PREDATORY BEHAVIOR OF A PIT-MAKING ANTLION, *MYRMELEON MOBILIS* (NEUROPTERA: MYRMELEONTIDAE)

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The larvae of antlions (Neuroptera: Myrmeleontidae) are renowned for their predatory tactic: the construction of funnel-shaped pitfall traps in sandy substrate, beneath which they wait for prey. Pit-building behavior, however, is limited to the tribe Myrmeleontini (New 1986) and is characteristic of the genus *Myrmeleon* (Lucas & Stange 1981). The lie-in-wait predation strategy suggests that various prey will be encountered by the antlion larva. Plasticity of predatory behavior should increase the efficiency by which an opportunistic predator subdues and processes different types of prey. Therefore, I asked the question: does the behavioral response of a pit-building antlion, *Myrmeleon mobilis* Hagen, differ among prey types? In this study I characterize the predatory behaviors of *M. mobilis* and compare the sequence and frequency of these behaviors in response to three prey types.

Thirty late first- and second-instar *M. mobilis* larvae were collected from sheltered, sandy areas in Clemson, Pickens County, South Carolina, on 8 October, 1995. Larvae were placed individually in containers with 3 cm of sterilized sand, and held at 25 ± 1°C, 65 ± 5%RH, and a photoperiod of 12:12 (L:D). Each larva was allowed to construct a pit and then fed a maintenance diet of earwigs, *Euborellia annulipes* Lucas (Carcinophoridae); rearing continued for 12 days, until all individuals had reached late second instar. The three experimental prey species (length ± SD/max. width ± SD) were the termite *Reticulitermes flavipes* Kollar (Rhinotermitidae) [5.7 ± 0.85 × 1.2 ± 0.08 mm], the ant *Prenolepis imparis* Say (Formicidae) [4.22 ± 0.20 × 1.5 ± 0.17 mm], and the beetle *Alphitobius diaperinus* Panzer (Tenebrionidae) [6.13 ± 0.82 × 2.72 ± 0.13 mm].

Behavioral trials were conducted at 23-25°C. Each *M. mobilis* larva was presented with one individual of a randomly selected prey species. Prey was dropped into the center of the pit, to standardize introduction (Griffiths 1980), and the resulting interaction was videotaped at a distance of ca. 7 cm. Recording began with prey introduction and ended when the prey either escaped, or was consumed, and the larva returned to the pre-introduction 'ready position' (jaw set). Ten trials of each prey species were recorded and no larva was used in more than one trial. Descriptions of predatory behaviors were based on videotaped trials and direct observation. Each trial was reviewed, and sequence and frequency of behaviors noted. Significant behavioral transitions ($p = 0.05$) were identified using a first order, preceding-following, behavioral transition matrix (after Willey et al. 1992). Flow diagrams of significant transitions were constructed.

The following 12 discrete predatory behaviors were identified in the behavioral catalog of *Myrmeleon mobilis*:

1. Attack.

The head is moved rapidly forward while closing the mandibles, and is often flicked rapidly back, expelling sand from the pit.

2. Holding.

The prey is gripped securely in the mandibles.

3. Submergence.

Holding prey, the larva moves down and back into the substrate until the entire larva and at least part of the prey are not visible.

4. Emergence.

Holding prey, the larva moves up and forward until the entire prey and at least part of the larva's head/mandibles is visible.

5. Prey Beating.

Holding prey, the larva rapidly flicks its head up and down (4-5 beats per bout) (Fig. 1.), often drumming the prey on the substrate.

6. Feeding.

While at least one mandible tip is inserted, fluids are extracted from the prey, often alternating with mandibular probing and manipulation of the prey.

7. Pit Clearing.

The head is moved laterally, accumulating sediment on the dorsal surface, then flicked rapidly back, expelling sediment.

