

**LARRA BICOLOR (HYMENOPTERA: SPHECIDAE), A
BIOLOGICAL CONTROL AGENT OF SCAPTERISCUS MOLE
CRICKETS (ORTHOPTERA: GRYLLOTALPIDAE),
ESTABLISHED IN NORTHERN FLORIDA**

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Larra is a largely tropical genus of digger wasps (Sphecidae) with atypical behavior. Typical sphecid females sting and paralyze other arthropods which then are taken to cells where they serve as food for larvae. *Larra* females attack and sting mole crickets (Gryllotalpidae), which suffer paralysis for only a few minutes. The *Larra* females oviposit on the mole crickets that they have paralyzed, and the neonate larvae develop as external parasitoids on active hosts (Bohart & Menke 1976). The only known hosts of *Larra* are mole crickets.

Larra analis F. is the only species native to coastal southeastern USA, and its host is *Neocurtilla hexadactyla* (Perty), the only mole cricket native to this region. Three immigrant species of mole crickets of the genus *Scapteriscus* arrived in the southeastern USA about 1900. Tens of thousands of these *Scapteriscus* mole crickets have been examined by personnel of the University of Florida's mole cricket research program since 1978, but none was found with an egg or larva of *L. analis*. This is strong evidence that *L. analis* does not attack *Scapteriscus* spp. in nature.

Some mole cricket species are pests of agriculture and horticulture. Notable examples are *Gryllotalpa orientalis* Burmeister in Hawaii, *Scapteriscus didactylus* (Latreille) in Puerto Rico and some other West Indian Islands, and *Scapteriscus vicinus* Scudder, *S. abbreviatus* Scudder, and *S. borellii* Giglio-Tos in the southern USA

(Frank 1994). These five species are immigrants in these areas and have been subject to classical biological control, i.e., the attempted introduction of natural enemies from their homelands into the areas where they are immigrants.

The earliest attempts at classical biological control of mole crickets used species of *Larra*. *Larra amplipennis* (F. Smith) introduced in 1921 from the Philippines and *L. bicolor* F. introduced in 1924 from Brazil did not become established in Hawaii, but *L. polita* (F. Smith) subspecies *luzonensis* Rohwer, introduced in 1925 from the Philippines, did become established (Williams 1928, Bohart & Menke 1976). *Larra bicolor*, introduced from Belem, Pará, Brazil, became established in Puerto Rico by 1941 (Wolcott 1938, 1941). We have discovered no assessment of the effectiveness of these wasps in suppressing mole cricket populations in Hawaii and Puerto Rico.

An attempt was made in the 1940s to introduce *L. bicolor* into Florida, summarized by Frank (1990). Plantings were made of *Spermacoce verticillata* L. and *Hyptis atrorubens* Poit. (nectar-bearing plants favored by *L. bicolor*) at Gainesville, and flowers of the latter attracted *L. analis*. Unfortunately, *L. bicolor* adults and larvae shipped from Brazil were dead on arrival in Florida and the attempt was not repeated in that decade.

A renewed effort was made to import *L. bicolor* into Florida beginning in 1979 under the leadership of R. I. Sailer, as part of the University of Florida's mole cricket research program. J. L. Castner, H. G. Fowler, W. G. Hudson, and J. R. Reinert (University of Florida) and E. Abreu (University of Puerto Rico) participated. Puerto Rican populations were surveyed and five sites for release were identified in Florida; these sites were prepared with plantings of *Spermacoce verticillata*. In 1981, scores of female wasps were released at Ft. Lauderdale, Gainesville, and Tampa, in 1982 at Bradenton and Ft. Lauderdale, and in 1983 near Lakeland. However, a population of *L. bicolor* became established only at Ft. Lauderdale (Sailer 1985, Frank 1990).

By late 1984, the Ft. Lauderdale *L. bicolor* population occupied two sites: a golf course, and the University of Florida's Agricultural Research Station, about 1 km distant. Attempts to expand the population to additional sites were unsuccessful (Castner 1988a). Mole crickets were trapped to assess the proportion infected with eggs or larvae of *L. bicolor*. Only *S. abbreviatus* were found infected; however, the combined number of trapped *S. borellii* and *S. vicinus* accounted for only 15% of the total ($n = 677$) collected in pitfall traps (Castner 1988a). Only 1% of mole crickets examined were infected with eggs or larvae (Castner 1988a). Establishment of *L. bicolor* only at Ft. Lauderdale and not at the four more northerly sites in Florida suggested that this wasp, of tropical origin, could not withstand colder or longer winters farther north in Florida. This theory was supported by poor survival of wasp pupae overwintered outdoors experimentally at Gainesville (Castner 1988a).

