Ant species richness of fynbos and forest ecosystems in the southern Cape

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The ant fauna in fynbos and forest habitats in the southern Cape are compared. There is no significant difference in ant species richness between the two undisturbed habitat types, and the only two species common to both are *Acantholepis capensis* and *Camponotus maculatus*. The degree of *Hakea sericea* infestation in the fynbos negatively affected ant species richness. Ant species richness in the Afromontane forest decreased from the drier to the wetter sites. The aggressive alien ant species, *Iridomyrmex humilis*, has not invaded natural areas to any great extent.

Die mierfauna in fynbos- en inheemse woud-habitatte in die Suid-Kaap is vergelyk. Daar is geen beduidende verskille in mierspesieverskeidenheid tussen die twee onversteurde habitat-tipes nie. Slegs twee spesies, *Acantholepis capensis* en *Camponotus maculatus* is in albei habitatte aangetref. Die mate van *Hakea sericea* besmetting in die fynbos verminder mierspesieverskeidenheid. Mierspesieverskeidenheid in die Afrikaanse bergwoud het 'n afname getoon van die droeër na die natter persele. Daar is nog geen beduidende indringing van die aggresiewe uitheemse mierspesie, *Iridomyrmex humilis*, in natuurlike habitatte nie.

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The ant fauna of the western Cape, South Africa, is fairly well known (Slingsby & Bond 1981; de Kock 1984; Donnelly & Giliomee 1985a, b). No information is, however, available on the species composition of the ants of natural and disturbed ecosystems of the southern Cape. Various research projects are in progress in the fynbos and forest habitats of the southern Cape which aim to determine and evaluate management practices, and to determine the relationship between faunal communities (vertebrate and invertebrate) and environmental factors. Infestation by alien vegetation (mainly *Hakea sericea*, an Australian Proteaceae) in the fynbos of the Outeniqua Mountain range is causing serious concern and the impact of *H. sericea* on the species composition (fauna and flora) of the natural communities is under investigation. The presence of alien plants (e.g. *Pinus radiata*) have been reported to affect species diversity of ants in the western Cape (Donnelly & Giliomee 1985b).

Data on the ant communities have been gathered during general arthropod surveys and are presented here to supply information on the distribution of ants in the coastal mountain range and in the evergreen high forests on the plateau to the south of this range. All identified ant specimens are lodged in the Saasveld Forestry Museum.

Study area

The fynbos study area is in the Waboomskraal Valley (33°51'S / 22°10'E) on the north-facing slopes of the Outeniqua Mountains, 30 km north-west of George. Fynbos communities were dominated by Proteaceae, Ericaceae, Restionaceae and Cyperaceae. The most common species include *Protea repens, P. lorifolia, Leucadendron salignum, L. eucalyptifolium* and *Hypodiscus striatus*. Three sites were chosen on a *H. sericea* infestation gradient. The uninfested, mature (18-year-old) fynbos (Site 1) is at a slightly higher elevation (645 m a.s.l.) than the two *H. sericea* infested sites (Site 2 = 35% and Site 3 = 100% *H. sericea* cover infestation) at 570 and 577 m a.s.l. respectively. Rainfall in the area is non-seasonal with a mean of 800 mm per annum. Climatic extremes are experienced in the area with periods of hot, dry berg winds or gale force winds, rain and very low temperatures with snow on the higher peaks. The soils in the Waboomskraal Valley are derived from Table Mountain sandstone and are generally shallow to moderately deep (G. Schafer, pers. comm.).

The forest study area is in evergreen high forest (Afromontane), 30 km to the north of Knysna, generally known as the Knysna Forest (Acocks 1953). In general, the canopy is 20–25 m high with the following common species: *Podocarpus falcatus, P. latifolius, Pterocelastrus tricuspidatus, Ocotea bullata, Olea capensis macrocarpa, Rapanea melanophloeos, Apodytes dimidiata, Gonioma kamassi* and *Nuxia floribunda*. Rainfall is also non-seasonal with a mean of 1100 mm. Climatic conditions similar to Waboomskraal prevail in the forest but without cold periods associated with snow. The soils in the area are variable and the underlying geology is Table Mountain sandstone (G. Schafer, pers. comm.).

Three study sites were selected along a soil moisture gradient to represent the spectrum of forest types in the area. Although not directly measured, soil moisture content affects the species composition of the associated vegetation (Koen & Crowe 1987). Sites 1 and 2 were in the Lily Vlei Nature Reserve of the Gouna State Forest (33°56'S/23°02'E), and Site 3 was on the Diepwalle State Forest (33°56'S / 23°09'E). Site 1 (dry forest) has fairly dense vegetation with an understorey of tree regeneration and thorny shrubs. Site 2 (moist forest) has a dense understorey of 2–5 m high *Trichocladus crinitus* and trees with rounded crowns. Site 3 (wet forest) consists of straight-stemmed and slender-crowned trees with an understorey of ferns, especially *Cyathea capensis* (Koen & Crowe 1987).

