

Association of Soldier Beetle (Coleoptera: Cantharidae) Population Decline with Red Imported Fire Ant (Hymenoptera: Formicidae)¹

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Regular observations of mating aggregation behavior of the common soldier beetle, *Chauliognathus pennsylvanicus* De Geer, on goldenrod, *Solidago* spp., and wingstem, *Verbesina alternifolia* L., were recorded from 1975 through 1993. During this time, mating pairs of this beetle were plentiful during late-summer and early-fall in old fields in the vicinity of Athens, GA (Clarke Co.). For example, in September 1991, 40 copulating pairs and 83 solitary beetles (46 males, 37 females) were collected from a single field of goldenrod in about 1 h. By 1995, extensive searching in the same area rarely revealed even a single adult.

We hypothesized that the arrival and subsequent increasing abundance of the red imported fire ant, *Solenopsis invicta* Buren, in the area was responsible for the decline in numbers of *C. pennsylvanicus*. *Solenopsis invicta* first appeared in the Athens vicinity about 1985 (K. G. Ross, pers. comm.). It became common in disturbed habitats by the early 1990s, coinciding with the disappearance of the soldier beetles. The range of *S. invicta* now includes all of northern Georgia and parts of western South Carolina.

To test our hypothesis, we surveyed a total of 37 sites in 12 counties (Fig. 1) in northeastern Georgia and western South Carolina in September of 2001 and 2002 for *C. pennsylvanicus* and *S. invicta*. Surveys were conducted on 12, 13, 17, 20 and 23 September 2001 and 7, 14, 16, and 28 September 2002. All observations were made between 1000 h to 1500 h while temperatures ranged above 21°C with the weather dry and mostly sunny. Each site was a disturbed old field habitat with flowering goldenrod and/or wingstem. Sites were selected based on a visible abundance of goldenrod and/or wingstem and were at least 1 km apart. No sites were more than 120 km apart. Although we would have liked to survey all sites in both years, several

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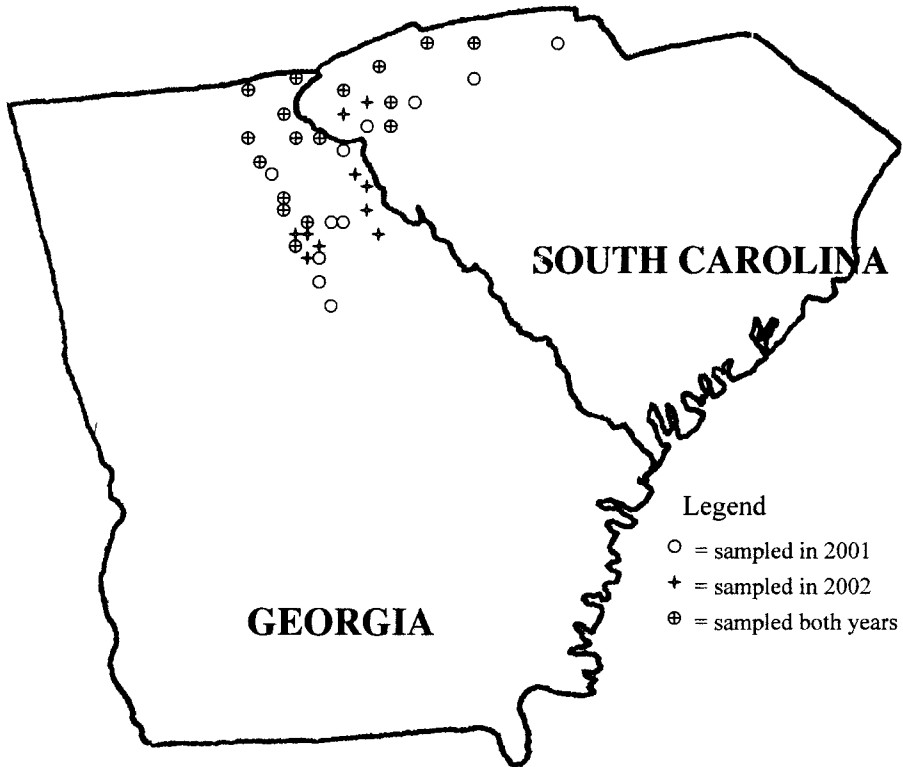


