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Deborah A. Waller
Old Dominion University, dwaller@odu.edu

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Termite Resource Partitioning Related to Log Diameter

Deborah A. Waller*

Abstract - The termites *Reticulitermes virginicus* and *R. flavipes* are sympatric in forests along the eastern United States from Florida to Maryland. These congeners construct subterranean nests, forage on surface and buried wood, and appear to have very similar ecological requirements. In the present study, I examined host-wood selection by these species in a coastal forest over two years. Logs inhabited by *R. virginicus* had significantly greater diameters than those used by *R. flavipes*. It is not known whether this pattern resulted from species-specific differences in preference for host size or competition for preferred logs. Host-wood temperature did not differ for *R. virginicus* and *R. flavipes*.

Introduction

Coarse woody debris (CWD) is increasingly recognized as an important component of forest ecosystems through its role in nutrient cycling and carbon storage (Lockaby et al. 2002). Additionally, CWD supports a wide diversity of organisms as a source of food and habitat (Bate et al. 2004), including fungi (Heilmann-Clausen and Christensen 2004, Lindhe et al. 2004, Norden et al. 2004) and soil arthropods (Bouget and Duelli 2004, Jabin et al. 2004, Lockaby et al. 2002, Niemela 1997). However, the specific characteristics of fallen logs that may impact the diversity of organisms associated with them have been ignored until recently (Bate et al. 2004).

Subterranean termites in the genus *Reticulitermes* are common inhabitants of dead wood in temperate forests (Waller and La Fage 1987). These insects are instrumental in degrading fallen trees and branches and they facilitate microbial and arthropod access to log interiors through their tunneling activities. Little is known about how termites find wood sources and whether specific log characteristics influence host selection.

In the present study, I investigated downed logs for the presence of subterranean termites over a two-year period in southeastern Virginia. Two termite species native to this area, *Reticulitermes virginicus* (Banks) and *R. flavipes* (Kollar), nest in the soil and forage above ground in dead wood. These species are abundant in forests along the East Coast and are sympatric from Florida to Maryland (Weesner 1970). A third species, *R. hageni* Banks, shares this range (Weesner 1970), but I have never encountered *R. hageni* alates over three years of intensive research on this study site. Although termites play vital roles in wood decomposition, their foraging preferences are poorly understood. I recorded the diameter and temperature of CWD occupied by *R. virginicus* and *R. flavipes* over two years in a coastal forest.

*Department of Biological Sciences, Old Dominion University, Norfolk, VA 23529; dwaller@odu.edu.

Methods

The study was conducted at the headquarters of the Virginia Coast Reserve near Nassawadox, VA, in a coastal pine forest. Every month from July 1993 through July 1995, I collected samples of foraging worker termites from ten logs on the property and brought them to the laboratory for species identification. Different logs were sampled every collection period by chopping into downed trunks and branches until termites were located. In the field, I measured log diameter to the nearest 0.1 cm at the widest point where termites were extracted. I also measured temperature with a Fisher thermometer probe at three locations within the wood where I found termites. The log species were not determined, but most were southern yellow pine, including *Pinus taeda* L. Termites were active in logs every month of the year, although in the winter they sometimes appeared quiescent and were occasionally surrounded by ice crystals. However, termites revived once they warmed up in the laboratory.

Workers of *R. virginicus* and *R. flavipes* cannot be reliably separated using morphological characteristics. Identification using soldiers is more reliable, although there can be overlap in characters among species. However, the gut protozoan faunas of these two species differ significantly and can be used in termite species identification (Lewis and Forschler 2004, Yamin 1979). *Reticulitermes flavipes* harbors a diagnostic protozoan species, *Dinenympha gracilis* Leidy, which is absent in other *Reticulitermes* species (Lewis and Forschler 2004, Yamin 1979). Protozoan species in *R. virginicus* guts differ in proportion from those found in *R. hageni* (Lewis and Froschler 2004). In addition to using a morphological key to separate species by soldiers (Scheffrahn and Su 1994), I examined the gut protozoan fauna. For each termite sample collected, I chilled three termite workers to anesthetize them and removed their guts with forceps. Gut contents were macerated in 0.5% NaCl with neutral red dye and examined under a compound microscope at 400x magnification to identify protozoan species. Termites that contained the protozoan *D. gracilis* in their guts were identified as *R. flavipes,* and those without this protozoan were identified as *R. virginicus* (Lewis and Forschler 2004, Yamin 1979).

