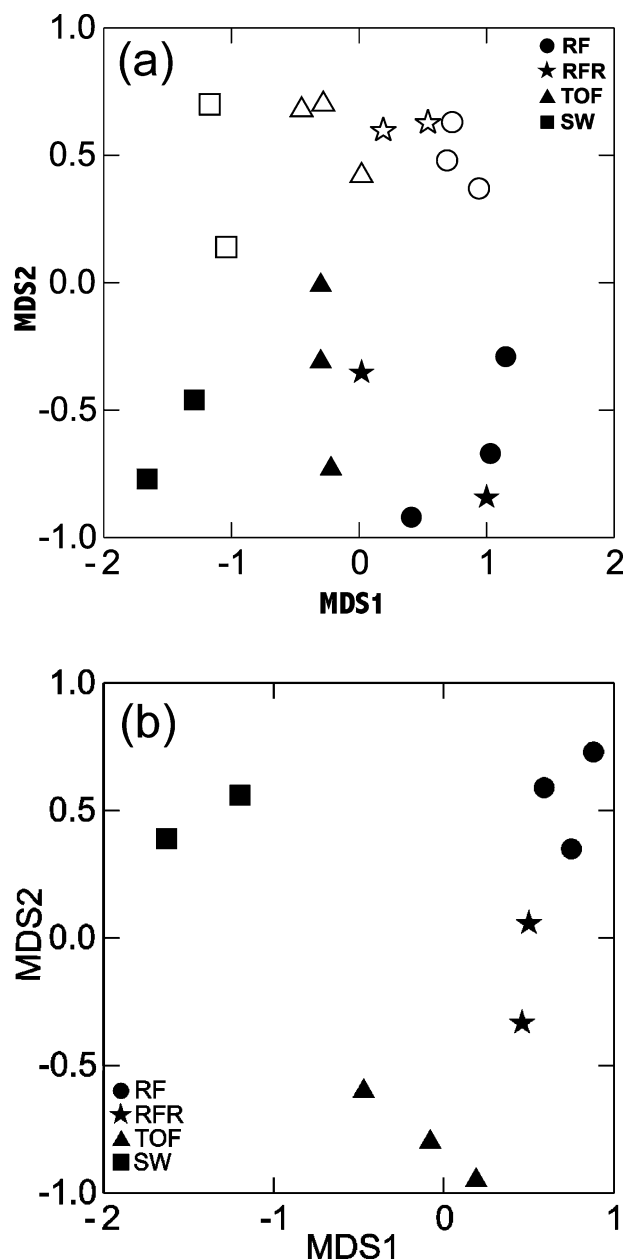


Figure 5. Two-dimensional multidimensional scaling (MDS) ordination of study sites (RF = rain forest, RFR = rain-forest regrowth, TOF = tall open forest, SW = savanna woodland) based on presence/absence data, considering ground and arboreal data separately (a; black and open symbols respectively) and pooled (b). Stress values are 0.15 and 0.07 respectively.

Functional groups and biogeographic affinities

Functional group composition varied substantially along the environmental gradient (Figure 6). Rain-forest habitat supported particularly high proportions of Specialist Predators, Cryptic Species and Cold-Climate Specialists, whereas Hot-Climate Specialists were absent. Hot-Climate Specialists were also absent from rain-

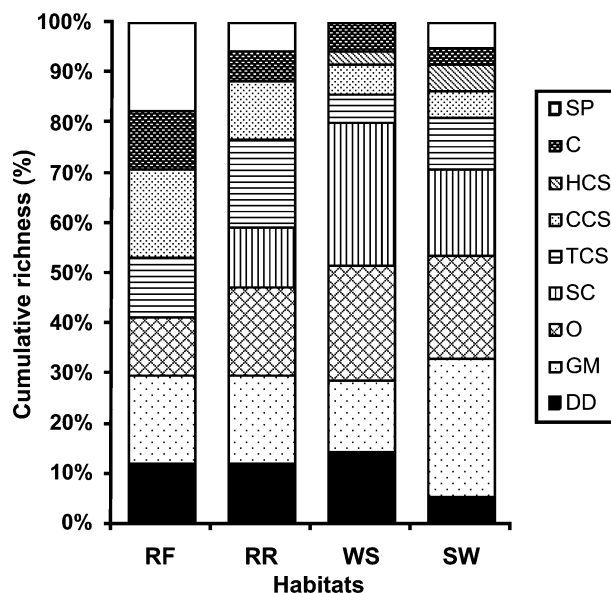


Figure 6. Functional group profiles of ant samples from rain forest (RF), rain-forest regrowth (RFR), tall open forest (TOF) and savanna woodland (SW) habitats. Data are proportions of total species represented by each functional group: Dominant Dolichoderinae (DD), Generalized Myrmicinae (GM), Opportunists (O), Subordinate Camponotini (SC), Tropical-Climate Specialists (TCS), Cold-Climate Specialists (CCS), Hot-Climate Specialists (HCS), Cryptic species (C) and Specialist Predators (SP).

