



## **Meeting the Challenge: Invasive Plants in PNW Ecosystems**

### **POSTER ABSTRACTS:**

#### **Garlic Mustard Control: Is Success a Possibility? Strategy and Potential Impact.**

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Garlic mustard, *Alliaria petiolata* (M. Bieb.) Cavara and Grande, presents a significant threat to the PNW natural areas. The impact to the northwest's biodiversity will be substantial without prompt action. Biology and adaptability contribute to its ability to successfully invade and thrive in our more sensitive areas. Because of its adaptability, an aggressive IPM approach should include a combination of methods, most importantly, monitoring. It is imperative that large property stakeholders be prepared to designate a portion of their time and manpower each year for garlic mustard control and monitoring. King County has the unique advantage of having it listed as a Class A noxious weed in Washington State. Garlic mustard populations in King County are still limited enough that there is a chance that it can be kept at a management level in the short term and eventually eradicated. The majority of the known sites have been prevented from seeding and therefore their spread has been contained in their range for the last few years. An important part of the control strategy will involve cooperation with other agencies fighting this problem, including those in counties, states and provinces outside King County. There are several known garlic mustard sites in the Pacific Northwest. Sharing resources and developing an overarching regional strategic approach to control will contribute to a higher probability of success.

#### ***Lamiastrum galeobdolon* 'Florentinum': Biology, Ecology and Control Methods in Washington State.**

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*Lamium galeobdolon* 'Florentinum,' in the Lamiaceae, is sold in nurseries as an ornamental groundcover. Currently, *L. galeobdolon* 'Florentinum' populations are established in a number of natural areas in western Washington, growing in woodland understories with native plants and other non-native species. Though listed on the Washington State Noxious Weed Control Board's Monitor List, scientific studies on *L. galeobdolon* 'Florentinum' in the Pacific Northwest are lacking. Additional information is needed about the biology and ecology of *L. galeobdolon* 'Florentinum' to determine the need for control. If *L. galeobdolon* 'Florentinum' is producing viable seed, this would indicate that plant populations are self-sustaining and would increase its potential to cause large-scale invasions. Due to its ability to spread vegetatively by having stolons that root at the nodes, *L. galeobdolon* 'Florentinum' populations are quickly expanding and establishing new populations.

Investigating invasive plant species to understand characteristics such as seed production, vegetative propagation, physiological factors and other attributes may allow prediction of new plant invaders, determination of invasion and effective measures of control. This study investigates several different traits of *L. galeobdolon* 'Florentinum' including seed viability and germination requirements, vegetative growth under varying light conditions and methods of control. Populations of *L. galeobdolon* 'Florentinum' in Washington State are also being mapped to provide accurate location information for county noxious weed boards. This study is ongoing with written results being available in 2007.

### **Factors Influencing Regeneration of Scotch Broom (*Cytisus scoparius*).**

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Scotch broom (*Cytisus scoparius*) is a large, leguminous shrub found extensively throughout 16 eastern and 6 western U.S. states. Vigorous seedling regeneration enables dense stands to form quickly, increasing hazardous fuels, excluding native plants, and altering community structure of meadows, prairies, and young forests. Laboratory research was initiated in 2003 to determine how seedling emergence varied with temperature, light, and stratification period, or following application of two soil-active herbicides on soils of differing texture. Seedling emergence also was studied under several densities of 40- to 70-year-old Douglas-fir (*Pseudotsuga menziesii*) forest near Olympia, WA. In the laboratory, maximum germination rates occurred between 15° and 25°C, and effects of heavy shading switched from detrimental to beneficial at temperatures above 20°C. Initial germination rates increased dramatically with duration of cold stratification, but cumulative germination was relatively unaffected. Seedling germination and biomass were moderately inhibited by single or combined applications of sulfometuron and metsulfuron herbicides, but mortality averaged only 7% for treated soils versus 1% for non-treated soils. In forested areas, seedling emergence was greater in low or moderate density stands of Douglas-fir versus in clearcuts, and it was greater on organic versus mineral seedbeds. However, cumulative emergence of seedlings remained

low ( $\leq 6\%$ ) two years after sowing seed, suggesting that relatively intact forest communities have low susceptibility to invasion.

