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Ants (Hymenoptera, Formicidae) of forest and savanna in the Biosphere Reserve Beni, Bolivia

Abstract
During an expedition to Bolivia in 1993 ants have been collected in different habitats (terra firme forest, inundation savanna, and forest islands in savanna) in the Biosphere Reserve „Estación Biológica del Beni" Intense, mainly hand collecting yielded a total of 188 ant species within seven days. 121 species were collected from forest islands, 74 from terra firme forest and 59 from savanna. 21 species and one genus are recorded for the first time from Bolivia. Most diverse ant genera were *Camponotus* (28 spp.), *Pheidole* (25 spp.) and *Pseudomyrmex* (20 spp.). A comparison of the ant faunas of the three examined habitats showed highest similarity in species composition between different forest islands (SØRENSEN quotient: S > 40%). Similarity between the ant faunas of forest islands and terra firme forest, respectively forest islands and savanna (including savanna trees) was between S = 30-40%, each. Lowest similarity (S = 10-20%) showed the ant faunas of forest islands and, especially, of terra firme forest with the one of the ground and grass stratum of the savanna (without trees).

Kurzfassung
Ameisen (Hymenoptera, Formicidae) aus Wald und Savanne des Biosphärenreservats Beni in Bolivien
Während einer Expedition nach Bolivien im Jahre 1993 wurden in verschiedenen Biotopen des Biosphärenreservats Beni (terra firme-Regenwald, Überschwemmungssavanne und Waldinseln in der Savanne) Ameisen gesammelt. Insgesamt konnten innerhalb von sieben Tagen 188 Arten überwiegend durch Handfang nachgewiesen werden, und zwar 121 aus Waldinseln, 74 aus terra firme-Wald und 59 aus der Savanne. Die Funde von 29 Arten und einer Gattung stellen Erstnachweise für Bolivien dar. Die artenreichsten Gattungen waren *Camponotus* (28 spp.), *Pheidole* (25 spp.) und *Pseudomyrmex* (20 spp.). Ein Vergleich der in den drei untersuchten Biotopen gefangenen Ameisenarten zeigte, daß die Faunen der Waldinseln sich untereinander am stärksten ähnelte (SØRENSEN Quotient: S > 40%). Waldinseln und terra firme-Wald, bzw. Waldinseln und Savanne (einschließlich Savannenbäume) wiesen eine Faunenähnlichkeit von S = 30-40% auf. Die mit S = 10-20% geringsten Gemeinsamkeiten im Artenbestand zeigten Waldinseln und besonders der terra firme-Wald im Vergleich mit dem Boden und Grasstratum der Savanne (ohne Savannenbäume).

Resumen
Hormigas (Hymenoptera, Formicidae) de bosque y sabana en la Reserva de la Biósfera „Estación Biológica del Beni", Bolivia
Durante una expedición a Bolivia en el año 1993 coleccionamos hormigas en varios biótopos (bosque de tierra firme, sabana de inundación y islas forestales en la sabana) de la Reserva de la Biósfera „Estación Biológica del Beni" En total cogimos - mayormente manualmente - 188 especies durante siete dias: 121 en islas forestales, 74 en bosque de tierra firme y 59 en la sabana. 29 especies y un género fueron encontrados por la primera vez en Bolivia. Los géneros los mas ricos en especies fueron *Camponotus* (28 spp.), *Pheidole* (25 spp.) y *Pseudomyrmex* (20 spp.). La comparación de los tres biotopos monstró que la fauna de las islas forestales entre sí fue la mas similar (SØRENSEN cociente: S < 40%). Islas forestales y bosque de tierra firme o sea islas forestales y sabana (incluido arboles) monstraron una similitud de S = 30-40%. Islas forestales y bosque de tierra firme se parecieron lo menos (S = 10-20%) en la composición de su fauna al suelo y estrato graminal de la sabana (sin arboles).

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1. Introduction

In July 1993 the second author had the opportunity to participate in an expedition to Bolivia organized under a convention between the Staatliches Museum für Naturkunde Karlsruhe (SMNK) and the Colleción Boliviana de Fauna La Paz (CBF) (for details see HÖFER & BRESCOVIT 1994, this volume). The main purpose of the journey was to collect animals in different ecoregions of Bolivia to broaden the still poor faunistic knowledge about this country. Here we present a species list of ants collected around the Biological Station of the Biosphere Reserve Beni (Estación Biológica del Beni - El Porvenir).

2. Locality and methods

Locality

Sampling was conducted around the Estancia El Porvenir, northeast of San Borja, Departamento Beni, at the Estación Biológica del Beni (EBB; 66°38' W 14°30' S midpoint, 175 - 190 m a.s.l.), a biosphere reserve with a surface of 135,000 ha situated at the southwestern edge of the Beni savannas. A description of landscape, climate and vegetation of the area is given by HANAGARTH (1993). The whole region is an ecotone of forests and (seasonal) wet areas of which about 70% are inundated for several months every year (duration and height of inundation depending on the relief). Beside low inundation forests (mainly 10 - 15 m high), poor in tree species, there exist evergreen as well as seasonal evergreen high forests

Table 1. Pattern of standardized sampling in different habitats at EBB with daytime and date; Fl 1-3: Forest islands in savanna; Sav: Inundation savanna; P: single trees, *Pseudobombax marginatum*, in the savanna; BS: *Ficus* tree at the Biological station in savanna; Tf: Terra firme forest near Trapiche, 8 km from the Biological Station; down: - searching for 2 h. on the ground, including litter, roots, and rotten wood; up: - searching for 1 h. (the same area as „down") the lower vegetation stratum including foliage, twigs, hanging rotten wood and the bark of trees.

	Fl 1		Fl 2		Fl 3		Sav	P	BS	Tf	
	down	up	down	up	down	up				down	up
day:											
date	21.7.93	21.7.93	21.7.93	21.7.93	22.7.93	22.7.93	23.7.93	23.7.93	20.7.93	26.7.93	26.7.93
time	10-12	12-13	14:30-16:30	16:30-17:30	10-12	12-13	9:30-11:30	12-13	12-13	9:30-11:30	11:30-12:30
							24.7.93		20.7.93		
							9:30-11:30		17-18		
night:											
date	22.7.93	22.7.93	23.7.93	23.7.93							
time	19-21	21-22	19-21	21-22							

(terra firme) of 30 - 40 m height. Especially around El Porvenir inundation savannas are dominating the landscape with interspersed forest islands of different size (see HANAGARTH 1993, and HÖFER & BRESCOVIT 1994 for photographic illustration of the area).

Sampling sites

1. Terra firme forest (= Tf) near Trapiche, about 8 km from El Porvenir, moderately influenced by human activities and cattle.
2. Forest islands (= Fl) in inundation savanna near the Estancia El Porvenir, in a distance of approx. 1 km from one each other.
   a. Forest island 1 (Fl 1), about 0.05 ha
   b. Forest Island 2 (Fl 2), about 0.05 ha
   – c. Forest Island 3 (Fl 3), about 1.5 ha

Fl 1 and Fl 2 were strongly influenced by cattle, but not Fl 3; this forest island had much undergrowth.

The whole area of Fl 1 and Fl 2 was searched for ants completely, in Fl 3 ants were collected in a plot of equivalent size. From a fourth forest island (Fl 4) a litter sample was included in the results.

3. Inundation savanna (= Sav), between Fl 1 - Fl 2 and Fl 2 - Fl 3, respectively, and several small solitary trees, *Pseudobombax marginatum*, Bombacaceae (= Sav-tr) at different sites in the savanna.
4. Stem of a big *Ficus* tree, Moraceae (at 1-3 m height) at the research station in savanna vegetation (= Sav-tr).

