NEST, WE HAVE A PROBLEM: *NASUTITERMES* TERMITE'S BEHAVIORAL RESPONSE TO TRAIL DAMAGE AT VARYING DISTANCES FROM NEST

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Abstract: Nasutitermes sp. termite colonies use chewed wood and fecal glue to construct a nest with radiating trails. When trails are damaged, worker termites rapidly locate the damaged area and begin repair. We examined how distance from the nest affected the onset of trail repair. Trail repair at damaged areas began sooner closer to the nest, and repair was initiated most frequently by ants moving from the direction of the nest. We infer that *Nasutitermes* colonies recruit workers and soldiers from the nest, for repair and for defense against predation at the repair site.

Key Words: Nasutitermes, *termites, colony repair, behavioral response*

INTRODUCTION

Termites of the genus *Nasutitermies* construct nests with radiating trails using carton, produced from chewed wood and fecal glue. Construction and defense of the nest and trails shows coordination of activity between the two sterile castes of termites: soldiers and workers. Soldiers protect the colony using a strong-smelling sticky secretion that impedes arthropod predators and is unpalatable to vertebrate predators such as anteaters. Workers are blind, relying on tactile and chemical signaling to coordinate nest and trail construction and repair. Soldiers respond in greater abundance to nest damage than to damage on trails farther from the nest (Lubin 1983).

We examined two responses: (1) the distance of trail damage from the nest relative to the time repair activity began and (2) the direction from which repair was initiated after damage. We hypothesized that these responses would be consistent with centralized coordination of repair from the nest. Thus, we predicted that repair would begin sooner for trails located closer to the nest and that repair activity would be initiated by ants moving from the direction of the nest. Termites have a highly organized social structure, which may require a centralized response, even in cases where damage occurs far from the nest.

METHODS

We used shears to cut gaps approximately 3 cm long in termite trails. We cut each trail at two distances from the nest, as follows. We randomly determined whether the proximal or distal cut would be made first. We generated a random number between 1 and 100 to determine the distance in cm that the proximal cut would be made, while the distal cut was made twice that distance from the nest. We watched the first cut until repair began. If we saw no termites at the damaged site for 10 minutes, we considered the colony abandoned and omitted it from our sample.

Ten minutes after making the first cut, we made the second cut and monitored them until repair began. We recorded the start time of repair, as well as the direction from which the first termite worker came to perform the repair.

We performed an ANCOVA between distance and time, with cut number as the covariate, a one way ANOVA of location vs. time, and a Contingency test of direction vs. location, using JMP 5.0.1.2 for all analysis.

RESULTS

Termites took longer to start repair on cuts farther from the nest (Fig. 1). The order of the cuts did not affect repair initiation time (F_1 = .09 P = .79) nor was there a significant interaction between cut order and distance from the nest (Analysis of Covariance, F_3 =4.12, P = .11).

Termites began trail repair on the cut closer to the nest, regardless of which cut was made first. Termites began repairing distal cuts after 333 $\pm$ 22 seconds and proximal cuts after 242 $\pm$ 15 seconds.

The distance of the cut from the nest did not affect the direction from which the termites arrived (Contingency test, $\chi^2_{1,50}$ = .31, P = .58). Termites arrived to repair trail damage on the side closest to the nest in 83% of all cuts.

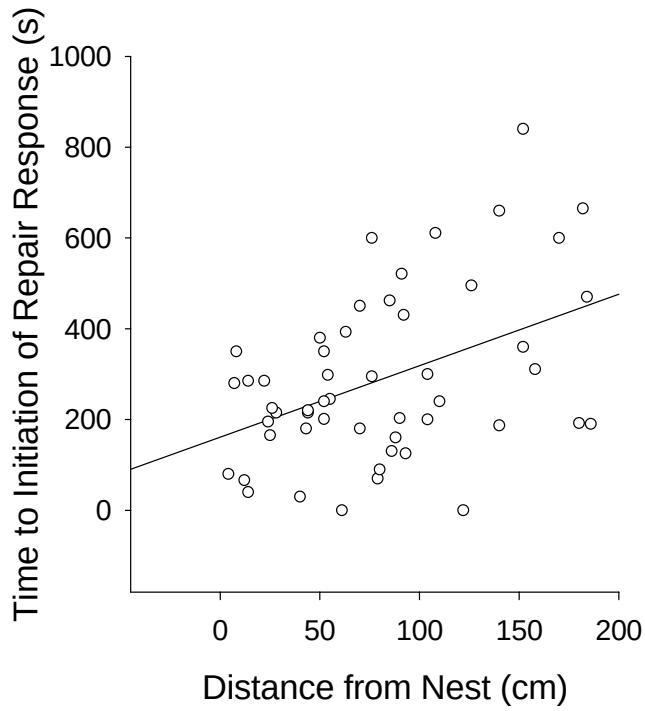

Figure 1. Relationship between the distance from the nest and the time of the repair response, for experimentally damaged trails of *Nasutitermes* termites at Palo Verde, Costa Rica (F_1=11.7, p = .0012)

DISCUSSION

The slower initiation of repair farther from the nest suggests that the workers travel from the nest to reach damaged areas. Moreover, within a trail, repair began earlier on cuts made closer to the nest than on cuts farther away. The direction from which the termites began repair activity did not depend on distance from nest, suggesting that the workers are recruited from the nest even if workers already in the trail are nearer to the damaged area.

Trail damage can result from predator attack. Thus, in the evolution of termite behavior, coordination of repair from the nest may have been favored by the benefits of recruiting soldiers for defense along with workers for the repair. Lubin

(1983) reported that *Nasutitermes* soldiers were found in greater abundance at damaged areas closer to (or on) the nest rather than at damaged areas farther from the nest. This distance-dependent pattern in the numerical recruitment response (which we did not examine) also indicates central control of recruitment from the nest.

LITERATURE CITED

Lubin, Y.D. 1983. *Nasutitermes*. in Costa Rican Natural History. Ed. D.H. Janzen. University of Chicago Press: Chicago. p. 743-745.