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Ants from the Ecoandes expeditions: diversity and distribution

Hormigas de las expediciones de Ecoandes: diversidad y distribución

by/por

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Resumen

Se presentan los datos sobre la distribución y diversidad de hormigas recolectadas por medio de embudos de Berlese, en los transectos del proyecto ECOANDES (Tabla 31; Fig. 50): norte de la Sierra Nevada de Santa Marta (Transecto SN, Buritica), vertientes Oeste y Este de la Cordillera Occidental (Transecto Tatamá, TAT), oeste y este de la Cordillera Central (Transecto Parque Nevados, TPN) y oeste y este de la Cordillera Oriental (Transectos Sumapaz, SUM). En vista de las limitaciones de la base de datos, solo se pueden mencionar conclusiones provisionales.

Se encontraron en total 96 especies diferentes, en aproximadamente 50 muestras del intervalo altitudinal inferior con hormigas, de los 7 (sub) transectos. El mayor numero de especies que solo se encontraron en una muestra o en un transecto, corresponde a la vertiente Oeste de la Cordillera Occidental, la vertiente Este de la Cordillera Oriental y la vertiente Norte del Macizo de Santa Marta, seguido por la vertiente Oeste de la Cordillera Central, que tienen los regímenes climáticos más húmedos (en orden decreciente). La vertiente Occidental de la Cordillera Occidental y la vertiente norte del macizo de Santa Marta tienen el mayor número de especies en el nivel bajo tropical, disminuyendo este número algo hacia arriba. No obstante, el promedio de todos los transectos muestra un número de especies algo más bajo en los niveles inferiores, y un máximo entre 900 y 1700 m. Números más bajos de especies se encuentran entre 1700 y 2300 m, y valores muy bajos entre 2300 y 2750 m. Arriba de este nivel no se encontraron mas hormigas en las muestras.

Un descenso gradual del número de especies desde el nivel tropical hacia arriba en condiciones generalizados de alta humedad/ pluviosidad, se encontró igualmente para especies de plantas. Cuando el nivel bajo tropical es relativamente seco (como en los grandes valles interandinos del alto Magdalena y del Cauca), y la humedad aumenta hacia las zonas de selvas nubladas, la diversidad de especies de hormigas parece ser mas baja en el nivel bajo tropical, y aumenta hacia arriba hacia un máximo, seguida por un descenso. Estas tendencias son también comparables con las de especies de plantas en las mismas vertientes.

Estos son solamente algunas indicaciones sobre los patrones de distribución y diversidad de hormigas en los transectos norandinos estudiados, que tendrán que confirmarse o modificarse por investigaciones futuras más amplias.

Abstract

Data are presented on ant distribution and diversity based on Berlese-samples collected in the Ecoandes transects in the Colombian Andes (Fig. 50; Table 31): north flank of the Sierra Nevada de Santa Marta (Buritaca transect, SN), east and west flank of the Cordillera Occidental (Tatamá transect, TAT), east and west flank of the Central Cordillera (Parque Los Nevados transect, TPN) and east and west flank of the Eastern Cordillera (Sumapaz transect, SUM). Because of the limitations of this data set, only provisional conclusions can be mentioned.

A total of 96 different species were found in the approximately 50 samples that contained ants (from the lower part of the sections), of the seven (sub) transects. The majority of species, and most of those that were found in one sample or one transect only, were found on the western flank of the Western Cordillera, the eastern flank of the Eastern Cordillera and the northern flank of the Santa Marta massif, followed by the western flank of the Central Cordillera. These are the regions that have the wettest climatic conditions (in decreasing order). The west flank of the Western Cordillera and the north flank of the Santa Marta massif have the largest number of species in the lower tropical zone, and this number decreases somewhat with altitude. Nevertheless, the averages of all the transects show a peak of species richness at middle elevations, between 900 and 1700 m. Relatively few species were found between 1700 and 2300 m, and very few species between 2300 and 2750 m. No ants were found in samples above that altitude.

A gradual decline in the number of species from lower elevations upwards, under generalised conditions of high humidity/rainfall, was also found for plant species. When the low tropical zone is relatively dry (as in the large interandean valleys of the upper Magdalena and Cauca), and the humidity/rainfall increases towards the cloud forest zones, then the diversity of ant species seems to be lower in the lowland tropics, and increases upwards to a maximum at middle elevations, followed by a decline. These tendencies are comparable to the species density of flowering plants in the same transects.

