

**Possible restoration of native plant communities inhabited by Himalayan blackberry.** Steven Radosevich and Daniel Jones, Dept. Forest Science, Oregon State University

**Introduction**

Invasive species alter ecosystems and threaten biodiversity. Although there are a number of biotic and abiotic characteristics that many invasive species share, there is no satisfactory generalized theory that enables scientists to predict which species will be invasive. Either the plant characterizations are too general, or they tend to be site specific. Many investigators believe, however, that further studies of specific plants that have already invaded an ecosystem are the fertile ground for restoration efforts. Himalayan blackberry (*Rubus armeniacus*) is a plant species that has invaded and naturalized in the western region of North America. It invades riparian areas and reduces species variety, forms monoculture stands, and changes the way those ecosystems provides services to animals and humans. Other than herbicide studies and hybridization research in horticulture, little is known about Himalayan blackberry in the habitats it invades.

We conducted studies to address questions about both the biomass accumulation and control of Himalayan blackberry on previously invaded sites. Specifically, we hypothesize that if existing Himalayan blackberry populations are subjected to stresses of plant competition and common manipulative treatments like mowing, tillage, or herbicides, spread of the blackberry patches may slow. Earlier observations suggest that shade may successfully retard the growth of blackberry in certain habitats and could be and are used as part of a long-term restoration program. Such a restoration program might also protect and enhance the biodiversity of areas subjected to invasion by Himalayan blackberry.

**Experiment I. Tillage and Competition Experiment: site preparation, inventory and sampling.**

During the summer of 2000, an old-field, seasonally dry wetland and riparian area of about 1.5 acres and about ninety percent covered with Himalayan blackberry at E.E. Wilson Wildlife Refuge was mowed (June 28, 2000) with a tractor mounted bush and grass mower. The site was divided into plots, each measuring 25 feet by 50 feet (1250 ft<sup>2</sup>), and blackberry crowns in a 450 ft<sup>2</sup> area in the center of each plot were counted before any site preparation. About 0.3 blackberry clumps/ft<sup>2</sup> were found. The entire area was plowed and then tractor raked to remove uprooted blackberry clumps and debris from each treatment plot on October 10, 2000. All uprooted blackberry clumps failed to sprout in a subsequent greenhouse experiment (data not reported).

The experimental area was then subdivided into four blocks (replications). Blocks contained three main treatments (each 75X150= 11,250 ft<sup>2</sup>), which were assigned randomly within each block. Treatments were: (1) planted with three-year-old Douglas-

fir seedlings, (2) planted with Douglas-fir and seeded with perennial grass (Italian rye and red fescue), or (3) planted with perennial grass only.

**First Year Observations.** It was expected that the sown grass seed and the Douglas-fir saplings would provide some competition to the remaining blackberry crowns and roots that sprouted the following spring. However, a release of vegetative growth from the seed bank replaced the seeded grass and covered the Douglas-fir seedlings. Three types of vetch (*Vicia sativa*, *V. americana*, and *V. villosa*) comprised the first flush of vegetation and grew to over five feet tall in places. Limited blackberry growth was also detected under the vetch. Because *Vicia* is an early herbaceous colonizer, it declined in abundance midway through the growing season, by June 2001. At that time, a flush of different vegetation grew through the senescing vetch. This vegetation consisted of *Cirsium* (two species), *Solanum* (Nightshade), *Daucus* (Queen Anne's Lace) and some grasses. The areas planted to Douglas-fir were mowed between the tree rows and landscape cloth installed between the seedling trees to assure further tree growth. Himalayan blackberry cover averaged less than 25 percent for any treatment. None of the canes grew more than one meter in length, nor did any significant flowering and fruiting occur.

