

LISTS OF SPECIES

Arthropoda, Arachnida, Scorpiones: Estação Científica Ferreira Penna and Juruti Plateau, Pará, Brazil.

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Abstract

Six scorpion species were recorded using pitfall traps with drift-fences in the Amazonian *terra firme* forest of Estação Científica Ferreira Penna, Floresta Nacional de Caxiuanã, Melgaço, Pará, Brazil, during four expeditions in 2003: *Brotheas* sp. (relative abundance 0.6); *Broteochactas parvulus* Pocock, 1897 (0.22), *Tityus paraensis* Kraepelin, 1896 (0.06); *Tityus silvestris* Pocock, 1897 (0.04); *Ananteris balzanii* Thorell, 1891 (0.04) and *Tityus strandi* Werner, 1939 (0.02). Abundance in the non-flooded forest is higher than the flooded forest probably due to the availability of dry shelters. Five new records are presented for the Juruti Plateau, Pará: buthids *Tityus metuendus* Pocock, 1897, *T. silvestris* Pocock, 1897, *T. strandi* Werner, 1939; chactids *Brotheas overali* Lourenço, 1988, and *Broteochactas parvulus* Pocock, 1897.

Introduction

The order Scorpiones comprises around 1450 living species. In Brazil, the northern region, mostly covered by the Amazonian Rain Forest, is the richest in scorpion species, holding about half of the 100 species recorded in the country (Fet et al. 2000; Lourenço 2002a; 2002b; updated to 2005). An estimate of the number of species in the Neotropics and even of the actual Amazonian species richness is a difficult task, mainly due to the lack of inventories or the absence of precise

type-locality information (Lourenço 2002a). Long term inventories in the Amazonian region are rare and the best studied regions are Serra Norte, Carajás, State of Pará, in Oriental Amazonia (Lourenço 1988), and mainly the Reserva Florestal Adolfo Ducke, Manaus, State of Amazonas, Central Amazonia (Höfer et al. 1996).

In this paper we present lists of the species of scorpions from Estação Científica Ferreira Penna (ECFP), in the municipality of Melgaço, and the Juruti Plateau, in the municipality of Juruti. Both localities are situated in the State of Pará, Oriental Brazilian Amazonia, the first being a well-preserved, research area inside the Caxiuanã National Forest, and the second, a relatively impoverished area which is presently subject to intense bauxite mining.

Sampling protocols currently applied to Arachnida in Amazonia generally undersample scorpions, probably due to the fact that the small pitfall traps used (generally 500 ml plastic cups) are mounted without drift fences. All specimens reported in this study were obtained with larger pitfall traps, equipped with drift fences, installed for herpetological inventories. Such traps proved to be very effective for the sampling large and medium-sized arachnids, and the use of drift fences seems to greatly improve the sampling effectiveness of ground wandering scorpions. The use of effective U.V. bulbs has not yet been largely applied in Amazonian studies.

Material and Methods

The ECFP has been under the administration of the Museu Paraense Emílio Goeldi (MPEG) since 1993 (Lisboa 1997), covering about 33,000 ha of dense rain forest inside a larger reservation, the Floresta Nacional de Caxiuanã (01°42'30" S, 51°31'45" W; 330,000 ha), in the State of Pará, Brazil. The *terra firme* (dry land) forest occupies about 85 % of ECFP, but a permanently flooded forest and a few patches of savanna-like vegetation are also recorded there. The region has a humid tropical climate with water deficit between the end of June and middle of November, and a rainy season between January and the beginning of June. Annual mean temperature is 26 °C and air humidity about 85 % (Lisboa 1997).

† *In memoriam*

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Four expeditions of nine days each were conducted during the rainy season (March and May) and the dry season (August and October) of 2003. Scorpions were sampled with pitfall traps (5 plastic buckets of 90 l, 75 cm high), with a drift fence in a line of 60 m in three areas of *terra firme* (TF1, TF2, TF3), and three very close to flooded areas (FL1, FL2, FL3; see Santos-Costa 2003). The lines were disposed at least 500 m apart. The traps contained no preservative fluid, and were visited each morning for remove captured specimens.

The dry land forest (*terra firme*) at the Juruti plateau (02°36' S, 56°11' W) is classified as "submountain ombro-phyllous plateau forest". This area was subject to intense wood extraction in the seventies, mainly of the *Pau-Rosa* tree (*Aniba rosaedora* Ducke, Lauraceae). The plateau itself is dominated by a nearly 30 years old secondary growth forest. The mature forests, in various degrees of disturbance, are found mainly in low valleys formed by small tributary creeks (*igarapés*). The annual mean precipitation in the Juruti River area is 2100 mm, with a short dry season, normally from July to October. The temperature ranges from 22 to 28 °C, and the relative air humidity varies from 77 to 88 %. Specimens were also obtained with 12 pitfall traps with drift fences (each with 4 plastic buckets of 30 l). A single expedition during 7-15 September, 2002 was implemented in two sites, 200 m apart from each other.