forest regrowth sites, and were best represented in savanna woodland. The relative contributions of both Cryptic species and Cold-Climate Specialists decreased systematically from rain forest to savanna woodland. Generalized Myrmicinae and Subordinate Camponotini were particularly prominent in savanna woodland and tall open forest respectively.

The biogeographic affinities of the fauna were remarkably consistent across habitat types, with about half the species representing Torresian taxa and about a quarter widespread in each case (Figure 7). However, Eyrean taxa were absent completely from rain forest and rain-forest-regrowth habitats, whereas they were equally as well-represented as Bassian taxa in savanna woodland.

DISCUSSION

We found a major disjunction in ant community structure along the environmental gradient from rain forest to savanna, and this occurred between savanna and forest (whether mesophyll or sclerophyll) rather than between rain forest and open eucalypt vegetation. The disjunction was evident in both species richness (which was far higher in savanna than in other habitats) and composition. The compositional disjunction occurred despite a very poor representation of species of *Iridomyrmex* from the savanna sites; such species are dominant members of most savanna

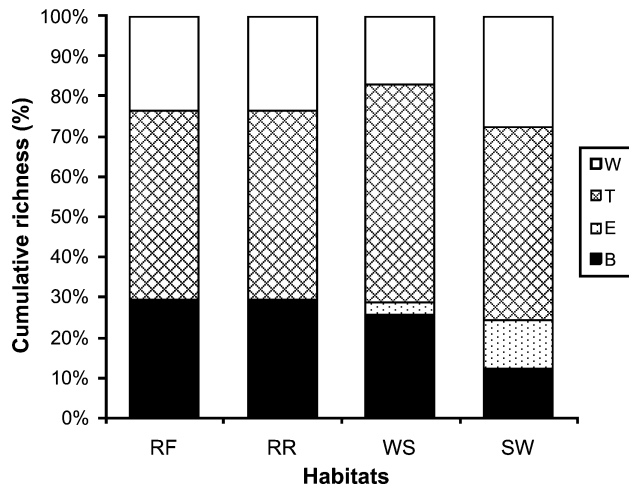


Figure 7. Biogeographical composition of ant assemblages in each habitat type (RF = rain forest, RFR = rain-forest regrowth, TOF = tall open forest and SW = savanna woodland). Stacked bars show proportions of species with Torresian (T), Eyrean (E) and Bassian (B) affinities, or are from widespread species-groups (W).

ant communities throughout northern Australia, and epitomise the contrasting rain-forest and savanna ant faunas (Andersen *et al.* 2007). Instead, the major behaviourally dominant dolichoderines at the savanna sites belonged to the shade-tolerant genus *Anonychomyrma*, which can be attributed to high grass density.

Rain-forest litter supports a very extensive cryptic ant fauna (Ward 2000), and given the lack of extensive litter in tall open forest and savanna, it is possible that the disjunction in this component of the fauna occurs between rain forest and tall open forest, rather than between tall open forest and savanna. Rain forest also supports a rich arboreal fauna (Blüthgen & Stork 2007, Brühl *et al.* 1998, Longino *et al.* 2002, Wilson 1959), which was undoubtedly under-sampled in this study. However, it is clear that many arboreal taxa of rain forest origin extend into tall open forest, with most of such taxa recorded in the present study (e.g. *Philidris* sp., *Polyrhachis* sp. nr. *mjobergi*, *Monomorium draculai*) occurring in this habitat. No such taxa were recorded in savanna woodland. The under-sampling of the cryptic and arboreal faunas contributed to the low species richness recorded from rain forest, and therefore exaggerated the contrast with savanna.