F. D. Bennett joined the mole cricket research program in 1985. He shared J. L. Castner's view that "Puerto Rican" *L. bicolor* had not become established in northern Florida because of the equatorial origin of this biotype at low altitude in Belem. He thought that a *Larra* stock from southern South America, or from high altitude elsewhere in South America, might be better adapted to survive in northern Florida. Although *Larra* females of other species had been observed to attack *Scapteriscus* mole crickets in South America (i. e., Uruguay and southern Brazil), only small numbers of these other *Larra* had been observed, and their identity was tenuous due to incomplete systematic treatment (Frank 1990). Bennett began studies on *Larra* with C. J. Pruett at Santa Cruz de la Sierra, Bolivia, where species attributed to *L. bicolor* and *L. braunsii* Kohl (and perhaps a third species) occurred (Frank 1990). By this time, A. S. Menke was revising Neotropical *Larra*. His identifications convinced Bennett and Pruett that they were dealing with *L. bicolor* and *L. praedatrix* (Strand), on which

they published behavioral notes (Bennett & Pruett 1991, Pruett & Bennett 1991). Live *Larra* were brought to Florida for release in Alachua County in 1988-1989. It is likely that specimens of three species, *L. bicolor*, *L. praedatrix*, and *L. godmani* Cameron (senior synonym of *L. braunsii* Kohl), were imported and released, but in unknown proportions. Female *L. praedatrix* and *L. bicolor* are not distinguishable with certainty (Menke 1992).

The release sites were as follows: Micanopy, about 10 km south of Gainesville (October 1988) where 175 ♀ wasps, 35 ♂ wasps, and 80 mole crickets bearing *Larra* eggs were released; the North Florida Regional Medical Center, Gainesville (March and May 1989) where 86 ♀ wasps, 24 ♂ wasps, and 29 mole crickets bearing *Larra* eggs were released; and the University of Florida Honey Plant, Gainesville (June 1989) where 13 ♀ wasps and 23 ♂ wasps were released. The Honey Plant site was the same location where *L. bicolor* had been released by R. I. Sailer in 1981. This site contained the original plot of *Spermacoce verticillata* planted by Sailer.

Spermacoce verticillata plants were brought from Miami to Gainesville in 1987 by J. H. Frank and maintained in pots. These plants were established in 1991 at the southeast corner of the new Entomology/Nematology building of the University, about 2 km northwest of the Honey Plant. In 1992, A. S. Menke published his major revision of Neotropical *Larra*, allowing reliable identification for the first time. No *Larra* were observed in Gainesville before the retirement of F. D. Bennett in July 1993 and his departure from Florida.

In October 1993, Entomology/Nematology Dept. technician J. A. Gillmore reported observing a wasp attack a mole cricket outside the departmental building. *Larra* adults were then observed feeding on flowers of *Spermacoce verticillata* in the plot at the southeast corner of the building. Dissection and microscopic examination revealed that these were *L. bicolor* (not *L. analis* or *L. godmani* or *L. praedatrix*). Microscopic examination further revealed a dense punctation of the vertex of the head typical of specimens from Santa Cruz, Bolivia, and not a sparse punctation typical of specimens from Puerto Rico (Menke 1992). *Larra* adults with the same morphological characteristics were found at the Honey Plant release site. We concluded that the wasps found were progeny of those released by F. D. Bennett in 1988-1989, originating from Bolivia.

Wasps were seen at the *Spermacoce* plot at the Entomology/Nematology building almost daily through the autumn of 1993. The last observation was on 9 December 1993, whereafter freezing temperatures occurred and the foliage was killed by frost. The plants regenerated in spring 1994, and the first *Larra bicolor* was seen on 9 May 1994. Wasps were seen occasionally in the plot during subsequent weeks to September 1994, but at a lower density than in the autumn of 1993. Peak wasp abundance at Ft. Lauderdale occurs in autumn (Castner 1988a), therefore, relatively low numbers in spring and summer are not surprising. In August 1994, a *Larra bicolor* female was observed by P. G. Koehler 2 km northeast of the Entomology/Nematology building at the University of Florida track and field complex. Adult wasps have been observed at the Entomology/Nematology building from October 1993 to September 1994. The population has spread a distance of at least 4 km, which is greater than ever observed at Ft. Lauderdale.

Life histories and behavior of *Larra analis* and of *Larra bicolor* are described by Smith (1935) and Castner (1988b), respectively. Under laboratory conditions *Larra bicolor* will sometimes attack *Neocurtilla hexadactyla* but is thwarted by the defensive secretion of this mole cricket (Castner 1984) or the inability of the larvae to develop on the host (Pruett & Bennett 1991). *Larra analis* has not been found to infect *Scapteriscus* mole crickets under field conditions. The native wasp is specialized to the na-

tive mole cricket, and the introduced wasp is specialized to immigrant (pest) mole crickets of the genus *Scapteriscus*.

Larra bicolor joins *Steinernema scapterisci* Nguyen & Smart (Rhabditida: Steinernematidae) and *Ormia depleta* (Wiedemann) (Diptera: Tachinidae) as South American biological control agents established in Alachua County, Florida as natural enemies of *Scapteriscus* mole crickets.

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SUMMARY

Larra bicolor, a biological control agent of *Scapteriscus* mole crickets, has established a population in Gainesville, northern Florida. This population results from specimens collected in Santa Cruz de la Sierra, Bolivia, and released by F. D. Bennett in 1989. Previously, a Florida population of this wasp had been established only at Ft. Lauderdale in southern Florida; it resulted from releases made in the early 1980s by R. I. Sailer. The proximal origin of the Ft. Lauderdale population of *L. bicolor* is Puerto Rico, but its initial home of origin is Belem, Pará, Brazil.

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