These provisional findings regarding the distribution and diversity of ants in the North Andean transects will have to be confirmed or modified by future investigations.

Introduction

During the Ecoandes expedition to study North Andean altitudinal transects, upper soil and litter samples (0, Ao) were taken and processed for the collection of soil meso-fauna by the Berlese funnel method. Samples were taken at the same sites where vegetation relevés were made and soil samples collected, along the Buritica – La Cumbre transect on the north flank of the Sierra Nevada de Santa Marta (SN), the Parque los Nevados transect through the Central Cordillera (TPN), the Tatamá transect through the Western Cordillera (TAT) and the Sumapaz transect through the Eastern Cordillera (SUM) (see the corresponding chapters in Studies of Tropical Andean Ecosystems Vol. 1, 2, 3, 4, 5, the present Vol. 6 and the future Vol. 7).

The samples were processed in the laboratory (SN samples) or in the field (TPN, TAT and SUM samples); Berlese funnels with the samples were in this last case protected against the rain by a transparent plastic sheet fixed several metres above them, and exposed to the sun. The processed samples (in alcohol) were transported to the Hugo de Vries Laboratory (University of Amsterdam), where Elly Beglinger separated each meso-fauna sample in major taxonomic groups. The ants (Formicoidea) were than sent to the second author (Dept. of Entomology, University of California, Davis), who determined the material as far as possible, differentiating species with numbers or letters in the most extensive and difficult genera (*Hypoponera, Pheidole, Solenopsis, Linepithema, Acropyga* and *Brachymyrmex*; see Table 31). The specimens of these genera require further study by specialists (the *Pheidole* specimen were sent to E.O. Wilson, who is revising the genus). Duplicate collections of the complete material are in the Entomology

Department of the University of Davis, California (USA) and in the Instituto de Ciencias Naturales-Museo de Ciencias, Universidad Nacional de Colombia, Bogotá (Colombia).

The Berlese method used does not provide exhaustive sampling of the ground-dwelling ants at each site; however, the average number of individuals collected per sample in this manner was relatively constant (in the order of 20, varying approximately between 0 and 100, the zero samples being only 3 on a total of some 50 samples), and the results should be in a certain way comparable. The data might be used to provide a first general impression on relative diversity and distribution, of ants taking into account that the samples represent probably only a fraction of the ant species that are really present, and that a more exhaustive way of collection may be expected to alter the pattern of vertical and horizontal distribution and diversity. It is only stressing these fundamental limitations of the data set that we mention some findings resulting from analysis of the data.

Results

Table 31 contains the complete list of the 96 species found in the analyzed samples. The occurrence of each species in the transects, and the corresponding altitude or altitudinal interval are indicated, considering separately the west flank and east flank of the TPN, TAT and SUM Cordilleran transects.

The total number of individual workers recovered in each sample of the altitudinal interval containing ants, varied between, 0 and 50 in the SN transect, between 2 and 71 en the TPN transect, between 2 and 73 in the TAT transect, and between 0 and 97 in the SUM transect.

In the SN transect, ants were found from the lowland tropical zone up to 1750 m altitude (average number of individuals per sample 15), in the TPN transect up to 2725 m (average numbers of individuals 21), in the TAT transect up to 2140 m (average numbers of individuals 22) and in the SUM transect up to 2300 m (average number of individuals per sample 18).

62 species were only found in one subtransect only (49 of them in one sample only); 6 were found in the two sub-transects of the same Cordillera (W and E). The other 28 species were found in 2 or more Cordilleras. Ants were found up to 2725 m (maximum; TPN) or up to 1750 m (minimum; SN); or up to 2140 or 2300 m (TAT and SUM). Above those altitudes ants are absent in the samples. Near the afore mentioned limits, the number of individuals and of species deminishes markedly.

Of the 25 species found in the Sierra Nevada (Buritica) transect (SN), 7 (28%) were not found in the other transects; 13 (52%) are in common the TPN transect, 8 (32%) with the TAT transect and 7 (28%) with the SUM transect. This might indicate a major relation of the Santa Marta massive with the Central Cordillera.

Of the 38 species found in the Tatama transect (TAT), 23 (60%) were not found in the other transects; 8 (21%) are in common with the SN transect, 13 (34%) with the TPN transect and 6 (16%) with the SUM transect.

