Knotweed Symposium Abstracts
Western Society of Weed Science
March 15-16, 2007
Portland, OR

ORAL PAPER SESSION

Thursday, March 15 (Morning Session), Ballroom II (Ballroom Level)

9:15-9:20 Welcome and Knotweed Symposium Overview
Tim Miller, Washington State University, Mount Vernon, WA

9:20-10:10 The Genetics of Invasive Knotweed Species in Europe
John Bailey, University of Leicester, UK

10:10-11:00 Invasion Dynamics and Ecology of Knotweeds in Central Europe: A Hybrid Superior to Parental Species
Petr Pysek, Academy of Sciences at Pruhonice, Prague, Czech Republic

11:00-11:30 Vegetative Regeneration by Japanese Knotweed
John Brock, Arizona State University Polytechnic, Mesa, AZ

11:30-12:00 Current Status of Herbicides for Controlling Invasive Knotweeds in the United States
Tim Miller, Washington State University, Mount Vernon, WA

12:00-1:30 Lunch (on your own); View Posters

Thursday, March 15 (Afternoon Session), Ballroom II (Ballroom Level)

1:30-1:50 Herbicide trials for Bohemian Knotweed Control
Kim Patten, Washington State University, Long Beach WA

1:50-2:10 Ecological Consequences of Giant Knotweed (*Polygonum sachalinense*) Invasion into Pacific Northwest Riparian Forests
Lauren Urgenson, University of Washington, College of Forest Resources, UW Botanic Gardens, Seattle, WA

2:10-2:30 Developing a Biological Control Program for Invasive Knotweeds
Fritzi Grevstad, University of Washington, Long Beach, WA

2:30-2:50 The Role of Temporal and Spatial Variability in the Treatment of Bohemian Knotweed (*Polygonum x bohemicum*) on the Hoh River, Washington, USA
Dan Campbell, National Park Service, Port Angeles, WA

2:50-3:30 Break; View Posters

3:30-3:50 What is the Threat from Invasive Knotweed Seed Production?
Tim Miller, Washington State University, Mount Vernon, WA

3:50-4:10 Invasive Knotweed Control in King County, Washington.
Sasha Shaw, King County Noxious Weed Program, Seattle, WA

4:10-4:30 Management of Knotweed in the Upper Skagit River Basin of Washington
Melisa Holman, The Nature Conservancy, Mount Vernon, WA

5:00-7:00 Evening Reception, Pavillion Ballroom East (Plaza Level)

Friday, March 16, Ballroom II (Ballroom Level)

8:00-8:30 Coffee; View Posters

8:30-8:50 Eradicating Small Knotweed Patches Without Herbicide
Sally Nickelson, Seattle Public Utilities, North Bend, WA

8:50-9:10 Non-herbicidal treatments of knotweed species on the Queen Charlotte Islands, BC.
Mike Cheney, Northwest Invasive Plant Council, Masset, BC, Canada

9:10-9:30 Replacing Knotweed with Desirable Vegetation in Northern Coastal Oregon
Glenn Ahrens, OSU Extension Service, Astoria, OR

9:30-9:50 The Nature Conservancy's Sandy River Watershed Knotweed Control Program: Lessons from six years of landscape scale control
Jonathan Soll, The Nature Conservancy, Portland, OR

9:50-10:30 Break; View Posters

10:30-10:50 The Washington State Program for the Control of Invasive Knotweeds
Marshall Udo, Washington State Department of Agriculture, Olympia, WA

10:50-12:00 Discussion session: Where Do We Go From Here?
Moderated by Cathy Lucero, Clallam County Noxious Weed Control, Port Angeles, WA

12:00 Adjourn

1. The genetics of invasive knotweed species in Europe. John Bailey, University of Leicester, UK. **jpb@leicester.ac.uk**

The introduction of a male-sterile clone of *Fallopia japonica* var. *japonica* to the West has had a number of important consequences, not the least being the addition of a tenacious and conspicuous addition to our various Floras. Leaving its numerous predators and diseases behind in the East, it has been a stunning success in its adventive range, and is recognized as a serious problem in North West, Central and Eastern Europe, the United States and Canada. A clonal plant would seem to be at a disadvantage as a successful invader, given its total lack of genetic diversity. The existence of hundreds of hectares of male-sterile *F. japonica* spread across several continents in its adventive range can be viewed as a vast unintentional breeding experiment. Anything that can possibly pollinate it will have done so. These hybrids with various related and not so related species are then able to backcross with *F. japonica*, providing the genetic diversity so conspicuously lacking in the mother. Whilst such viable hybrid seed may be produced in considerable amounts throughout its adventive range, it does not meet with conditions suitable for overwintering and establishment in large parts of its new range. The talk will deal with the history of its introduction, some of the reasons for its success, breeding behaviour, the taxonomy and nomenclature of the group, recognition of the hybrids and a comparison of the genetic and cytological diversity of the introduced plants and the native plants in Japan. A point I am always keen to make, is that in this group of high polyploids where individuals may have different mixtures and proportions of the *sachalinensis* and *japonica* genomes at different ploidy levels, the value of a molecular approach, in the absence of basic morphological and cytological data is severely limited. This talk brings together historical, taxonomical, morphological, cytological and molecular approaches in an attempt to unravel the knotweed story. Particular emphasis will be placed on the differences between the European and American experience of the plant.

