

ENHANCEMENT OF FOREIGN COLLECTION AND QUARANTINE EVALUATION OF HEMLOCK WOOLLY ADELGID NATURAL ENEMIES

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ABSTRACT

The objectives of this newly funded Forest Service activity are to promote the biological control of hemlock woolly adelgid (*Adelges tsugae* Annand) by (1) hiring an entomologist to work in Asia; (2) revisit known collecting sites and find promising new ones; (3) study the life history and phenology of HWA and its predators; (4) establish protocols for estimating the host ranges of candidate biological agents for use against HWA; (5) enhance quarantine facility capacity; and (6) ship more natural enemies (more species, more individuals) to U.S. quarantine. Initial work is focused in central China (Shaanxi, Sichuan and Yunnan Provinces) and central Japan. An entomologist trained in America, Wenhua Lu, has been contracted to work overseas in China. Additionally, agreements have been made with experts in each country to conduct and assist with field research in China and in Japan. This project builds on previous collecting and study of HWA natural enemies by Mike Montgomery, Scott Salom, and previous cooperators in China.

Work in China has been initiated at eight sites (three in Sichuan, four in Yunnan, and one in Shaanxi). Sites are mostly remote, mountainous slopes with small hemlock stands. Collecting and research teams were formed through cooperative agreements with provincial institutions and training provided to team members on collection and recognition of HWA lifestages and its natural enemies as needed. The study of HWA phenology in China suggests that it differs from

that in the eastern United States and that there may be a third generation, as eggs are present in August and September, which is usually not the case in the eastern United States. HWA density (as percentage of branch tips with HWA) ranged from 6 to 11 percent. Predator complexes were examined by beat sheet sampling at the principal study sites. The Coccinellidae (lady beetles) is the predator group that has the greatest diversity and has the most abundant species. *Laricobius* beetles and anthrocorid bugs also play an important role in regulating HWA in China. In Sichuan Province the dominant coccinellid predators were *Scymnus camptodromus*, *S. geminus* and *S. lycotropus*. In Yunnan Province, the dominant species were *S. camptodromus* and *S. sinuanodulus*. Collecting from pine vs hemlock revealed high fidelity of *S. camptodromus* to hemlock, *S. geminus* to pine, and an even split between pine and hemlock for *S. lycotropus* and *S. sinuanodulus*. A few *Laricobius* spp. also were collected. In 2006 an intense effort at optimal times will be made to import the *Laricobius* species and *S. lycotropus*.

In Japan, Mr. Shiyake has established a study site where HWA has the same genetics as in the eastern United States and *Sasjiscymnus tsugae* was collected previously for export to the United States. He has discovered a new species of *Laricobius* at this site, which will be exported to the United States in early 2006. Exploration for natural enemies in other areas of Japan will begin in 2006.