### **Early Detection Protocol Development in the National Parks: Integrating All the Pieces.**

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Invasive plant species management is a national priority for the National Park Service (NPS). The NPS and other land management agencies have limited resources available for invasive plant control and, therefore, must optimize control efforts. Following the introduction of invasive plants, the most effective management strategy is to detect and respond to invasive species before they become so well established that control is not economically or logistically feasible. At this early stage, predictive capabilities and monitoring strategies that efficiently cover large areas are necessary. Natural resource managers require species prioritization tools, spatially-explicit models, non-spatial models, risk analyses, adaptive sampling designs, and incidental reporting to accomplish these tasks. Many of these components have been applied in other contexts or exist in isolation, but no effort has been made to combine these components into a comprehensive protocol for early detection of invasive plants. We discuss NPS collaborative effort with the United States Geologic Survey (USGS) to integrate these diverse approaches and apply them in National Parks. Our goal is to produce a tool for natural resource managers to develop an early detection monitoring program. A handbook for developing early detection protocols will be available in late 2006 that has broad application yet is sufficiently detailed to be practical for managers. An overview of the individual and collective efforts, their status, and opportunities for sharing these products will be discussed.

## **Controlling Invasive Plants Without Herbicide, Cedar River Municipal Watershed.**

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The >90,000-acre Cedar River Municipal Watershed is managed to supply Seattle's drinking water while restoring wildlife habitat, natural ecosystem processes, and native biological diversity. Invasive plants threaten all three of these restoration goals. Currently no herbicide is used within the watershed, so we are exploring alternative methods to control three invasive species. In 2004 we used geotextile fabric to cover several large Bohemian knotweed (*Polygonum x bohemicum*) patches in a wetland. We monitored the project every three weeks during the growing season, crushing any growth under the fabric and pulling all small starts outside the fabric. After the first growing season, there was no growth under the fabric. After three seasons, the pulling, along with growth of competing native vegetation, has greatly reduced the knotweed outside the fabric. Tansy ragwort (*Senecio jacobaea*) occurs along many of the roads in the watershed. We pulled all plants annually from 2002 through 2006 and are monitoring this method's effectiveness and cost efficiency. In 2006 we established four biocontrol areas in high density patches, where tansy flea beetles will be released and results monitored. Scots broom (*Cotises scoparius*) grows along roads and in other disturbed areas in the watershed. In 2004 we began hand-cutting Scots broom at the ground surface during or shortly after flowering. There is little or no regrowth when the plants are large and competing native vegetation is present, as well as in sites where the plants only recently established and the seed bank is minimal.

## **Biogeography of Non-Native Plants in the San Juan Islands, Washington.**

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Islands offer unique opportunities to investigate biogeographical questions relating to the dispersal and persistence of species. We recently surveyed the vascular plant flora of 44 small (<20 ha) islands in the San Juan Archipelago, and here we examine how mode of dispersal, island size, and other factors correlate with the distribution patterns of non-native taxa. Collectively, 30% of the islands' flora was non-native, with a range of 0-56% on individual islands. This proportion was unrelated to an island's area or species richness. Most non-natives occurred on relatively few islands, with less than a dozen occurring on over half the islands. The most widely distributed non-natives included six grass and two forb species (*Geranium molle* L., *Hypochaeris radicata* L.). The fruits of these eight species possess either awns, barbs, or bristles aiding in animal or wind dispersal. Species richness of non-native taxa increased significantly as a log function of island area, but this rate was two and a half times less than that of native species across

the same islands. There was no relationship between non-native species richness and the distance from the nearest large island. We hypothesize that only the most cosmopolitan, readily dispersible non-native taxa have become established on the islands, and only a small percentage of these are considered invasive. We conclude that both life history traits and land use history contributed to the distribution patterns that we observed. Our results emphasize that not all widely distributed non-natives are invasive, and that some widely distributed taxa may be exploiting unfilled niches.

### **Got Milk Thistle? Controlling Milk Thistle in King County, Washington.**

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Milk thistle, *Silybum marianum* (L.) Gaertner, can be an aggressive pasture and rangeland weed. Milk thistle is a winter annual or biennial, germinating throughout the year in western Washington. Milk thistle can form dense stands, excluding livestock and reducing forage species. The largest occurrence of milk thistle in Washington is found on the Enumclaw plateau in King County. Approximately 7 acres are infested in an area of 8 square miles. Beginning in 2003, infestations were surveyed, land owners provided with herbicide, and results monitored. In 2006, a more intensive program was initiated. Areas with seedlings and rosettes were treated with clopyralid in October 2005. In April 2006, known infestations were surveyed and 23 land owners were provided 2,4-D. As a trial on the largest infestation, 5 acres were treated with aminopyralid at a rate of 5 ounces per acre. Aminopyralid was slow acting and the soil residual effect was uncertain. In May, plants missed by the initial applications were surveyed and treated with aminopyralid plus 2,4-D to assure a quicker kill. In June, when plants had bolted and flower heads were visible, surveys were conducted for survivors and new infestations. Viable seed heads were removed and these plants were treated with aminopyralid plus 2,4-D. In October, aminopyralid or clopyralid will be applied to rosettes and seedlings.