Fig. 1. Sites sampled in South Carolina and Georgia.

of the sites we had selected in 2001 did not have an abundance of goldenrod or wingstem in 2002 and were not surveyed. We visually searched for *C. pennsylvanicus* adults crawling on flowering sprays of these plants. We also surveyed for foraging fire ant workers using 5 bait stations with vegetable oil and dry cat food (Special Kitty®, 2 pieces, shaken with 2 mL of vegetable oil) placed on the ground at 2-m intervals across the plot. Baits were inspected for foragers after 10 min. In addition, we visually inspected each habitat for active fire ant mounds. Fire ants were scored as simply present or absent, and no attempt was made to estimate relative abundance.

Counts of beetle abundance began as soon as the first adult was seen. During the following 15 s, the total number of individuals seen while walking from plant to plant was recorded. If no soldier beetles were found after a 5 min search of the entire plot, the site was recorded as having no soldier beetles.

The mean number of soldier beetles found at sites where fire ants were determined to be present was compared to the mean number of soldier beetles at sites where fire ants were determined to be absent. For statistical analyses, we used a *t*-test (samples of unequal variance, $\alpha = 0.05$) (SAS 2001).

In 2001, 27 sites were surveyed (Table 1). *Solenopsis invicta* was detected at 15 sites, and *C. pennsylvanicus* was found at 12 sites. Both species were found at 4

Table 1. Occurrence of *Solenopsis invicta* Buren and *Chauliognathus pennsylvanicus* De Geer at 27 sites sampled during September 2001 in north-east Georgia and western South Carolina

Sample location	GPS coordinates (decimal degrees)	Fire ant presence*	Number of individual soldier beetles**
Anderson Co., SC	34.4793°N, 82.5552°W	+	1
Banks Co., GA	34.2433°N, 83.4575°W	+	0
Barrow Co., GA	33.9550°N, 83.5780°W	+	0
Clarke Co., GA	33.9300°N, 83.3533°W	+	0
Greenville Co., SC	34.7474°N, 82.2237°W	+	0
Habersham Co., GA	34.7541°N, 83.6072°W	+	1
Jackson Co., GA	34.1111°N, 83.4339°W	+	0
Jackson Co., GA	34.1307°N, 83.4267°W	+	0
Oconee Co., SC	34.7789°N, 83.1150°W	+	0
Oconee Co., SC	34.7568°N, 83.0377°W	+	8
Oconee Co., GA	33.8826°N, 83.4193°W	+	0
Oconee Co., GA	33.8878°N, 83.4150°W	+	0
Oconee Co., GA	33.8998°N, 83.3872°W	+	1
Spartanburg Co., SC	34.9291°N, 81.9591°W	+	0
Stephens Co., GA	34.5995°N, 83.2300°W	+	0
Banks Co., GA	34.2303°N, 83.4038°W	–	0
Franklin Co., GA	34.4438°N, 83.2659°W	–	15
Habersham Co., GA	34.7363°N, 83.3924°W	–	0
Habersham Co., GA	34.7699°N, 83.5898°W	–	0
Oconee Co., SC	35.0020°N, 83.0250°W	–	11
Oconee Co., SC	34.9158°N, 83.0404°W	–	7
Oconee Co., SC	34.9528°N, 83.0189°W	–	13
Oconee Co., SC	34.7821°N, 83.0187°W	–	3
Oconee Co., SC	34.9170°N, 83.0114°W	–	5
Rabun Co., GA	34.7558°N, 83.3958°W	–	0
Rabun Co., GA	34.9690°N, 83.3889°W	–	9
Rabun Co., GA	34.8449°N, 83.5893°W	–	7

* As determined by cat-food baits and the presence of active mounds.