Of the 33 species found in the Sumapaz (SUM) transect, 21 (64%) were not found in the other transects; 7 (21%) are in common with the SN transect, 6 (18%) with the TAT transect, and 6 (18%) with the TPN transect.

Of the 39 species found the Parque Los Nevados (TPN) transect, 14 (36%) were not found in the other transects; 13 (33%) occur also in the SN transect, 13 (33%) in the TAT transect, and 6 (15%) in the SUM transect.

If we consider the relative species richness in relation to the number of analysed samples, the SN transect has 25 species in 9 samples, TAT has 38 species en 13 samples, SUM 33 species in 14 samples and TPN 39 species in 21 samples with averages of 2.8, 2.9, 2.4 and 1.9 species per sample, respectively, relative apparent richness being highest in SN and TAT, lower in SUM and lowest in TPN.

Table 31. Ants from the Colombian Ecoandes expeditions (identifications by P.S. Ward).

– Hormigas de las expediciones de Ecoandes (identificaciones de P.S. Ward).

		SN	TPN		TAT		SUM	
			W	E	W	E	W	E
	Cerapachyinae							
1	Cerapachys sp.				550			
	Ponerínae							
2	Anochetus mayri Emery	900	1000			1275		
3	Discothyrea sp.	700+900	1250					
4	Gnamtogenys andina Lattke					1950		
5	Gnamtogenys haenschi (Emery)	900						
6	Heteroponerasp. cf microps Borgmeier			2700				
7	Hypoponera sp. 1			1290				
8	Hypoponera sp. 2					1800		
9	Hypoponera sp. 3							1480
10	Hypoponera sp. 4	1100	1000	1290+1150		1275		
11	Hypoponera sp. 5			2180				
12	Hypoponera sp. 6	1t00+1500	2345+1500					
13	Hypoponera sp. 7						2180	
14	Hypoponera sp. 8							1700
15	Hypoponera sp. 9				730–1350			
16	Hypoponera sp. 10				730			1120
17	Hypoponera sp. 11				730			
18	Hypoponera sp. 12							1480–1300
19	Hypoponera sp. 13	500	1500+1000	1150	550–1350			
20	Pachycondyla aenescens Mayr						2180	
21	Pachycondyla crassinoda (Latreille)							550
22	Pachycondyla obscurícornis Emery							1120
23	Pachycondyla stigma (Fabricius)							1700
24	Pachycondyla sp.	1500	2345					
25	Prionopelta ? amabilis Borgmeier	500			550			
26	Prionopelta? antillana Forel	700		710				
27	Prionopelta modesta Forel				550–730			1300–1120

21	Pachycondyla crassinoda (Latreille)							550
22	Pachycondyla obscurícornis Emery							1120
23	Pachycondyla stigma (Fabricius)							1700
24	Pachycondyla sp.	1500	2345					
25	Prionopelta ? amabilis Borgmeier	500			550			
26	Prionopelta? antillana Forel	700		710				
27	Prionopelta modesta Forel				550–730			1300–1120
28	Adelomyrmex sp. cf. trístani (Menozzi)				t650+1550	1830		
29	Atta cephalotes (Linnaeus)							1120+550
30	Cardiocondyla nuda Mayr			2030–1850 +1580+840		2140		
31	Crematogaster nigropilosa Mayr			1290				
32	Cyphomyrmex sp. cf. rimosus (Spinola)						1540	1120
33	Cyphomyrmex salvini Forel				1550			
34	Cyphomyrmex sp. cf. salvini Forel	13~+1500						
35	Eurhopalothrix alopeciosa Brown & Kempf				730			
36	Eurh rix gravis (Mann)				1080			
37	Hylomyrma sp. cf sagax Kempf	1700						
38	Megalomyrmex íncisus M.R. Smith				730			
	Myrmicinae							
39	Octostruma balzani Emery	1500			550+1550 +1900			1300+930
40	Octostruma iheringi (Emery)	500						
41	Oligomyrmex sp.			1290+1150				
42	Pheidole biconstricta Mayr (s.l.)	500						1120
43	Pheidole sp. A			2180–1290				
44	Pheidole sp. B						t 625	
45	Pheidole sp. C				1550			
46	Pheidole sp. D							1120+2300 +930
47	Pheidole sp. E		2700+2500 +1725	1580–500				
48	Pheidole sp. F				550			
49	Pheidole sp. G			710				