### **The Ecological Consequences of Japanese Knotweed Invasion into Riparian Forests.**

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Japanese (*Polygonum cuspidatum*), giant (*Polygonum sachalinense*) and bohemian (*Polygonum bohemicum*) knotweed are three closely related congeners invading riparian areas, roadsides, and parklands throughout the United States and Europe. The spread of knotweed along river corridors has been of particular concern to natural resource agencies and conservation organizations. Knotweed's invasion of riparian forests has the potential to alter critical ecological processes including streambank stability, channel morphology, nutrient cycling, forest and

understory regeneration and organic matter inputs into aquatic food webs. Currently, there is limited field research documenting the level and significance of these suspected impacts.

This research investigates two suspected impacts of knotweed's invasion: 1) the displacement of native riparian plant communities and biodiversity, and 2) alteration of the quantity and nutrient quality of riparian leaf litter inputs into streams. Field data were collected in summer- fall 2004 at Grandy Creek, a tributary of the Skagit River densely colonized by giant knotweed, *Polygonum sachalinense*.

Study results indicate a negative correlation between knotweed invasion and the species richness and abundance of native understory herbs, shrubs, and juvenile trees. A reduction in riparian tree establishment could have detrimental and long lasting effects on the successional trajectory of riparian forests, bank stability, hydrology, nutrient loading, micro-habitat conditions and aquatic biota of adjacent lotic systems.

### **Invasion by *Buddleja davidii*: Potential Impacts to Geomorphology of a Gravel Bar on the Tolt River, Washington.**

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*Buddleja davidii* is a pioneering shrub native to shingle banks and river bars of China. As land managers throughout Washington State increasingly report dense thickets of escaped populations along riparian corridors, there is growing concern regarding the impact of *Buddleja* to these native ecosystems. We investigated the potential impacts of colonization by *Buddleja* to channel geomorphology. We compared species distribution, contribution to channel roughness, and contribution to bank stability for *Buddleja* and co-establishing native pioneers *Populus* and *Salix*. For each species, we measured 1) the presence of seedlings and persistent plants relative to elevation, substrate, and landform position, 2) the density of basal shoots and crown shoots, and 3) root density and tensile strength. No significant patterns of seedling establishment were detected for any species. However, persistent *Buddleja*, *Populus*, and *Salix* appear to be distributed throughout the bar according to species-specific tolerances of hydrogeomorphological regimes. Compared to *Populus* or *Salix*, *Buddleja* was present in greater density at higher elevations and sheltered locations of lower shear stress, suggesting that *Buddleja* is comparatively less tolerant of both frequent and intense flooding. *Buddleja* crown shoots contribute significantly greater surface area to overall channel roughness than either *Populus* or *Salix* shoots, which could accelerate rates of sediment accretion. Although there were no significant differences in root density between species, *Buddleja* had a greater density of fine roots than *Populus* which suggests that colonization by *Buddleja* may result in increased bank strength.

## **Knotweed Control in the Chehalis River Basin: Strategies and Successes.**

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The Chehalis River Basin includes over 3000 miles of stream, and is the third largest watershed in Washington State. Infestations of *Polygonum cuspidatum*, *Polygonum sachalinense*, and *Polygonum bohemicum* (Japanese, Giant, and Bohemian Knotweed) are widespread throughout the basin, and are likely to significantly alter riparian habitat on this river if spread continues unchecked. In 2004, The Nature Conservancy, in partnership with Washington State Department of Agriculture and county weed boards, initiated a project to control knotweed throughout the Basin. The goal of this project is to identify and treat knotweed infestations with the intention of eliminating knotweed's spread through riparian corridors. We expect to accomplish this goal over several years through a top-down control strategy, beginning with the most upstream knotweed infestations. This approach reduces chances of reinfestation lower in the watershed via stream transport of stem or root fragments, or possibly by seed. We use either of two application types, injection of 100% glyphosate, or targeted foliar spray of 2% glyphosate and 1% imazapyr, which has resulted in a 90% reduction in treated knotweed along Chehalis River tributaries. Kill rates of 80-100% have been achieved following a single treatment with injection treatments, and similar results for foliar treatments. Efficacy has varied depending on several environmental factors, including substrate, shading, and the dynamic of the specific plants and patches. This poster will present the strategies employed as well as illustrate the quantitative and qualitative results of the two methods used to control the knotweed species.

