

**Parameters that Influence the Establishment and Volume
of *Microcerotermes exiguus* and *Nasutitermes corniger* Nests
in an Atlantic Forest Fragment in Northeastern Brazil
(Isoptera: Termitidae)**

by

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ABSTRACT

This study aimed to evaluate the parameters that influence the establishment and volume of *Microcerotermes exiguus* and *Nasutitermes corniger* nests in an Atlantic Forest fragment in northeastern Brazil. Between September and October 2011, five 1000 m² parcels (100 x 10 m; 10 m apart) were examined and the volume was estimated for all *M. exiguus* and *N. corniger* nests. Additionally, the following variables were measured: distance between nest and soil, height and diameter at breast height (DBH) of the supporting tree, and the minimum distance to the nearest nest. Data was checked for normality with the Shapiro-Wilk test and the variation between the parcels was calculated using the Kruskal-Wallis nonparametric test. The analyses were carried out using Bioestat 5.0. A total of 72 nests were sampled, of which 59 belonged to *M. exiguus* and 13 to *N. corniger*. Species occurred in different strata, which prevented direct competition between the two. DBH had the greatest influence on colony volume.

Keywords: termites, nesting, rain forest

INTRODUCTION

The Atlantic Forest is one of the richest biomes in the world in terms of biodiversity; nevertheless, due to the rapid process of fragmentation initiated by anthropic disturbances, it has become one of the areas with the highest

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conservation priority (Dário and Almeida 2000; Morellato and Haddad 2000).

In South America, approximately 35% of the termite species that occur in tropical rainforests such as the Atlantic Forest construct conspicuous nests (Martius 1994), and a rapid analysis of these species can promptly provide information about their habitat (Vasconcellos *et al.* 2008). However, in order to understand this process well, all of the factors that influence the establishment and distribution of termite colonies must be known.

Although such studies are still incipient, the diameter at breast height of the supporting tree seems to be an important parameter that influences the establishment of termite colonies (Gonçalves *et al.* 2005; Polatto and Alves-Júnior 2009). Similarly, other parameters such as exposure to wind and sunlight, the growth shape of the supporting tree and the biological characteristics of the termite species studied may strongly influence nest establishment in the environment (Thorne 1984; Gonçalves *et al.* 2005; Leite *et al.* 2011).

According to Vasconcellos *et al.* (2007) and Vasconcellos *et al.* (2008), nest volume is positively correlated with population size. Thus, it is possible to say that larger colonies are better established in the environment. Within this perspective, this study aimed to evaluate the parameters that influence the establishment and volume of *Microcerotermes exiguus* and *Nasutitermes corniger* nests in an Atlantic Forest remnant.

MATERIALS AND METHODS

Study area

The study was carried out in an Atlantic Forest remnant (Alto da Buchada) located in the Tapacurá Ecological Station (8°2'56.9"S, 35°13'14.5"O), São Lourenço da Mata municipality, state of Pernambuco, Brazil (Azevedo-Júnior 1990). The station is approximately 776 ha, of which only 382 ha are made up of Atlantic Forest; the rest is occupied by the lake created after the Tapacurá River was dammed (Coelho 1979).

The station is classified as a semi-deciduous seasonal forest, which average yearly rainfall is of 1300 mm; the five drier months are September-January (CONDEPE 2000). Climate is type As' and the vegetation is typical of dry, predominantly arboreal forest, which trees reach approximately 30 m in height (Lyra-Neves *et al.* 2007).

Sampling design & data collection

Data was collected between September and October 2011. Five 1000 m² parcels (100 x 10m) were established in the study area, 10 m apart, going from the forest edge to its interior. All of the *M. exiguus* and *N. corniger* nests in these parcels had their volume estimated and parameters that could influence colony establishment were evaluated.

In order to estimate nest volume, mathematical formulas (for cylinder or hemiellipsoid shapes) were used according to the format observed. To obtain more precise estimates, when surrounded by a nest the volume of the trunk was calculated and subtracted from the total value found for the colony. Nests of the same species built in the same tree and connected by galleries were treated as a single colony, which volumes were added (adapted from Vasconcellos *et al.* 2008).

The following parameters were evaluated in this study: minimum distance between each colony and from the soil, height and diameter at breast height (DBH) of the supporting tree and minimum distance to the nearest colony. A malleable metric tape with a 0.1 cm precision was used to measure these parameters and to estimate nest volume.

Parcels were characterized regarding the type of predominant vegetation, tree size, luminosity, distance from the forest's edge, and successional stage (Table 1).