Data analysis

Two-factor analysis of variance (month x termite species) was performed using StatView statistical software (www.StatView.com/product/index.shtml) to determine whether diameters of logs inhabited by termites changed seasonally or varied according to termite species. Mean log temperature was calculated from the three readings per log and similarly examined using two-factor analysis of variance.

Results

Reticulitermes virginicus inhabited logs with significantly greater diameters than those occupied by *R. flavipes* ($F = 56.184$; $df = 1, 199$; $p = 0.0001$)

(Fig. 1). The mean log diameter inhabited by *R. virginicus* during the study was 16.7 ± 0.6 SE cm for 135 logs measured, while *R. flavipes* occupied 107 logs with a mean diameter of 9.9 ± 0.4 SE cm. Log diameter did not vary significantly over the two-year period (F = 1.362; df = 25, 199; p = 0.1258).

In contrast, there was no temperature difference in logs inhabited by *R. virginicus* and *R. flavipes* (F = 2.432; df = 1, 199; p = 0.1205) (Fig. 2). However, log temperature varied significantly throughout the two years (F = 111.301; df = 25, 199; p = 0.0001) as expected in an environment with marked seasonality. The lowest mean temperature recorded in a log was 1.0 ºC ± 0.8 SE in January 1994 for *R. virginicus*, while the highest was 33.7 ºC ± 0.8 SE in July 1995, also for *R. virginicus*.

Discussion

Gause (1934) suggested that two species with identical niches cannot coexist indefinitely. In this study, *R. virginicus* inhabited logs with significantly larger diameters than did the congeneric *R. flavipes*, consistent with Gause's Law. It is unclear why host-log diameter differed for these two species. The difference might be related to the preference of one or both species for hosts of a given diameter. Evans et al. (2005) found that drywood termites can estimate wood size by assessing the resonant frequency of the

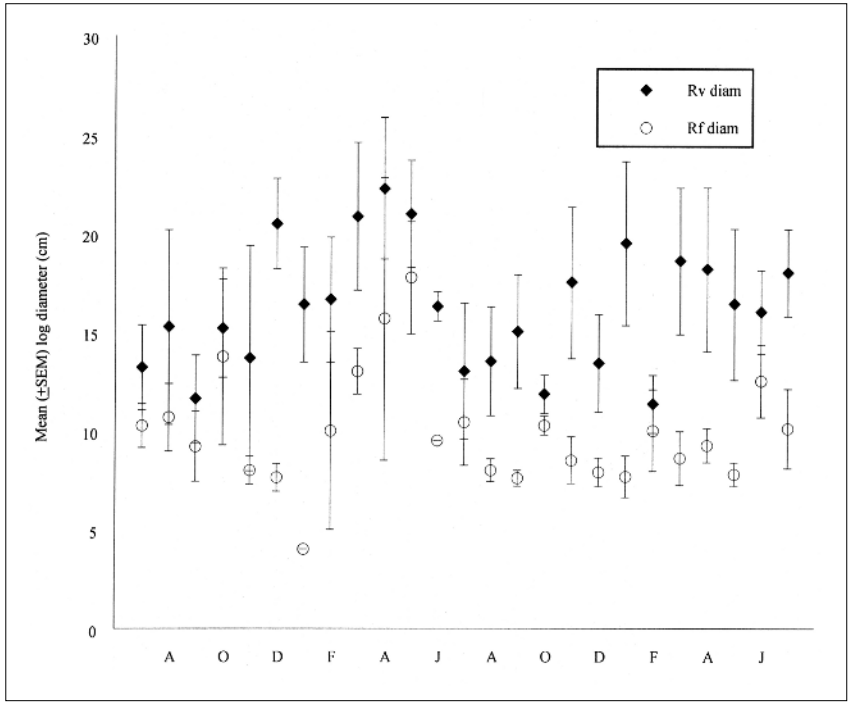

Figure 1. Diameter of logs inhabited by *Reticulitermes virginicus* and *R. flavipes* from July 1993–July 1995.

wood. This capability might be more important for drywood termites which live in discrete wood pieces than for subterranean termites that can forage on several different wood sources.

