Rev. Biol. Trop., 45(4): 1641-1648, 1997

Ants (Hymenoptera:Formicidae) from Atlantic rainforest at Santa Catarina Island, Brazil: two years of sampling

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Received 14-III-1997. Corrected 6-VI-1997. Accepted 10-VI-1997.

Resumen: Se muestreó las hormigas diurnas y nocturnas durante el período 1992/1994, en una región de selva atlantica ("mata atlântica"), en cerro de "Lagoa da Conceição", Florianópolis, Santa Catarina, Brasil, con cebos de sardina distribuidos sobre el suelo y en la vegetación arbustiva y arbórea para las especies diurnas, y embudo de Berlese-Tullgren para las nocturnas. Se identificó 74 especies diurnas (d) y 49 nocturnas (n) en las subfamilias: Dolichoderinae (7d, 3n), Ecitoninae (1d), Formicinae (15d, 4n), Myrmicinae (35d, 25n), Ponerinae (14d, 17n) y Pseudomyrmecinae (2d). La Subfamilia Myrmicinae fue la más importante en relación a la diversidad de especies y su abundancia (diurna y nocturna). El muestreo con embudo mostró un aumento en las especies crípticas, particularmente en *Heteroponera* Mayr (Ponerinae) y *Strumigenys* Fr. Smith (Myrmicinae).

Key words: Soil ants, vegetation ants, Atlantic rainforest, Santa Catarina Island, Brazil.

In Brazil there are many studies about Amazonian ant faunas and a few studies about faunas of particular states, especially São Paulo (Luederwaldt 1918, Kempf 1978). For Santa Catarina Island (State of Santa Catarina), there are some studies involving ants from soil and vegetation in an area of Atlantic rainforest (Lopes and Leal 1991, Leal and Lopes 1992), ants of coastal sand dunes (Bonnet and Lopes 1993) and ants of mangroves (Santos and Lopes 1995).

Taxonomic and ecological differences between the fauna of ants from soil and vegetation were discussed by Wilson (1959) and Longino and Nadkarni (1990). According to the latter authors, there is a very conspicuous discontinuity in forests between these two habitats, the species from soil typically being distinct from the arboricolous species. Oliveira and Brandão (1991) demonstrated that there is a variation in the composition of the main visiting species in the day-night period in Brazilian savannas ("cerrado").

Here we examine, as basic objectives, the ant fauna in an Atlantic rainforest area located at Santa Catarina Island, providing a more complete faunal list of this region, and evaluating the mirmecological fauna in the diurnal and nocturnal periods.

The study was done at Lagoa da Conceição Hill (27°35'38" S and 48°29'00" W), Santa Catarina Island, Brazil, in an area of Atlantic rainforest secondary vegetation (Lopes and Leal 1991). Three trails of 200m each were chosen inside the rainforest. The vegetation had trees of 10 to 15m high, an herbaceous stratum and the soil is rich in litterfall.

In the first year of sampling (diurnal samples, autumn of 1992/summer of 1993), 20 baits (with sardine, Romero and Jaffé 1989) were distributed on the soil and 20 among the vegetation (between 1-2m high) at 10m intervals, along each trail. The samples were repeated in each season, always between 1:00 and 5:00 PM, totaling 12 samples from 25/III/92 until 20/III/93.

For each sample, baits were exposed for about 60 minutes. Following, the attracted ants

were transfered to test tubes with 70% alcohol.

During the second year (autumn of 1993/summer of 1994) nocturnal samplings were taken between 5:00 and 11:00 PM. Due to methodological difficulties during field work at night, we have only chosen trail I (wider than trails II and III) and were distributed onto soil 15 baits at 10m intervals. The samplings were repeated twice in each season, totaling 8 samplings.

In order to complete the nocturnal samplings and for species record in which were not attracted by the baits, litterfall was withdrawn from the trails edge, in order to be submitted to the Berlese-Tullgren funnel (Knudsen 1966, Hölldobler and Wilson 1990). Additionally, some spare manual samplings were also applied to soil and among vegetation during the first and second years of samplings.

The voucher specimens were deposited in the reference collection of the Laboratório de Zoologia de Invertebrados, Departamento de Ecologia e Zoologia, CCB/UFSC.