Data analysis

Volume data from *Microcerotermes exiguus* nests were submitted to the Shapiro-Wilk normality test. The next step was to analyze the variation between parcels by applying the Kruskal-Wallis nonparametric test. All tests were carried out using Bioestat 5.0.

A descriptive analysis was not carried out for *N. corniger* as the amount of data obtained insufficient to undertake more robust statistical tests.

In order to evaluate the correlation between the parameters measured, descriptive canonical correlation was applied with the aid of Statistica 8.0. The parameters with the most correlations were then submitted to Spearman's correlation test using Bioestat 5.0.

Table 1. Characteristics of parcels studies in an Atlantic Forest fragment at the Tapacurá Ecological Station, Pernambuco, Brazil.

Parcel	Characteristics
1	Located parallel to the edge of the fragment studied; thus, it receives more sunlight and wind. Presence of adult individuals of Brazil wood (<i>Caesalpinia echinata</i>), common to the area studied, and some representatives of Family Arecacea. Vegetation with several development strata.
2	Located 20 m from the fragment's edge. Few representatives of Family Arecacea, but a great number of creeping plants and individuals from Family Bromeliaceae.
3	Located 40 m from the fragment's edge. Presence of small clearings, which promotes the incidence of sunlight. Bamboos (Poaceae: Bambusoideae) and individuals of Family Melastomatacea in an initial developmental stage. A large amount of creeping plants.
4	Located 60 m from the fragment's edge. Great occurrence of individuals from Family Bromeliaceae. Presence of adult individuals of Family Melastomatacea. Great occurrence of herbaceous plants.
5	Located 80 m from the fragment's border. Great occurrence of adult and juvenile individuals of Family Arecaceae. Presence of bromeliads (Bromeliaceae). Bamboos (Poaceae: Bambusoideae) and individuals of Family Melastomatacea in an initial developmental stage.

RESULTS AND DISCUSSION

A total of 72 nests were sampled – 59 of *M. exiguus* and 13 of *N. corniger*. The greatest occurrence of *M. exiguus* was recorded in parcel 2, the same with the lowest occurrence of *N. corniger*. Conversely, the greatest occurrence of *N. corniger* was recorded in parcel 1, the same with the lowest occurrence of *M. exiguus*.

This result could indicate interspecific competition, as even when the two species were found using the same supporting tree, we observed that *M. exiguus* used the lower part of the trunk (below 1 m) while *N. corniger* used the higher portion (above 1.5 m). Thus, trees are used in a specific manner, avoiding elimination by direct competition. According to Levings and Adams (1984) and Adams and Levings (1987), territoriality mediates the growth and expansion of neighboring colonies by making distinct species explore different areas or die after contact between colonies. Therefore, niche specialization can reduce interspecific competition (Bourguignon, Leponce and Roisin 2011)

All of the parcels had a lower percentage of *N. corniger*. This species – which has a certain plasticity and adaptive capacity – is commonly found in urban

or agricultural environments that have undergone some kind of disturbance, where may cause serious damage (Constantino 2002; Costa, Espírito-Santo Filho and Brandão 2009; Novaretti and Fontes 1998). Such an adaptation to altered environments has also become clear in studies carried out in Atlantic Forest areas where this species was more frequent in environments which had undergone a shorter period of regeneration (Reis and Cancellato 2007; Vasconcellos *et al.* 2008). Thus, the low occurrence of this species may indicate the conserved state of the studied area.

For *M. exiguus*, the greatest nest volumes were observed in parcel 1, which was significantly different from parcels 3, 4 and 5 (Fig. 1).

Parcels number 1 and 4, where the greatest nest volumes were found, were those with the lowest density of nests. Similarly, while studying an assemblage of termites that build conspicuous nests in areas of Atlantic Forest in different stages of regeneration, Vasconcellos *et al.* (2008) observed that *M. exiguus* colonies occurred less densely in the area which had undergone the longest regeneration process; the greatest nest volumes were also in this area. The same authors suggested that this might be related to the vegetation's regeneration stage, lower climactic oscillation and greater resource availability. Neverthe-

