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Red imported fire ants (Hymenoptera: Formicidae) are unsuitable prey for a native antlion (Neuroptera: Myrmeleontidae) in Florida

David G. Brothers and James K. Wetterer

Adventive species often prey on or otherwise have a negative impact on native species. For example, *Solenopsis invicta* Buren (Hymenoptera: Formicidae), a fire ant native to the grasslands of South America, has become an important pest in the southeastern U.S., where it commonly preys on native wildlife (Allen et al. 2004). Adventive species may also be unsuitable or even toxic prey. For example, the cane toad, *Rhinella marina* (L.) (Anura: Bufonidae), is native to the Neotropics but is now established in Australia, where it has had severe consequences for many native Australian predators, which naïvely feed on the toads and then die from the toad's toxins (Doody et al. 2009). Conversely, Glenn & Holway (2008) found that native antlions in California fed on a diet of the Argentine ant, *Linepithema humile* (Mayr) (Hymenoptera: Formicidae), showed increased growth rates and no difference in survival compared with larvae feeding on native ants. In this study, we sought to examine the suitability of *S. invicta* as prey for the antlion *Myrmeleon crudelis* Walker (Neuroptera: Myrmeleontidae), which occurs in Florida.

Solenopsis invicta arrived in North America by ship in Mobile, Alabama, in the 1930s and has spread across the southeastern U.S. and northeastern Mexico. More recently, *S. invicta* has become established the West Indies and parts of the Old World (Wetterer 2013).

Myrmeleon crudelis larvae are sit-and-wait predators that reside at the bottom of conical pits dug into sandy soils. Small arthropods, such as ants, that fall into the pit are often unable to climb out and are captured by the antlion larva (Farji-Brener 2003). *Myrmeleon crudelis* is widespread in North and Central America, where it is most often found in sheltered areas (Lucas & Stange 1981).

We collected *M. crudelis* larvae at 3 sites in southeastern Florida: below building eaves at Bathtub Beach in Stuart (Martin County; 27.186°N, 80.160°W); beneath the boardwalk in Juno Beach (Palm Beach County; 26.895°N, 80.057°W); and at the Abacoa Greenway in Jupiter (Palm Beach County; 26.898°N, 80.115°W). We used a ladle to scoop out antlion pits and put the sand into a plastic tub, which we brought back to the laboratory. In a separate bucket, we collected sand from Juno Beach to use in the experiments.

We sifted the collected sand through a sieve to remove the larger pieces of detritus and mixed the sand to ensure a homogeneous substrate. We labeled 266 mL plastic cups (n = 32) and filled them each about 75% full with the homogenized sand. The room was kept at 26 ± 1 °C and lit by natural sunlight.

After about 36 h in the laboratory, we weighed 32 *M. crudelis* larvae to the nearest 0.1 mg by using an electronic balance. We placed each larva into a separate cup of sand and sprayed each cup with deionized pH 7 water. We waited 36 h for larvae to build pits before introducing prey.

Using an aspirator, we collected workers of *S. invicta* and the native pyramid ant *Dorymyrmex bureni* (Trager) (Hymenoptera: Formicidae) on the Jupiter campus of Florida Atlantic University, where these are 2 of the most common ant species in open areas. Field-collected ants were stored in capped vials; immediately prior to feeding, prey were placed in a freezer for 10 min to immobilize or kill them. To account for the size differences between individuals of *S. invicta* workers, which are polymorphic, and *D. bureni* workers, which are monomorphic, we weighed each ant and used only workers of about 3 mg (*S. invicta* = 3.2 ± 0.4 mg; *D. bureni* = 2.9 ± 0.2 mg [mean ± SD]). Using forceps, we placed 1 *S. invicta* worker in each of the 16 even number cups, and 1 *D. bureni* worker in each of the 16 odd number cups.

The *M. crudelis* larvae reacted immediately by flinging sand to de-stabilize the ant so that it fell to the bottom of the pit, and larvae demonstrated no noticeable difference in their treatment of the 2 ant species. We fed each antlion 1 ant per week for 12 wk or until the antlion died. Every 4 wk, we weighed each antlion and returned it to the same cup. We then sprayed the sand with deionized pH 7 water to ensure that the antlions did not desiccate during the experiment. We calculated average growth rate of antlions as final live mass minus starting mass divided by number of weeks fed. One *M. crudelis* larva fed *S. invicta* workers died before the first re-weighing at 4 wk and was excluded from the analysis.

