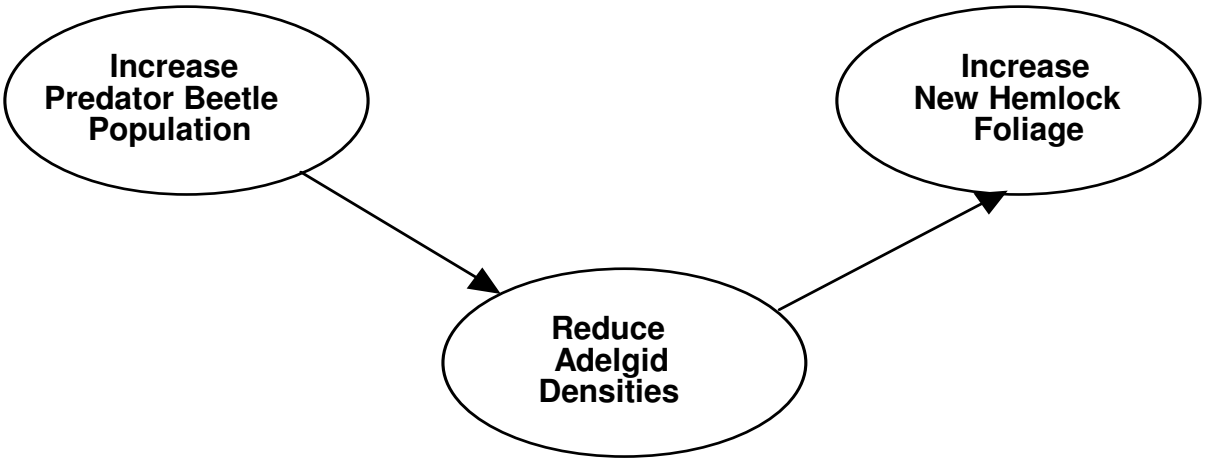
Beetle Recovery or Hemlock Recovery?
Strategies for Assessing HWA Predator Beetle Releases

Assessment is an important part of any environmental intervention and the intervention to establish biological control of the hemlock woolly adelgid (HWA) is no exception. And in this particular case, the choice of "outcome measure" used to assess the efficacy of biological control intervention is a pivotal issue for both research and public policy. The reason for this is that researchers using different assessment measures tend to reach different conclusions about the effectiveness of biological control efforts. And this, in turn can lead to divergent policy recommendations.

An assessment design begins with a model for how introduction of predator beetles is expected to work to establish biological control of HWA. A simple representation of this biological control process is:



In words, the introduction and reproductive increase of predator beetles will reduce the HWA density by predation, and this HWA reduction will reduce the HWA stress on hemlocks, leading to improvements in hemlock foliage health. This is a theory, which needs empirical assessment; so it's critical that empirical observations be conducted (at both beetle release and control sites) to see if these expectations are realized. But what should be the focus for this observation and measurement?

There are three different possible outcomes, corresponding to the elements in the "theoretical" process posited above, that have been used to assess environmental interventions using predator beetles. These are: 1) recovery of beetles; 2) change in adelgid density; and 3) change in hemlock foliage health. Each of these represents an important component of the hypothesized biological process, and ideally valid information on all three outcomes should be collected and utilized.

However, the practice of only sampling for beetles (as preferred by the Forest Service) raises reliability/validity problems for obtaining useful information, especially in wild areas. For example, field sampling for beetles will typically be limited to more accessible (lower) areas of the hemlocks, so that upper portions of hemlocks will not be well represented. Such a sampling bias is important in light of preliminary evidence that beetle predation and reproduction in the 1st several years is concentrated at the crowns (tops) of larger hemlocks – which are typically not accessible for beetle sampling.

Sampling for adelgids - This intermediate outcome in the biological control process, faces some similar location bias, but less so because of alternative methods for obtaining new growth branch or twig segments to assess adelgid densities. For example, windfall new growth twigs from the crown or upper levels can be readily collected during the winter months to obtain valid information on adelgid densities at all levels of new hemlock growth, and to measure changes in adelgid densities over time.

New hemlock foliage growth is directly linked to beetle and adelgid densities, because heavy adelgid infestation leads to destruction of hemlock foliage and the suppression of new foliage growth. Because of this, heavily HWA-infested hemlocks exhibit little new foliage growth, unless some reduction in the HWA densities occur. So new foliage growth on previously defoliated trees is indicative of a decline in adelgid densities. Plus monitoring of new foliage growth production on all parts of the tree (not just ground level) is usually possible in hemlock areas, especially during the winter season.

Summary

Forest Service assessment efforts which rely on "beetle recovery" sampling typically conclude that biological control interventions with *Sasjiscymnus tsugae* are not effective, while USDA-funded research assessments utilizing adelgid density and crown foliage measures typically conclude that biological control interventions with *Sasjiscymnus tsugae* are effective. Both conclusions cannot be correct! And the presence of such a disparity in research results calls for a more careful examination of assessment methods. Building an intervention assessment on a demonstrably inadequate criterion is bad research practice and bad science. And building policy on such a flawed research foundation can lead to policy recommendations that are based on ignorance rather than knowledge.

Patrick Horan, Saving Hemlocks