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Richness of Termite Genera in a Semi-Arid Region (Sertão) in NE Brazil (Isoptera)

by

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ABSTRACT

The genus richness of the termite fauna of a semiarid area (caatinga) in Northeastern Brazil was investigated in the dry season of 1996 and the rainy season of 1998. Eight genera belonging to three termite families (Termitidae, Rhinotermitidae and Kalotermitidae) were found in assessments of termite nests and mounds, investigation of dead wood, and cardboard baits buried 10 cm deep in the soil. The nest-builder guild was represented by only three genera: *Nasutitermes*, *Constrictotermes* and *Microcerotermes*. Their density (about 1-3 nests ha^{-1}) was very low. In mounds of *Constrictotermes*, the genus *Inquilinitermes* is almost invariably found as an inquiline. During the dry season of 1996, wood-inhabiting Kalotermitidae (*Neotermes* sp.) were abundant in dead branches still attached to the trees. In dead wood on the ground we recorded *Heterotermes* of the Rhinotermitidae, and *Amitermes* and *Termes* of the Termitidae. A relatively high activity of *Heterotermes* on the baits was recorded within 3 months of exposure. Thus, this site is characterized by a very low genus diversity of termites; nest builders are rare, but soil- and wood-dwelling species are highly active in spite of the adverse conditions (drought) which reign during the larger part of the year.

KEY WORDS: Termites, Semiarid, NE Brazil, caatinga, generic richness, mound density

INTRODUCTION

Termites are an important faunal element of tropical ecosystems,

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pivotal agents of the decomposition processes. In South America, numerous assessments of termite species richness have been made in the humid forests of Amazonia (e.g.; Mathews 1977, Bandeira & Torres 1985, Bandeira & Macambira 1988; cf. revision in Martius 1994) and in the savannas (cerrados) of central Brazil (e.g.; Rocha *et al.* 1990, Domingos *et al.* 1986). However, few studies have been made in other ecosystems on this continent. This lack of data hampers the understanding of the ecology of these ecosystems, and the discussion of diversity and biogeography of termites (Eggleton *et al.* 1994.).

In the present paper we report on collections in a semiarid ecosystem of North-Eastern Brazil. The sertão or caatinga of Northeastern Brazil is an open vegetation of deciduous, xerophytic bushes and trees of up to 8-10 m height in an area of hot, semiarid climate, characterized by average annual rainfalls of about 300-800 mm and a long dry season of generally 8-9, but sometimes up to 11 months. Annual rainfall is very variable, some years being without rainfall at all (Eiten & Goodland 1979, Eiten 1982). Walter & Breckle (1984) point to the fact that in this "transition biome" the daily variation is larger than seasonal variation ("Tageszeitenklima") as in tropical forests, but annual precipitation is low as in deserts. At first glance it appears, at least to the researcher accustomed to moist tropical forests, that such a vegetation would not support termites at all. However, a considerable activity of different termite taxa can be detected on closer inspection.

Study Site

The study was carried out in the government reserve Estação Ecológica (ESEC) Seridó, run by IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis), which is situated between the towns of Serra Negra do Norte and Caicó, in the Brazilian State of Rio Grande do Norte, approximately 330 km West of the city of Natal. The reserve comprises 1 166.38 ha of former farmland (which had been extensively used for cattle growing and firewood extraction) and is located between 6°33'30"/6°37'00" S and 37°14'30"/37°16'30" W. The region is characterized by hot, semi-arid climate. Precipitation is 500-700 mm yr^{-1} and occurs predominantly in from March to May. Varela-Freire (1985) gives average air temperatures of 28-30°C and an average air humidity of 30-50% in the dry season.

The hilly landscape consists of acid, coarse-textured soils with a lithic contact within the upper 50 cm of profile depth. Sloping areas showed evidence of surface runoff. The pH of the surface soils averaged 4.1 in 1 M KCl and 5.3 in H_2O, respectively. Soil units found on the hill tops, upper and steeper slopes were Dystric Leptosols, being associated with

Humic and Haplic Alisols in gently sloping to levelled areas (classification according to FAO-UNESCO, 1997; mainly isohyperthermic Lithic Haplustalfs according to Soil Survey Staff 1996). *Microcerotermes* nests were almost exclusively found in the Humic Alisol soil area, whereas *Constrictotermes* seemed to be more common at the other two soil types.

The vegetation is characterized as hyperxerophile caatinga, locally known as caatinga, consisting of deciduous, xerophytic bushes and trees of up to 8-10m height, under which a herbaceous layer is well developed, at least during the rainy season (Eiten & Goodland 1979, Eiten 1982). Dominant tree species are juazeiro (*Zyzyphus joazeiro*), angico (*Piptadenia macrocarpa*), catingueira (*Caesalpinia pyramidalis*), jucá (*C. ferrea*), jurema (*Pithecolobium dumosum, Mimosa acustipula*), favela (*Cnidoscolus phyllacanthus*), and marmeleiro (*Croton sanderianus*).