Methods

Ants were mainly hand collected between 20-27 July 1993 (7 sampling days) according to methods proposed by CODDINGTON et al. (1991) for spiders but modified in order to collect ants - and further called „standardized sampling" - in the following scheme (see tab. 1):

„looking down": a careful examination (on the knees) of the ground layer including the litter, roots, and rotten wood (2 h.).

„looking up": a search in about the same area as in „looking down" but of the lower vegetation stratum above the knee up to a height of 2 - 2.5 m including foliage, twigs, hanging rotten wood, and bark of the tree stems (1 h.).

The aim of such a sampling procedure is not to pick up every ant encountered but to detect as much different species as possible. Thus, just some voucher specimens of each assumed assemblage or colony were taken and not much time was spent when a nest was found.

Terra firme forest and forest islands were sampled 3 hours during the day, 2 h. on the ground, 1 h. in the vegetation. In the savanna we searched for ants 2 times 2 h. during the day, on the *Ficus* tree 2 times 1 h., and on the *Pseudobombax* trees 1 h. Fl 1 and Fl 2 were sampled for another 3 hours during the night (2 h. ground, 1 h. vegetation). In the savanna we did not collect at night, because the vegetation was completely wet.

Beside this standardized sampling some more random hand collecting was done during the day and, in the forests, at night as well. Additionally, from each of the four forest islands (Fl 1 - Fl 4) 2 m^2 litter were collected and searched for ants. The complete sample number (samples ranging from a single ant to part of a nest) was 495, with 313 from forest islands (143 Fl 1, 96 Fl 2, 64 Fl 3, 10 Fl 4), 93 from terra firme forest, and 88 from savanna (62 from low vegetation and ground, 26 from trees). 1 sample (*Solenopsis saevissima*) from the station's kitchen was counted as savanna sample. 407 of all samples were collected during the day, 8 a.m. to 6 p.m. and 88 at night from 7 to 10 p.m.

For comparison of species similarity in two habitats we used the SØRENSEN quotient:

$$S = 2j/(a+b) \times 100(\%)$$

where j is the number of species common (joint) to the two habitats compared and a and b are respectively the total number of species in each habitat (SOUTHWOOD 1978). We made no efforts to test significance for different values of S in habitat comparisons as we think that the ant fauna could not be sampled sufficiently within the 7 days we spent at EBB.

Species determination was done by the first author and is, if not otherwise stated, based on workers. Beside the actual taxonomic literature some species were identified by direct comparisons with species of the ant collection of the SMNK which were formerly cross-checked with material in the ant collection of the Museum of Comparative Zoology, Cambridge. New records for Bolivia are mainly based on the catalogues of neotropical ants of KEMPF (1972) and BRANDÃO (1991). Specimens are deposited in the collections of SMNK and CBF.

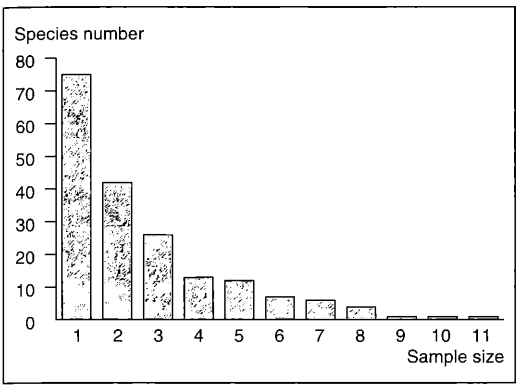

Figure 1. Relation between sampling frequency (sample size) and species number for all 188 species collected at EBB.

3. Results and Discussion

During the 7-day-expedition to EBB we found a total of 188 ant species representing 43 genera from 6 subfamilies (tab. 7, see comments on some species in the appendix). 5 species were only represented by single dealated queens, or males (*Gnamptogenys* sp. [*rastrata*-group], *Pseudomyrmex* sp. 3, *Procryptocerus* sp., *Apterostigma* sp., and *Labidus coecus*). 148 species were found during 25 h. of standardized sampling (tab. 1, tab. 8), another 40 species by additionally hand sampling and litter searching. Only six species were exclusively found in the litter samples (*Apterostigma* sp., *Strumigenys eggersi*, *Pheidole* sp. 25, *Monomorium floricola*, *Solenopsis* (*Diploropthrum*) sp. 3, *Iridomyrmex* sp. 1), and one species, *Solenopsis saevissima*, was only collected in the kitchen of the station.

129 species were collected exclusively during the day, 41 species during night and day, and 18 species at night only (in the majority *Camponotus* species). As many species (62,2 %) were found only one or two times (fig. 1) it cannot be stated in many cases whether a species is definitely diurnal or nocturnal.

Many species - so far determination was possible - are widespread in the neotropics and typical elements of the Amazonian ant fauna. Most abundant were the Myrmicinae with 80 species, followed by Formicinae (36 spp.), Ponerinae (31 spp.), Pseudomyrmicinae (20 spp.), Dolichoderinae (17 spp.), and at last 4 species of Ecitoninae (tab. 3, 7). 29 species and 1 genus represent new records for Bolivia (tab. 2). The collection in its proportional composition and dominance ranking is highly similar to the hitherto species richest known ant fauna of the neotropics, the one of Panguana in central Amazonian Peru (tab. 3) which was assessed during 27 months field work and comprised both forest and open habitats (pastures, plantations;

Table 2. Species recorded for the first time from Bolivia

Ponerinae
Platythyrea angusta FOREL 1901
Hypoponera opaciceps (MAYR 1887)
Hypoponera parva (FOREL 1909)
Pachycondyla (= *Neoponera*) *apicalis* (LATREILLE 1802)
Pachycondyla (= *Mesoponera*) *constricta* (MAYR 1883)
Pachycondyla (= *Neoponera*) *obscuricornis* (EMERY 1890)
Pachycondyla (= *Neoponera*) *unidentata* (MAYR 1862)

Ecitoninae
Eciton vagans (OLIVIER 1791)

Pseudomyrmicinae
Pseudomyrmex dendroicus (FOREL 1904)
Pseudomyrmex ethicus (FOREL 1911)
Pseudomyrmex filiformis (FABRICIUS 1804)
Pseudomyrmex maculatus (F. SMITH 1855)
Pseudomyrmex simplex (F. SMITH 1877)

Myrmicinae
Cyphomyrmex major FOREL 1901
Cyphomyrmex minutus MAYR 1862
Mycetarotes parallelus (EMERY 1905)
- first record of the genus from Bolivia
Eucryptocerus placidus (F. SMITH 1860)
Strumigenys cordovensis MAYR 1887
Nesomyrmex asper (MAYR 1887)
Nesomyrmex echinatinodis (FOREL 1886)
Monomorium floricola (JERDON 1852)
Solenopsis bondari SANTSCHI 1925

Formicinae
Camponotus (*Myrmaphaenus*) *novogranadensis* MAYR 1870
Camponotus (*Myrmobrachys*) *burtoni* MANN 1916
Camponotus (*Myrmothrix*) *femoratus* (FABRICIUS 1804)
Camponotus (*Tanaemyrmex*) *abuanus* MANN 1916
Camponotus (*Tanaemyrmex*) *hagemanni* FOREL cit. apud SANTSCHI 1922
Dendromyrmex chartifex (F. SMITH 1860)
Paratrechina longicornis (LATREILLE 1802)

VERHAAGH 1990, 1991 and unpubl. results). Thus, the collecting methods used in Bolivia seem to be highly effective for a quick assessment of the relative composition of the ant fauna. There are two main exceptions: Ecitoninae and small Dacetini (*Strumigenys*, *Smithistruma* a. o. genera) were not well represented in this collection with 2.1, respectively 1.6%, of the whole fauna when compared with the fauna of Panguana, where, both Ecitoninae and Dacetini, each had a portion of 4.8% of the whole fauna. Reasons for the former are in our opinion their nomadic habits which makes longer study periods necessary to find more species. For the latter, their cryptic life style requires intense sampling by extraction methods (BERLESE, WINKLER etc.). For the same reason, other small cryptic living ants with small colony size of different genera and

