SYSTEMATICS, MORPHOLOGY AND PHYSIOLOGY

A Survey of the Termite Fauna (Isoptera) of an Eucalypt Plantation in Central Brazil

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Levantamento da Termitofauna (Isoptera) de uma Plantação de Eucalipto no Brasil Central

RESUMO - Os cupins de uma plantação de *Eucaliptus urophylla* S.T. Blake (Myrtales: Mytaceae) em Buritis, MG, foram amostrados manualmente em 12 transectos. A taxocenose encontrada continha 28 especies pertencentes a Termitidae e Rhinotermitidae. Essa taxocenoce corresponde a um subconjunto da fauna nativa do cerrado anteriormente presente na mesma área. Comparada com a fauna original, ela tem riqueza menor, uma proporção muito menor de humívoros e maior de ceifadores. O exame de 1600 árvores recém-cortadas revelou que apenas três delas (0.2%) apresentavam dano ao cerne causado por *Coptotermes* sp. Apesar da presença de uma fauna diversa incluindo várias espécies consideradas pragas, os cupins não são considerados um problema significativo nessa região.

PALAVRAS-CHAVE: *Coptotermes*, cupim-do-cerne, cerrado, Minas Gerais, *Eucalyptus*

ABSTRACT - The termite fauna of a plantation of *Eucaliptus urophylla* S.T. Blake (Myrtales: Mytaceae) in Buritis, Minas Gerais, was manually sampled in 12 transects. The assemblage contained 28 species belonging to Termitidae and Rhinotermitidae. This assemblage corresponds to a subset of the native fauna of the cerrado previously present in this region. Compared to the original native fauna, it has a lower species richness, a much lower proportion of soil-feeders and a higher proportion of litter-feeders. A total of 1600 recently cut trees were examined and only three (0.2%) had damage to the heartwood caused by *Coptotermes* sp. Despite the presence of a diverse termite fauna including several putative pest species, termites are not considered a significant problem to eucalypt plantations in this region.

KEY WORDS: *Coptotermes*, Minas Gerais, *Eucalyptus*

There are more than 3 million ha of eucalypt plantations in Brazil. The first plantations were established in the State of São Paulo, about 100 years ago, by the São Paulo Railroad Company (Cia Paulista de Estradas de Ferro). Termite damage has been reported to be significant, especially in sites with poor soil previously covered by cerrado vegetation (Valerio *et al*. 2004).

According to Fonseca (1949), from 1908 to 1942, termites killed 70% of the young eucalypts grown by the Cia. Paulista at Guarani, SP. The damage was supposedly caused by termites feeding on the root cortex, especially *Syntermes* spp. This kind of termite damage is usually limited to the first six months (Berti Filho 1995). After that time the plants become resistant or tolerant to termites. Berti Filho (1995) also lists several other termite genera which have been observed feeding on the roots of eucalypts. However, according to Santos *et al.* (1990), estimates of termite damage to young eucalypts have been exagerated. Junqueira & Berti Filho (2000), on the other hand, reported that termites killed 9–11% of eucalypt seedlings in a forestry experimental station in the State of São Paulo.

Termite damage to adult eucalypt trees was reported by Nogueira (1987), Santos *et al.* (1990) and Moraes *et al.* (2002). The species was identified as *Coptotermes testaceus* (L.), (Isoptera: Rhinotermitidae) which nests inside the base of the tree trunk and sometimes makes a large cavity partially filled with clay.

However, termites are also major elements of the soil fauna and play an important role as decomposers while only a few termite species are pests. Their activity accelerates nutrient cycling and improves soil fertility and structure (Wood & Sands 1978, Constantino & Acioli 2006). The negative impact of termites has often been exagerated and their beneficial effects underestimated. Furthermore, most reports of termite "damage" do not make a distinction between true economic damage and simple injury. Termites can feed on living or dead parts of a living tree, but this may or may not result in economic loss.

Despite the long history of reported problems, there are very limited termite surveys in eucalypt plantations in Brazil. The published information is mostly based on qualitative

data and ignore the different functional groups. In this paper, we present the results of a survey of the termite fauna of an eucalypt plantation in the Cerrado region of Central Brazil.

Material and Methods

This study was conducted at Fazenda São Miguel, Municipality of Buritis, State of Minas Gerais (15°58'22" S and 46°32'6" W). The average elevation is 900 m. The soil is classified as latosol (oxysol) and contain, on average, 30% of clay. Annual rainfall is about 1500 mm and mean annual temperature is approximately 22°C. This survey was conducted in a 15-year old plantation of *Eucalyptus urophylla* S.T. Blake (Myrtales: Mytaceae), which was cut after eight years and was in its 7th year of second growth.

The termites were sampled in 12 transects of 30 m x 6 m distributed in two sites located 10 km apart. Termites were searched in nests, wood and soil by three people for 1h in each transect. The total area sampled was, therefore, 21,600 m^2 and the total collecting effort was 36 person-hours. The specimens were preserved in 80% ethanol for identification and were deposited in the Entomological Collection of the University of Brasília.