Three factors that potentially have an important influence on ant community structure co-vary along the environmental gradient studied: rainfall, temperature and vegetation structure. These are inextricably linked in the immediate study region, as rain forest distribution is driven by rainfall, and rainfall and temperature follow the same elevational gradient. However, the relative importance of these factors as direct drivers of the observed ant community patterns can be assessed through a broader analysis of patterns of ant community structure

in rain forest and open sclerophyll habitats across Australia. Elsewhere in Queensland, similar disjunctions between rain-forest and open sclerophyll ant faunas have been documented in the absence of an altitudinal gradient, where variation in habitat type is determined by edaphic conditions rather than by rainfall or temperature (Greenslade & Thompson 1981). Savanna vegetation occurring under very high annual rainfall (up to 2000 mm) elsewhere in northern Australia still supports a characteristically savanna ant fauna (e.g. Tiwi Islands, Andersen *et al.* 2004). Temperature clearly has a direct influence on ant species composition, and can explain, for example, changes in the relative contributions of Tropical- and Cold-Climates Specialists along the Mt Lewis gradient. Tropical-Climates Specialists tend to prefer high temperatures, and are known to be progressively replaced by Cold-Climates Specialists with increasing altitude (Andersen 2000a). However, the broader disjunction in ant community structure described here cannot be directly attributed to temperature, as characteristic rain-forest ant community structure is maintained throughout the rain forest that extends all the way to the coast on the eastern (higher rainfall) side of the mountain ranges that include Mt Lewis. Indeed, rain-forest ant communities have similar structure throughout northern Australia, regardless of temperature (Andersen 2000a). Similarly, ant community structure comparable to that recorded in savanna woodland in our study occurs in open sclerophyll habitats in much cooler habitats than Mt Lewis, including in the temperate zone (Andersen 1995).

This leaves vegetation structure as the likely ultimate cause of disjunction between savanna and forest ant communities. The structure of the ground-layer is critical here, as this is where the great majority of savanna ant species nest and forage. Savanna has more open ground than forest, and therefore provides ground-foraging ants with greater direct insolation and unimpeded foraging surfaces, which are critically important factors driving ant community structure (Andersen 1995).

The far higher local richness of savanna compared with rain-forest ant communities in Australia is opposite to the pattern found elsewhere in the tropical world. For example, in Brazilian Amazonia local ant richness in rain forest is twice that in savanna (Vasconcelos & Vilhena 2006). In Brazilian cerrado (savanna) landscapes, ant richness is highest in forest patches and there is more generally a positive relationship between ant species richness and tree density (Ribas *et al.* 2003, Silva *et al.* 2004). This inter-continental contrast can be explained by a combination of two factors: the neotropics have a far richer forest-associated arboreal fauna (Andersen *et al.* 2007), and Australian savannas are unusually rich, reflecting an exceptionally diverse arid-adapted fauna (Andersen 2003). The species compositional contrast in savanna and forest ant faunas also seems to be greater in

Australia than in the neotropics: in Brazilian Amazonia about two-thirds of the savanna species also occur in forest (Vasconcelos & Vilhena 2006), whereas in the present study nearly 80% of savanna species were not recorded in any forest type.

In conclusion, our study of ant community structure along an extended rain forest–savanna gradient in tropical Australia has shown relatively continuous variation between rain forest and tall open forest, but a major discontinuity between tall open forest and savanna woodland. These findings indicate that the contrast between rain-forest and savanna ant communities is an extreme manifestation of a broader forest–savanna disjunction.

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Appendix 1. Functional group, biogeographic affinity and total abundance in each habitat type of all species collected in traps. Functional groups (see Table 2): CCS, Cold-Climates Specialists; C, Cryptic Species; DD, Dominant Dolichoderinae; GM, Generalized Myrmicinae; HCS, Hot-Climates Specialists; O, Opportunists; SC, Subordinate Camponotini; SP, Specialist Predators; TCS, Tropical-Climates Specialists. Biogeographic affinity (following Andersen 2000b): B, Bassian; E, Eyrean; T, Torresian; W, Widespread.

