SIZE-DEPENDENT NEST SITE CHOICE BY CAVITY-DWELLING ANTS

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ABSTRACT

Nest site choice by cavity-dwelling ants of north temperate deciduous forests was studied at two sites in the northeastern United States. The two numerically dominant ant species in these communities, *Myrmica punctiventris* and *Leptothorax longispinosus*, chose different cavity sizes in experiments employing artificial nest sites. These preferences for different cavity sizes should prove useful for studies involving experimental manipulation of cavity-dwelling ant species.

INTRODUCTION

Competition for space, particularly for nest sites, exerts profound influence on ant communities in north temperate ant forests (Herbers, 1989). Most ant species living on the forest floor utilize cavities such as rotten twigs, acorns, and hollow sticks. The suggestion that competition for nest sites is important has been bolstered by experimental work showing that availability of nest sites dramatically influences social structure in the common ant species *Leptothorax longispinosus* (Herbers, 1986). The other numerically dominant species, *Myrmica punctiventris*, occupies similar nest sites and may be its major competitor for space in many areas (Herbers, 1989).

We supplemented the availability of ant nest sites in north temperate forests in New York (E. N. Huyck Preserve, Albany County)

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Manuscript received 30 August 1995.

and Vermont (Mallett's Bay State Park, Chittenden County). Our experiments were designed to explore the effects of nest site availability on nest size, colony structure, and queen number in these locations. Those results have been published elsewhere (Herbers, 1986; Banschbach and Herbers, in prep). Here we report that the occupation of cavities by these two common ant species depends on the sizes of those cavities. The importance of cavity size to nest site selection has been well documented for the honey bee (Seeley and Morse, 1976) but has not been reported previously for ants.

Methods

Our artificial nest sites consist of a 10-cm piece of birch doweling through which a hole has been drilled lengthwise. We used drill bits of 2.5 mm diameter and 4 mm diameter to produce nest sites with volumes of 0.4 ml and 1.3 ml, respectively. Since the maximum body width of an *M. punctiventris* queen is 1.5 mm and for an *L. longispinosus* queen is 0.9 mm wide, both species can easily fit into either the small- or large-diameter cavities.

We performed three separate experiments (Table 1). Small-cavity dowels were placed into the New York woods in spring 1982 (Expt. 1) and in the Vermont woods in spring 1985 (Expt. 2). In both these experiments, a single 10m × 10m plot was seeded with three dowels per square meter (= 300 added nest sites each). In Expt. 3, large-diameter dowels were seeded in the Vermont site only, in spring 1992; for this experiment, we used six plots, each 6m × 6m, that received additions of two dowels per square meter.

In all cases, dowels on the plots were monitored for 1–2 years and their occupants censused every three weeks from May–October and periodically throughout the winter (cf. Herbers, 1986). At the end of Expts. 1 and 3, plots were completely excavated to determine overall density.

Results

Occupancy rates for the small-holed and large-holed dowels are summarized in Table 2 for two focal species, *M. punctiventris* and *L. longispinosus*. Occasionally, we recorded the presence of other ants (including *Lasius alienus*, *Stenamma diecki*, and *Aphaenogaster rudis*) and arthropods, but together they never accounted for more than 2% occupancy.

Table 1. Synopsis of the data base.

	Experiment 1	*Experiment 2*	*Experiment 3*
Site	New York	Vermont	Vermont
Diameter of cavity	small (2.5 mm)	small (2.5 mm)	large (4.0 mm)
Volume of cavity	small (0.4 ml)	small (0.4 ml)	large (1.3 ml)
Total forest area	100 m^2	100 m^2	216 m^2
Supplementation	3 dowels/m^2	3 dowels/m^2	2 dowels/m^2
Dates	1982–1984	1985–1986	1992–1994
Maximum number of nests in dowels	12 *Myrmica* 60 *Leptothorax*	13 *Myrmica* 52 *Leptothorax*	117 *Myrmica* 17 *Leptothorax*

Table 2 shows that the overall occupancy rates of *M. punctiventris* and *L. longispinosus* were strongly dependent on the cavity size of the dowel. The larger species (*M. punctiventris*) moved preferentially into the larger cavities while the smaller species (*L. longispinosus*) preferred the smaller cavities. Thus, it appears the two ant species assort by the size of the cavities they inhabit.

Discussion

Our two study species exhibit the phenomenon of seasonal polydomy: during the active season, colonies expand into multiple nesting sites and then contract in autumn (Herbers and Tucker, 1986; Snyder and Herbers, 1991; Banschbach and Herbers, 1996). Thus movement into our dowels was the result of colony fractionation, as Herbers (1986) has discussed in detail. The occupants of any one dowel represented a colony subunit, whose demography was no different from other subunits existing nearby in acorns and hollow sticks (Herbers, 1986; Herbers and Banschbach, unpublished data).

Table 2. Maximum density of ants (number of nests/number of dowels) residing in artificial nest sites.

	New York	*Vermont*	*Vermont*
Ant species	small cavities	small cavities	large cavities
M. punctiventris	0.040	0.043	0.271
L. longispinosus	0.200	0.187	0.039

The assortment by cavity size we found (Table 2) could be attributable to a host of factors. We do not know whether the ants use nest diameter or nest volume as they choose among potential sites. Because the two ant species are different sizes, the two cavity sizes would also present different microclimates, which could influence their choices. Since the average number of workers per nest is very similar for our two species (Herbers, 1990; Snyder and Herbers, 1991), the larger-sized *M. punctiventris* doubtless requires more *Lebensraum* than does *L. longispinosus*. While we have no information on why the species chose different cavity sizes, the fact that they do assort may have profound ecological implications.

Our result that the larger ant (*M. punctiventris*) chose the larger cavity seems intuitive, but in fact we had no such *a priori* expectation. Kelly (1973) had found that the closely related *M. rubra* was able to rear brood successfully in nest volumes as small as 0.19 ml.; deleterious effects of crowding were found only at volumes smaller than 0.19 ml, which is less than half those used in our experiments. Kelly's (1973) experiments used worker numbers very similar to the average worker numbers found in nests of *M. punctiventris*, from 20-50 workers (Snyder and Herbers, 1991; Banschbach and Herbers, 1995) and so we expected our small-sized cavities to be quite suitable for *M. punctiventris*; indeed nests did occasionally make use of them.

Similarly, we had no *a priori* reason to suppose that the smaller ant species *L. longispinosus* would avoid the larger cavity. We have no indication that the small ants were pre-empted or otherwise aggressively kept out of the larger cavities, unlike the finding of Yamaguchi (1992), that nests of *L. congruus* were aggressively usurped by *Monomorium intrudens* workers. On our experimental plots there were plenty of dowels to go around, and the small species has the intrinsic advantage that they over-winter aboveground to retain their nest sites (Herbers, 1989). Furthermore, the *L. longispinosus* workers sealed up dowel holes of both sizes with mud and debris to give an actual entrance hole of approximately 1 mm width. This behavior was so consistent that we were able to determine whether a given dowel was occupied by *L. longispinosus* or by *M. punctiventris* simply by inspecting the entrance hole.

Preferences for different sized cavities have proven extremely useful for targeted studies of north temperate deciduous forest ants. For studies of the population biology of *Leptothorax* ants, a smaller cavity will selectively attract them, whereas larger cavities selectively attract nests of *Myrmica* ants. This assortment by cavity size reinforces our interpretation that competition for suitable nest sites has shaped community structure for these ants.

ACKNOWLEDGMENTS

These studies have been supported by grants from the National Science Foundation and Vermont EPSCoR.

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