Damage to adult trees by *Coptotermes* spp. was evaluated by examination of 1,600 recently cut eucalypts (less than 15 days). Trees with tunnels or cavities in the heartwood were counted as damaged.

Termites were classified into feeding groups based on their morphology and information from the literature. Wood-feeders: termites that feed on sound wood or moderately decayed wood; litter-feeders: termites that feed on leaf- or grass-litter on the surface; soil-feeders or humivores: termites that feed on soil, with organic matter, ingesting large quantities of mineral soil; intermediates: termites that feed on decayed organic matter and do not fit in any of the previous groups. This classification is not exact because the feeding habits form a continuum and there are many borderline cases which can be accommodated in more than one group. There are also other such classifications in the literature (e.g. Eggleton *et al*. 1995, Donovan *et al*. 2001).

The species accumulation curve and the species richness estimates were calculated with the "R" statistical program (R Development Core Team, 2005) and library Vegan (Oksanen *et al.* 2005).

Results

A total of 160 samples were collected from the 12 transects. The collection contained 28 species of 20 genera (Table 1). The species accumulation curve (Fig. 1) indicates that the number of species is approaching stabilization, and the Chao estimate of total richness is 30.6 ± 3.8 species. The dominant species were *Armitermes euamignathus* Silvestri, *Heterotermes tenuis* (Hagen) and *Velocitermes heteropterus* (Silvestri).

The intermediates were the dominant group, comprising 32% of the species and 38% of the samples, followed by the litter-feeders with 29% of the species and 31% of the samples. Wood-feeders comprised 18% of the species and 22% of the samples. The soil-feeders were 21% of the species, but only 9% of the samples.

The nests of most species listed in Table 1 are subterranean. The only exceptions are *Constrictotermes cyphergaster* (Silvestri), which builds an arboreal nest, and *A. euamignathus*, *Cornitermes bequaerti* Emerson, and *Cornitermes cumulans* (Kollar), which are mound-builders.

This is the first record of *Syntermes obtusus* Holmgren for the State of Minas Gerais. Both *Neocapritermes* sp. and *Velocitermes* sp. are undescribed species. The other undetermined species are soldierless termites (Apicotermitinae), and are nearly impossible to identify based on the current taxonomic knowledge of this group.

Termite damage to adult trees was observed only in 3 out of 1600 trees (0.2%), and only one still had termites present. The species present was *C. testaceus*. The low incidence of this kind of damage was confirmed by the technical staff of the farm. According to them, termites in general were not regarded as a problem for the eucalypt plantation.

Discussion

The termite assemblage present in the eucalypt plantation is relatively diverse and comprises a subset of the fauna present in the original cerrado vegetation. The most detailed termite survey in a native cerrado in this region was conducted in the municipality of Paracatu (Constantino 2005), where 65 species were found. Most species found in the eucalypt plantations of Fazenda São Miguel were also present in the cerrado of Paracatu. The sampling at Paracatu followed a different protocol and the native cerrado is structurally much more complex and diverse than the eucalypt plantation. Nevertheless, there are strong similarities and the major patterns are comparable.

The main differences between the termite assemblage of the eucalypt plantation and the native fauna of the cerrado are the following: lower species richness; higher proportion of litter-feeders; lower proportion of intermediate feeders; and much lower proportion of soil-feeders (Fig. 2). Termite studies in tropical forests have shown that the soil-feeders are more vulnerable to habitat disturbance than the other groups (Bandeira & Vasconcellos 2002, Jones *et al.* 2003). The results of the present study indicate that the conversion of the cerrado into eucalypt plantations result in the elimination of many soil-feeders, while most of wood- and litter-feeders remain present. This is caused by changes in the microclimate, habitat structure, and the quality and diversity of the litter. The consequences of these changes in the termite assemblage to the soil and ecosystem processes are unknown.

Amaral-Castro *et al.* (2004) reported 32 termite species from eucalypt plantations at four different localities in Minas Gerais. However, their survey was purely qualitative and strongly biased because they collected only soldiers (missing all Apicotermitinae) and tried to sort the morphospecies in the field, not collecting "repeated ones". Junqueira *et al.* (2004), using a combination of baiting and manual collecting,

Table 1. Termites species found in a plantation of *E. urophylla* in Buritis, MG.

