

## Estimating Non-Target Effects: No Detectable, Short-Term Effect of Feeding by Cinnabar Moth Caterpillars on Growth and Reproduction of *Senecio triangularis*

K. Higgs and P. McEvoy

Oregon State University, Department of Botany and Plant Pathology, 2082 Cordley Hall,  
Corvallis OR USA higgsk@science.oregonstate.edu

### Abstract

Studies of the effects of biological control organisms on both target and non-target populations are needed to balance risks, costs, and benefits. The benefits and costs of controlling ragwort have been well quantified both in ecological and economic terms; however, uncertainty remains regarding non-target effects. The 1960 introduction of the cinnabar moth, *Tyria jacobaea* L., to Oregon for control of tansy ragwort, *Jacobaea vulgaris* L., led to colonization of a non-target host arrowleaf ragwort, *Senecio triangularis* Hook. Our 2009-2010 observational study found no detectable effect of defoliation level (0-100%) caused by the cinnabar moth larvae, on rates of plant growth (changes in number, length and thickness of stems) or reproduction (change in number of seed heads) for a population of *S. triangularis* in the wilderness of the Cascade Mountains. Four features of the *S. triangularis* life cycle buffer the plant from potentially adverse effects: perenniality, iteroparity, stored reserves in the roots, and a mismatch of plant and herbivore phenologies. We plan further, long-term studies to estimate (1) mean, variance and covariance in damage by multiple herbivore species, (2) possible delayed effects of defoliation on plant survival, and (3) possible effects of defoliation on life-time reproductive success and plant recruitment from seed. This study highlights (1) the features of life-cycle and environment that buffer plants from adverse effects of herbivory, (2) the difficulty estimating the consequences of herbivory for plant distribution and abundance when plant recruitment and mortality events are rare, growth rates are slow, life is long, and levels of herbivory vary, and (3) the need to weigh target and non-target effects to fully evaluate outcomes of biological control.