escaping Myrmeleon pits than the P. ferruginea are.

To eliminate capture efficiency differences due to ant species rather than ant size, we suggest a future experiment using only one size of ant, and different sized Myrmeleon pits since capture efficiency directly affects the speed with which a larvae will reach adulthood, different capture rates of different sized ant lions could affect their eventual survivorship.

Table 1 Success Rates of Ant Lions at Palo Verde, Costa Rica. Ant Lion Pit Size. Numbers in parentheses are number of successes per number of trials.

	small	medium	large
small	(2/11) 18%	(5/9) 56%	(5/11) 45%
medium	(7/10) 70%	(6/9) 67%	(8/11) 72%
large	(1/10) 10%	(4/9) 44%	(4/10) 40%

PREDATION EFFICIENCY OF ANT-LION LARVAE

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Abstract (T.Gr.)

In this experiment, we determined that larger ant lion larvae are more effective predators than small ant lion larvae. We could not show, however, that there is a correlation between larvae size and predation efficiency. Perhaps factors other than how quickly ant lion larvae execute the predation cycle determine efficiency, like differences in prey density.

Introduction (T.Gr.)

Many insects metamorphose during their lifetime. Among these is the Ant Lion (Myrmeleon), a species that spends up to three years in the larval form before emerging as a nocturnal insect that resembles damsel-flies. The larvae spend these years living in conical pits that they build in sandy soil (Janzen, 1983). When an ant (or any other suitable arthropod) falls in the pit, the larva throws sand on the individual, catches the prey in its mandibles, and sucks the insect's fluids for nourishment.

The ant lion larva depends on this food-gathering method to enable it to grow to its adult stage. It would seem that the largest larvae, because they are stronger and have larger mandibles, would have the best chance of catching prey. Do these larger larvae, then, have a higher survival rate than smaller individuals? Does chance of survival increase as the larvae grow larger? In many animal species, foraging efficiency and chances for survival increase as the animals grow older and larger. Certain fish, for example, show an increase in predation success as they grow because their gape size increases and they therefore can catch more prey.

Because this trend has been noted in various animals, we hypothesized that there is also a correlation between size of ant lion larvae and their predation effectiveness and efficiency. To examine this, we formed five hypotheses:

1) Effective ant lion larvae (those that capture) are significantly larger than ineffective larvae (those that fail to capture).
2) Overall cycle time of predation is shorter for large ant lion larvae than for small ant lion larvae.
3) Capture time is shorter for large ant lion larvae than for small ant lion larvae.
4) Ingestion time is shorter for large larvae than small larvae.
5) Pit reconstruction time is shorter for large larvae than for small larvae.

Methods (T.Gr.)

We conducted our experiment on the front lawn of the OTS Field Station in Palo Verde, Costa Rica. We collected data from 0827 hours to 1717 hours on January 10, 1991. We selected fifty ant lion larvae pits, ensuring that they were in similar soil types. The pits we selected ranged in diameter from 0.8cm to 4.4cm. Because pit size correlates positively to the resident larva size (Janzen, 1983), we used these pit diameters as a measure of relative larva size.

To test our five hypotheses, we watched fifty ant lion's in a predatory situation, collecting data on capture success, overall cycle time, capture time, ingestion time, and pit reconstruction time. To do this, we collected acacia ants (Pseudomyrmex ferruginea) from an acacia tree (Acacia collensii) two meters off the road east of the field station. We used only healthy adult ants of similar size in each of the trials. We then marked twelve holes with numbered flags made from nails and marking tape. We began testing these twelve pits within a few minutes of each other, overlapping the trials and watching them simultaneously so that we could have a sufficient sample size.

For each trial, we dropped an acacia ant in a larval pit, recording the beginning of the trial as the point when the ant hit the center of the pit. Following contact, we recorded the times of: capture (defined as the point at which the larva's mandibles grabbed the ant), any releases and recaptures; the time when the ant stopped struggling, the time the larva tossed the ant carcass from the pit; the time the larva finished reconstructing its pit. If the ant escaped, we recorded that time and ended the trial there.