### **Successful Biological Control of Invasive Species in Washington.**

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The Integrated Weed Control Project (IWCP) at Washington State University Extension has been implementing biological weed control since 1999. In this time we have seen several substantial successes after the biocontrol insect releases. *Larinus minutus* Gyllenhal, a seed-feeding beetle, has reduced *Centaurea diffusa* Lam. (diffuse knapweed) by not only reducing the seed production but outbreak populations of the adults have defoliated and killed many plants. Before and after pictures demonstrate reduced populations within 5 years. Similarly, *Lythrum salicaria* L. (purple loosestrife) has been

dramatically reduced with the use of the foliage-feeding beetles, *Galerucella californiensis* and *G. pusilla*. Infestations throughout much of Washington have been reduced to non-damaging levels in as little as four years from initial release. Recently, *Mecinus janthinus*, a stem-mining beetle for the control of *Linaria genistifolia* ssp. *dalmatica* (L.) Mill. (L.) Maire & Petitm.(Dalmatian toadflax), has demonstrated similar results in areas of eastern Washington. Although successes such as these are encouraging, many challenges still exist. The distribution of biocontrol agents for a variety of weed species and their success is an ongoing requirement. IWCP aims to meet these challenges by continuing biocontrol re-distribution, site-specific evaluation and planning, and insect and plant monitoring. IWCP serves county, state, federal, tribal and private land-managers by providing expertise, on-site evaluations, educational seminars and demonstrations, and biological control agents at no cost.

### **Garden Loosestrife (*Lysimachia vulgaris*), a Spreading Threat in Western Waterways.**

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Garden loosestrife (*Lysimachia vulgaris*) is a rhizomatous perennial native to Eurasia that is widely distributed across the northern United States and southern Canada. It thrives in wetland and riparian areas with its long, red rhizomes that can be seen extending 10 feet or more into the water. Considered naturalized in areas like New England, it may be that their cold winters are the only factor keeping it in check.

Garden loosestrife is particularly worrying for several reasons. It is difficult to control, has been observed to outcompete purple loosestrife (*Lythrum salicaria*), and according to Cusick (1986), will form easily-overlooked thickets of non-flowering young plants before appearing in flower as a full blown infestation. In addition, Washington is the only state that has listed this plant as a noxious weed, although in several other states the climate should not limit its dispersal or establishment.

In King County this invasive weed has established a number of large infestations that may give us some indication of its real potential in the west, and the challenges in controlling it. The King County Noxious Weed Control Program is currently working with government agencies, community groups and private landowners to control garden loosestrife. Our control strategies vary according to the extent of the infestation and land ownership in each area. This poster will discuss these strategies as well as describing the plant and its invasive tendencies, delineating the extent of infestations and discussing real and potential damage.

## **Policies to Reduce the Risk of Invasive Plant Introductions via Horticultural Trade.**

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Invasive alien plant species are known to cause both economic losses and ecological damages. However, the introduction of a non-native species can be simultaneously classified as destructive by one segment of society and desirable by another. Indeed, many potentially invasive plant species are deliberately introduced for economic benefit despite the risks associated with them. Notably, the horticulture industry is the most significant pathway for the intentional introduction of invasive alien plants.

Nonetheless, prevailing policies aimed at tackling the invasive alien plant problem largely ignore its horticultural dimension. Specifically, existing policies fail to explicitly consider both the role of the horticulture industry in causing the problem and the substantial revenues generated through the introduction and sale of ornamental plants. Although new government strategies are currently being devised and implemented, the economic benefits derived from the horticultural use of alien plant species continue to be overlooked.

My proposed poster will present a range of credible policy options for reducing the risk of invasive plant introductions via horticultural trade. Incentive-based policies that consider both the benefits and risks associated with the import and sale of non-native plants will be among the policy alternatives described. In addition, I will outline my graduate research, which involves conducting a survey to determine stakeholder preferences with respect to the alternative policy interventions. Through this research, I will assess the various policy options, discern stakeholder perceptions of the invasive plant problem, and identify determinants of stakeholder preferences.