Species	Samples	Feeding group
Rhinotermitidae		
Coptotermes testaceus (L.)	1	Wood-feeder
Heterotermes longiceps (Snyder)	2	Wood-feeder
Heterotermes tenuis (Hagen)	22	Wood-feeder
Termitidae: Apicotermitinae		
Anoplotermes sp. 1	3	Soil-feeder
Anoplotermes sp. 2	3	Soil-feeder
Anoplotermes sp. 3	1	Soil-feeder
Grigiotermes sp.	1	Soil-feeder
Ruptitermes sp.	1	Litter-feeder
Termitidae: Nasutitermitinae		
Armitermes euamignathus Silvestri	34	Intermediate
Constrictotermes cyphergaster (Silvestri)	7	Wood-feeder
Convexitermes manni (Emerson)	2	Intermediate
Cornitermes bequaerti Emerson	6	Intermediate
Cornitermes cumulans (Kollar)	3	Intermediate
Cyrilliotermes strictinasus (Mathews)	1	Soil-feeder
Diversitermes diversimiles (Silvestri)	7	Litter-feeder
Embiratermes festivellus (Silvestri)	2	Intermediate
Labiotermes brevilabius Emerson	5	Soil-feeder
Parvitermes bacchanalis Mathews	11	Litter-feeder
Rhynchotermes nasutissimus (Silvestri)	4	Litter-feeder
Syntermes obtusus Holmgren	4	Litter-feeder
Velocitermes heteropterus (Silvestri)	18	Litter-feeder
Velocitermes paucipilis Mathews	3	Litter-feeder
Velocitermes sp.	2	Litter-feeder
Termitidae: Termitinae		
Cylindrotermes brevipilosus Snyder	3	Wood-feeder
Neocapritermes araguaia Krishna & Araujo	1	Intermediate
Neocapritermes opacus (Hagen)	3	Intermediate
Neocapritermes sp.	8	Intermediate
Termes bolivianus (Snyder)	2	Intermediate
Total	160	

recorded 10 termite species in a 12-year-old plantation of *Eucalyptus pilularis* Smith in the State of São Paulo. Other publications mention only the species regarded as pests, often identified only to genus level.

Among the termite species found in the eucalypt plantation in this study, the following have been reported as possible pests of eucalypt (Constantino 2002): *A. euamignathus*, *C. cumulans*, *C. testaceus*, *H. tenuis*, *H. longiceps*, and *Neocapritermes opacus* (Hagen). Among these, *C. testaceus* is the only species that damages adult trees. All the others have been reported damaging the roots of young plants.

Despite the presence of a relatively diverse termite fauna including several putative pest species, termites do not seem to be a significant problem for eucalypts in this region, at least for *E. urophylla*. The results of the present work contrast with previous studies in Minas Gerais (Moraes *et al.* 2002,

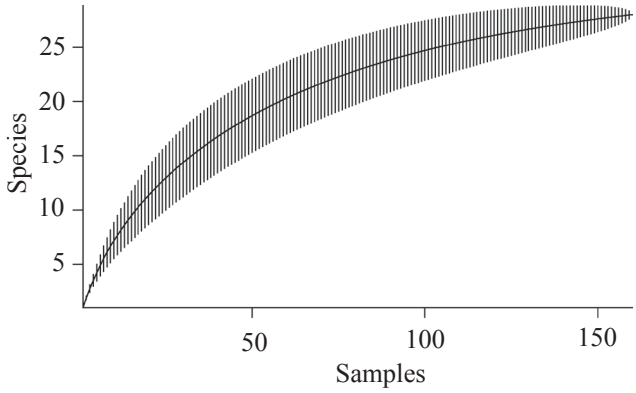

Fig. 1. Species accumulation curve of a termite survey in a eucalypt plantation in central Brazil. The mean curve and its standard deviation were calculated from 500 random permutations of the data using function "specaccum" of Vegan (Oksanen *et al.* 2005).

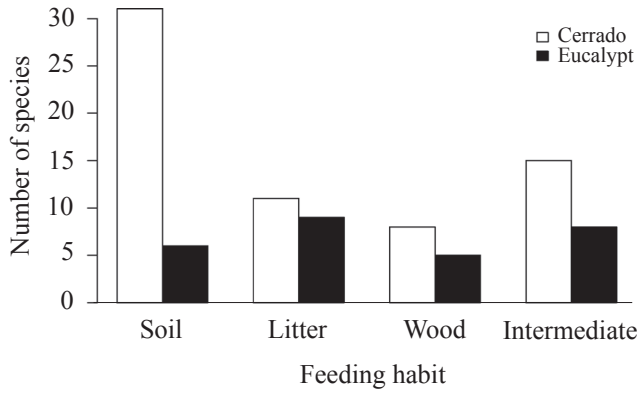

Fig. 2. Proportion of different feeding groups in the termite assemblage of an eucalypt plantation in central Brazil (Buritis, MG), compared to a natural assemblage in a cerrado habitat in the same region (Paracatu, MG).

Santos *et al.* 1990), which report significant damages to adult eucalypts caused by *Coptotermes*. The apparent discrepancy among different studies is probably caused by differences among sites and sampling methods. Nevertheless, the results of the present study indicate that the importance of termites as pests of eucalypts has been exagerated, for a simple reason: the absence of pests is usually not reported and most studies are biased because study sites are selected mainly due to previous evidence of termite damage.

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