SN = Sierra Nevada de Santa Marta (Buritaca transect) - Interval of continuous presence, TPN = Parque los Nevados Transect (Central Cordillera) - Intervalo de presencía continua
TAT = Tatamá - transect (Westem Cordíllera) + presence in separate samples, SUM = Sumapaz - transect (Eastern Cordillera) + Presencia en muestras separadas

Table 31. ...continuation

		SN	TPN		TAT		SUM	
			W	E	W	E	W	E
50	Pheidole sp. H				550+1080 +1350			
51	Pheidole sp. I							1120
52	Pheidole sp. J							930
53	Pheidole sp.					1950		
54	Pheidole sp. K			2180	1900			
55	Pyramica denticulata Mayr							1120+930
56	Pyramica gundlachi Roger	500+ 700	1500	1150	550+1080 +1350			1300
57	Pyramica microthrix Bolton				1650			
58	Pyramica nubila (Lattke & Goitia)		2500					
59	Pyramica raptans Bolton						1625	
60	Pyramica vartana Bolton		2700+2345 +1980	2540+2340 +2180		1950		
61	Pyramicamica zeteki (Brown)			1150				
62	Rhopalothrix sp. cf. ciliata Mayr		1980–1725	1880				
63	Rogeria alzatei Kugler							t 700– 1500+930
64	Rogeria nevadensis	1500+1700 +1750						
65	Solenopsis geminata (Fabricius)			2180+1670		1950		
66	Solenopsis (Diplorhoptrum) sp.1	700	1000	1150+840+ 710				
67	Solenopsis (Diplorhoptrum) sp.2	1500	1950				2180+1625	1700+1300
68	Solenopsis (Diplorhoptrum) sp.3	700	1500	1580+710	10B0 t 350		1540	
69	Solenopsis (Diplorhoptrum) sp.4	500+700 +g00	1725	1670+1290				1700+1300
70	Solenopsis (Diplorhoptrum) sp.5			1290+1150	1350			
71	Solenopsis (Diplorhoptrum) sp.6	500						
72	Solenopsis (Diplorhoptrum) sp.7		1500					
73	Solenopsis (Diplorhoptrum) sp.8	1300+1500	2700+2500				19(i0	
74	Solenopsis (Diplorhoptrum) sp.9						1050	
75	Solenopsis (Diplorhoptrum) sp.10					2140		

67	Solenopsis (Diplorhoptrum) sp.2	1500	1950				2180+1625	1700+1300
68	Solenopsis (Diplorhoptrum) sp.3	700	1500	1580+710	10B0 t 350		1540	
69	Solenopsis (Diplorhoptrum) sp.4	500+700 +g00	1725	1670+1290				1700+1300
70	Solenopsis (Diplorhoptrum) sp.5			1290+1150	1350			
71	Solenopsis (Diplorhoptrum) sp.6	500						
72	Solenopsis (Diplorhoptrum) sp.7		1500					
73	Solenopsis (Diplorhoptrum) sp.8	1300+1500	2700+2500				19(i0	
74	Solenopsis (Diplorhoptrum) sp.9						1050	
75	Solenopsis (Diplorhoptrum) sp.10					2140		
76	Stenamma sp.				550			
77	Strumigenys biolleyi Forel				730			
78	Strumigenys elongata Roger			710				
79	Strumigenys perpava Brown		1250					
80	Strumigenys precava Brown							1120
81	Tetramorium bícarinatum (Nylander)				730+1550	2140+1950		
82	Wasmannia auropunctata (Roger)	500			550+730			
	Dolichoderinae							
83	Dolíchoderus bispinosus (Olivier)						1540	
84	Linepithema sp. 1			2180+2030 +1670+12~ +1150+500				
85	Linepithema sp. 2			2340	1550			
	Formicinae							
86	Acropyga sp. 1	500+900						
87	Acropyga sp. 2	1100		710				
88	Acropyga sp. 3		1725					
89	Acropyga sp. 4							1480
90	Brachymyrmex sp. 1		1000	1150+500				
91	Brachymyrmex sp. 2				1650			
92	Brachymyrmex sp. 3			1580	1550			
93	Brachymyrmex sp. 4			1290				
94	Brachymyrmex sp. 5				1080			
95	Camponotus sp.						2180	
96	Paratrechina sp.				1550			1120