**Second Year Observations.** In early spring, 2002, the site appeared at first to be similar to the previous year. Vetch began to grow, but did not reach the height that it did in 2001. Other plant species germinated from the seedbank and were more prominent than in the first year. Patches of teasel (*Dipsacus* sp.), Shasta daisy (*Chrysanthemum* sp.), and a strong sward of grasses that had been planted the previous year covered most of the area. Himalayan blackberry covered less than 25 percent of the plots. Crowns counted in April, 2002 averaged 0.2 crowns/ft<sup>2</sup> and few canes that reached a meter in height. Three important observations were made during the first and second years of this experiment. (1) The seed bank under the Himalayan blackberry is extensive and exists for a number of years. (2) Direct manipulation of Himalayan blackberry facilitates the reestablishment of other plant species. (3) It is possible to till a relatively large area of Himalayan blackberry and have the area return to an earlier point in succession, in this case grass and other broad-leaved species.

### **Experiment II. Effects of tillage, herbicide and shade on Himalayan blackberry regrowth.**

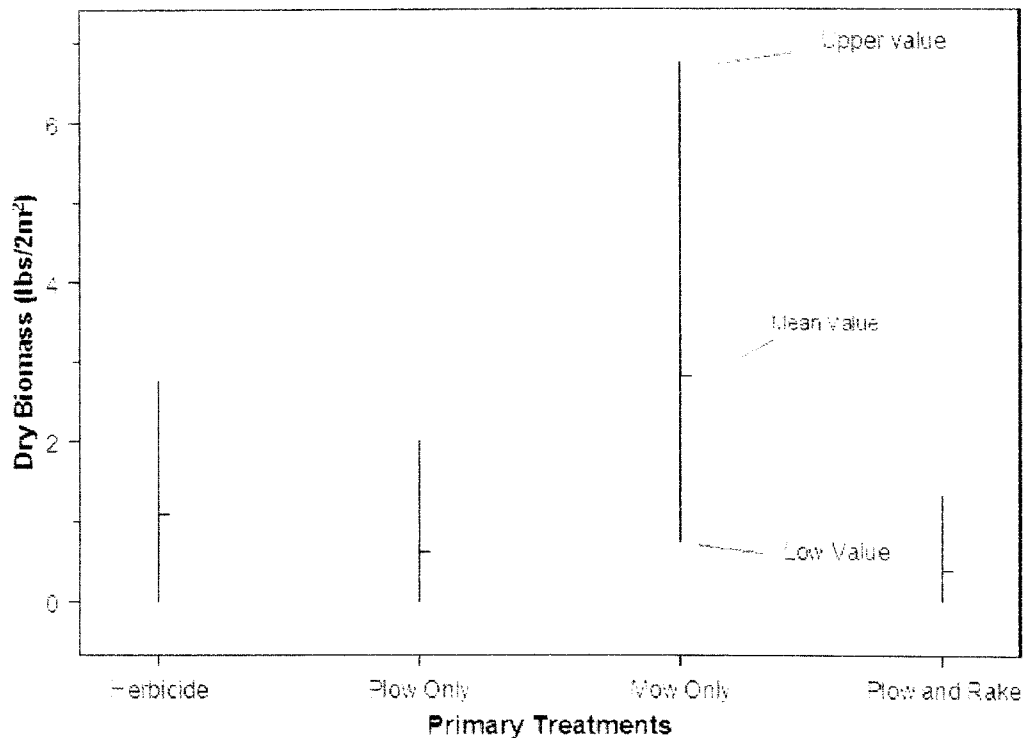
A second experiment was established at the same time as Experiment I following initial site preparation (see Experiment I for details). The purpose of this experiment was to examine the effects of tillage, herbicide treatment and artificial shade on the regrowth potential of Himalayan blackberry. In this experiment, sixteen 25 X 50 foot (1250 ft<sup>2</sup>) plots were divided into four blocks (4 plots/block). Each block contained the following main treatments: (1) plowed only, (2) plowed and disked, (3) herbicide only (glyphosate applied at 1.4 pounds a.i. per acre), (4) no treatment other than initial mowing. During the winter of 2000-2001 three 2-meter<sup>2</sup> shade structures were constructed and randomly placed in each main plot. Shade cloth was placed over two of the three structures, each blocking 73 and 55 percent sunlight respectively. No shade was placed over the third

structure. Light intensity was measured periodically using a Li-Cor® model LI-185-A light sensor at various times during the growing season.