To test our first hypothesis, we compared the sizes of larvae who successfully captured prey to the sizes of those who failed to successfully capture prey (capture success). The overall cycle time (hypothesis 2) was measured as the total time from contact to end of pit reconstruction. We defined capture time (hypothesis 3) as the time from the beginning of the trial to the time of the last capture in the same series. Ingestion time (hypothesis 4) was defined as the time of the final capture to the time the larva tossed the ant carcass from the pit. We defined pit reconstruction time (hypothesis 5) as the time from carcass expulsion to the end of reconstructive activity.

We repeated this procedure in three further rounds, watching 13, 12, and 13 larvae respectively at different sites for a total of fifty trials.

Results (T.Go.)

Our data supported hypothesis 1, showing a significant difference between size of larvae that captured successfully and size of larvae that failed to capture (Us = 242, n = 20, $n_2 = 15$, $p < 0.05$) (Table 1). The data did not support hypotheses 2 through 5,

however, showing that there were no significant correlations between size of the larvae and the various times of the predation cycle which we tested:

H2: $r_s = -0.632$; $r^2 = 0.399$; $U = 27_1 = 0.05$

H3: $r_s = -0.208$; $r^2 = 0.043$; $U = 31_1 = 0.05$

H4: $r_s = -0.566$; $r^2 = 0.320$; $U = 21_1 = 0.05$

H4: $r_s = -0.337$; $r^2 - 0.114$; $U = 13_1 = 0.05$

Discussion (T.Go.)

Although we set out to show that predation efficiency increases with the size of the ant lion larvae, our one hypothesis that was supported (hypothesis 1) really showed how the predation effectiveness of larvae is significantly related to their size. Some traps were just too small to be effective on the ants we used. Therefore, we see that there is a significant difference between size of effective larvae that do capture prey and size of ineffective larvae that fail to capture prey.

The fact that none of the tests of our correlation hypotheses (hypotheses 2-5) produced significant results is a bit more difficult to explain, as it seems intuitive that predation should increase with the size of the predator. The time it takes to capture, ingest the prey and reconstruct the pit for the next predatory cycle should be shorter for larger predators handling equal sized prey if they are more capable of dealing with prey. We did not see significant correlations for one of 2 reasons.

1) Perhaps there really were relationships but inappropriate definition of the time period of the predation event prevented these from appearing. We strictly defined our criteria for when a predation cycle began and ended, and assumed that the larva could only be ready for another prey item once the first carcass was tossed and the trap was completely reset. We cannot say this for sure. Maybe some ant lions were ready for the next prey while they still had the first prey item in their midst. Since we never allowed another ant into the pit before the cycle was complete, we cannot be sure that the larger ones were not ready sooner. So there may still be a significant correlation if larger larvae were in fact ready sooner than what we designated as the end of the cycle.

2) There really were no relationships and there is some other explanation why larger larvae were not faster at executing the predation cycle than the smaller larvae. Perhaps how fast a larvae captures prey is not a realistic measure of predation efficiency. Maybe it's not how fast the larva is, but where the pit is located that influences the length of the predation cycle. If a larvae is in an area of greater prey density than another larva, then it may be capture more prey irrespective of the length of the predation cycle. In addition if

these larvae are only getting prey once every three days or so, then the 45 minute cycles that we observed would be an insignificant time frame in the grand scheme of overall predation. Therefore, perhaps the amount of time a larvae takes to execute the predation cycle is not a selective force, and one should not expect larger larvae to execute the cycle any faster than smaller larvae. Thus, even though size influences predation efficiency in many animals, it does not seem to be a factor for ant lion larvae.

Literature Cited

Costa Rican Natural History. Janzen, Dan, ed. Chicago University Press, 1983.