

# Comparative Biology of Three *Scymnus* Lady Beetles (Coleoptera: Coccinellidae): Predators of *Adelges tsugae* (Homoptera: Adelgidae)

Wenhua Lu<sup>1</sup> and Michael E. Montgomery<sup>2</sup>

## Abstract

*Scymnus* (*Neopullus*) *sinuanodulus* Yu et Yao, *S. (N.) camptodromus* Yu et Liu, and *Scymnus* (*Neopullus*) n. sp. (in press<sup>3</sup>) were collected in the People's Republic of China from hemlocks infested with the hemlock woolly adelgid, *Adelges tsugae* Annand. To date, 3 of the 14 provinces in China where hemlock occurs naturally have been surveyed; *S. sinuanodulus* was found in Yunnan, *Scymnus* n. sp. was found in Shaanxi, and *S. camptodromus* was found in Yunnan and Sichuan. The three lady beetles were imported from 1996 to 1998 to the USDA Forest Service Quarantine Laboratory in Ansonia, Connecticut, for evaluation as biological controls of *A. tsugae*. This report discusses the development, oviposition, and feeding behavior of the three species.

Development of immature stages of all three species was compared at 20°C. Eggs of *S. sinuanodulus* and *Scymnus* n. sp. hatched 8 to 10 days after being laid. Eggs of *S. camptodromus* hatched only after they had been held for two or more months at room temperature, followed by a month or more at cold temperature, and then returned to room temperature. Larval development of *S. sinuanodulus* and *S. camptodromus* was completed in 20 days. Larval

development of *Scymnus* n. sp. was 4 days faster. All three species spent 8 to 10 days in the pupal stage. Both larvae and adults fed on all stages of *A. tsugae*, but all three species grew best if the egg stage was available. Mortality of first instars was very high unless they had adelgid eggs or first instar crawlers as food.

Adults became quiescent at cool temperatures (5°C). We saw no evidence of a true diapause in adults regardless of temperature or photoperiod. Adults became active within a few hours after removal from overwintering conditions; all of *S. sinuanodulus* and *Scymnus* n. sp. fed within 24 hours and laid eggs within 48 hours. It took several days for all of *S. camptodromus* to begin feeding, and egg laying and oviposition did not occur during the first 2 weeks. The oviposition rate of *S. sinuanodulus* and *Scymnus* n. sp. was much higher during the first 4 weeks if adelgid eggs rather than only nymphs were the food source. Oviposition by *S. sinuanodulus* and *Scymnus* n. sp. was similar, lasting for 12-22 weeks, with peaks around 4 and 14 weeks. Oviposition of *S. camptodromus* started later and continued at a lower weekly rate to the end of summer.

All species have been reared through at least one complete generation in the laboratory and *S. sinuanodulus* has been reared for 3 generations. Adults of *S. sinuanodulus* have lived for 3 years in the laboratory.

*Scymnus sinuanodulus* occurs in a more northern area of China with lower winter and higher summer temperatures. The climate in the native habitat of *S. sinuanodulus* is more like the southern Appalachians, while the climate of *Scymnus* n. sp. is more like southern New England. Although they differ in oviposition behavior and egg development, the eggs of all 3 species likely hatch when hemlock woolly adelgid eggs are at peak abundance.

<sup>1</sup>University of Rhode Island, Department of Plant Sciences, Kingston, RI 02881

<sup>2</sup>USDA Forest Service, Northeastern Center for Forest Health Research, 51 Mill Pond Road, Hamden, CT 06514

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