COMPARISON OF FECUNDITY AND SURVIVAL OF HEMLOCK WOOLLY ADELGID (HEMIPTERA: ADELGIDAE) IN NORTHERN AND SOUTHERN POPULATIONS

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ABSTRACT

The hemlock woolly adelgid (HWA), *Adelges tsugae* Annand (Hemiptera: Adelgidae), is an introduced species first reported in the eastern United States in 1951. The infestation has since spread in all directions from its initial sighting in Virginia, to its current range from northern Georgia, to southern Maine, and westward into Tennessee, causing substantial mortality to eastern (*T. canadensis*) and Carolina (*T. caroliniensis*) hemlocks. Tree death often occurs in as little as 4 years, especially in southern populations; however, in New England, it has been shown that *A. tsugae* populations may often persist at relatively low density for many years. Various studies have shown that cold winter temperatures cause high mortality in northern populations and in some years are sufficient to cause major declines in *A. tsugae* population density, but whether overwintering mortality can account for the apparent low density stability of *A. tsugae* at these sites remains to be demonstrated. We initiated a study to quantify *A. tsugae* density and fecundity in southern sites (Georgia and Tennessee) to complement the ongoing studies of northern populations.

As expected, overwintering mortality in 2009 was much higher in the north (84 percent) than the south (32 percent). The levels of mortality in the north (mean mortality 84 percent) were relatively high compared to that observed in most years at these sites (2003-2008). Furthermore, overwintering mortality increased significantly with *A. tsugae* density in the north (PROC Logistic SAS 9.13; logit $p = 0.24 + 4.07 * \log_{10}(x+1)$, df=1, Wald Chi sq = 267.7, $P<0.001$), while no density-dependent trend was evident in the south (PROC Logistic SAS 9.13; logit $p = -0.6.878 + 0.1474 * \log_{10}(x+1)$, df=1, Wald Chi sq= 0.7375, P=0.3905). Overwintering mortality may thus contribute to the evident stability of northern *A. tsugae* populations. We note, however, that this mortality may not increase with density in all years as reported by previous investigators.

We found no significant relationship between density and fecundity in either the north (F=0.0122, df=30, p=0.9127) or the south (F=2.1164, df=66, p=0.1505). This result was surprising in that McClure reported pronounced reductions in fecundity as HWA populations declined from high density. We chose populations of HWA at southern sites that had only recently been infested, so that we could document the entire course of the expected rise and fall of HWA populations. Thus, we may have quantified fecundity during the increasing phase of the HWA populations at these sites before the expected decline in density and associated reduction in fecundity. We plan to collect more data along these lines in the coming year to see if this expected pattern occurs.