Scientific Note

Predators collected from balsam woolly adelgid and Cooley spruce gall adelgid in western Oregon and Washington, U.S.A., with reference to biological control of hemlock woolly adelgid (Hemiptera: Adelgidae)

As part of a comprehensive study to survey predators associated with hemlock woolly adelgid, *Adelges tsugae* Annand, 1928 in the Pacific Northwest (PNW), U.S.A. (Kohler et al. 2008), predators of balsam woolly adelgid, *Adelges piceae* (Ratzburg, 1844) and Cooley spruce gall adelgid, *Adelges cooleyi* (Gillette, 1907) (all Hemiptera: Adelgidae) were sampled on nine dates from June 2005 to October 2006 on a small number of trees. Samples were collected every 6–8 weeks. Predators were collected from two *A. piceae* infested grand fir, *Abies grandis* (Douglas ex David Don) Lindley, and one *A. cooleyi* infested Engelmann spruce, *Picea engelmannii* Parry ex Engelmann, on the Oregon State University campus in Corvallis, Oregon, and two *A. cooleyi* infested Douglas-fir, *Pseudotsuga menziesii* (Mirbel) Franco (all Pinaceae). One Douglas-fir was an ornamental tree in Corvallis, Oregon and the other was in a seed orchard on Whidbey Island, Washington. *Adelges cooleyi* predators were collected by striking an infested branch four times over a plastic tub with an area of 0.16 m². *Adelges piceae* predators were collected by brushing adelgid wool on the bole of infested trees with a 2-inch wide paintbrush over a beat sheet. Predators were collected from the tub and beat sheet with an aspirator. Adult insects were killed in a sealed 9-dram plastic vial containing a small piece of Hot Shot No-Pest Insecticide Strip (Spectrum Brands Inc., Atlanta, Georgia). Immature insects were killed in KAAD mixture (10 parts 95% ethanol, 1 part kerosene, 2 parts glacial acetic acid, and 1 part dioxane) and preserved in 70% ethanol (Borrer et al. 1989). Adult specimens were identified either by taxonomic specialists or by comparison to previously identified museum specimens. Voucher specimens were deposited in the Oregon State Arthropod Collection, Department of Zoology, Oregon State University, Corvallis, Oregon.

Nine predator families representing four orders were collected from *A. cooleyi*. Eleven species were identified as adults, all of which were also found associated with *A. tsugae* (Table 1) (Kohler 2007). One alate *A. cooleyi* was collected. Only two predator families, Reduviidae and Chamaemyiidae, were collected from *A. piceae* (Table 1). The one species of Reduviidae collected, *Empicoris rubromaculatus* (Blackburn, 1888) (Hemiptera: Reduviidae), has also been collected from *A. tsugae* (Kohler 2007). Four of the chamaemyiid larvae were reared to adults in the lab and identified as *Neoleucopis tapiae* (Blanchard, 1864) [= *Leucopis tapiae*] (Diptera: Chamaemyiidae), a native species. This species has not been found associated with *A. tsugae*.

The species of predators that were not found in this sampling are significant with respect to the ongoing biological control program for *A. tsugae* in the eastern U.S. In the more comprehensive survey of *A. tsugae* predators, three species of adelgid specialist predators were identified, *Laricobius nigrinus* Fender, 1945 (Coleoptera: Derodontidae), *Leucopis argenticollis* Zetterstedt, 1848 (Diptera: Chamaemyiidae), and *Leucopis piniperda* Malloch, 1921 (Diptera: Chamaemyiidae) [misidentified as *Leucopis atrifacies* Aldrich, 1925 (Diptera: Chamaemyiidae), see Grubin et al. 2011] (Kohler et al. 2008). Adults or immatures of *L. nigrinus* were collected at all 16 of the sample tree locations, and adults or immatures of one or both *Leucopis*