Species	Functional group	Biogeographic affinity	Rain forest	Rain-forest regrowth	Tall open forest	Savanna woodland	Total
Aenictinae							
<i>Aenictus</i> sp. 2	TCS	T	0	0	1	550 ¹	551
Cerapachyinae							
<i>Cerapachys adamus</i>	SP	T	1	0	0	0	1
Dolichoderinae							
<i>Anonychomyrma gilberti</i>	DD	B	38	80	402	0	520
<i>Anonychomyrma</i> sp. A (<i>nitidiceps</i> gp.)	DD	B	0	88	9	78	175
<i>Anonychomyrma</i> sp. C (<i>nitidiceps</i> gp.)	DD	B	0	0	1	22	23
<i>Anonychomyrma</i> sp. D (<i>nitidiceps</i> gp.)	DD	B	38	0	0	0	38
<i>Iridomyrmex gracilis</i>	DD	E	0	0	1	0	1
<i>Iridomyrmex</i> sp. 2 (<i>mattiroloi</i> gp.)	DD	E	0	0	0	6	6
<i>Leptomyrmex ruficeps</i>	TCS	T	0	1	1	0	2
<i>Leptomyrmex</i> sp. A	TCS	T	3	12	0	0	15
<i>Philidris</i> sp. A	DD	T	0	0	7	0	7
<i>Tapinoma</i> sp. B	O	W	0	0	0	4	4
<i>Technomyrmex nitens</i>	O	W	5	0	0	0	5
<i>Technomyrmex</i> sp. B	O	W	0	0	0	1	1
Ectatomminae							
<i>Rhytidoponera anceps</i>	O	W	0	0	0	4	4
<i>Rhytidoponera</i> sp. nr. <i>kurandensis</i>	O	T	0	0	4	0	4
<i>R. lamellinodis</i>	O	T	0	0	0	11	11
<i>R. purpurea</i>	O	T	0	16	26	0	42
<i>R. victoriae</i>	O	B	166	29	452	58	705
<i>Rhytidoponera</i> sp. C (<i>spoliata</i> gp.)	O	T	0	0	0	8	8
<i>Rhytidoponera</i> sp. E (<i>araneoides</i> gp.)	O	T	0	0	51	0	51
<i>Rhytidoponera</i> sp. F (<i>convexa</i> gp.)	O	E	0	0	0	45	45
<i>Rhytidoponera</i> sp. H (<i>metallica</i> gp.)	O	W	0	0	0	15	15
<i>Rhytidoponera</i> sp. J (<i>convexa</i> gp.)	O	E	0	0	0	62	62
Formicinae							
<i>Acropyga</i> sp. C	C	W	0	0	0	1	1
<i>Camponotus confusus</i>	SC	T	0	0	0	9	9

Appendix 1. Continued.