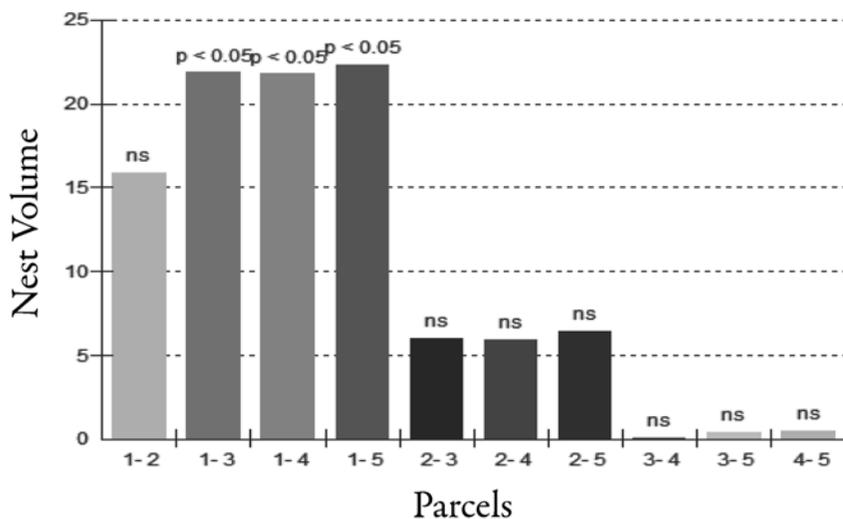


Fig. 1: Variation in the volume of *Microcerotermes exiguus* nests among the parcels sampled at the Tapacurá Ecological Station, based on the Kruskal-wallis test ($p < 0.05$).

less, such an explanation does not apply to this study because parcel 1 is subjected to the greatest climactic oscillations among the parcels examined, such as sunlight and wind. This divergence in results might also be related to the scale being evaluated: while Vasconcellos *et al.*, (2008) examined two areas of Atlantic Forest that measured 1 ha each, this study compared five 1000 m² parcels.

The descriptive canonical correlation demonstrated that, among the parameters evaluated, DBH had the greatest influence on the volume of *M. exiguus* (Table 2). Although it was not possible to establish such a correlation for *N. corniger* due to the small sample obtained, Spearman's correlation coefficient showed that the DBH positively influences this species' nest volume ($r_s = 0.4286$; $p = 0.1439$) just as it positively influences the volume of *M. exiguus* nests ($r_s = 0.3538$; $p = 0.0059$).

A positive correlation between *Nasutitermes* sp. nest volume and the circumference at breast height of the supporting trees has been verified by Polatto and Alves-Júnior (2009). Gonçalves *et al.* (2005) has also shown that the volume of *Nasutitermes* spp. and *M. exiguus* nests is positively correlated with the circumference at breast height of the supporting trees. One of the explanations for such results is that trees with greater circumferences could represent more stable habitats (Gonçalves *et al.* 2005). Araújo *et al.* (2010) confirmed that the greater the tree diameter (and, consequently, the more the resource is available), the greater the number of trails, which would indicate an increase in colony activity.

Although the volume of the colonies of the two species studied was influenced by the supporting trees' DBH, *M. exiguus* colonies established themselves in trees with an average DBH of 0.113 ± 0.05 m, while for *N. corniger* colonies that average was of 0.173 ± 0.18 m. Considering that the *M. exiguus* nests' average volume was of 0.022 ± 0.07 m³ and that of *N. corniger* was of 0.068 ± 0.08 m³, such a preference for greater or smaller DBHs reflects the need of

Table 2: Descriptive canonical correlation between the volume of *Microcerotermes exiguus* nests and supposedly influential parameters at the Tapacurá Ecological Station, São Lourenço da Mata, Pernambuco, Brazil.

Parameters	
DBH	0.316
Height of the supporting tree	0.225
Nest height in relation to the soil	0.002
Distance to the closest nest	-0.011

each species. Greater nests need trees with larger DBH values, because large circumferences offer better adherence for nest fixation; this, in turn, would allow an increase in nest volume with a lower risk of the nest becoming loose from the supporting tree (Polatto and Alves-Júnior 2009).

Although they were not analyzed in this study, some factors related to the biology of the species involved undoubtedly influence colony establishment and success. It is known, for instance, that *N. corniger* is a facultative polygamist and that the presence of multiple queens can directly influence the colony's success, as the high growth rates of colonies with multiple queens increases the probability of survival and decreases the time needed to produce fertile winged individuals (Thorne 1982; Thorne 1984).

We verified that the supporting tree's DBH had the greatest influence on the establishment and volume of *M. exiguus* colonies. The DBH was also positively correlated with the volume of *N. corniger* colonies.

The biological characteristics of each species certainly influenced colony implantation. Thus, we recommend that new studies be carried out to investigate how these features might be linked to environmental characteristics, such as those evaluated here, for to influence colony success and establishment.

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