For the identification of the collected ants, taxonomic keys in Hölldobler and Wilson (1990) and Bolton (1994) were used.

We calculated the frequency of occurrence of each species on baits. Simpson's diversity index and the Morisita's similarity index were used for analysing and comparing the mirmecofauna (soil *vs.* vegetation; day *vs.* night), the values were adapted to the annual average frequencies of each ant species (Brower and Zar 1984, Krebs 1989).

PERIOD 1992/1993: The three trails produced 26 genera and 74 species (Table 1). Many ants were identified to morphospecies (52 in 74), because there were no identification keys to some genera, *e.g. Pheidole* Westwood. Similar problematic genera were: *Camponotus* Mayr, *Crematogaster* Lund, *Linepithema* Mayr and *Solenopsis* Westwood (Hölldobler and Wilson 1990).

The main subfamily in number of genera and species was Myrmicinae (10 genera and 35 species), followed by Ponerinae (7 and 14), Formicinae (4 and 15), Dolichoderinae (3 and 7), Pseudomyrmecinae (1 and 2) and Ecitoninae (1 species) (Table 1). This was similar to the result of Lopes and Leal (1991) at Santa Catarina Island and of Kempf (1978) in the State of São Paulo, Brazil.

TABLE 1

Species of diurnal ants from soil (S) and vegetation (V) on the three trails sampled, Lagoa da Conceição Hill, Florianópolis, SC (1992/1993).

DOLICHODERINAE		
Azteca sp. **		
Linepithema sp.1 **(L1)**	S	V
Linepithema sp.2 **(L2)**	S	V
Linepithema sp.3 **(L3)**	S	V
Tapinoma melanocephalum (Fabricius) **(T.m.)**	S	V
Tapinoma sp.1 **(T1)**	S	-
Tapinoma sp.2 **(T2)**	S	-
ECITONINAE		
Eciton burchelli (Westwood) *		
FORMICINAE		
Brachymyrmex sp.1 **(B1)**	S	V
Brachymyrmex sp.2 **(B2)**	S	V
Brachymyrmex sp.3 **(B3)**	-	V
Camponotus sp.1 **(Ca1)**	-	V
Camponotus sp.2 **(Ca2)**	S	-
Camponotus sp.3 **(Ca3)**	-	V
Camponotus sp.4 **(Ca4)**	-	V
Camponotus sp.5 **(Ca5)**	-	V
Camponotus sp.6 **(Ca6)**	-	V
Camponotus sp.7 **(Ca7)**	S	-
Myrmelachista sp.1 **(M1)**	S	V
Myrmelachista sp.2 **(M2)**	-	V
Myrmelachista sp.3 **(M3)**	S	-
Myrmelachista sp.4 **(M4)**	-	V
Paratrechina sp. **(Pa)**	S	V
MYRMICINAE		
Acromyrmex coronatus (Fabricius) *		
Acromyrmex disciger Mayr *		
Acromyrmex niger (Fr. Smith) *		
Acromyrmex sp. *		
Crematogaster sp.1 **(Cr1)**	S	V
Crematogaster sp.2 **(Cr2)**	S	V
Crematogaster sp.3 **(Cr3)**	S	V
Crematogaster sp.4 **(Cr4)**	S	V
Crematogaster sp.5 **(Cr5)**	S	V
Crematogaster sp.6 **(Cr6)**	S	-
Crematogaster sp.7 **(Cr7)**	-	V
Cyphomyrmex sp. *		
Hylomyrma reitteri (Mayr) **(H.r.)**	S	-
Pheidole sp.1 **(P1)**	S	V
Pheidole sp.2 **(P2)**	S	V
Pheidole sp.3 **(P3)**	S	V
Pheidole sp.4 **(P4)**	S	V
Pheidole sp.5 **(P5)**	S	V
Pheidole sp.6 **(P6)**	S	V
Pheidole sp.7 **(P7)**	S	V
Pheidole sp.8 **(P8)**	S	V
Pheidole sp.9 **(P9)**	S	V
Pheidole sp.10 **(P10)**	S	V
Pheidole sp.11 **(P11)**	S	V
Pheidole sp.12 **(P12)**	S	V
Procryptocerus convergens (Mayr) **		
Solenopsis sp.1 **(S1)**	S	V
Solenopsis sp.2 **(S2)**	S	V
Solenopsis sp.3 **(S3)**	S	V
Solenopsis sp.4 **(S4)**	S	V
Solenopsis sp.5 **(S5)**	-	V
Solenopsis sp.6 **(S6)**	S	V