Table 3. a) Comparison of the ant fauna of EB Beni, Bolivia and Panguana, Peru (VERHAAGH 1990, 1991 and unpubl.). Number of species [n] and relative portion [%]. b) Comparison of the 10 most diverse ant genera of EB Beni and Panguana, number of species [n] and relative portion of the total species number [%].

a)	EBB, Bolivi		Panguana, Peru	
	n	%	n	%
Ponerinae	31	16.5	92	17.7
Ecitoninae	4	2.1	25	4.8
Pseudomyrmicinae	20	10.6	33	6.3
Myrmicinae	80	42.6	242	46.5
Dolichoderinae	17	9.0	47	9.0
Formicinae	36	19.1	81	15.6
Σ	188		520	

b) EBB, Bolivia			Panguana, Peru		
		%			%
Camponotus	28	14.9	*Pheidole*	57	11.0
Pheidole	25	13.3	*Camponotus*	52	10.0
Pseudomyrmex	20	10.6	*Pseudomyrmex*	33	6.3
Solenopsis	12	6.4	*Gnamptogenys*	23	4.4
Crematogaster	10	5.3	*Solenopsis*	23	4.4
Pachycondyla	9	4.8	*Crematogaster*	22	4.2
Zacryptocerus	9	4.8	*Pachycondyla*	21	4.0
Dolichoderus	8	4.3	*Dolichoderus*	21	4.0
Gnamptogenys	6	3.2	*Azteca*	18	3.5
Hypoponera	6	3.2	*Strumigenys*	18	3.5
Σ	133	70.8		288	55.3

subfamilies (Ponerinae, Myrmicinae, Formicinae) are believed to be underrepresented, too. On the other hand, Formicinae and Pseudomyrmicinae were relatively highly represented in the samples of EBB, in comparison to Panguana. This might be due to the collecting method biased towards epigeic and arboreal species, or to a real difference in the composition of the ant faunas of EBB and Panguana. Approx. 60% of the collected ant species can probably be regarded as at least partly arboreal or living in vegetation. In Panguana the proportion was about 50%.

3.1 Comparison of the faunal composition in different habitats

Most species were found in the forest islands, primarly, due to the longer time spent in these habitats but also due to higher species numbers than in the other habitats as revealed by comparison of species numbers after the same sampling time (tab. 8). 66 species (35.1%) were exclusively recorded from these forest islands in contrast to 39 (20.7%) from terra firme forest and 25 (13.3%) from the savanna. Only 8 species were common to all three habitats.

Forest islands

In the forest islands ant species of all subfamilies but Ecitoninae were well present. Especially species rich in these habitats were *Pheidole*, *Camponotus*, *Pseudomyrmex*, *Crematogaster* and *Zacryptocerus*. The standardized sampling showed on the average within a single forest island the following degrees of similarity: $S(\bar{x}) = 43.2\%$ (ground ant fauna) and 25.0% (vegetation ant fauna) in a comparison day versus night, and 23.5% (day) and 30.0% (night) in a comparison between ground versus vegetation ant fauna (tab. 4). The least similar samples were the nocturnal ones from the ground compared with those from the vegetation during the day ($\bar{x} = 10.2\%$).

The similarities between the different islands Fl 1, Fl 2 and Fl 3 (tab. 4) were also higher in the ground fauna ($S = 29.0 - 47.7\%$, $\bar{x} = 38.7\%$) than in the fauna found in the vegetation ($S = 8.2 - 36.8\%$, $\bar{x} = 22.3\%$). The two smaller islands Fl 1 and Fl 2 (0.05 ha each) seemed to be more similar to each other in their faunal composition than to the larger (1.5 ha) forest island Fl 3 (tab. 4 and 8).

Terra firme forest

The most striking feature of the terra firme forest ant fauna was the relatively high proportion of Ponerinae and *Camponotus* species as well as the occurrence of all four army ant species (Ecitoninae) encountered during this study. Similarity between ground and vegetation fauna was low ($S < 20\%$). We assume that this is the least completely sampled habitat in the study.

Savanna

Very conspicuous was the dissimilarity between the ant fauna found on the ground and in the grass layer of the savanna and the ants on the savanna trees. The two examined savanna areas situated between forest islands Fl 1 - Fl 2 and Fl 2 - Fl 3 - showed a high level of species overlap ($S = 45.5\%$, tab. 4). In contrast, similarity with the savanna tree fauna was very low in the standardized samples (tab. 4, 5) as well as regarding overall sampling ($S = 12.7\%$, tab. 6). The total number of 39 species found in the savanna (not regarding savanna trees) seems to be very low and may be in part due to methodical reasons: We did not collect at night, and collecting in general was difficult in the grass layer of the savanna. The only ant genera better represented in this habitat were *Pseudomyrmex*, *Pheidole* and *Camponotus* whereas we did not find any dolichoderine species.

Of the few trees examined, most species (20 out of 24) were found on the stem of a single *Ficus* at the biologi-

Table 4. Species similarity between habitats (standardized sampling). Indicated are SØRENSEN quotients (in %) and species numbers common to both habitats compared. Fl 1 - Fl 3. = Forest islands; Tf = Terra firme forest; Sav1 + 2 = Savanna between Fl 1-Fl 2 respectively Fl 2-Fl 3, without trees; Sav-tr = Trees in savanna; gro = ground, veg = vegetation, d = day, n = night; species number of habitats in ().

	Fl1 gro n (27 spp)	Fl1 veg d (27 spp)	Fl1 veg n (20 spp)	Fl2 gro d (42 spp)	Fl2 gro n (20 spp)	Fl2 veg d (16 spp)	Fl2 veg n (9 spp)	Fl3 gro d (27 spp)	Fl3 veg d (22 spp)	Tf gro d (18 spp)	Tf veg d (13 spp)	Sav1 d (21 spp)	Sav2 d (23 spp)	Sav-tr d (24 spp)
Fl1 gro d (46 spp)	41.1%-15	35.6%-13	24.2%-8	47.7%-21	21.2%-7	16.1%-5	14.5%-4	35.6%-13	26.5%-9	18.8%-6	13.6%-4	9.0%-3	5.8%-2	22.9%-8
Fl1 gro n (27 spp)		3.7%-1	25.5%-6	34.8%-12	42.6%-10	4.7%-1	22.2%-4	25.9%-7	4.1%-1	17.8%-4	5.0%-1	8.3%-2	16.0%-4	3.9%-1
Fl1 veg d (27 spp)			34.0%-8	23.2%-8	0	23.3%-5	0	0	8.2%-2	0	10.0%-2	4.2%-1	4.0%-1	51.0%-13
Fl1 veg n (20 spp)				3.2%-1	15.0%-3	0	20.7%-3	8.5%-2	4.8%-1	5.3%-1	12.1%-2	4.9%-1	4.7%-1	27.3%-6
Fl2 gro d (42 spp)					45.2%-14	10.3%-3	15.7%-4	29.0%-10	34.4%-11	20.0%-6	18.2%-5	12.7%-4	21.5%-7	21.2%-7
Fl2 gro n (20 spp)						16.7%-3	34.5%-5	29.8%-7	14.3%-3	26.3%-5	6.1%-1	14.6%-3	23.3%-5	0
Fl2 veg d (16 spp)							16.0%-2	14.0%-3	36.8%-7	11.8%-2	34.5%-5	0	5.1%-1	30.6%-6
Fl2 veg n (9 spp)								22.2%-4	25.8%-4	22.2%-3	18.2%-2	0	6.3%-1	6.1%-1
Fl3 gro d (27 spp)									24.5%-6	26.7%-6	10.0%-2	0	4.0%-1	3.9%-1
Fl3 veg d (22 spp)										20.0%-4	17.1%-3	4.7%-1	8.9%-2	17.4%-4
Tf gro d (18 spp)											19.4%-3	5.1%-1	4.9%-1	0
Tf veg d (13 spp)												0	0	0
Sav 1 d (21 spp)													45.5%-10	8.9%-2
Sav 2 d (23 spp)														12.8%-3

cal station. They were mostly *Pseudomyrmex*, Cephalotini and *Camponotus* species. Ponerinae, Ecitoninae, Attini, Dacetini, Leptothoracini, Pheidolini and Solenopsidini were not found on the stems of the examined trees.

