

A stage structured model with seasonality of hemlock woolly adelgid and two predatory beetle species in the GSMNP

Hannah Thompson¹ Suzanne Lenhart^{1,2} Gregory Wiggins^{2,3}

¹ *University of Tennessee- Knoxville, Department of Mathematics, Knoxville, TN, US 37996* hthomp15@vols.utk.edu

² *National Institute for Mathematical and Biological Synthesis, Knoxville, TN, US 37996* slenhart@utk.edu

³ *University of Tennessee- Knoxville, Department of Entomology and Plant Pathology, Knoxville, TN, US 37996* wiggbug@utk.edu

The hemlock woolly adelgid has greatly impacted populations of eastern hemlock trees in the eastern US. As part of a long-term management strategy including biological control organisms, two predator beetles have been released in an attempt to reduce the impact of the adelgid on hemlocks. The two predators have been found coexisting on infested trees in the field[1], but little is known about their interaction and their joint impact on adelgid populations in natural settings. Using data collected in the Great Smoky Mountains National Park, we model the population dynamics of the adelgid and the two predators with a system of ordinary differential equations. The model is life-stage structured for each of the predator species. As the predators are active at different times of the year, we include seasonality in the model by using different systems of equations to reflect the active life stages for different times of the year and by including time dependent parameters.

References

- [1] Hakeem, A., Grant, J., Wiggins, G., Lambdin, P., Rhea, J. (2011). Establishment and coexistence of two predators, *Laricobius nigrinus* and *Sasajiscymnus tsugae*, introduced against hemlock woolly adelgid on eastern hemlock. *Bio-control Science and Technology*, 21(6), 687-691.