SN = Sierra Nevada de Santa Marta (Buritaca transect) - Interval of continuous presence, TPN = Parque los Nevados Transect (Central Cordillera) - Intervalo de presencia continua
TAT = Tatamá - transect (Westem Cordíllera) + presence in separate samples, SUM = Sumapaz - transect (Eastern Cordillera) + Presencia en muestras separadas

If we consider the western and eastern flanks of the three Cordilleran transects separately, we find average values for TAT-W of 4.2 species per sample, TAT-E of 1.8, SUM-W of 1.6, SUM-E of 3.3, TPN-W of 2.5 and TPN-E of 2.2 species per sample showing that TAT-W and SUM-E by far the highest values, followed by TPN-W. This seems to suggest that higher species richness is associated with a more humid climate, the western slope of the Western Cordillera being the wettest, followed by the eastern slopes of the Eastern Cordillera and the western slopes of the Central Cordillera, in that order; the northern slope of the Sierra Nevada de Santa Marta with an average value of 2.8 species per sample is also very wet. The eastern slopes of the Western Cordillera, and the western slopes of the Eastern Cordillera, with values of respectively 1.8 and 1.6 species/sample are decidedly drier; the eastern slopes of the Central Cordillera with a value of 2.2 may have an intermediate position.

As we mentioned already, a number of species were only found in one sample or in one Cordillera: in SN 7 sp., in TAT 22 sp., in SUM 22 sp. and in TPN 17 sp. The corresponding ciphers for the average number per sample, are TAT 1.7, SUM 1.6., TPN 0.8 and SN 0.8. TAT and SUM have again the highest values. If we consider the west and east flanks separately, we find the following:

TAT-W	– 16	species in 7 samples,	average 2.3 / sample
TAT-E	– 4	species in 6 samples,	average 0.7 / sample
SUM-W	– 7	species in 7 samples,	average 1.0 / sample
SUM-E	– 14	species in 7 samples,	average 2.0 / sample
TPN-W	– 3	species in 8 samples,	average 0.4 / sample
TPN-E	– 11	species in 13 samples,	average 0.8 / sample
SN	– 7	species in 9 samples,	average 0.8 / sample

The order now is TAT-W, SUM-E, SUM-W, TPN-E, SN, TAT-E and TPN-W. Here again, the highest values are for TAT-W and SUM-E, the two exterior slopes of the Andes, respectively towards the Chocó and the Amazonian lowlands, both regions with the highest measures of biodiversity of de country and the world.

Thus, although the statistical basis is very feeble, both the values for the average number of species per sample and the average number of species that only occur in one transect, per sample, are highest on the very wet outer Andean slopes towards large areas of mega-diversity.

In Fig. 50 the vertical distribution of the ant species is shown summing across all regions. Here again, it will be clear that the real vertical distribution, especially of many relatively rare species, may be much wider. This figure therefore can be interpreted as a very approximate indicator of ant distribution, above a certain detectable threshold. At right is a graph of the number of species found per altitudinal interval of respectively 150 and 200 m. In both cases, the number increases slightly from 500 m upward to reach a maximum between 1100 and 1300 m. It is noteworthy, however, that in both the wet Sierra Nevada de Santa Marta transect, and in the very wet Tatamá West transect more species were found in the lower intervals than higher up (in this case 250 m intervals were used, of at least 2 samples per interval). Above 1700 m the number of ant species decreases in all transects and only eight species were found above 2300 m; no species were found above 2700 m.

Conclusions

In view of the limitations of the data set only some provisional conclusions can be made. At total number of 96 species were found in the approximately 50 samples from different altitudinal intervals with ants from the 7 (sub) transects.