3.2 Comparison between the habitats

Forest islands and terra firme forest

Similarity quotients of the different standardized sampling in forest islands and in terra firme forest during the day were between 0 and 34.5%, with an average of only 16.7% (tab. 4). The quotients were higher (between 20 and 30%) when collections of ants from the ground and vegetation were taken together (tab. 5). Highest similarity (S = 35.3%) resulted when all samples of the habitats collected during the day were recognized (tab. 6). Regarding all samples, both habitats had 32 species in common.

Forest islands and savanna

Comparison of single standardized samples (tab. 4) resulted in average similarity quotients of 8.8% (2 h. collections of the ground of forest islands versus 2 h. savanna collections excluding trees) and 4.5% for vegetation collections of forest islands (1 h.) versus savanna collections (2 h.). Much higher were the SØRENSEN quotients when samples from ground or vegetation of forest islands were compared with those from the few examined savanna trees (*Ficus* and *Pseudobombax*): $\bar{x}$ = 16.0, respectively 32.8%, with a top similarity of 51.0% between ants from savanna trees and vegetation of Fl 1 (tab. 4). These direct comparisons between standardized collections yielded a total mean of only 12.6%. Higher quotients resulted from combined data of diurnal sampling on the ground and in the vegetation of the forest islands, respectively grass stratum and trees in the savanna: up to 39.6% in standardized sampling (tab. 5) and 38.7% regarding all samples (tab. 6). A look

Table 5. Species similarity between habitats (standardized sampling). Species found on the ground or in the vegetation are taken together for forest islands and terra firme forest. Indicated are SØRENSEN quotients (in %) and species number common to both habitats compared. Fl 1 - Fl 3. = Forest islands; Tf = Terra firme forest; Sav1 + 2 = Savanna between Fl 1-Fl 2 respectively Fl 2-Fl 3, without trees; Sav-tr = Trees in savanna; d = day, n = night; species number of habitats in (), n.d. = not determined.

	Fl 1 n (40 spp)	Fl 2 d+n (54 spp)	Fl 2 d (44 spp)	Fl 2 n (23 spp)	Fl 3 d (44 spp)	Sav1 + Sav-tr d (41 spp)	Sav2 + Sav-tr d (42 spp)	Sav1+2 d (34 spp)	Sav-tr d (24 spp)	Tf d (28 spp)
Fl 1 d+n (79 spp)	n.d.	49.6%-33	n.d.	n.d.	34.1%-21	31.6%-19	31.4%-19	15.9%-9	31.1%-16	20.6%-11
Fl 1 d (60 spp)	42.2%-23	n.d.	46.2%-24	21.7%-9	36.5%-19	39.6%-20	39.2%-20	12.8%-6	38.1%-16	22.7%-10
Fl 1 n (40 spp)		n.d.	28.6%-12	41.3%-13	23.8%-10	19.8%-8	22.0%-9	13.5%-5	18.8%-6	14.7%-5
Fl 2 d+n (54 spp)			n.d.	n.d.	44.9%-22	25.3%-12	29.2%-14	25.0%-11	20.5%-8	29.3%-12
Fl 2 d (44 spp)				41.8%-14	38.6%-17	23.5%-10	27.9%-12	23.1%-9	20.6%-7	27.8%-10
Fl 2 n (23 spp)					32.8%-11	12.5%-4	18.5%-6	21.1%-6	4.3%-1	27.5%-7
Fl 3 d (44 spp)						11.8%-5	14.0%-6	7.7%-3	8.8%-3	27.8%-10
Sav1+ Sav-tr d (41 spp)							n.d.	n.d.	n.d.	5.8%-2
Sav2+ Sav-tr d (42 spp)								n.d.	n.d.	2.9%-1
Sav1+2 d (34 spp)									10.3-3	6.5%-2
Sav-tr d (24 spp)										0

on the combined samples shows that the ant fauna from the trees is responsible for the higher quotients. Without the fauna of savanna trees similarity of forest islands and savanna remains low (S < 20%) even when all samples are considered. Similar results were reported by VERHAAGH (1991) from pastures in Panguana, Peru, where also the total number of species in the grassland strongly depended on the presence of trees.

Terra firme forest and savanna

Both habitats were extremely dissimilar in the samples taken. Most samples of these habitats had none or just a single species in common, therefore the average SØRENSEN quotient was extremely low (S = 1.7%). The quotients remained low in combined standardized samples (tab. 5) and reached only 16.5% in the comparison of all collections (tab. 6) when savanna trees were included, and 8.8% (or just 5 species common to both habitats) when not. Thus, terra firme forest and savanna showed the lowest overlap in species composition of the three examined habitats.

4. Conclusions

The collection of 188 ant species in 7 days is certainly far away from a complete species inventory of the examined habitats. Nevertheless, the intense search resulted in a collection that is very similar in its relative taxonomic composition to the better known Amazonian ant fauna of Panguana, Peru (VERHAAGH 1990, 1991 and unpubl.). The standardized method yielded 148 species in 25 collecting hours but duration of sampling was to short as shown by increasing SØRENSEN quotients when more samples were included in the comparisons. The quotient, however, depends also on the question whether compared units were collected under similar conditions (collecting duration, day time of collecting, strata etc.).

In spite of the limits set by short collecting time some preliminary conclusions can be drawn regarding the three compared habitats:

1. The ant faunas of the forest islands show greatest similarity among each other especially those of the

Table 6. Species similarity between habitats regarding all - standardized and additional - samples from ground, litter and vegetation. Indicated are SØRENSEN quotients (in %) and species numbers common to both habitats compared. Fl = Forest islands (Fl 1-4); Sav = Savanna between Fl 1-Fl 2 respectively Fl 2-Fl 3, without trees; Sav-tr = Trees in savanna; Tf = Terra firme forest; d = day; species number of habitats in (); n.d. = not determined.

	Sav total + Sav-tr (59 spp)	Sav total (39 spp)	Sav-tr (24 spp)	Tf total (74 spp)
Fl total (121 spp)	34.4%-31	18.8%-15	26.2%-19	32.8%-32
Fl d (96 spp)	38.7%-30	17.8%-12	20.0%-18	35.3%-30
Sav total + Sav-tr (59 spp)		n.d.	n.d.	16.5%-11
Sav total (39 spp)			12.7-4	8.8%-5
Sav-tr (24 spp)				10.2%-5

two smaller islands.

2. The combined ant faunas of the forest islands seem to be almost equally similar to the ant faunas of the terra firme forest and the savanna when savanna trees are included.
3. Low similarity seems to exist between the faunas of forest islands and that of the ground and the grass stratum of the savanna (excluding trees), and, especially, between the savanna ant fauna and that of terra firme forest.

An explanation for these results may be that forest islands and terra firme forest show a lot of structural similarities thus offering a similar spectrum of nesting sites. But both forest types differ considerably in their physical settings and therefore in their ecological conditions. The small forest islands should be characterized by a warmer climate because radiation is higher inside than in the continous terra firme forest. This could result, for example, in an unability for heat sensible army ants to colonize these islands permanently.

