PIT DISPERSION IN ANTLION LARVAE
(NEUROPTERA: MYRMELEONTIDAE): IS COMPETITION IMPORTANT?

RISA H. ROSENBERG
Ecology and Evolutionary Biology
Cornell University
Ithaca, NY 14853

Antlion larvae of the genus Myrmeleon (Neuroptera:Myrmeleontidae) forage by pit trapping. Insects fall into these pits and are captured and eaten by the antlion buried in the soil at the bottom of the pit. As sit and wait predators, antlion larvae have only a limited number of ways of increasing their foraging success; pit relocation may be one such way. Recently there has been some discussion of the relocation and dispersion of antlion larvae pits (Heinrich and Heinrich 1984, Simberloff et al.1978, Griffiths 1980a,b, McClure 1976, Wilson 1974), but there is little agreement as to the relative importance of the causal factors. Griffiths (1980a), Wilson (1974) and McClure (1976) claim that antlions relocate their pits in response to food limitation. Heinrich and Heinrich (1984) argue that intraspecific competition for prey is only influential over long time periods, and within a shorter time frame, microclimatological factors such as soil temperature and moisture can better account for pit dispersion. If pits are located in an area with warm, dry soil, antlion foraging success may be enhanced since antlions in these environments can spend more time foraging than can conspecifics with pits in shaded, moist areas (Griffiths 1980a), since dry soil is energetically easier to toss (Lucas 1982). Simberloff et al. (1978) also mention food limitation as a possible factor affecting pit dispersion, but argue that data are too scant to be conclusive, and that prey limitation probably is not a motivating factor in pit spacing since antlion larvae can survive without food for several months at a time. Rather, they claim that microclimatological factors and sandthrowing during pit maintenance are more influential in the spacing of antlion larvae pits. The aim of this study is to investigate the relative importance of food limitation and microclimatological factors on antlion pit dispersion.

This study was conducted during the dry season at the Archbold Biological Station, Highlands County, Florida from 24 March-4 April 1986. Myrmeleon carolinus Banks larvae were collected from a 100m area along the western firetrail from pits of uniform size (2 cm radius). Since pit size is correlated with owner size (Wheeler 1930, Wilson


1974), this minimized individual differences with respect to food capture and sand throwing. Forty circular plots (of 380 cm² each) were placed in seemingly homogeneous microhabitats that had been cleared of leaf litter, overhanging branches, stones and soil. Vertical sticky traps and a 1 cm circumference of tanglefoot spread around the plots were used to keep prey items out. Soil of different textures (as determined by sifting with sieves of different sizes; mesh for grainy soil = 2mm, mesh for fine soil = .5mm) was placed to a depth of 2.5 cm in each plot. Five larvae were placed in the center of each plot, and were undisturbed for 24 hours to allow pit formation. Eight treatments, each with five replicates, were randomly assigned to the 40 plots. The treatments consisted of all combinations of plots with grainy or fine soil, placed in sunny or shaded areas, and with fed or unfed larvae. All larvae in the fed plots were given one antapiece daily; observations assured that this prey item was caught.

The number of pits relocated per day was used as a measure of the effect each treatment had on the dispersion of *M. carolinus* larvae. These data were analyzed using analysis of variance (square root transformed).

In order to investigate the validity of the test conditions, measurements of pit diameters and distance of individual pits to their neighbors within a plot were recorded and compared with those of pits in nature.

The comparison of natural and experimental plots revealed no differences in pit diameters or dispersion (t-test, p > 0.05). In the experimental plots, antlion larvae relocated their pits equally often in the different substrate types and in the different temperature regimes (sun vs. shade), suggesting that soil texture (ANOVA, p > 0.4) and microclimate (ANOVA, p > 0.09) did not significantly affect pit dispersion. Feeding regime, however, was found to influence their pit relocation, with non-fed antlions relocating their pits more often than fed individuals (ANOVA, p < 0.05). Figure 1 plots the number of relocated pits per day for larvae in the fed versus unfed plots. In this study, food limitation was found to be the most important factor influencing pit dispersion in *M. carolinus* larvae.