The sampling design applied in ECFP allowed for statistical treatment of scorpion relative abundance. We used the t-test ($\alpha = 0.05$) in order to compare scorpion abundance between dry and rainy season and *terra firme* and flooded forests in ECFP using BioEstat ver. 4.0 (Ayres et al. 2005). Voucher specimens are deposited in the Museu Paraense Emílio Goeldi, and in the Museu de Zoologia da Universidade de São Paulo. The females mesosomal pleurite were cut with scissor and internal organs removed to look for embryos in the ovariouterus.

Results and discussion

In ECFP, forty five specimens belonging to six species were recorded in 192 samples (mean: 0.22 specimens/day). Chactidae (82.2 %) was dominant

over Buthidae (17.78 %). The highest abundance was registered for *Brotheas* sp. (24 males, 3 females, 60 %) and *Broteochactas parvulus* (10 males, 22.2 %). Other species represented less than 8 % of the total (see Table 1). No other species were observed in several additional collecting trips (148 specimens) to ECFP during the period of 2003-2006. The scorpion species richness in Amazonian dense forest sites are among the highest in non-desert communities (see Polis 1990): Reserva Ducke, Amazonas (8 species: chactids *Brotheas amazonicus* Lourenço, 1988, *Chactopsis amazonica* Lourenço & Francke, 1986, *Broteochactas fei* Pinto-da-Rocha et al., 2002; buthids *Tityus metuendus* Pocock, 1897, *Tityus silvestris* Pocock, 1897, and *Ananteris* sp.; see Höfer et al. 1996; Pinto-da-Rocha et al. 2002); Juruti, Pará (6 new records: buthids *Tityus metuendus* Pocock, 1897, *T. silvestris* Pocock, 1897, *T. strandi* Werner, 1939, *Ananteris* aff. *balzanii*; chactids *Brotheas overali* Lourenço, 1988, and *Broteochactas parvulus* Pocock, 1897; MPEG collection), and Serra Norte/Carajás, Pará (6 species: buthids *Tityus tucurui* Lourenço, 1988, *T. silvestris* Pocock, 1897, *T. paraensis* Kraepelin, 1896, *Guyanochactas mascarenhasi* (Lourenço, 1988), *Broteochactas parvulus*, and *Broteochactas* sp.; see Lourenço 1988; MPEG collection).

Males were much more common in two Chactidae species of ECFP. However this possibly results from a sampling bias, since pitfall trap are more efficient in capturing more vagile animals, which is the case of male scorpions, at least in the reproductive period. Pregnant females of *Brotheas* sp. (n = 9, including 6 with large embryos) were observed throughout the year, whereas initial embryos (without appendage differentiation, n = 3) were observed during the dry season. This suggests that the mating period could be in the dry season and embryonic development extends through both seasons. Chactid data on this topic is unknown (see Polis 1990).

No differences were observed in scorpion abundance between the dry and rainy seasons in flooded areas (n = 6; t = -0.894; p = 0.42) and *terra firme* (n = 6; t = -0.848; p = 0.44), and also between *terra firme* and flooded areas (n = 6; t = 2.3778; p = 0.07). However, the abundance of

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ground-dwellers chactid scorpions is higher in *terra firme* sites than in flooded areas ($n = 6$; $t = 3.4066$; $p = 0.02$), probably due to the high availability of shelters, as observed in southeastern Brazil by Yamaguti and Pinto-da-Rocha (2006) for another ground-dweller taxa, the bothriurid *Thestylus aurantiurus* Yamaguti & Pinto-da-Rocha 2002, which itself prefers areas far away from water sources.

The predominance of chactid over buthid on the ground was also observed in Reserva Ducke, Amazonas, by Höfer et al. (1996), using pitfall traps (95.3 %). The use of photoeclector in the latter locality revealed a predominance of buthids

on trees (74.5 %). Data on these localities (also including Juruti) indicate chactids are almost exclusively ground dwellers and buthid live predominantly on tree trunks and bushes.

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Table 1. Scorpions of the Estação Científica Ferreira Penna, Pará, Brazil, sampled with pitfall traps in 2003. TF = *Terra Firme* (dry land) Forest; FL = Flooded Forest.

Families	Species	TF1	TF2	TF3	FL1	FL2	FL3	Total	Abundance(%)
CHACTIDAE	<i>Brotheas sp.</i>	9	7	3	1	3	4	27	60
	<i>Broteochactas parvulus</i> Pocock 1897	2	5	3				10	22.2
BUTHIDAE	<i>Tityus paraensis</i> Kraepelin, 1896		2				1	3	6.7
	<i>Tityus silvestris</i> Pocock, 1897		1		1			2	4.44
	<i>Ananteris balzanii</i> Thorell, 1891		1		1			2	4.44
	<i>Tityus strandi</i> Werner, 1939				1			1	2.22

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