Methods

Data on arthropod communities were gathered during two separate studies: one on the effects of *H. sericea* on the community structure of plants and insects, and the other on the changes in the community structure of birds and insects between different forest types. Although different collection methods were employed, the data is sufficient to make gross comparisons between the ant communities in the two habitats.

Arthropods were sampled nine times during the period May 1983 to March 1984 (fynbos) and monthly from April 1983 to March 1984 (forest) using 150 mm wide pitfall traps with vehicle anti-freeze as preservative. Although Marsh (1984) found pitfall trapping to be an unreliable way of determining relative abundances of ant species in the Namib Desert, Samways (1983), de Kock (1984), Andersen (1986a, b) and Marsh (1986) found it a reliable method to determine species richness in various habitats. We used 12 traps in each of the fynbos sites, set 10 m apart on a contour running through the length of the study area.

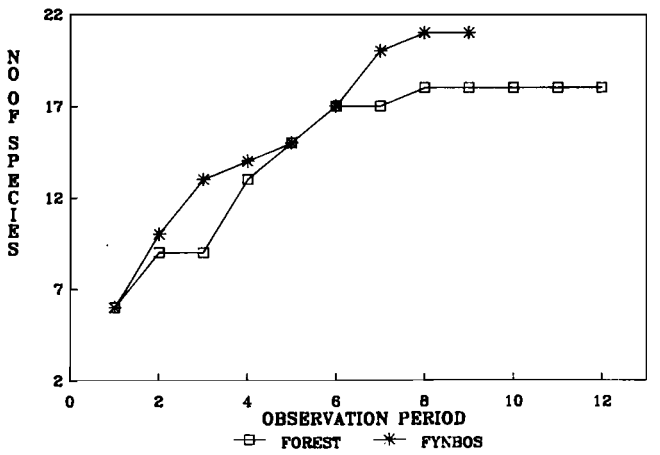

Figure 1 Cumulative species diversity curves for fynbos and forest habitats in the southern Cape.

Table 1 Number of ant species caught per bait type for a one-year period in the fynbos study site

Date	Meat	Faeces	Banana/ rum mixture	Unbaited	Mean/ trap
05/1983	5	6	0	4	3,75
06/1983	5	7	7	1	5
08/1983	3	10	9	8	7,5
09/1983	3	10	4	3	5
10/1983	12	12	9	3	9
11/1983	9	6	10	8	8,25
01/1984	8	7	10	13	9,5
02/1984	13	8	10	7	9,5
03/1984	8	4	11	13	9
Mean	7,3	7,7	7,7	6,6	7,3

Std dev. of mean no. species / bait type = 0,51.
Std dev. of mean no. species / month = 2,2.

Table 2 Formicidae collected in two areas in the southern Cape with presence (+) and absence (–) indicated

	Fynbos			Forest		
	S1 0%*	S2 35%*	S3 100%*	S1	S2	S3
Dolichoderinae						
Iridomyrmex humilis	–	–	–	–	+	–
Technomyrmex albipes	+	–	–	–	–	–
Formicinae						
Anoplolepis custodiens	+	+	+	–	–	–
Acantholepis capensis	+	+	+	–	+	–
Camponotus maculatus	+	+	+	+	–	+
Camponotus niveosetosus	+	–	–	–	–	–
Camponotus rufoglaucus	+	+	–	–	–	–
Camponotus (sp. nova)	+	–	–	–	–	–
Camponotus sp. 2	–	+	–	–	–	–
Plagiolepis decora	–	–	–	+	+	–
Myrmicinae						
Crematogaster liengmei	+	+	–	–	–	–
Crematogaster peringueyi	+	–	–	+	+	–
Meranoplus peringueyi	+	+	+	–	–	–
Monomorium delagoensis	+	+	+	–	–	–
Monomorium australe	+	–	–	–	–	–
Monomorium springvalense	+	–	–	–	–	–
Monomorium sp. 1	–	+	–	–	–	–
Monomorium sp. 2	–	+	–	–	–	–
Monomorium sp. 3	–	–	–	+	–	–
Ocymyrmex barbiger	+	–	–	–	–	–
Pheidole capensis	–	+	–	–	–	–
Pheidole foreli	–	–	+	–	–	–
Pheidole sp. 2	+	+	–	–	–	–
Solenopsis punctaticeps	+	–	–	–	–	–
Strumigenys havilandi	–	–	–	+	+	–
Syllaphopsis arnoldi	–	–	–	+	–	–
Syllaphopsis sp. 1	–	–	–	+	–	–
Tetramorium ackermani	+	–	–	–	–	–
Tetramorium delagoensis	–	–	–	+	–	–
Tetramorium grassii	–	–	–	+	+	+
Tetramorium sp. 1	+	–	–	–	–	–
Tetramorium sp. 2	+	–	–	–	–	–
Tetramorium sp. 3	–	+	–	–	–	–
Tetramorium sp. 4	–	–	–	+	+	–
Gen. nov. (near *Pheidole*)	+	–	–	–	–	–
Ponerinae						
Discothyrea poweri	–	–	–	+	+	–
Hypoponera natalensis	–	–	–	–	+	–
Hypoponera punctatissima	–	–	–	+	–	–
Leptogenys attenuata	–	–	–	–	+	–
Leptogenys nitida	+	–	–	–	–	–
Trachymesopus wroughtoni	–	–	–	+	+	+
Pseudomyrmicinae						
Tetraponera emeryi	–	–	–	–	–	+
Total	21	13	6	13	11	4