Species	Functional group	Biogeographic affinity	Rain forest	Rain-forest regrowth	Tall open forest	Savanna woodland	Total
<i>C. ?novaehollandiae</i>	SC	T	0	0	0	12	12
<i>Camponotus</i> sp. 9 (<i>novaehollandiae</i> gp.)	SC	T	0	1	0	0	1
<i>Camponotus</i> sp. C (Group E)	SC	T	0	1	2	0	3
<i>Camponotus</i> sp. D (<i>novaehollandiae</i> gp.)	SC	T	0	0	13	0	13
<i>Camponotus</i> sp. E (<i>novaehollandiae</i> gp.)	SC	T	0	0	1	0	1
<i>Camponotus</i> sp. F (<i>novaehollandiae</i> gp.)	SC	T	0	0	2	20	22
<i>Camponotus</i> sp. G (<i>claripes</i> gp.)	SC	W	0	0	0	1	1
<i>Camponotus</i> sp. J (<i>aureopilus</i> gp.)	SC	T	0	0	0	1	1
<i>Melophorus</i> sp. A (Group D)	HCS	E	0	0	0	3	3
<i>Melophorus</i> sp. B (Group A)	HCS	E	0	0	0	1	1
<i>Melophorus</i> sp. C (<i>mjobergi</i> gp.)	HCS	E	0	0	0	4	4
<i>Notoncus</i> sp. B (<i>enormis</i> gp.)	CCS	B	0	0	0	1	1
<i>Notostigma carazii</i>	SC	T	0	0	19	0	19
<i>Opisthopsis jocosus</i>	SC	T	0	0	0	14	14
<i>O. haddoni</i>	SC	T	0	0	0	3	3
<i>Paratrechina</i> sp. C (<i>minutula</i> gp.)	O	W	0	0	1	0	1
<i>Paratrechina</i> sp. D (<i>vaga</i> gp.)	O	W	0	1	7	5	13
<i>Paratrechina</i> sp. 2 (<i>minutula</i> gp.)	O	W	0	0	0	8	8
<i>Plagiolepis</i> sp. A (<i>exigua</i> gp.)	TCS	T	0	0	0	7	7
<i>Polyrhachis ammon</i>	SC	T	0	0	0	2	2
<i>P. femorata</i>	SC	B	0	0	1	0	1
<i>Polyrhachis</i> sp. nr. <i>femorata</i>	SC	B	0	0	1	1	2
<i>P. lata</i>	SC	T	0	0	0	3	3
<i>Polyrhachis</i> sp. nr. <i>mjobergi</i>	SC	T	0	0	1	0	1
<i>Polyrhachis</i> sp. nr. <i>penelope</i>	SC	T	0	0	1	0	1
<i>P. phryne</i>	SC	B	0	0	1	0	1
<i>Prolasius</i> sp. nr. <i>nitidissimus</i>	CCS	B	11	2	12	2	27
Gen. nov. (?Myrmecorhynchini)	CCS	T	1	0	0	0	1
Heteroponerinae							
<i>Heteroponera imbellis</i>	CCS	B	1	0	0	0	1
<i>H. relictata</i>	CCS	B	0	5	4	0	9
Myrmicinae							
<i>Crematogaster</i> sp. B (<i>cornigera</i> gp.)	GM	T	0	0	0	13	13
<i>Crematogaster</i> sp. 2 (<i>australis</i> complex)	GM	W	0	0	0	21	21
<i>Crematogaster</i> sp. D	GM	T	0	0	0	64	64
<i>Mayriella spinosior</i>	TCS	T	0	0	0	1	1
<i>Meranoplus hirsutus</i>	HSC	T	0	0	39	0	39
<i>Monomorium destructor</i>	GM	T	0	0	0	1	1
<i>M. draculai</i>	TCS	T	0	3	0	0	3
<i>M. euryodon</i>	CCS	B	0	0	0	1	1
<i>M. ?fieldi</i>	GM	T	0	0	0	2	2
<i>M. ?nigrius</i>	GM	T	0	0	0	24	24
<i>Monomorium</i> sp. G (<i>laeve</i> group)	GM	W	0	0	0	9	9
<i>Monomorium</i> sp. I (<i>sordidum</i> gp.)	GM	E	0	0	0	7	7
<i>Monomorium</i> sp. K (<i>laeve</i> gp.)	GM	W	0	0	0	1	1
<i>Monomorium</i> sp. L (<i>rubriceps</i> gp.)	TCS	T	0	0	0	2	2
<i>Pheidole ?athertonensis</i>	GM	T	0	0	7	3	10
<i>P. impressiceps</i>	GM	T	0	0	117	58	175
<i>Pheidole</i> sp. F (Group K)	GM	T	60	6	0	0	66
<i>Pheidole</i> sp. G (<i>ampla</i> gp.)	GM	W	70	11	6	0	87
<i>Pheidole</i> sp. H (Group E)	GM	W	1	0	1	56	58
<i>Pheidole</i> sp. I (Group E)	GM	W	0	0	0	4	4
<i>Pheidole</i> sp. K (<i>ampla</i> gp.)	GM	W	0	140	0	0	140
<i>Pheidole</i> sp. L (<i>variabilis</i> gp.)	GM	W	0	0	4	0	4
<i>Pheidole</i> sp. O (Group E)	GM	W	0	0	0	185	185
<i>Pheidole</i> sp. P (<i>longiceps</i> gp.)	GM	T	0	0	0	1	1
<i>Pheidole</i> sp. Q (<i>variabilis</i> gp.)	GM	W	0	0	0	7	7
<i>Pristomyrmex wilsoni</i>	TCS	T	14	0	0	0	14
<i>Solenopsis</i> sp. C	C	W	2	1	2	0	5
<i>Solenopsis</i> sp. D	C	W	0	0	0	2	2

Appendix 1. Continued.

Species	Functional group	Biogeographic affinity	Rain forest	Rain-forest regrowth	Tall open forest	Savanna woodland	Total
<i>Strumigenys</i> sp. nr. <i>friedae</i>	C	T	0	0	2	0	2
<i>Tetramorium</i> ? <i>strictum</i>	O	T	0	0	5	2	7
Ponerinae							
<i>Bothroponera</i> sp. B (<i>sublaevis</i> gp.)	SP	T	0	0	0	1	1
<i>Bothroponera</i> sp. C (<i>porcata</i> gp.)	SP	T	0	0	0	1	1
<i>Leptogenys</i> sp. A (<i>conigera</i> gp.)	SP	T	2	0	0	0	2
<i>Leptogenys</i> <i>exigua</i>	SP	T	0	0	0	4	4
<i>Leptogenys</i> sp. nr. <i>mjobergi</i>	SP	T	6	5	0	0	11
<i>Odontomachus</i> <i>cephalotes</i>	O	T	0	0	9	0	9
Proceratiinae							
<i>Discothyrea</i> sp. A	C	T	1	0	0	0	1
Pseudomyrmecinae							
<i>Tetraponera</i> <i>punctulata</i>	TCS	T	0	0	0	3	3
<i>Tetraponera</i> sp. nr. <i>punctulata</i>	TCS	T	0	0	0	9	9
Total abundance			420	402	1213	1444	3479

¹Primarily from a single trap.