Even more severe consequences for terrestrial, especially hypogeic ant species should result from the annual flooding of the savanna for several months which effects the forest islands, too. Therefore the preponderance of at least partly arboreal species that we found in the samples is possibly not exclusively a methodical one but can be explained by ecological reasons. The Estación Biológica del Beni is apparently an exellent area for comparative studies on habitat choice, competition and ecological effects of physical stress in a tropical ant fauna.

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Appendix

Table 7. Occurrence of ant species around EBB - El Porvenir according to different habitats and daytime; Fl-lit = from litter samples of forest islands Fl 1-4; Fl-gro = from ground stratum of forest islands (looking down); Fl-veg = from lower vegetation stratum of forest islands (looking up); Sav = from soil surface and grass stratum of inundation savanna; Sav-tr = from trees in savanna, P = *Pseudobombax marginatum*, BS = *Ficus* sp. at the Biological Station; Tf-gro = from ground stratum in terra firme forest; Tf-veg = from lower vegetation stratum in terra firme forest; d = capture between 8.00 and 18.00, x^{lit} = species represented by litter sample only; n = capture between 19.00 and 22.00; sa = number of samples; $q/^{q}$ = species represented by a single dealated queen only, ^{aq} = including a single alated female, $m/^{m}$ = species represented by a single male only; ^{ki} = species collected only in the kitchen of the station; ^{hyp} = species found in the soil (hypogeicly); ^{n} = located nest.

Species number	Fl-lit 31	Fl-gro 89	Fl-veg 65	Sav 39	Sav-tr 24	Tf-veg 46	Tf-gro 36	d 170	n 59	sa
Ponerinae (31)										
Amblyoponini (1)										
Prionopelta sp.		x						x		1
Ectatommini (9)										
Ectatomma edentatum ROGER 1863	$x^{Fl\ 3}$	x		x				x	x	4
Ectatomma quadridens (FABRICIUS 1793)	$x^{Fl\ 1}$	x						x		3
Ectatomma tuberculatum (OLIVIER 1791)				x				x		1
Gnamptogenys cf. *tornata* (ROGER 1861)		x		x				x		2
Gnamptogenys cf. *rustica* (SANTSCHI 1929)		x					x	x	x	2
Gnamptogenys cf. *sulcata* (F. SMITH 1858)			x					x		1
Gnamptogenys teffensis (SANTSCHI 1929)		x						x	x	2
Gnamptogenys sp.							x	x		1
Gnamptogenys sp. (*rastrata*-group) (q)							x	x^{q}		1
Platythyreini (1)										
Platythyrea angusta FOREL 1901						x		x		2
Ponerini (19)										
Anochetus mayri EMERY 1884				x				x		1
Hypoponera distinguenda (EMERY 1890)	$x^{Fl\ 3,4}$	x						x		3
Hypoponera opaciceps (MAYR 1887)							x	x		1
Hypoponera parva (FOREL 1909)	$x^{Fl\ 3}$	x^{aq}						x		3
Hypoponera cf. *trigona* (MAYR 1887)	$x^{Fl\ 2}$	x						x		3
Hypoponera sp. (near *opaciceps*)				x			x^{hyp}	x		3
Hypoponera sp. 1		x							x	1
Odontomachus brunneus (PATTON 1894)	$x^{Fl\ 2}$	x		x			x	x	x	5
Odontomachus haematodus (LINNAEUS 1758)		x^{n}	x			x	x	x	x	8
Odontomachus minutus EMERY 1894		x					x	x	x	6
Pachycondyla (=*Neoponera) apicalis* (LATREILLE 1802)		x	x					x		4
Pachycondyla (=*Mesoponera*) constricta (MAYR 1883)		x		x				x	x	4
Pachycondyla crassinoda (LATREILLE 1802)							x^{n}	x		2
Pachycondyla (=*Neoponera*) *crenata* (ROGER 1861)		x				x			x	2
Pachycondyla harpax (FABRICIUS 1804)	$x^{Fl\ 1}$	x						x	x	4
Pachycondyla (=*Neoponera*) *obscuricornis* (EMERY 1890)							x	x		1
Pachycondyla (=*Trachymesopus*) *stigma* (FABRICIUS 1804)		x						x		2
Pachycondyla (=*Neoponera*) *unidentata* (MAYR 1862)						x		x		1
Pachycondyla (=*Neoponera*) *villosa* (FABRICIUS 1804)		x	x			x	x	x	x	9
Typhlomyrmicini (1)										
Typhlomyrmex pusillus EMERY 1894							x^{hyp}	x		1

	Fl-lit	Fl-gro	Fl-veg	Sav	Sav-tr	Tf-veg	Tf-gro	d	n	sa
Ecitoninae (4)										
Eciton drepanophorum (F. SMITH 1858)				x			x	x		2
Eciton vagans (OLIVIER 1791)							x	x		1
Labidus coecus (LATREILLE 1802) (m)							x	x^{m}		1
Neivamyrmex gradualis BORGMEIER 1953							x	x		2
Pseudomyrmicinae (20)										
Pseudomyrmex curacaensis (FOREL 1912)		x	x^{n}					x		4
Pseudomyrmex dendroicus (FOREL 1904)						x^{n}		x		2
Pseudomyrmex eduardi (FOREL 1912)		x	x		x^{BS}	x		x		5
Pseudomyrmex elongatus (MAYR 1870)		x	x					x		3
Pseudomyrmex ethicus (FOREL 1911)			x			x	x	x		3
Pseudomyrmex filiformis (FABRICIUS 1804)			x					x		1
Pseudomyrmex gracilis (FABRICIUS 1804)		x	x	x^{n}	x^{BS}			x		7
Pseudomyrmex laevifrons WARD 1989					x^{BS}			x		1
Pseudomyrmex maculatus (F. SMITH 1855)		x	x					x		3
Pseudomyrmex oculatus (F. SMITH 1855)		x	x			x		x		5
Pseudomyrmex sericeus (MAYR 1870)			x					x		1
Pseudomyrmex simplex (F. SMITH 1877)		x	x	x	x^{BS}			x		5
Pseudomyrmex tenuis (FABRICIUS 1804)	$x^{Fl\ 4}$	x	x			x	x	x		7
Pseudomyrmex tenuissimus (EMERY 1906)		x	x		x^{BS}			x		5
Pseudomyrmex termitarius (F. SMITH 1855)				x				x		3
Pseudomyrmex triplarinus (WEDELL 1849)						x		x		1
Pseudomyrmex sp. 1 (*pallidus*-group)				x				x		3
Pseudomyrmex sp. 2 (*pallidus*-group)				x^{n}	x^{BS}			x		3
Pseudomyrmex sp. 3 (q)				x				x^{q}		1
Pseudomyrmex sp. 4 (*viduus*-group)						x^{n}		x		1
Myrmicinae (80)										
Attini (11)										
Acromyrmex subterraneus FOREL 1893							x	x		1
Apterostigma sp. (m)	$x^{Fl\ 3}$							$x^{lit/m}$		1
Atta cephalotes (LINNAEUS 1758)							x^{n}	x		1
Atta sexdens (LINNAEUS 1758)		x					x	x		3
Cyphomyrmex major FOREL 1901				x				x		2
Cyphomyrmex minutus MAYR 1862	$x^{Fl\ 2,3}$	x^{n}						x	x	7
Cyphomyrmex rimosus (SPINOLA 1853)		x	x					x		3
Mycetarotes parallelus (EMERY 1905)				x				x		1
Mycocepurus smithi FOREL 1893		x						x		3
Sericomyrmex sp.		x						x		1
Trachymyrmex sp.		x						x		2
Cephalotini (12)										
Cephalotes atratus (LINNAEUS 1758)		x	x		x^{BS}	x		x		6
Eucryptocerus placidus (F. SMITH 1860)						x		x		1
Procryptocerus sp. (q)				x				x^{q}		1
Zacryptocerus conspersus (F. SMITH 1867)			x					x		1
Zacryptocerus depressus (KLUG 1824)				x				x		3
Zacryptocerus grandinosus (F. SMITH 1860)			x^{n}		x^{BS}			x		3
Zacryptocerus maculatus (F. SMITH 1876)			x					x		1
Zacryptocerus minutus (FABRICIUS 1804)		x	x		x^{BS}	x		x	x	7
Zacryptocerus pallens (KLUG 1824)			x		x^{BS}			x	x	3
Zacryptocerus pusillus (KLUG 1824)			x		x^{P}			x		2
Zacryptocerus simillimus (KEMPF 1951)		x	x			x		x		3
Zacryptocerus umbraculatus (FABRICIUS 1804)					x^{BS}			x		1