One possibility is that log size is related to log temperature dynamics. Reproductive alates of *R. flavipes* perform mating flights earlier in the year than do those of *R. virginicus*. Perhaps smaller logs provide the appropriate temperatures for alate development during the winter months. Houseman et al. (2001) suggested that *R. flavipes* and *R. hageni* partition resources related to soil moisture and temperature in Texas. However, log temperature did not differ for *R. virginicus* and *R. flavipes* in the present study.

Some insects have specific preferences for branch size (Hespenheide 1969, 1976). Wood-boring beetle size is correlated with host-branch size for the buprestid *Agrilus* (Hespenheide 1976). In the present study, the smaller termite species *R. virginicus* inhabited logs with greater diameters than the larger congener *R. flavipes*.

Schiegg (2001) found greater species numbers and increased diversity of saproxylic Diptera and Coleoptera in tree limbs than in trunks in beech trees. These resources may support different insect communities, although Schiegg (2001) found significant overlap in species. In the present study, the origin of host wood was not identified, although it is likely that very large diameter logs represented fallen trunks while those with small diameters

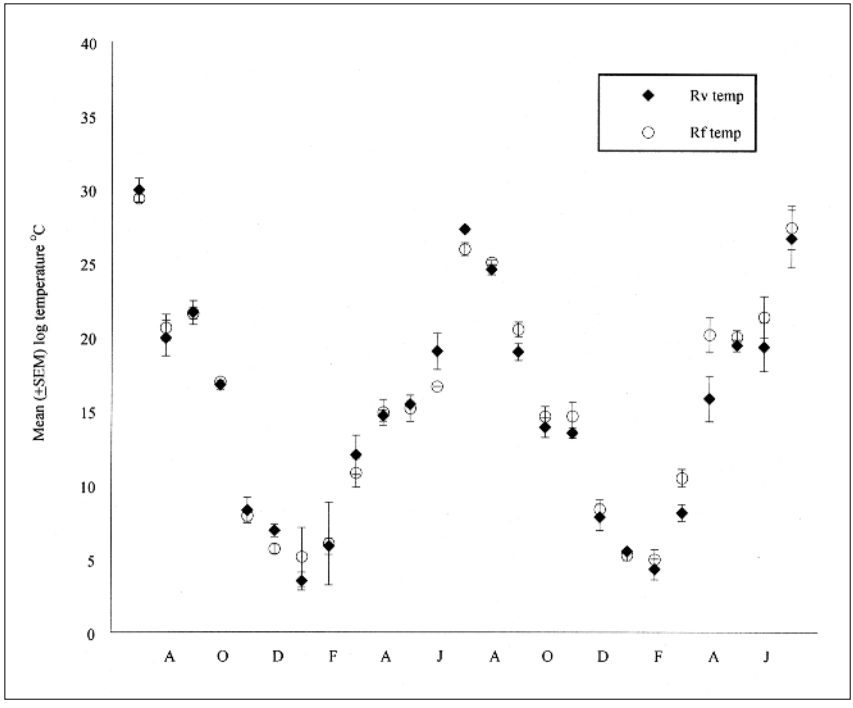

Figure 2. Mean temperature of logs inhabited by *Reticulitermes virginicus* and *R. flavipes* from July 1993–July 1995.

derived from fallen limbs. Therefore differences in the wood characteristics other than size of trunks versus limbs may have influenced host choice by *R. virginicus* and *R. flavipes*.

Schiegg (2001) argued that sound forest management should leave tree trunks and limbs on the forest floor to support insect diversity. The present study provides support for this position because two congeneric termite species foraged on logs of significantly different sizes throughout the year. Given their importance in forest nutrient cycles, more information on these species will benefit our understanding of forest ecosystems.

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