*Percentage *Hakea* present.

The traps remained *in situ* for a 30-day period/month. Twenty-five traps were used in each of the forest sites on a 25 × 25 m grid and the trapping continued for a 4–7-day period per month. Although more days trapping was done in the fynbos, we feel confident that most species were sampled in the forest as no additional species were added to the cumulative total after 8 months sampling (Figure 1). Various baits (banana/rum mixture, rotten pork) were used but were discontinued in the forest after 6 months because they made no difference in species captured. Traps baited with similar baits (human faeces instead of rotten pork) were used throughout the trapping period in the fynbos but did not seem to affect the number of species sampled (Table 1). Detailed analysis of the changes in species composition with bait type in the fynbos will be reported on in a subsequent paper.

Results

A total of 27 species was collected in the fynbos (*H. sericea* infested sites included) and 18 in the forest, of which only two species were shared (Table 2). According to de Kock (1984) and Prins (pers. comm.) most of the ants collected in the fynbos are 'elaiosome hunters'. Their seed-harvesting activities are directed towards seeds that have elaiosomes (fatty tissues). These ants do not destroy the seed itself, but effectively disperse the propagule (Bond & Slingsby 1983). Four of the species collected (*Crematogaster liengmei, C. peringueyi, Acantholepis capensis* and *Leptogenys nitida*) do not collect seeds with elaiosomes. *C. peringueyi* and possibly *C. liengmei* are omnivorous and, amongst other things, remove the elaiosomes and discard the seed on the soil surface (Bond & Breytenbach 1985). *A. capensis* is aphidicolous and *L. nitida* is a predator.

Nine of the species collected in the forest could be considered 'elaiosome hunters' or general seed gatherers (*Tetramorium* spp., *Monomorium* sp., *Crematogaster* sp., *Plagiolepis* sp., *Syllaphopsis* spp. and *Camponotus* sp.). The other species are mostly carnivorous (A.J. Prins pers. comm.).

Table 3 Monthly ant species richness in three forest sites

Month	Site 1 Dry forest	Site 2 Moist forest	Site 3 Wet forest	Total species
January	6	0	0	6
February	3	0	2	4
March	3	2	2	3
April	3	6	2	6
May	7	2	2	3
June	0	0	0	0
July	3	4	3	7
August	1	4	0	4
September	5	2	2	6
October	1	1	0	1
November	1	0	0	1
December	0	0	0	0

Table 4 Ant species richness in various 'natural' and disturbed habitats. ** = 'natural' sites, * = disturbed sites

Habitat and Locality	Richness	Source
Heathland** S.E. Australia	22 (Heathland)	Andersen 1986a
Woodland (Mallee)** S.E. Australia	47	Andersen 1986b
Mature fynbos** S. Cape South Africa	21	This paper
Mature fynbos** W. Cape South Africa	14	Donnelly & Giliomee 1985
Namib Desert** South West Africa	27	Marsh 1986
Dry Afromontane** forest. S. Cape South Africa	13	This paper
Moist Afromontane** forest. S. Cape South Africa	11	This paper
Riparian forest** S.W. Australia	14	van Schagen 1986
Upland forest** S.W. Australia	13	van Schagen 1986
Wet Afromontane** forest. S. Cape South Africa	4	This paper
Mature fynbos* S. Cape South Africa	6 (100% *H. sericea* infestation)	This paper
Mature fynbos* S. Cape South Africa	13 (35% *H. sericea* infestation)	This paper
Pine plantation* Western Cape South Africa	9 (*Pinus* plantation)	Donnelly & Giliomee 1985
Rehabilitated* coal mines S.W. Australia	10	van Schagen 1986
Sand Mine* Eneabba W. Australia	6 (Heathland)	Majer *et al.* 1982 in Majer 1984
Bauxite Mine* Jarrahdale Del Park, W. Austr.	10 (Heathland)	Majer *et al.* 1982 in Majer 1984
Sand Mines* Myall Lakes N.S.W.	11 (Forest with heathland understorey)	Fox & Fox 1984 in Majer 1984
Citrus orchards* E. Transvaal South Africa	49 (Grassland)	Samways 1983