	Fl-lit	Fl-gro	Fl-veg	Sav	Sav-tr	Tf-veg	Tf-gro	d	n	sa
Crematogastrini (10)										
Crematogaster sp. 1	x[Fl 4]		x		x[BS]			x		4
Crematogaster sp. 2		x	x		x[BS]			x	x	4
Crematogaster sp. 3				x				x		2
Crematogaster sp. 4		x	x		x[P]			x	x	4
Crematogaster sp. 5	x[Fl 4]	x	x					x	x	5
Crematogaster sp. 6		x					x	x		2
Crematogaster sp. 7			x						x	1
Crematogaster sp. 8	x[Fl 2,3]	x	x			x	x	x	x	11
Crematogaster sp. 9 (cf. *levior* Forel 1911)						x[n]		x		1
Crematogaster sp. 10				x				x		2
Dacetini (3)										
Daceton armigerum (Latreille 1802)		x	x			x		x	x	6
Strumigenys cordovensis Mayr 1887							x	x		1
Strumigenys eggersi Emery 1890	x[Fl 1]							x[lit]		1
Leptothoracini (4)										
Nesomyrmex asper (Mayr 1887)			x					x		1
Nesomyrmex echinatinodis (Forel 1886)			x					x		1
Nesomyrmex spininodis (Mayr 1887)		x		x				x		2
Nesomyrmex sp.				x				x		1
Myrmicini (1)										
Hylomyrma sp.							x	x		1
Pheidolini (25)										
Pheidole cephalica F. Smith 1858		x				x	x	x	x	3
Pheidole sp. 1		x	x					x	x	6
Pheidole sp. 2		x						x	x	3
Pheidole sp. 3		x						x		2
Pheidole sp. 4		x						x	x	2
Pheidole sp. 5		x						x	x	2
Pheidole sp. 6		x						x	x	2
Pheidole sp. 7			x					x		1
Pheidole sp. 8		x	x	x				x	x	5
Pheidole sp. 9	x[Fl 1]	x		x[n]			x	x	x	8
Pheidole sp. 10	x[Fl 3]	x	x					x	x	4
Pheidole sp. 11		x						x		1
Pheidole sp. 12		x	x			x		x		4
Pheidole sp. 13		x						x		1
Pheidole sp. 14							x	x		1
Pheidole sp. 15		x							x	1
Pheidole sp. 16	x[Fl 2]			x				x		2
Pheidole sp. 17	x[Fl 3]	x					x	x	x	5
Pheidole sp. 19		x						x		1
Pheidole sp. 20		x						x		1
Pheidole sp. 21							x	x		1
Pheidole sp. 22							x	x		1
Pheidole sp. 23				x				x		1
Pheidole sp. 24				x				x		3
Pheidole sp. 25	x[Fl 4]							x[lit]		1
Solenopsidini (13)										
Monomorium floricola (Jerdon 1852)	x[Fl 1]							x[lit]		1
Solenopsis bondari Santschi 1925	x[Fl 2,4]	x					x	x	x	7
Solenopsis saevissima (F. Smith 1855)				x[ki]					x	1

	Fl-lit	Fl-gro	Fl-veg	Sav	Sav-tr	Tf-veg	Tf-gro	d	n	sa
Solenopsis (*Diploropthrum*) sp. 1		x	x			x^{n}		x		3
Solenopsis (*Diploropthrum*) sp. 2				x^{n}				x		2
Solenopsis (*Diploropthrum*) sp. 3	$x^{Fl\ 3}$							x^{lit}		1
Solenopsis (*Diploropthrum*) sp. 4		x	x					x	x	2
Solenopsis (*Diploropthrum*) sp. 5				x				x		1
Solenopsis (*Diploropthrum*) sp. 6	$x^{Fl\ 1,3,4}$	x						x	x	5
Solenopsis (*Diploropthrum*) sp. 7		x						x		1
Solenopsis (*Diploropthrum*) sp. 8		x						x	x	2
Solenopsis (*Diploropthrum*) sp. 9						x		x		1
Solenopsis (*Diploropthrum*) sp. 10		x		x				x		2
Myrmicinae incertae sedis (1)										
Wasmannia auropunctata (ROGER 1863)	$x^{Fl\ 1,4}$	x^{n}		x		x	x	x	x	10
Dolichoderinae (17)										
Dolichoderini (8)										
Dolichoderus attelaboides (FABRICIUS 1775)						x		x		1
Dolichoderus bispinosus (OLIVIER 1792)						x		x		1
Dolichoderus debilis EMERY 1890		x	x					x		2
Dolichoderus ghilianii (EMERY 1894)						x			x	1
Dolichoderus imitator EMERY 1894			x						x	1
Dolichoderus lamellosus (MAYR 1870)			x			x		x	x	2
Dolichoderus lutosus (F. SMITH 1858)			x^{n}		x^{BS}			x	x	3
Dolichoderus quadridenticulatus (ROGER 1862)					x^{BS}	x		x		2
Tapinomini (9)										
Azteca sp. 1			x					x	x	2
Azteca sp. 2		x	x		x^{P}			x		4
Azteca sp. 3			x					x		1
Azteca sp. 4			x			x		x		2
Iridomyrmex sp. 1	$x^{Fl\ 1-4}$							x^{lit}		4
Iridomyrmex sp. 2		x							x	1
Iridomyrmex sp. 3							x	x		1
Tapinoma sp. 1			x						x	1
Tapinoma sp. 2		x	x						x	3
Formicinae (36)										
Camponotini (29)										
Camponotus (*Myrmaphaenus*) *novogranadensis* MAYR 1870		x	x		x^{BS}	x		x	x	6
Camponotus (*Myrmaphaenus*) sp. 1						x		x		1
Camponotus (*Myrmaphaenus*) sp. 2		x	x		x^{P}			x		5
Camponotus (*Myrmaphaenus*) sp. 3				x				x		2
Camponotus (*Myrmaphaenus*) sp. 5		x				x		x	x	3
Camponotus (*Myrmaphaenus*) sp. 6				x				x		2
Camponotus (*Myrmobrachys*) *burtoni* MANN 1916		x	x			x		x		4
Camponotus (*Myrmobrachys*) cf. *crassus* MAYR 1862		x	x	x		x		x		8
Camponotus (*Myrmobrachys*) sp. 8		x	x^{n}		x^{BS}			x		6
Camponotus (*Myrmobrachys*) sp. 9			x					x		2
Camponotus (*Myrmobrachys*) sp. 11						x		x		1
Camponotus (*Myrmobrachys*) sp. 12		x				x		x		2
Camponotus (*Myrmobrachys*) sp. 13						x		x		2
Camponotus (*Myrmocladoecus*) cf. *sanctaefidei* DALLA TORRE 1892		x	x					x		2
Camponotus (*Myrmocladoecus*) *latangulus* ROGER 1863						x		x		1
Camponotus (*Myrmocladoecus*) sp. 16		x	x			x		x		5
Camponotus (*Myrmothrix*) *abdominalis* (FABRICIUS 1804)							x^{n}	x		1