Strumigenys denticulata Mayr **(S.d.)**	S	-
Trachymyrmex oetkeri Forel *		
Wasmannia sp. **(W)**	S	V
PONERINAE		
Ectatomma edentatum Roger **(E.e.)**	S	-
Gnamptogenys rastrata (Mayr) **(G.r.)**	S	-
Heteroponera flava Kempf **(H.f.)**	S	V
Hypoponera sp.1 **(Hy1)**	S	-
Hypoponera sp.2 **(Hy2)**	S	-
Hypoponera sp.3 **(Hy3)**	S	-
Odontomachus affinis Guérin **(O.a.)**	S	V
Odontomachus chelifer (Latreille) **(O.c.)**	S	-
Odontomachus minutus Emery **(O.m.)**	S	-
Pachycondyla crenata (Roger) **(P.c.)**	-	V
Pachycondyla harpax (Fabricius) **(P.h.)**	S	-
Pachycondyla striata Fr. Smith **(P.s.)**	S	-
Pachycondyla villosa (Fabricius) **(P.v.)**	-	V
Proceratium sp. **(Pr)**	S	-
PSEUDOMYRME CINAE		
Pseudomyrmex gracilis (Fabricius) * **		
Pseudomyrmex picinus Ward **		

* = Spare manual sampling in soil, ** = Spare manual sampling in vegetation.
The terms in parenthesis refer to the codes used for the species in Fig. 1 and Fig. 2.

The values of Simpson's diversity index were high, and similar when comparing soil and vegetation (Fig. 1). Among the soil ants, only five species had annual average frequencies above 20% (Fig. 1). *Pheidole,* one of our most important genera was also cited in other ecosystems (Jeanne 1979, Brown 1981, Cover *et al.* 1990). In vegetation, we recorded a slightly smaller number of species with annual average frequencies below 12%. A smaller number of ants in vegetation was expected, in comparison with soil, because of the adaptations required by arboreal life (Hölldobler and Wilson 1978).

Morisita's similarity index had a medium value of 0.57 (soil and vegetation). Despite 33 species in common among the two communities, the most frequent soil ant species were not recorded in the vegetation or were found in low frequencies. Such fact contributed for a structure difference between these communities. As an example, the ponerine *Pachycondyla striata* Fr. Smith, a common predatory soil ant (Leal and Lopes, 1992), was not found in vegetation samples. In the other hand, *Azteca* sp. and *Tapinoma melanocephalum* (Fabricius) (Dolichoderinae); *Myrmelachista* spp. (Formicinae), *Procryptocerus convergens* (Mayr) (Myrmicinae), *Pseudomyrmex gracilis* (Fabricius) and *P. picinus* Ward (Pseudomyrmecinae) were primarily registered in the vegetation.