Biomass was harvested from under each of the shade structures (sub-plots) through April, 2002. Samples were placed in plastic bags, weighed, then placed in a dry shed. Bags were open and the vegetation allowed to dry over the summer, after which they were again weighed.

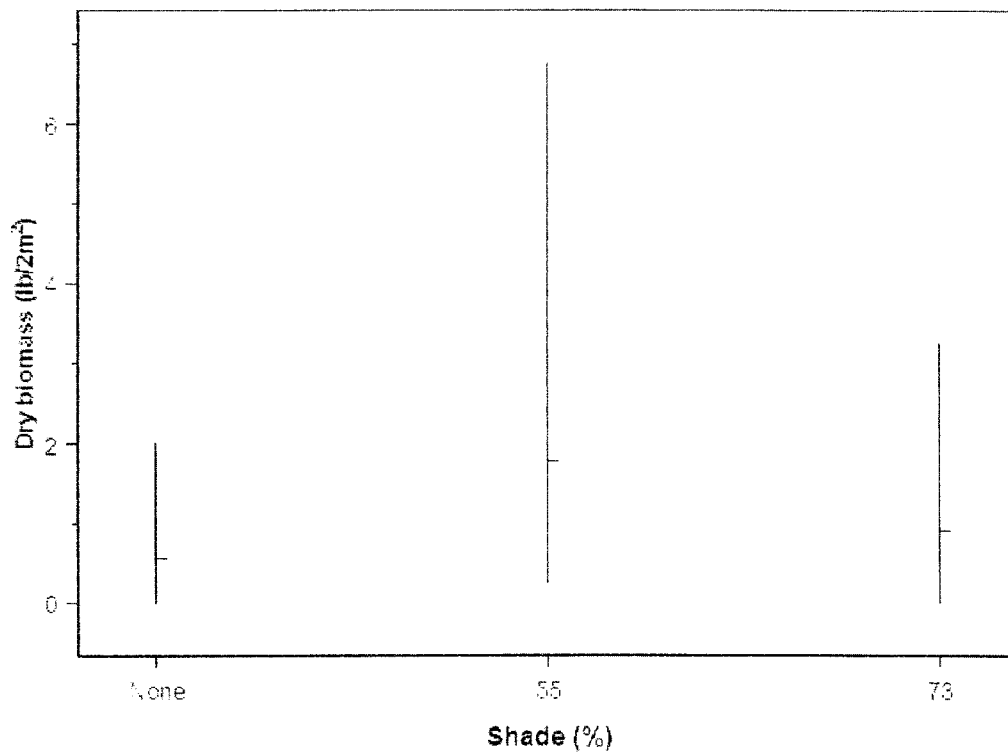
**Results.** When only comparing primary treatments without considering the effects of shade levels, significant differences were found (Figure 1). Plots receiving no treatment, produced the most biomass, followed by herbicide, plowed and plowed and raked, respectively.

Figure 1. Himalayan blackberry biomass resulting from primary site preparation treatments.



Shade structures that allowed 55 percent sunlight averaged twice as much dry biomass (1.73 pounds vs. 0.86 pounds, respectively) as the vegetation from within structures that blocked 73 percent of the light (Figure 2).

**Figure 2.** Himalayan blackberry biomass resulting from artificial shade applied after primary site preparation treatments. Values are means when applied to all site preparation treatments



However, the unshaded areas of each main plot produced the least dry matter (0.61 pounds). The shade structures prevented the vines from spreading, and since vines in the unshaded area were not contained, an underestimate of the biomass in unshaded areas resulted. Nonetheless, shade was found to be a factor in reduced blackberry and other plant biomass.

These results indicate site-preparation plus shade is a workable method of inhibiting the spread and growth of Himalayan blackberry. These data (Figures 1 and 2) suggest that primary stress (site disturbance) plus shade interact to reduce the rate of production of Himalayan blackberry and indicate that such approaches should be tried on larger areas (as in Experiment I). However, the rate of re-vegetation on undisturbed or mowed only plots by blackberry also indicates that repeated treatment, though perhaps less intense than the initial site preparation, may be required until planted or natural vegetation can maintain a site against the blackberry.