** Individuals observed during a 15 second survey.

Table 2. Occurrence of *Solenopsis invicta* Buren and *Chauliognathus pennsylvanicus* De Geer at 27 sites sampled during September 2002 in north-east Georgia and western South Carolina

Sample location	GPS coordinates (decimal degrees)	Fire ant presence*	Number of individual soldier beetles**
Anderson Co., SC	34.4793°N, 82.5552°W	+	0
Banks Co., GA	34.2433°N, 83.4575°W	+	0
Clarke Co., GA	33.9300°N, 83.3533°W	+	0
Clarke Co., GA	33.9906°N, 83.3974°W	+	0
Clarke Co., GA	33.9606°N, 83.3076°W	+	0
Clarke Co., GA	33.9585°N, 83.4377°W	+	0
Jackson Co., GA	34.0518°N, 83.4122°W	+	0
Franklin Co., GA	34.2941°N, 83.2537°W	+	0
Jackson Co., GA	34.1613°N, 83.4433°W	+	0
Jackson Co., GA	34.1830°N, 83.4412°W	+	0
Madison Co., GA	34.1134°N, 83.2271°W	+	0
Oconee Co., SC	34.6650°N, 83.0364°W	+	0
Oconee Co., SC	34.7970°N, 83.0364°W	+	0
Stephens Co., GA	34.5995°N, 83.2300°W	+	0
Banks Co., GA	34.2303°N, 83.4038°W	+	0
Franklin Co., GA	34.4438°N, 83.2659°W	+	0
Habersham Co., GA	34.7363°N, 83.3924°W	+	0
Habersham Co., GA	34.7699°N, 83.5898°W	+	0
Oconee Co., SC	35.0020°N, 83.0250°W	–	15
Oconee Co., SC	34.9158°N, 83.0404°W	–	4
Oconee Co., SC	34.9528°N, 83.0189°W	–	3
Oconee Co., SC	34.7821°N, 83.0187°W	–	0
Oconee Co., SC	34.9170°N, 83.0114°W	+	0
Rabun Co., GA	34.7558°N, 83.3958°W	+	0
Rabun Co., GA	34.9690°N, 83.3889°W	–	6
Rabun Co., GA	34.8449°N, 83.5893°W	–	1

* As determined by cat-food baits and the presence of active mounds.

** Individuals observed during a 15 second survey.

sites. The mean number of soldier beetles at sites where *S. invicta* was detected was 0.73 (SEM = 0.51). The mean number of soldier beetles at sites where *S. invicta* was not detected was 5.83 (± 1.49). A *t*-test revealed that the mean number of soldier beetles at sites where fire ants were detected was significantly lower than the mean

number of soldier beetles at sites where fire ants were not detected ($t = 2.789$; $df = 25, 1$; $P = 0.004$).

In 2002, 26 sites were surveyed (Table 2). *Solenopsis invicta* was present at 19 of these sites, and *C. pennsylvanicus* was present at 7. In 2002, there were no sites that contained both species. At sites where *S. invicta* was not detected, the mean number of soldier beetles was $4.14 (\pm 1.86)$. A t -test revealed that the mean number of soldier beetles at sites where fire ants were detected was significantly lower than the mean number of soldier beetles at sites where fire ants were not detected ($t = 1.793$; $df = 18, 1$; $P = 0.041$).

Sixteen sites were sampled both years. The mean number of soldier beetles at these sites in 2001 was $4.44 (\pm 1.31)$ and the mean number of soldier beetles at these sites in 2002 was $1.81 (\pm 0.99)$. A paired t -test revealed that there was a significant decrease in the mean number of soldier beetles at each site ($t = 2.260$; $df = 15, 1$; $P = 0.019$). At 6 of these sites fire ants were detected in 2002 but not in 2001. Fire ants were detected at 3 of these sites both years, and fire ants were not detected in either year at 7 sites.

While preliminary and non-exhaustive, our long-term observations and current survey suggest that local occurrence and abundance of *C. pennsylvanicus* may be negatively associated with the presence of the red imported fire ant. While association does not automatically equate to causation, we feel these results are sufficient to report this potential interaction.