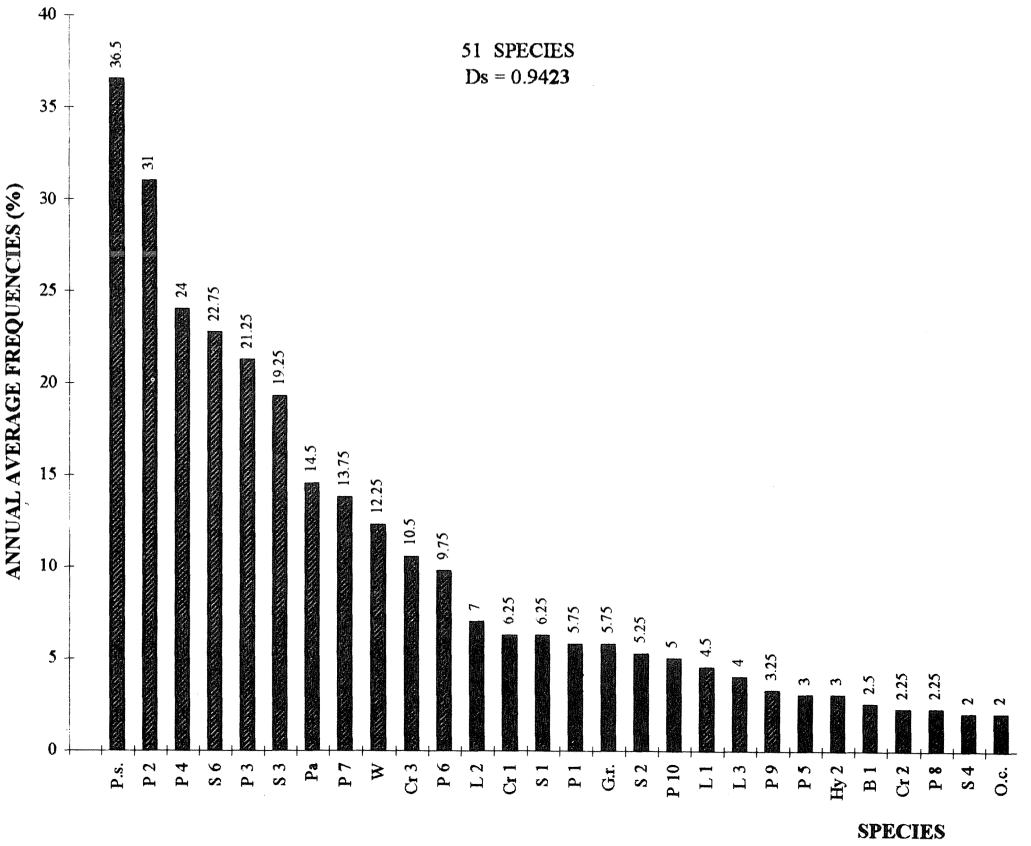
PERIOD 1993/1994: Nocturnal samplings produced 17 genera and 49 species (Table 2), also dominated by Myrmicinae (8 genera and 25 species), which was followed by Ponerinae

TABLE 2

Species of nocturnal ants from soil on trail I, Lagoa da Conceição Hill, Florianópolis, SC (1993/1994).

DOLICHODERINAE
Linepithema sp.1 Δ
Linepithema sp.2 Δ
Linepithema sp.3 Δ
FORMICINAE
Camponotus sp.2 Δ
Camponotus sp.8 **(Ca8)**
Camponotus sp.9 **(Ca9)**
Paratrechina sp. Δ
MYRMICINAE
Acromyrmex subterraneus Forel *
Hylomyrma reitteri (Mayr) Δ
Octostruma stenognatha Brown & Kempf #
Pheidole sp.1 Δ
Pheidole sp.2 Δ
Pheidole sp.3 Δ
Pheidole sp.4 Δ
Pheidole sp.7 Δ
Pheidole sp.9 Δ
Pheidole sp.10 Δ
Procryptocerus convergens (Mayr) ** Δ
Solenopsis sp.2 Δ
Solenopsis sp.3 Δ
Solenopsis sp.6 Δ
Strumigenys denticulata Mayr # Δ
Strumigenys eggersi Emery #
Strumigenys elongata Roger #
Strumigenys louisianae Roger #
Strumigenys schmalzi Emery #
Strumigenys sp.1 until sp.5 #
Wasmannia sp. Δ
PONERINAE
Acanthoponera mucronata **
Gnamptogenys rastrata (Mayr) Δ
Gnamptogenys sp. #
Heteroponera sp.1 **(He1)**
Heteroponera sp.2 until sp.4 #
Hypoponera sp.1 until sp.3 # Δ
Hypoponera sp.4 **(Hy4)**
Hypoponera sp.5 #
Odontomachus affinis Guérin Δ
Odontomachus chelifer (Latreille) Δ
Odontomachus minutus Emery # Δ
Pachycondyla crenata Roger ** Δ
Pachycondyla striata Fr. Smith Δ

