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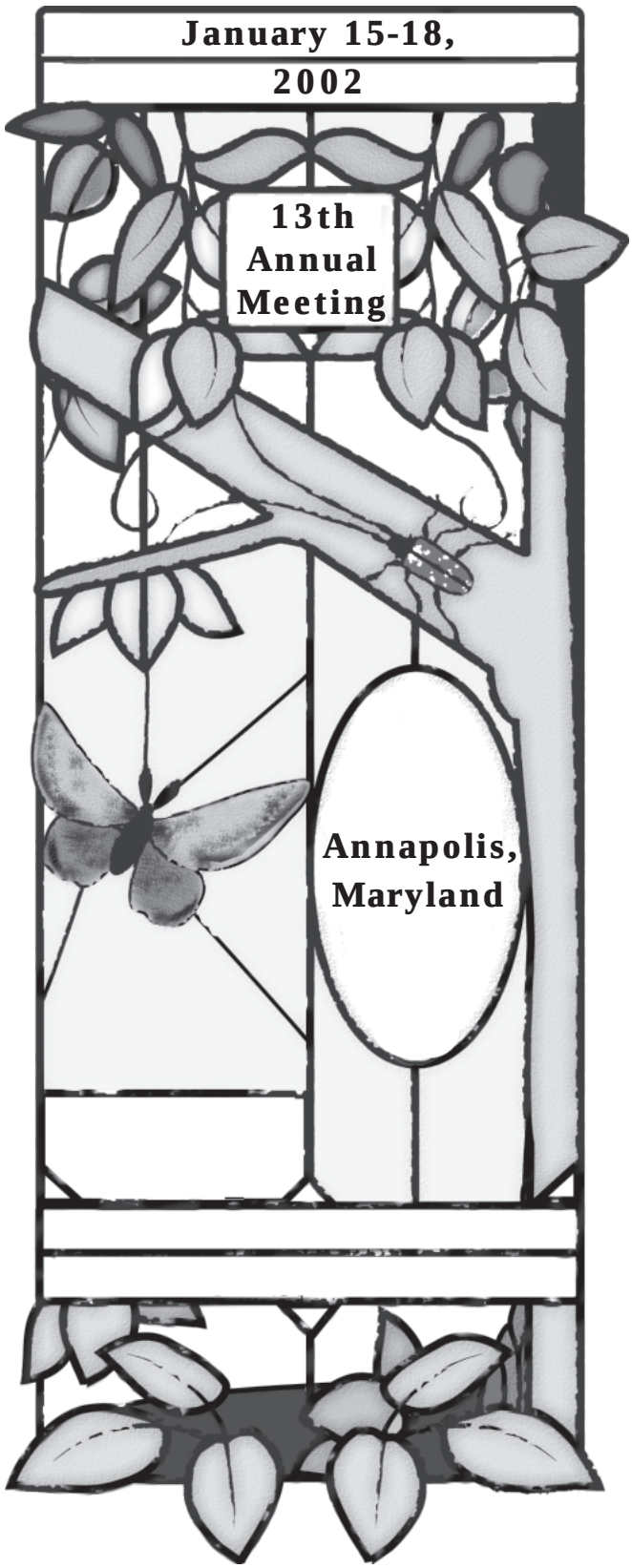

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Comparative Impact of *Scymnus ningshanensis* and *Pseudoscymnus tsugae* (Coleoptera: Coccinellidae) on the Hemlock Woolly Adelgid

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Abstract

The hemlock woolly adelgid (*Adelges tsugae* Annand) is an introduced pest thought to be native to Asia. Damage to eastern hemlock and Carolina hemlock can be serious (Salom et al. 1996), but western and Asian hemlocks are seldom damaged. Potential biological control agents have been observed in Japan and China (Sasaji and McClure 1997, Yu et al. 2000). We compared two of these which have been previously imported, *Scymnus ningshanensis* Yu et Yao, a coccinellid from China (Yu et al. 2000) and *Pseudoscymnus tsugae* Sasaji & McClure a coccinellid from Japan (Sasaji and McClure 1997).

For each lady beetle, we examined the host range and the numerical response to prey density (adelgid egg masses) in the laboratory, and in field studies, their ability to reduce hemlock woolly adelgid population growth. When given a choice between two prey species in the laboratory, *S. ningshanensis* preferred *A. tsugae* to *Adelges laricis* and *Prociphilus tesselatus* ($p<0.05$, 2 sample t-test) but preferences between *A. tsugae* and *Adelges cooleyi* or *Pineus strobi* were not different ($p>0.05$, 2 sample t-test). The host range results for *P. tsugae* were inconclusive because the beetles fed very little on all prey species provided, including the hemlock woolly adelgid. *S. ningshanensis* showed a positive numerical response ($p<0.05$, linear regression), and *P. tsugae* showed a density independent response ($p>0.05$, linear regression) to an increasing density of hemlock woolly adelgid egg masses. In the field, caged branches with a pair of *S. ningshanensis* resulted in a negative population growth of *A. tsugae*, while cages with a pair of *P. tsugae* adults and the control without lady beetles resulted in an increase in the population growth of *A. tsugae* ($p<0.05$, ANOVA).

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