MATERIAL AND METHODS

The collections of material from termite nests and mounds were carried out between 10 and 16 September 1996 (dry season) and between 1 and 5 April 1998 (rainy season). Termites from conspicuous arboreal and epigeal nests were collected and stored in 70% alcohol; nest size and height from ground were recorded. (In April, material was collected for chemical analysis; see forthcoming paper). Also, termites in dead wood (dead branches attached to living trees; dead wood on the floor, and the trunks and, partially, roots of dead trees) were collected. In September 1996, 60 cardboard baits (pieces of corrugated cardboard in rolls of 20 cm length and approx. 4 cm diameter) were exposed in six rows of ten baits at a distance of 10 m, buried about 10 cm deep in the soil. The rows had a distance of several hundred meters of each other, covering areas of different vegetation. The baits were moistened once and then covered with stones; they were retrieved after 83 days. In April 1998, the density of conspicuous nests was mapped in three transects of 500x20 m.

Additionally, material collected by Adalberto Antônio Varela-Freire (Universidade Federal de Rio Grande do Norte, Natal/Brazil) between December 1995 and May 1996 was identified.

The material was identified using a preliminary version of a key to termite genera by Constantino (1998b); in dubious cases the key to Termitidae genera of Mill (1983) was used; the material is stored in the collection of the IBAMA station Estação Ecológica do Seridó, Serra Negra do Norte/RN, and also in the collection of the Museu de Zoogeografia da UFRN, Laboratório de Recursos Naturais (LARENA), and in the collection of the Laboratorio de Entomologia of the Departamento de Microbiologia e Parasitologia, Centro de Biociências

(DMP/CB/UFRN), both of the Universidade Federal do Rio Grande do Norte, Natal/RN, Brazil.

RESULTS

In 113 samples of termite material collected from different sites (nests, wood, and baits) at the station, only eight genera belonging to three termite families (Kalotermitidae, Rhinotermitidae, and Termitidae) were identified (Table 1).

Table 1: Records of termite genera in collections from nests, dead wood and baits in the sertão at the Estação Ecológica do Seridó, Serra Negra do Norte, Rio Grande do Norte, Brazil, during several stays between 12/1995 and 04/1998.

Genus	Nests		Dead Wood	Gramineae Stalks	Cardboard Baits
	Dry Season 1996	Rainy Season 1998			
		Kalotermitidae			
Neotermes	-	-	4	1	-
		Rhinotermitidae			
Heterotermes	-	5	3	4	
		Termitidae			
Amitermes	-	-	6	-	-
Constrictotermes	1	3	-	-	-
*Inquilinitermes**	-	2	-	-	-
Microcerotermes	3	3	-	-	-
Nasutitermes	6	3	3	3	-
Termes	-	-	2	-	-

**Inquilinitermes* is no nest builder but a social parasite in colonies of other species

The only genera found to be true nest builders were *Nasutitermes*, *Constrictotermes*, and *Microcerotermes* (Table 1). *Nasutitermes* nests were always arboricolous (Table 2), made of carton material (only organic matter, probably derived from wood and feces) and had an average calculated volume of 58 l per nest. They belonged to several species. *Microcerotermes* nests were also strictly arboreal; they were, on average, smaller (mean volume 24 l). *Constrictotermes* nests were mostly arboreal but often attached to the foot of the tree trunk so that

Table 2: Average nest sizes and heights from ground in the nests recorded in September 1996 and April 1998. Estação Ecológica do Seridó, Serra Negra do Norte, Rio Grande do Norte, Brazil. Diameter D1 is the largest distance from one side of the nest to the other; diameter D2 is perpendicular to D1. Nest volume was calculated using the average diameter (D1+D2/2) and height in the formula of a sphere

Genus	n (number of nests investigated)	Height of nest bottom above ground (dm)	Height of nest (top to bottom) (dm)	Diameter D1 (dm)	Diameter D2 (dm)	Calculated Volume (l)
Nasutitermes	9	13.9±5.7	5.2±2.3	3.9±1.4	3.4±1.3	57.9±48.1
Constrictotermes	4	6.0±4.3	6.8±1.3	4.9±1.4	4.4±0.7	97.0±52.6
Microcerotermes	6	11.4±5.5	3.6±0.9	3.3±0.7	3.3±0.7	24.2±11.0

there was almost direct ground contact. Nevertheless, these nests were easily detached from the ground. Their volume was, on average, 97 l per nest. *Microcerotermes* nests were more cartonaceous, similar to those of *Nasutitermes*, whereas *Constrictotermes* nests clearly contained mineral soil material (cf. forthcoming papers). Nest density of *Nasutitermes*, *Microcerotermes* and *Constrictotermes* together was very low: In three transects of 1 ha, we recorded 1, 1 and 2 nests ha^{-1}, respectively.