* = spare manual sampling on soil, ** = spare manual sampling on vegetation, # = sampling with Berlese-Tullgren funnel, Δ = registered species also in the diurnal period (see Table 1).
The terms in parenthesis refer to the codes used for the Fig. 2



Horizontal axis (continued):

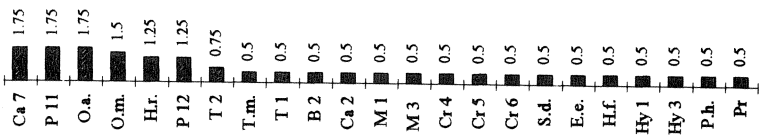
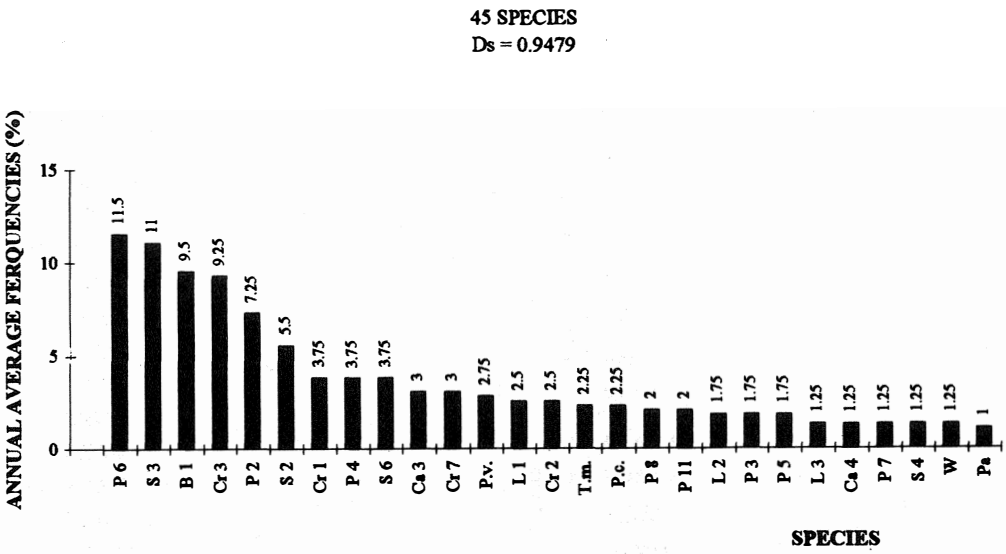


Fig. 1A. Annual average frequencies of diurnal ants from soil on the three trails sampled at Lagoa da Conceição Hill, Florianópolis, SC (1992/1993). For codes see Table 1.



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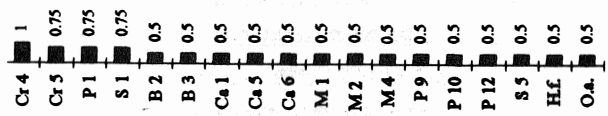

Fig. 1B. Annual average frequencies of diurnal ants from vegetation on the three trails sampled at Lagoa da Conceição Hill, Florianópolis, SC (1992/1993). For the codes used see Table 1.

