Myrmeleon habitat preference and substrate-dependent predation success

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Abstract: Ant lions (Neuroptera: *Myrmeleon*) construct pits in soil to trap prey such as ants and small arthropods. We hypothesized that ant lions would exhibit a soil type preference. In laboratory experiments we simultaneously offered ant lions both fine and coarse soils to determine soil preference and introduced ant prey to assess the capture efficiency of pits constructed in the two soil types. We predicted that (1) ant lions would prefer fine soils over coarse, (2) predation success would increase in fine soils, and (3) predation success would increase with increasing pit diameter. Ant lions constructed pits in fine soils significantly more than in coarse and mixed soils. The diameter of pits significantly differed among soil types; pits in fine soils had larger diameters. We were unable to show a significant effect of soil type or pit diameter on predation success, probably due to low sample size in coarse soil.

Key Words: ant lion, Myrmeleon, *substrate preference*

Introduction

Myrmeleon larvae dig small pits in soil to capture and prey upon ants and small arthropods that fall into these pits. Previous research has shown that it takes *Myrmeleon* twice as long to dig a pit in coarse soil as in fine soil (Beadell and Bird, 1996). Assuming that less construction time means less energy expenditure for the ant lion, we hypothesized that *Myrmeleon* would have a preference for fine soil when given the choice of several substrate types. Furthermore, Perlroth et al. (1995) found that pits built in fine soil had steeper slopes than those built in coarse soil, which may reduce escapes of prey. We therefore also predicted that preference for fine soil would correspond to increased predation success in fine soil.

Methods

Soil and ant lions were collected from a campground one mile WNW of the OTS station at Palo Verde National Park, Costa Rica. Cheese cloth was used to sift out fine soil, and coarse soil was obtained by sifting the remaining soil through flexible mosquito mesh. Four cardboard boxes (ca. 40 cm x 14 cm) were divided lengthwise with cardboard partitions to create two bays per box. Each bay was filled to a 2 cm depth with coarse soil on one half and fine soil on the other.

Twenty-four *Myrmeleon* larvae were collected from pits of similar size using spoons. Three *Myrmeleon* were introduced to each of the eight bays at the interface between coarse and fine soils. The bays were left undisturbed for 20 hours. We then noted pit diameter and location, classifying the soil at each pit as fine, coarse, or mixed (i.e., on the interface between soil types).

We collected black ants (species unknown) of similar size from the field station bathroom using an aspirator and introduced five ants at either end of each bay (ten ants per bay). The number of ants entering and exiting each pit was recorded over a 10-minute experimental period. Because containment of the ants in the bays required a great deal of experimenter interference, we were unable to assess encounter probability of ants with pits.

Results

Furrows appear as ant lions move just below the surface (McClure 1983). These tracks were apparent within two hours of ant lion introduction. In several bays, furrows indicated that at least some individuals explored the entire bay. The mean proportion of *Myrmeleon* pits differed significantly with soil type (ANOVA, $F = 7.52$, $df = 2$, $P = 0.0034$). The number of pits in fine soil was 3 times greater than in either coarse or mixed soil (Tukey-Kramer HSD, $P < 0.05$, Fig. 1). Distribution of mean proportion of *Myrmeleon* pits was nonnormal, but Sokal and Rohlf (1981) suggest that ANOVA is robust to moderate nonnormality, and these data were homoscedastic (O'Brien test, $F = 5317$, DF 2, 21, $P = 0.60$). The mean diameter of *Myrmeleon* pits was significantly different across soil types (ANOVA, $F = 3.68$, $df = 2$, $P = 0.046$, Fig. 2). Pairwise comparisons did not reveal significant differences among soil types (Tukey-Kramer HSD, $P > 0.05$) but visual inspection of Figure 2 suggests that greater diameter of pits in fine soil accounts for the significant ANOVA test results. Ant capture success (Table 1) did not differ significantly with soil type (ANOVA, $F = 0.52$, $df = 2,16$, $P = 0.60$), or pit diameters (ANOVA, $F = 0.02$, $df = 1, 18$, $P = 0.88$).

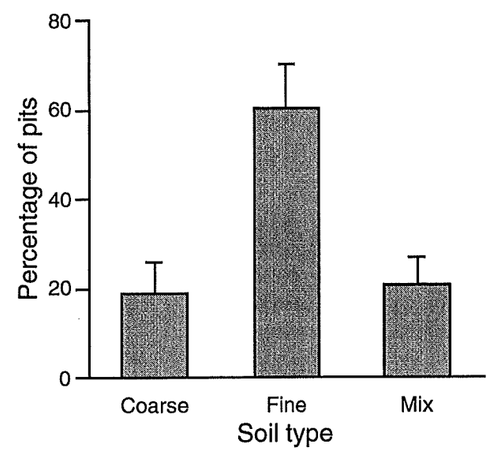

Fig. 1. Mean percentage (± 1 SE) of pits constructed in three different soil types.

Table 1. Mean capture success of *Myrmeleon* pits in soils with different grain sizes.

Soil Type	Capture Success (mean ± 1 SE)	n
Fine	0.58 ± 0.11	11
Mixed	0.73 ± 0.085	5
Coarse	0.59 ± 0.12	3

Discussion

Myrmeleon larvae preferred fine soil for pit construction (Fig. 1), and built pits of larger diameter in fine soil (Fig. 2). Furrows observed during the experiment support the conclusion that some ant lions explored both soil types before choosing a substrate. Preference for fine soil and larger diameter pits may be related to ease of pit construction; Beadell and Bird (1996) found that pit construction takes twice as long in coarse soils as in fine. Our results coupled with those of previous studies may indicate that *Myrmeleon* habitat preference is an optimization in predatory and energy conservation strategies.

The interface between fine and coarse soils was used in pit construction more than we anticipated (23% of pits were located along the interface, Fig. 1). Determination of preference for mixed soil is consequently complicated by the smaller area devoted to this soil type in the bays, and the initial placement of the ant lions on this interface. In addition, due to the fact that three ant lions were released in each replicate, we were unable to exclude the

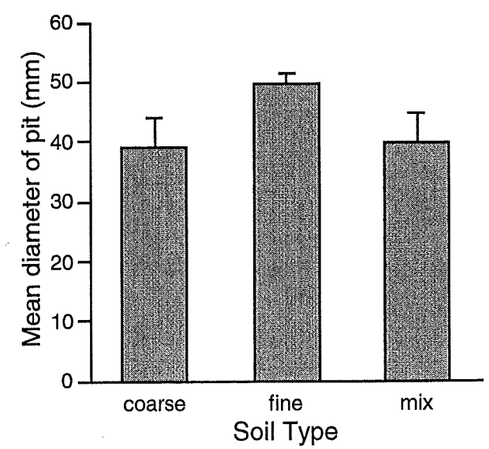

Fig. 2. Mean diameter (± 1 SE) of pits found in each soil type.

effects of intraspecific competition on the location of pits. Further study with just one ant lion per replicate may show even stronger patterns in ant-lion substrate choice.

Contrary to our predictions, soil preference did not correlate with capture efficiency. This result may be due to low sample size for pits in coarse soil (n = 3). However, Perlroth et al. (1995) also found no significant difference in ant capture time for ant lion pits built in either fine or coarse soil. Despite these findings that capture efficiency was not different, greater diameter increases the probability that an ant will encounter a pit, which should influence overall predation success.

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