The average growth rate was lower for *M. crudelis* larvae fed *S. invicta* workers than for *M. crudelis* larvae fed *D. bureni* workers (–0.2 mg/wk vs. 0.2 mg/wk; $P < 0.05$; 2-tailed t-test). Mortality was higher for *M. crudelis* larvae fed *S. invicta* workers; 5 of 16 died during the course of the study, with no deaths among the 16 *M. crudelis* larvae fed *D. bureni* workers ($P < 0.05$; Fisher's exact test).

Because the growth and survival rates of *M. crudelis* larvae fed *S. invicta* workers were significantly lower than of those fed *D. bureni* workers, we conclude that *S. invicta* is unsuitable prey for *M. crudelis*. If indeed *S. invicta* is unsuitable prey, it may have a negative impact on *M. crudelis* and possibly other antlions in areas where it invades. Similarly, Myers et al. (2014) found that northern bobwhite, *Colinus virginianus* (L.) (Galliformes: Odontophoridae), chicks in Texas that fed on *S. invicta* had reduced survival and weight gain. In addition, ingestion of *S. invicta* by fish has repeatedly been implicated in fish-kills in North America (Crance 1965; Contreras & Labay 1999). If *S. invicta* is also a poor or even toxic food source for ant-feeding predators, this suggests that there may be broader implications concerning the impact of *S. invicta* on native species than currently recognized.

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In North America, the eastern mole, *Scalopus aquaticus* (L.) (Eulipotyphia: Talpidae), selectively avoids feeding on *S. invicta* (Hartman et al. 2000), but many native species have been observed feeding on *S. invicta*, including southern toads, *Anaxyrus terrestris* (Bonnaterre) (Anura; Bufonidae) (Moseley et al. 2004); eastern narrow-mouthed toads, *Gastrophryne carolinensis* Holbrook (Anura: Microhylidae) (Deyrup et al. 2013); and nine-banded armadillos, *Dasypus novemcinctus* L. (Cingulata: Dasypodidae) (Loughry & McDonough 2013). Given the ubiquity of *S. invicta* in many regions of North America, vertebrate and invertebrate predators may be regularly consuming *S. invicta*, which may be a previously unrecognized factor influencing predator health and mortality.

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Summary

We examined the suitability of S*olenopsis invicta* Buren (Hymenoptera: Formicidae) as prey for a native antlion, *Myrmeleon crudelis* Walker (Neuroptera: Myrmeleontidae), in south Florida. We found that average growth rate was significantly lower and mortality was significantly higher for *M. crudelis* larvae fed *S. invicta* workers than for *M. crudelis* larvae fed *Dorymyrmex bureni* (Trager) (Hymenoptera: Formicidae) workers. Thus, *S. invicta* appears to be unsuitable prey for *M. crudelis* and may have a negative impact on *M. crudelis* and other ant predators in areas where it invades.

Key Words: biological invasion; exotic species; invasive species; *Myrmeleon*; *Solenopsis*

Sumario

Se examinó la idoneidad de *Solenopsis invicta* Buren (Hymenoptera: Formicidae) como presa para el leon de hormigas nativo, *Myrmeleon crudelis* Walker (Neuroptera: Myrmeleontidae) en el sur de la Florida. Se encontró que el promedio de la tasa de crecimiento fue significativamente más baja y la mortalidad fue significativamente mayor para larvas de *M. crudelis* alimentadas de trabajadores de *S. invicta* que para las alimentadas de trabajadores de *Dorymyrmex bureni* (Trager) (Hymenoptera: Formicidae). Entonces, parece que *S. invicta* no es una presa adecuada para *M. crudelis* y puede tener un impacto negativo sobre *M. crudelis* y otros depredadores de hormigas en las zonas donde la especie invada.

Palabras Clave: invasión biológica; especies exóticas; especies invasivas; *Myrmeleon*; *Solenop*sis

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