If sandthrowing plays an important role in the spacing of antlion larvae pits, as Simberloff et al. (1978) suggest, then antlion pits in different soil types should show different spatial patterns, reflecting individuals' abilities to toss sand grains of different textures. Lucas (1982) found that antlion larvae could toss larger particles further. This may cause neighboring antlions to move more often to escape inundation by sand from their neighbor's activity, thereby leading to larger distances between neighboring pits than for those antlion larvae with pits in finer soil types. This prediction was not upheld in this study, since the amount of movement was similar in the different substrate types. This suggests that sand-throwing is not an important determinant in the dispersion of antlion larvae pits, at least for the *Myrmeleon* species studied here.

Food limitation is a more potent force in structuring the spatial distribution of the pits of *M. carolinus* larvae. The unfed study populations moved significantly more often than did the fed antlions, suggesting that unfed individuals relocate in order to search for food, while the fed individuals move less often, perhaps because they are positively reinforced to remain in areas where prey items are present. Thus, it appears that within a homogenous microhabitat, food limitation is an important factor in determining the redistribution and spacing of the pits of at least one species of *Myrmeleon*.

Unlike the results of Heinrich and Heinrich (1984), unfed individuals did move significantly more often than fed antlions, even within as short a time period as 6 days. Perhaps this behavioral variation is due to differences among antlion species from Florida (this study) and those from Vermont (the Heinrichs' study). In addition there may be more suitable habitats (with more prey items) in subtropical areas (Krebs 1978), so that relocation may be more profitable in these areas than in temperate environments. Thus, antlions of different species may relocate their pits in response to different causal
Fig. 1. The number of pits relocated/day by fed and unfed Myrmeleon carolinus larvae.

factors. Arguments about the relative importance of factors determining ant lion dispersion may only be resolved if ant lions of the same species are tested.

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REFERENCES CITED

APHID PARASITOIDS (HYMENOPTERA, APHIDIIDAE)  
FROM GAUDELOUPE, WEST INDIES

PETR STARY
Institute of Entomology, Czechoslovak Academy of Sciences,  
Bramšovská 31, 37005 České Budějovice, Czechoslovakia

GEORGES REMAUDIERE
Institut Pasteur, 28 rue du Docteur Roux, 75724 Paris Cedex 15, France

JEAN ETIENNE
INRA Centre Antilles—Guyane, Station de Zoologie et de  
Lutte biologique, B.P. 1232, 97184 Pointe-a-Pitre Cedex, Guadeloupe

The distribution of aphid parasitoid species in mainland Central America as well as in the Antilles manifests several faunal features that should be investigated in more detail. For this reason, any information on parasitoids of this area may be valuable both from the fundamental and applied points of view.

The material used for the present account was collected and reared by J. Etienne in the course of his stay in Guadeloupe in 1984-1986. The aphids were identified by G. Remaudière and the parasitoids by P. Stary.

The only parasitoid species collected in Guadeloupe (1984-1986) from several aphid species was *Lyssiphlebus testaceipes* (Cress.). (Table 1). It is a widely oligophagous parasitoid, of Nearctic origin, but penetrates through C. America far into neotropical America, although its dominance seems to decrease southwards. *Lyssiphlebus testaceipes* is known from most of the Greater and Lesser Antilles, and from most of the Central American countries (Mackauer & Stary 1967). Southwards from Colombia and Venezuela it occurs together with *Aphidius colemani* Vier. (= *platensis* Brethes) which seems to be a typical and predominant species in most of S. America. *A. colemani* occurs as a common parasitoid in Colombia and Venezuela, but not in Central America. Almost certainly, it does not occur in Mexico (Stary & Remaudière 1982, 1983, Stary 1983), or in Cuba (Stary 1981) and is probably absent from the Greater Antilles. The results of the current study, showing the frequent occurrence of *L. testaceipes* in Guadeloupe, tend to confirm the absence of *A. colemani* in the southern Lesser Antilles. Trinidad occupies a peculiar position in this respect: Bennett (1985) failed to find any aphidid parasitoids of aphids there in 1962-1969, and only in 1969 he began to find aphids mummified by *L. testaceipes*. This allows us to classify Trinidad as apparently free of aphid parasitoids until about 1969: this situation was in a sharp contrast to the neighbouring Barbados where *L. testaceipes* was common (Bennett 1985), as well as to Venezuela where both *L. testaceipes* and *A. colemani* are common (Stary & Cermeli in press).