As found by Majer (1984) in a similar climatic zone in Australia, there was also a seasonal trend in the fynbos with lower ant species richness from May to September (winter) (Table 1). Although the general arthropod survey revealed a distinct seasonal pattern in the forest (Koen & Crowe 1987), no seasonality was apparent in the ant fauna (Table 3).

Species richness in the fynbos and forest ant faunas were compared to that of other habitat types in the world (Table 4). As indicated, habitat disturbance decreases the number of ant species. Such disturbances are usually associated with physical change in the environment or with the introduction of alien plant species into an ecosystem, especially when such species tend to occur in mono-specific stands. The species richness found by Samways (1983) is higher than in the other disturbed sites (Table 4). This could be the result of sampling in 11 different habitats associated with citrus orchards.

Discussion

Plant species richness in the two undisturbed vegetation types are fairly similar (fynbos = 47; forest = 63), and there was no apparent difference in ant species richness between the two habitats (fynbos 21; forest 18). There was, however, a major difference in ant species composition between the areas with only two species in common (*Acantholepis capensis* and *Camponotus maculatus*). Both species are widespread in southern Africa and do not appear to be habitat specific (Skaife 1961; Samways 1983; Donnelly & Giliomee 1985a, b).

Species in the subfamily Ponerinae were restricted mainly to the forest sites with only one species in the fynbos. This subfamily contains the most primitive southern African ants (Scholtz & Holm 1985).

Ant species richness in both Australian heathland and mature southern Cape fynbos are very similar. However, mature fynbos in the western Cape has a much lower species richness (Table 4). This could be a consequence of the effects of the hot, dry summers in the latter on ant behaviour. The ant species richness of the *H. sericea* infested sites (35% infestation = 13; 100% infestation = 6) has an inverse relationship to the degree of infestation. This illustrates the important negative influence of this aggressive alien plant, not only on the vegetation, but also on the smaller invertebrates. Four of the species sampled in the 100% *H. sericea* infested site (*Pheidole foreli, Monomorium delagoensis, Meranoplus peringueyi* and *Anoplolepis custodiens*) forage in trees or are aphidicolous (Samways 1983; A.J. Prins pers. comm.). The lack of elaiosome-bearing seeds in the infested areas probably precludes the presence of seed-gathering ants.

The ant species richness in the three forest sites has an inverse relationship to the soil moisture content of the sites, with a three-fold difference between the dry and the wet sites (dry = 13; wet = 4). Although this could possibly indicate a substrate specificity in relation to soil moisture content or the associated vegetation, other microclimatic factors such as temperature may play an important role. The ant species richness decreases as canopy cover increases from the dry to the wet sites. As this study was not structured to collect tree-living ants, the possible increase in community importance of the latter in the wetter sites could not be demonstrated.

As in the *H. sericea* infested sites where there is an inverse relationship between the degree of infestation and the plant species richness in the lower layers, there is a similar decrease in plant species richness in the lower layer from the dry to the wet forest types (unpublished data). In both areas, the ant fauna in the site with the lowest plant species richness is characterized by tree-foraging/aphidicolous species.

The habitats associated with citrus orchards (Samways 1983) and Mallee woodland (Andersen 1986b) have similarly high species diversities. This could be a consequence of a more diverse, but superficially similar vegetation structure offering more foraging opportunities.

Iridomyrmex humilis, an aggressive alien, has already been collected in various natural or disturbed sites in the western Cape (Bond & Slingsby 1984; de Kock 1984; Donnelly & Giliomee 1985a, b). Concern has been expressed at the possible ecological effect that this species may have on the reproductive capacity of the vegetation (Bond & Slingsby 1984). It effectively excludes seed-dispersing species from an area, and by not burying the seeds, the seeds are subjected to a high level of rodent predation (Bond & Breytenbach 1985). This species has fortunately not been found in any of the fynbos sites during this study and only in one of the forest sites (one specimen only). As this species is usually unknowingly dispersed by man it is probable that it was introduced to the forest during normal management operations. Although collection work was restricted to two areas it does not appear as though *I. humilis* has invaded natural areas in the southern Cape, to any great extent.

This study supplies some information on the species diversity of the ant faunas of the southern Cape, but surveys conducted in more sites are needed to indicate the geographical distribution and habitat requirements of the different species. The extension in the range of the Argentine ant should also be closely monitored.

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