	Fl-lit	Fl-gro	Fl-veg	Sav	Sav-tr	Tf-veg	Tf-gro	d	n	sa
Camponotus (*Myrmothrix*) *femoratus* (FABRICIUS 1804)						x^{n}		x		2
Camponotus (*Myrmothrix*) *renggeri* EMERY 1894	$x^{Fl\,1}$	x	x	x	x^{BS}			x	x	5
Camponotus (*Tanaemyrmex*) *abuanus* MANN 1916			x						x	1
Camponotus (*Tanaemyrmex*) *hagemanni* FOREL cit. apud SANTSCHI 1922					x^{BS}			x		1
Camponotus (*Tanaemyrmex*) sp. 22			x						x	1
Camponotus sp. 23						x			x	1
Camponotus sp. 24		x	x						x	2
Camponotus sp. 25				x					x	1
Camponotus sp. 26						x			x	2
Camponotus sp. 27		x							x	1
Camponotus sp. 28						x			x	1
Dendromyrmex chartifex (F. SMITH 1860)						x		x		1
Myrmelachistini (2)										
Brachymyrmex sp. 1	$x^{Fl\,2}$	x	x					x	x	8
Brachymyrmex sp. 2				x				x		1
Prenolepidini (5)										
Paratrechina longicornis (LATREILLE 1802)	$x^{Fl\,1}$				x^{BS}			x		3
Paratrechina sp. 1						x	x	x		2
Paratrechina sp. 2	$x^{Fl\,3}$	x^{n}						x	x	7
Paratrechina sp. 3	$x^{Fl\,4}$	x						x		3
Paratrechina sp. 4	$x^{Fl\,4}$	x	x	x				x	x	6
Σ samples										495

Table 8. Occurrence of ant species in different habitats during standardized sampling (see tab. 1). 1 - 4 Forest island I (Fl 1); 5 - 8 Forest island II (Fl 2), 9 -10 Forest island III (Fl 3), 11 - 12 Inundation savanna, without trees (Sav), 13 - 15 Savanna trees (Sav-tr), 16 - 17 Terra firme forest (Tf): 1, 5, 9, 16 - vegetation, day (1 h.); 2, 6 - vegetation, night (1 h.); 3, 7, 10, 17 - ground, day (2 h.); 4, 8 - ground, night (2 h.); 11, 12 - savanna, day (2 h.); 13, 14 - *Ficus* tree at the station, day (1 h.); 15 - *Pseudobombax* trees in savanna, day (1 h.).

	Fl 1				Fl 2				Fl 3		Sav		Sav-tr			Tf	
Habitat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Number of samples	30	20	47	28	16	9	42	20	23	29	23	23	15	7	4	13	18
Species number	27	20	46	27	16	9	42	20	22	27	21	23	15	7	4	13	18
Ponerinae																	
Prionopelta sp.										x							
Ectatomma edentatum								x		x		x					
Ectatomma quadridens			x				x										
Gnamptogenys cf. *tornata*							x					x					
Gnamptogenys cf. *rustica*										x							
Gnamptogenys cf. *sulcata*									x								
Gnamptogenys teffensis							x	x									
Platythyrea angusta																x	
Anochetus mayri												x					
Hypoponera distinguenda										x							
Hypoponera opaciceps																	x
Hypoponera parva										x							
Hypoponera cf. *trigona*			x							x							
Hypoponera sp. (near *opaciceps*)											x	x					
Hypoponera sp. 1				x													
Odontomachus brunneus							x	x			x						
Odontomachus haematodus		x	x	x		x				x						x	x

	Fl 1				Fl 2				Fl 3		Sav		Sav-tr			Tf	
Habitat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Odontomachus minutus			x	x			x	x		x							
Pachycondyla apicalis			x				x		x	x							
Pachycondyla constricta				x			x	x				x					
Pachycondyla crenata				x													
Pachycondyla harpax			x	x						x							
Pachycondyla stigma			x				x										
Pachycondyla villosa			x		x	x	x	x	x	x							x
Pseudomyrmicinae																	
Pseudomyrmex curacaensis	x		x														
Pseudomyrmex eduardi					x		x		x				x				
Pseudomyrmex elongatus	x		x				x										
Pseudomyrmex ethicus									x								x
Pseudomyrmex filiformis	x																
Pseudomyrmex gracilis	x						x				x	x	x				
Pseudomyrmex laevifrons													x				
Pseudomyrmex maculatus	x		x				x										
Pseudomyrmex oculatus	x				x		x									x	
Pseudomyrmex sericeus	x																
Pseudomyrmex simplex					x		x		x			x	x				
Pseudomyrmex tenuis			x				x		x	x							x
Pseudomyrmex tenuissimus	x		x		x		x						x				
Pseudomyrmex termitarius											x	x					
Pseudomyrmex sp. 1 (*pallidus*-group)											x	x					
Pseudomyrmex sp. 2 (*pallidus*-group)											x	x	x				
Pseudomyrmex sp. 3 (q)											x						
Myrmicinae																	
Atta sexdens							x			x							
Cyphomyrmex major											x	x					
Cyphomyrmex minutus			x	x			x			x							
Cyphomyrmex rimosus					x		x		x								
Mycetarotes parallelus											x						
Mycocepurus smithi			x				x			x							
Sericomyrmex sp.			x														
Trachymyrmex sp.			x				x										
Cephalotes atratus	x				x		x						x				
Procryptocerus sp. (q)											x						
Zacryptocerus conspersus					x												
Zacryptocerus depressus											x						
Zacryptocerus grandinosus	x												x				
Zacryptocerus maculatus					x												
Zacryptocerus minutus	x	x	x						x				x				
Zacryptocerus pallens	x	x												x			
Zacryptocerus pusillus	x														x		
Zacryptocerus simillimus					x		x									x	
Zacryptocerus umbraculatus													x				
Crematogaster sp. 1	x												x	x			
Crematogaster sp. 2	x	x	x											x			
Crematogaster sp. 3												x					
Crematogaster sp. 4	x	x	x												x		
Crematogaster sp. 5	x	x	x	x													
Crematogaster sp. 6			x														x
Crematogaster sp. 7		x															

	Fl 1				Fl 2				Fl 3		Sav		Sav-tr			Tf	
Habitat	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Crematogaster sp. 8					x	x	x	x	x	x						x	x
Crematogaster sp. 10											x	x					
Daceton armigerum	x	x	x													x	
Strumigenys cordovensis																	x
Nesomyrmex asper									x								
Nesomyrmex echinatinodis									x								
Nesomyrmex spininodis			x								x						
Nesomyrmex sp.												x					
Hylomyrma sp.																	x
Pheidole cephalica										x							x
Pheidole sp. 1			x	x	x		x	x		x							
Pheidole sp. 2			x	x			x										
Pheidole sp. 3			x							x							
Pheidole sp. 4			x	x													
Pheidole sp. 5			x	x													
Pheidole sp. 6			x	x													
Pheidole sp. 8		x		x				x			x	x					
Pheidole sp. 9				x			x	x			x						x
Pheidole sp. 10		x						x		x							
Pheidole sp. 11							x										
Pheidole sp. 12					x		x		x							x	
Pheidole sp. 13							x										
Pheidole sp. 14																	x
Pheidole sp. 15								x									
Pheidole sp. 16												x					
Pheidole sp. 17								x		x							x
Pheidole sp. 19										x							
Pheidole sp. 20									x								
Pheidole sp. 21																	x
Pheidole sp. 23											x						
Pheidole sp. 24											x	x					
Solenopsis bondari			x	x			x	x									x
Solenopsis (*Diploropthrum*) sp. 1	x		x													x	
Solenopsis (*Diploropthrum*) sp. 2											x						
Solenopsis (*Diploropthrum*) sp. 4		x	x														
Solenopsis (*Diploropthrum*) sp. 5												x					
Solenopsis (*Diploropthrum*) sp. 6				x						x							
Solenopsis (*Diploropthrum*) sp. 7										x							
Solenopsis (*Diploropthrum*) sp. 8				x			x										
Solenopsis (*Diploropthrum*) sp. 9																x	
Solenopsis (*Diploropthrum*) sp. 10			x								x						
Wasmannia auropunctata			x	x			x	x				x					x
Dolichoderinae																	
Dolichoderus debilis									x	x							
Dolichoderus imitator		x															
Dolichoderus lamellosus		x															
Dolichoderus lutosus	x	x												x			
Dolichoderus quadridenticulatus													x				
Azteca sp. 1	x	x															
Azteca sp. 2	x		x												x		
Azteca sp. 3	x																
Azteca sp. 4	x																
Iridomyrmex sp. 2				x													