**Discussion.** Ecological succession is the directional change in the composition of species overtime. However, a Himalayan blackberry monoculture probably represent a static state of succession. Whether a static, “equilibrium” truly exists in a dynamic ecosystem has been debated. However, the temporary removal of the Himalayan blackberry in this study by site preparation allowed the site to revert to a condition that may or may not have existed prior to the invasion of blackberry. From a restoration viewpoint, the fact that the site is now in an earlier successional state suggests that it is closer to the “pre-

disturbance” condition than when Himalayan blackberry was present, i.e. easier to restore to a desired condition in succession. In this study the soil seed bank and planting native grasses following site disturbance achieved this earlier stage from which further management can be implemented.

This study demonstrated that it is possible to manipulate a large area of blackberry and by doing so change site conditions. The plowing and raking of the soil to remove the majority of root crowns of Himalayan blackberry provided the opportunity for other vegetation to respond to the reduction of blackberry cover and disturbance. By shading Himalayan blackberry sprouts, it was found that low levels of light reduce biomass accumulation progressively as the light diminished. This fact is important for management, because it indicates that Himalayan blackberry will not flourish in some habitats that are common to the Pacific Northwest, such as mid- and older Douglas-fir plantations, ash swales and oak woodlands. Taken together, the destruction of Himalayan blackberry stands and the manipulation of light or other resources by planting vegetation or stimulating the seedbank during restoration provides a direction for management of areas invaded by Himalayan blackberry (Figure 3).

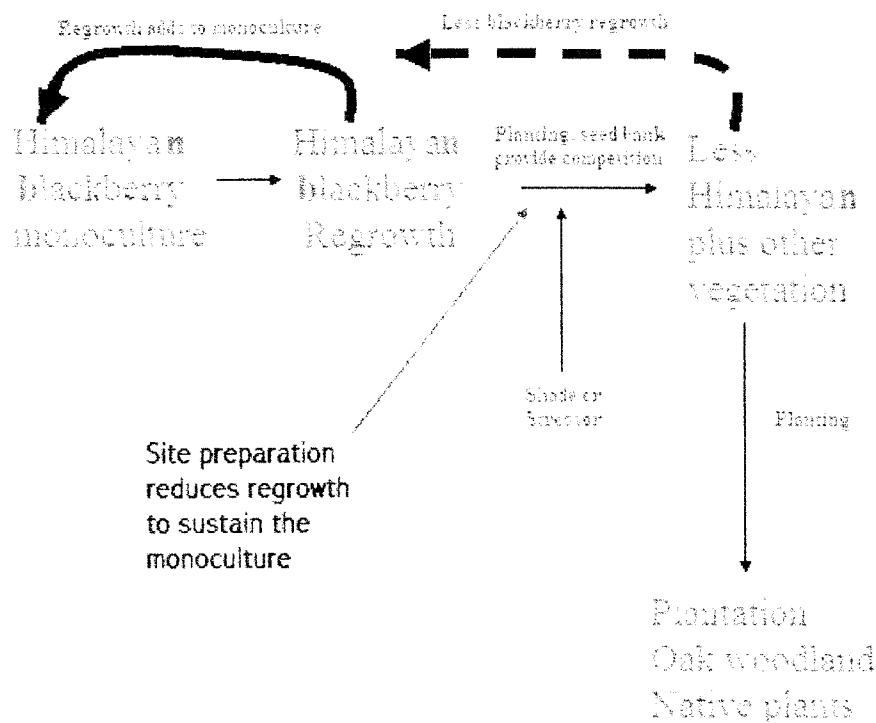


Figure 3. Effect of site preparation treatments, competition, and/or shade as management tools to create an earlier more manageable stage of succession. By planting species that stress regrowth of Himalayan blackberry more desirable plant communities can be favored and invaded areas restored to more desirable uses

Finally, this project revealed more than just responses of Himalayan blackberry to different control treatments. While many restoration efforts have been directed toward the response of a given species to specific control measures, it is apparent that the treatment of an individual plant species provokes a response from the entire habitat it occupies. Efforts that consider the response of the entire habitat to both invasion and manipulation will probably be more productive (restorative) than efforts that only describe target plant responses.