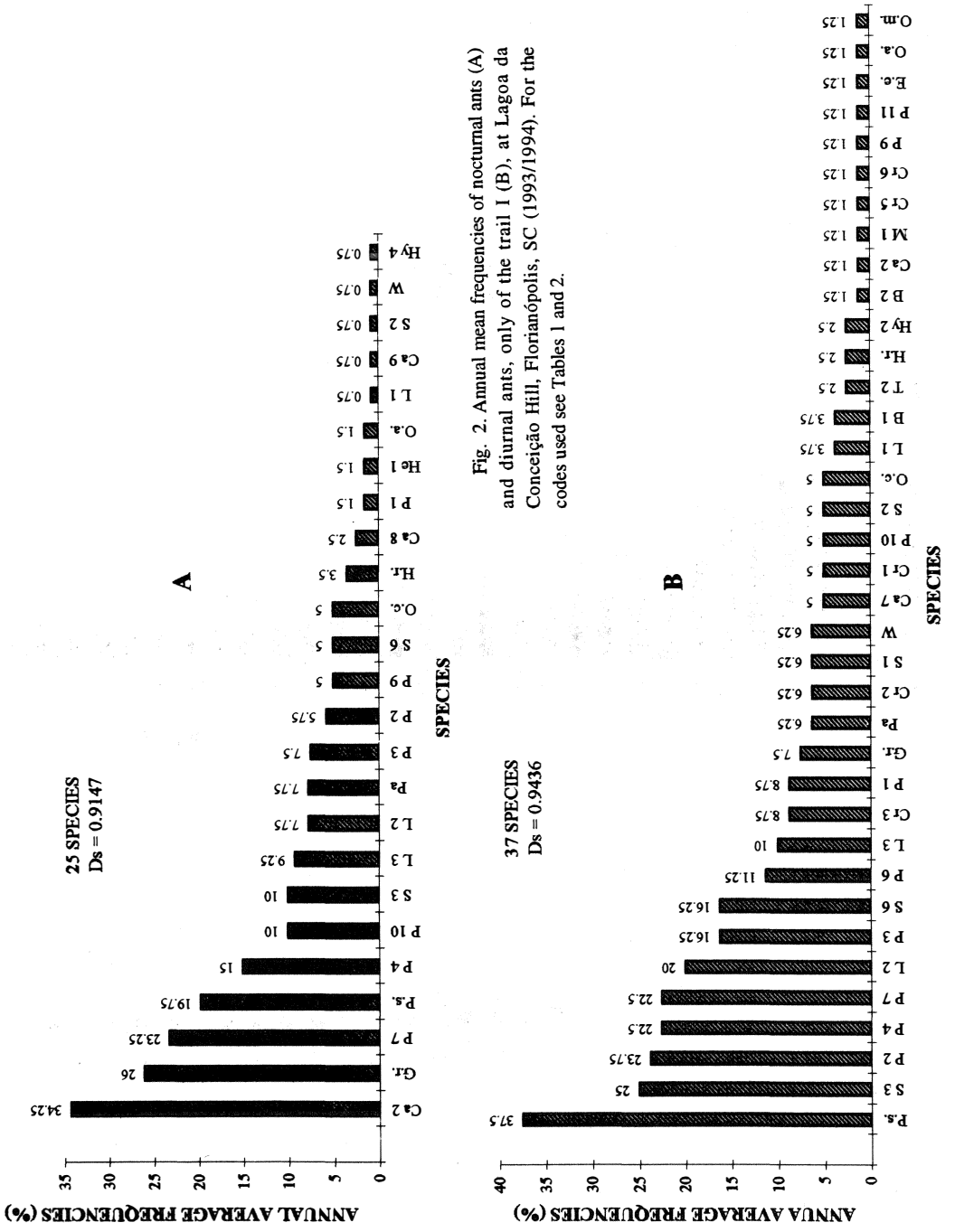

Fig. 2. Annual mean frequencies of nocturnal ants (A) and diurnal ants, only of the trail I (B), at Lagoa da Conceição Hill, Florianópolis, SC (1993/1994). For the codes used see Tables 1 and 2.

(6 and 17), Formicinae (2 and 4) and Dolichoderinae (1 and 3).

Simpson's values were high (Fig. 2). On trail I, the main diurnal ants were *Pachycondyla striata* (Ponerinae, 37.50% annual average frequency) and *Solenopsis* sp.3 (Myrmicinae, 25.00%), while, at night, the most representative were *Camponotus* sp.2 (Formicinae, 34.25%) and *Gnamptogenys rastrata* Mayr (Ponerinae, 26.00%). The genus *Camponotus* is predominantly nocturnal (Hölldobler and Wilson 1990, Oliveira and Brandão 1991) and *G. rastrata* was mostly recorded at night.

Morisita's similarity index was 0.63 (day and night, trail I). This may be due to the smaller species richness at night (only 25 species for the calculus of the index) and to the fact that the dominant ant species were different during day comparing to night (Table 1 and Table 2).

The Berlese-Tullgren funnel put into evidence new genera and species that due to their cryptic life, normally were not attracted to the sardine baits. This is the case of *Octostruma* Forel and *Strumigenys* (Myrmicinae) and of *Gnamptogenys* sp., *Heteroponera* sp.2 to 4 and *Hypoponera* sp.5 (Ponerinae) all obtained only with the Berlese-Tullgren funnel.