All other genera were found in dead wood. *Neotermes* sp. typically inhabited small dry branches still attached to the tree, but they were also recorded in dry stalks of Gramineae near the artificial pond of the station. *Heterotermes* was also found in dead branches (on the ground)

Table 3: Termite activity in cardboard baits at the Estação Ecológica do Seridó, Serra Negra do Norte, Rio Grande do Norte, Brazil. Exposure time September to December 1996 (83 days).

Site	n (baits exposed)	Baits not found	Baits recovered			
			no activity	termite feces and feeding traces	termites present	totally consumed
1	10	0	5	5	0	0
2	10	5	4	1	0	0
3	10	1	5	4	0	0
4	10	0	2	4	2	2
5	10	0	4	4	1	1
6	10	0	1	2	1	6
Total	60	6	21	20	4	9
Per Cent	100	10	35	33	7	15

and stalks of Gramineae near an artificial pond; this was the only genus collected in the cardboard baits (Table 3), suggesting more subterranean habits. *Termes* and *Amitermes* are typically found in the root region of still standing trunks of dead trees where there is a contact with the soil, suggesting a feeding habits which is intermediate between wood and soil feeding.

The material collected by A. Varela-Freire consisted in 30 samples collected exclusively from dead wood and stalks of aquatic Gramineae. Only *Neotermes*, *Heterotermes*, and *Nasutitermes* were present in these samples.

The activity in the baits was high. Although only 4 baits (7%) were recovered with termites active in them, 33% of the baits showed signs of former termite presence (traces of feeding, presence of typical feces deposits), and 15% were detectably totally consumed. In total, 55% of the baits had been attacked by termites (Table 3).

DISCUSSION

The genus-area curves plotted separately for the nest collections and for the collections from dead wood (our samples and those of Varela-Freire pooled) reach a plateau after 3 nests and after 8 wood samples, respectively. Therefore, we assume that the chance for different genera to appear in more samples is quite low. However, soil-dwelling, humivorous termites belonging to the soldierless genus Apicotermitinae are ubiquitous in South American soils and may not have been recorded for the lack of direct soil-sampling.

Eight genera were recorded in the "seridó" ecosystem of Northeastern Brazil. In total, 82 genera are recorded in South America (Constantino 1988a). Between 17 and 44 genera are found in Amazonian rain forests, depending on collection procedure and site (Bandeira & Torres 1985, Bandeira & Macambira 1988, Constantino 1992, Apolinário 1993), and 23 genera in a rain forest at the Atlantic coast of Brazil (Mata Atlântica near the town of João Pessoa; Bandeira *et al.* 1998). Eggleton *et al.* (1995) recorded 29 termite genera in an African "near primary" rain forest. In a central Brazilian savanna (cerrado), an equally high number of 27 termite genera were found by Domingos *et al.* (1986). On the other hand, Bandeira & Torres (1985) registered 4-14 genera in "campina" vegetation, an open forest growth on sandy soils found throughout Amazonia, and only 3-8 genera were recorded in Amazonian white- and black-water influenced floodplain forests (Constantino 1992, Martius 1997, Gonçalves & Martius unpubl.) where annual rainfall is high. Termite generic richness is well correlated with species richness (Eggleton *et al.* 1994).

Much less information exists on termite density, but in Amazonian rain forests, 60-120 termite nests (conspicuous mounds) are found, and even more (up to 260 nests per hectare) in certain areas of floodplain forest (Martius 1994).

In ecosystems of equal productivity, e.g. rain forests and floodplains of Central Amazonia, termite genus diversity is influenced by external stress factors (periodic flooding; Martius 1997). However, the low diversity in floodplain forests is compensated by the high abundance shown by the few existing termite taxa. In contrast, the low diversity of termites in the seridó goes hand in hand with a very low density of 1-2 nests ha^{-1}. Thus, it seems that termite diversity is correlated to annual rainfall, but density is correlated to ecosystem productivity. Annual production and standing stocks of wood in the seridó have not been measured but are clearly below the values for tropical forests and floodplains. Many of the tree species dominating the vegetation are being used for firewood and folk medicine, a hint at the existence of secondary plant substances which could act as feeding deterrents for the termites, further reducing the amount of wood available as a food source.

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