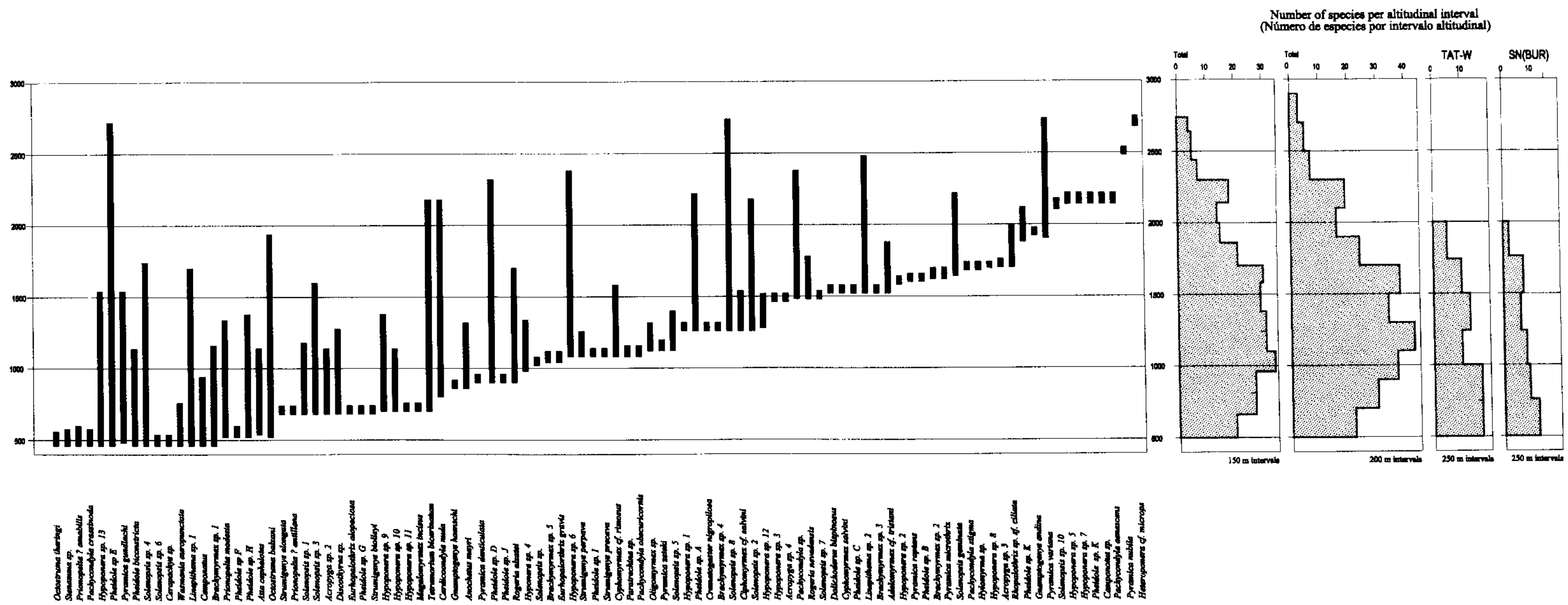

Fig. 50. Vertical combined distribution of ant species in the Ecoandes transects through the Western, Central and Western Cordillera and the northern flank of the Santa Marta massif, and number of species per altitudinal interval.

– Distribución vertical combinada de especies de hormigas en los transectos Ecoandes por las Cordilleras Occidental, Central y Oriental y el flanco norte de la Sierra Nevada de Santa Marta, y el número de especies por intervalo altitudinal.

The largest number of species found only in one sample or transect, occur on the western slope of the Western Cordillera, the eastern slope of the Eastern Cordillera and the northern slope of the Santa Marta massif, these areas having the relatively wettest climate regimes, followed by the western slope of the Central Cordillera. The western slope of the Western Cordillera and the northern slope of the Santa Marta massif have the highest number of species at the lowest tropical level, decreasing monotonically upward. The average of all the transects however, shows somewhat lower number of species at the lower altitudes, and a maximum of species richness between 900 and 1700 m. Lower numbers of species are found between 1700 and 2300 m, and very few between 2300 and 2750 m. Above that level no ants were found in the samples.

A gradual decrease in the number of species from tropical level upward under overall wet circumstances was also found for plant species. When the lower tropical level is relatively dry (like in the large interandean valleys of upper Magdalena and Cauca) and the humidity increases upward towards the cloud forest zones, ant species diversity seems to be lower at tropical level and increases upwards towards a mid-elevation maximum, followed by a decrease. These tendencies are also similar to those found in flowering plant species on the same slopes (van der Hammen 2000). They also agree with other studies that have reported a mid-elevation peak in ant species richness, for example in Panamá (Olson 1994) and Madagascar (Fisher 1998, 1999), and for a worldwide assemblage of tropical sites (Ward 2000). Our results from Colombia suggest the importance of climatic variables in modulating this effect.

These and other patterns of ant distributions that we report here will have to be confirmed by future more detailed investigations.

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