It is interesting to notice that there was an increase in the number of Ponerinae species at night.

ACKNOWLEDGMENTS

We thank DAP/UFSC for the grants, Carlos Roberto Ferreira Brandão for the ant identification, Tania Tarabini Castellani for the statistical analysis and Blanca Sierra do Ledo for the Resumen.

REFERENCES

Bolton, B. 1994. Identification Guide to the Ant Genera of the World. Harvard University, Cambridge, Massachusetts. 222 p.

Bonnet, A. & B.C. Lopes. 1993. Formigas de dunas e restingas da Praia da Joaquina, Ilha de Santa Catarina, SC (Insecta:Hymenoptera). Biotemas 6:107-114.

Brower, J.E. & J.H. Zar. 1984. Field & Laboratory Methods for General Ecology. Wm. C. Brown, Dubuque, Iowa, 226 p.

Brown, Jr. W.L. 1981. Preliminary cont ibutions toward a revision of the ant genus *Pheidole* (Hymenoptera:Formicidae). Part I. Kansas Ent. Soc. 54:523-530.

Cover, S.P., J.E. Tobin, & E.O. Wilson. 1990. The ant community of a tropical lowland rainforest site in Peruvian Amazonia, p. 699-700. *In*: G.K. Veeresh, B. Mallik. & C.A. Viraktamath. (eds.). Social Insects and the Environment, Proceedings of the 11th International Congress of IUSSI, 1990. Oxford & IBH Publishing Co. New Delhi.

Hölldobler, B. & E.O. Wilson, 1978. The multiple recruitment systems of the African weaver ant *Oecophylla longinoda* (Latreille) (Hymenoptera:Formicidae). Behavioral Ecology and Sociobiology 3:19-60.

H^lldobler, B. & E.O. Wilson, 1990. The Ants. Harvard University, Cambridge, Massachusetts, 732 p.

Jeanne, R.L. 1979. A latitudinal gradient in rates of ant predation. Ecology 60:1211-1224.

Kempf, W.W. 1978. A preliminary zoogeographical analysis of a regional ant fauna in Latin America. Studia Entomologica 20:43-62.

Knudsen, J.W. 1966. Biological Techniques. Harper & Row, New York, 525 p.

Krebs, C.J. 1989. Ecological Methodology. Harper & Row, New York, 654 p.

Leal, I.R. & B.C. Lopes. 1992. Estrutura das comunidades de formigas (Hymenoptera:Formicidae) de solo e vegetação no Morro da Lagoa da Conceição, Ilha de Santa Catarina, SC. Biotemas 5:107-122.

Longino, J.T. & N.M. Nadkarni. 1990. A comparison of ground and canopy leaf litter ants (Hymenoptera:Formicidae). Psyche 97:81-93.

Lopes, B.C. & I.R. Leal. 1991. Levantamento preliminar de formigas (Hymenoptera:Formicidae) de solo e vegetação em um trecho de mata atlántica, Morro da Lagoa da Conceição, Ilha de Santa Catarina, SC. Biotemas 4:51-59.

Luederwaldt, H. 1918. Notas myrmecológicas. Rev. Mus. Paulista 10:16-64.

Oliveira, P.S. & C.R.F. Brandão. 1991. The ant community associated with extrafloral nectaries in the Brazilian cerrados, p. 198-212. *In*: C.R. Huxley & D.F. Cutler (eds.). Ant Plant Interactions. Oxford University, Oxford.

Romero, H. & K. Jaffé. 1989. A comparison of methods for sampling ants (Hymenoptera:Formicidae) in savannas. Biotropica 21:348-352.

Santos, R.A. & B.C. Lopes. 1995. Formigas de manguezal: espécies envolvidas e utilização das plantas, p. 82. *In*: E. Diehl-Fleig (ed.). XII Encontro de Mirmecologia. UNISINOS, São Leopoldo.

Wilson, E.O. 1959. Some ecological characteristics of ants in New Guinea rain forests. Ecology 40:437-447