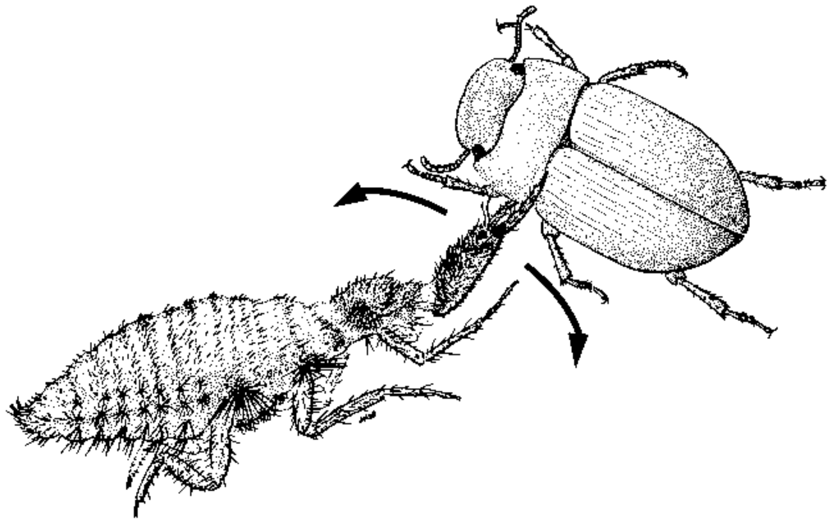

Fig. 1. Prey-beating behavior exhibited by *Myrmeleon mobilis* with beetle prey, *Alphitobius diaperinus*.

8. Head Roll.

The head is raised and swept in a circular motion along the pit wall, accumulating sediment in the pit center.

9. Prey Clearing.

The mandibles are used to position prey on the dorsal head surface, then the head is flicked rapidly back, expelling prey.

10. Grooming.

The tip of one mandible is moved along the groove on the inside edge of the opposing mandible.

11. Quiescence.

Larva remains motionless, without prey, for 7+ seconds.

12. Jaw Set.

The larva pulls beneath the sand, while fully opening the mandibles. The eyes, antennae and mandible tips remain visible.

Sequences for all prey types typically followed a core pattern of behaviors (Fig. 2), starting with attack and holding, followed by submergence, emergence, and feeding. After feeding ended, maintenance behavior generally occurred (prey clearing, pit clearing, head roll, and grooming) and, finally, jaw set. The major difference in behavioral sequence was prey beating behavior: 90% of the beetle prey-trials resulted in