Habitat	Fl 1				Fl 2				Fl 3		Sav		Sav-tr			Tf	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Iridomyrmex sp. 3																	x
Tapinoma sp. 1		x															
Tapinoma sp. 2		x		x		x											
Formicinae																	
Camponotus (*Myrmaphaenus*) *novogranadensis*			x			x			x	x			x				
Camponotus (*Myrmaphaenus*) sp. 2	x		x		x		x								x		
Camponotus (*Myrmaphaenus*) sp. 3												x					
Camponotus (*Myrmaphaenus*) sp. 5							x	x									
Camponotus (*Myrmaphaenus*) sp. 6												x					
Camponotus (*Myrmobrachys*) *burtoni*			x						x							x	
Camponotus (*Myrmobrachys*) cf. *crassus*			x				x		x		x	x					
Camponotus (*Myrmobrachys*) sp. 8	x		x		x		x						x				
Camponotus (*Myrmobrachys*) sp. 9	x								x								
Camponotus (*Myrmobrachys*) sp. 12			x														
Camponotus (*Myrmobrachys*) sp. 13																x	
Camponotus (*Myrmocladoecus*) cf. *sanctaefidei*			x						x								
Camponotus (*Myrmocladoecus*) sp. 16					x		x		x							x	
Camponotus (*Myrmothrix*) *renggeri*		x		x										x			
Camponotus (*Tanaemyrmex*) *abuanus*		x															
Camponotus (*Tanaemyrmex*) *hagemanni*														x			
Camponotus (*Tanaemyrmex*) sp. 22						x											
Camponotus sp. 24						x		x									
Camponotus sp. 27				x													
Brachymyrmex sp. 1		x	x	x		x	x	x	x								
Brachymyrmex sp. 2											x						
Paratrechina longicornis													x	x			
Paratrechina sp. 1																x	x
Paratrechina sp. 2			x	x			x	x		x							
Paratrechina sp. 3			x	x													
Paratrechina sp. 4				x		x	x	x				x					

Biological and taxonomical remarks on some species

Hypoponera parva
An alated queen on July 27 on the ground of a forest island.

Odontomachus haematodus
A soil nest under rotten wood in a forest island.

Pachycondyla crassinoda
A nest in rotten wood on the ground in terra firme forest.

Eciton vagans
Workers of this species carried workers and pupae of *Odontomachus brunneus* as prey during a raid in the litter of terra firme forest.

Pseudomyrmex curacaensis
A nest in a rotten twig hanging in a height of 1.8 m in the vegetation.

Pseudomyrmex dendroicus
We found a colony on an undetermined tree of 8 m height in the terra firme forest. So far known this species is an obligate inhabitant of trees of the genus *Triplaris* (WARD 1989).

Pseudomyrmex gracilis
A nest in the dry stalk of a savanna plant.

Pseudomyrmex sp. 2 (*pallidus*-group)
A nest in a blade of grass in savanna. The three yellow species of the *pallidus*-group we found during this

study (*Pseudomyrmex* sp. 1, sp. 2, and *P. simplex*) are very similar in their morphology. In the savanna all three species were collected several times nearby each other, but only *P. simplex* could also be detected in forest islands.

Pseudomyrmex sp. 4 (*viduus*-group)
We found a colony of this species on an undetermined tree of 6 m height in terra firme forest. Species of the *viduus*-group are mainly associated with trees of the genera *Tachigali* and *Triplaris* (WARD 1989).

Atta cephalotes
A big nest of this species was found in terra firme forest with workers carrying leaves during the day. Leaf cutting ants have been considered enlarging forest islands in the Beni savannas by modifying the soil relief with their nesting activities (HANAGARTH 1993).

Crematogaster sp. 8
A number of workers was encountered together with a dealated queen on lianas in the largest of the forest islands. In Panguana, Peru, colonies of several *Crematogaster* species could be observed in budding processes, during which part of the workers leave the nest together with young dealated queens to a new nesting site (VERHAAGH unpubl.).

Crematogaster sp. 9
This species was found in a carton nest in the terra firme forest together with *Camponotus femoratus* and belongs to the *C. limata parabiotica*-complex. Already SWAIN (1980) had the suspicion that the *Crematogaster* species living in „parabiosis" with *Camponotus femoratus,* respectively *Dolichoderus* (=*Monacis*) *debilis* may represent two different species. B. BOLTON discovered morphological differences between both (cit. apud SWAIN 1980). Also during the study of the ant fauna of Panguana, Peru (VERHAAGH unpubl.), two morphospecies of *Crematogaster* were encountered in these interspecific associations, and the morphological differences between them are the same found by BOLTON. The one living with *D. debilis* (and sometimes also found together with *D. bispinosus*) is on the average larger and darker than the species found with *C. femoratus* and characterized by several prominent longitudinal rugulae on the lateral parts of the promesonotum. In the species occurring together with *C. femoratus* the promesonotum is almost completely smooth and shining. With regards to published names the larger and darker of the two morphospecies agrees with the description of *Crematogaster limata parabiotica* FOREL 1904 (also originally described as living in parabiosis with *D. debilis*), and the smaller and lighter species with *Crematogaster limata parabiotica* var. *levior* FOREL 1911. Of course, only a thorough revision of the whole *limata*-complex will clear the status of the two morphs.

Cyphomyrmex major
The taxonomy of the *Cyphomyrmex rimosus*-group, having been for a long time in a confusing state, was elucidated recently by SNELLING & LONGINO (1992). Following their revision, *C. major* is only known so far from the type series from Guatemala. The authors believe that specimens from the state São Paulo, Brazil, published later by FOREL under this name are probably not conspecific. The morphology of the specimens from EBB agrees well with the characters given by SNELLING & LONGINO (1992) for this species.

Cyphomyrmex minutus
After SNELLING & LONGINO (1992), *C. minutus* is widespread throughout the Carribean and ranges from Texas and Florida to northern South America (Venezuela, Colombia). Thus, the record from the Beni savannas enlarges the geographical range of the species considerably. The species has been found in Panguana, central Peru, too (VERHAAGH unpubl.). In EBB we found a nest on the ground under rotten wood in a forest island.

Zacryptocerus grandinosus
A nest in a rotten twig in a height of 1.50 m in a forest island.

Pheidole sp. 9
A soil nest in the savanna.

Solenopsis (*Diploropthrum*) sp. 1
A nest in a rotten twig hanging in a height of approx. 1.80 m in the vegetation.

Solenopsis (*Diploropthrum*) sp. 2
A nest in the savanna grass.

Wasmannia auropunctata
A nest in the soil of a forest island.

Camponotus (*Myrmobrachys*) sp. 8
A nest in a rotten twig hanging in a height of approx 1.80 m in the vegetation of a forest island.

Camponotus (*Myrmothrix*) *abdominalis*
A nest in rotten wood on the ground of terra firme forest.

Dolichoderus quadridenticulatus
One worker was collected with a 7-8 mm large fly between the mandibles.