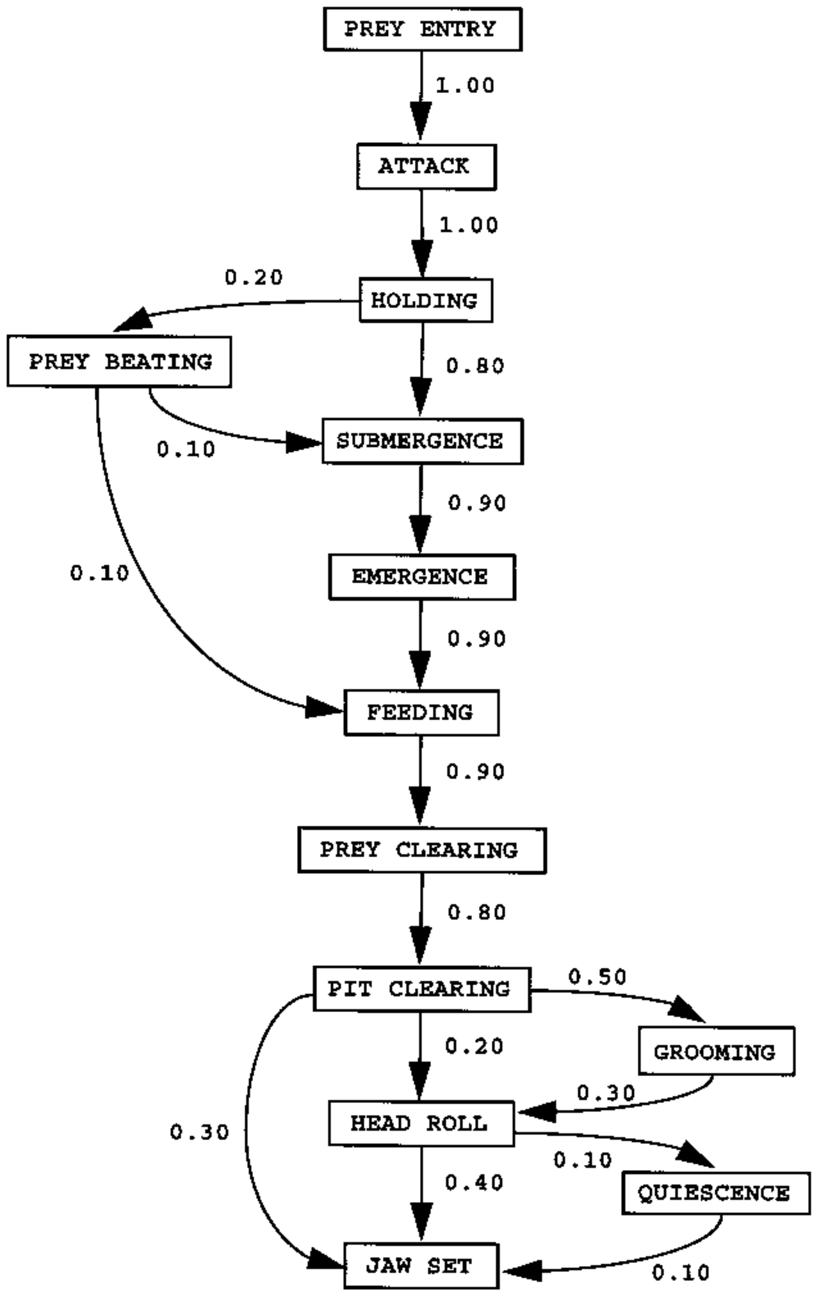

Fig. 2. Flow diagram of predatory behavior for *M. mobilis*, showing sequence of significant behavioral transitions ($p = 0.05$) and transition frequency ($n = 10$ trials) when presented with ant prey, *Prenolepis imparis*.

prey beating, compared to 20% of the ant trials, and 10% of the termite trials. The mean frequency of prey-beating bouts for the beetle (42.40 ± 12.59SE) was significantly different ($p \leq 0.005$) from that for both the termite (2.00 ± 2.00SE) and the ant (8.90 ± 7.57SE); the latter two were not significantly different (Tukey's, $p > 0.05$).

My field observation in areas of *M. mobilis* habitation revealed that taxa including Hymenoptera, Coleoptera, Orthoptera, and non-insect arthropods are consumed by antlion larvae. In the laboratory, *M. mobilis* larvae ate both soft and hard-bodied prey. However, trials with highly sclerotized prey (beetles) differed significantly from those with softer prey (ants and termites) in sequence and frequency of prey-beating behavior, demonstrating that the predatory response of *M. mobilis* varies with prey type. Prey-beating behavior may be an adaptation to facilitate mandibular penetration (in beetles, this usually occurred in a coxal joint or between tagma), or to disorient and subdue vigorously struggling prey. Griffiths (1980) described behavior similar to prey beating for 'difficult' prey in the feeding biology of *Morter obscurus* Rambur, and noted that treatment of hard and soft-bodied ant prey varied with respect to mandibular insertion. In addition, previous research suggests that phylogeny may be reflected by behavior (Mansell 1988, Matsura & Murao 1994). An interspecies comparison of predatory behavior in Myrmeleontidae may prove worthwhile in relating behavioral differences to phylogeny.

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Summary

The predatory behavior of a pit-making antlion, *Myrmeleon mobilis*, is characterized. Behavioral sequences among three prey types were similar, when compared via flow diagrams. A significant difference in behavioral frequency existed between hard-bodied and soft-bodied prey types.

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