2. Invasion dynamics and ecology of knotweeds in Central Europe: a hybrid superior to parental species. Petr Pyšek, Institute of Botany, Academy of Sciences of the Czech Republic, Průhonice, Czech Republic, **pysek@ibot.cas.cz**

Three *Fallopia* species occur in Central Europe, including two parental taxa, *Fallopia japonica* var. *japonica* and *F. sachalinensis*, which cross and produce a hybrid *F.* × *bohemica*. Their distribution in the Czech Republic is well known which made it possible to reconstruct the history of their invasion and compare the dynamics of spread in the last 50 years among the three taxa. The two parental species were first recorded at the beginning of the 20th century, while the hybrid as late as in 1950. Since this first record in the wild, the hybrid exhibits twice the rate of invasion of its parents, measured as the number of occupied localities. The reasons for this remarkable invasion success were explored in a series of experiments, comparing the regeneration ability and competitiveness of the three taxa. It appears that higher regeneration ability of the hybrid, compared to both parents, contributes to its invasiveness at the landscape level, and so does the fact that it outcompetes parental species in controlled pot experiments. Within the hybrid *F.* × *bohemica*, hybrids genetically intermediate between the parents regenerate better than those closely related to parents, which indicates ongoing evolution of new invasive genotypes. Novel hybrid invasive genotypes may be produced by rare sexual reproduction, fixed by clonal growth, and present a previously unknown threat to native vegetation.

3. Vegetative regeneration by Japanese knotweed. John H. Brock, Arizona State University Polytechnic, 7001 E. Williams Field Rd., Mesa, AZ 85212 john.brock@asu.edu

Japanese knotweed (*Fallopia japonica* syn. *Polygonum cuspidatum*) and its closely related conegers are tall, rapidly growing alien perennial plants forming dense stands. The majority of this plant's dispersal is related to the rhizome system. The regenerative potential of the rhizomes has been recognized for many years. In the early 1990's its potential to reproduce by from stems was documented. Buds are formed in the autumn near the base of the plant and in nodes of the rhizomes. Over-time, large basal crowns and perennial rhizomes are formed. As little as 10 mm length, or 0.7 g fresh weight of a rhizome can produce new shoot growth. Rhizome segments commonly have over 70 % regeneration success. Fresh stems can produce new shoots from the nodes, with more activity from basal cuttings than upper stem parts. The most successful greenhouse stem regeneration of Japanese knotweed was from segments placed in water. Stem cuttings in water had approximately 60 % regeneration. Shoots began to emerge by about 6 days and by 21 days adventitious roots were formed. Hybrid genotypes of Japanese knotweed have been found to have greater success in rhizome regeneration compared to the parental species. Rhizome regeneration by Japanese knotweed makes moving soil contaminated with this invasive species a common dispersal method. Japanese knotweed is often an invader of riparian habitats. Live stems separated from the parent plant during high flow events, can be spread along water courses, further enhancing its ability to invade new sites.

4. Current status of herbicides for controlling invasive knotweeds in the United States.
Timothy W. Miller, Washington State University Mount Vernon Research and Extension Center, 16650 State Route 536, Mount Vernon, WA 98273. twmiller@wsu.edu

The knotweeds are some of the most difficult to control of all the noxious weeds. In particular, it is the very large invasive knotweeds, those species usually growing to five or more feet tall and whose jointed, hollow stems are up to two inches in diameter, that cause the greatest concern. At least four species are recognized by the botanists to occur in the US: Japanese (*Polygonum cuspidatum*), giant or Sakhalin (*P. sachalinense*), Himalayan (*P. polystachyum*), and Bohemian (*P.* x *bohemicum*, a hybrid of Japanese and giant). Herbicidal control research has centered on three herbicides: glyphosate, imazapyr, and triclopyr. Imazapyr is the most active herbicide at equivalent doses of active ingredients, causing symptoms and providing foliar control at 0.5% foliar-applied solutions. Current recommendations for imazapyr range from doses of 0.75 to 1.5% applied to foliage. Glyphosate also can provide excellent results, with recommendations ranging from 3.5% to 8%. Glyphosate mixed with imazapyr can provide superior results at rates of 2.5 to 3% glyphosate plus 0.5% imazapyr. Triclopyr has also shown good activity on the knotweeds, quickly producing epinastic symptoms. Rates from 1.5 to 2.5% applied to foliage are considered adequate for triclopyr, although control can be improved by mixing with glyphosate or imazapyr. Injection of glyphosate at a rate of 5 ml per knotweed stem is also registered for use in the United States. These applications have provided excellent control of knotweed crowns in the Pacific Northwest. There do not appear to be major differences in herbicide susceptibility among these species, although the hybrid Bohemian knotweed seems to be the most tolerant to herbicide applications. Results from herbicide wiped on the stems have been inconsistent. All these herbicide applications have the potential to injure non-target vegetation, including glyphosate injection.

5. Herbicide trials for Bohemian knotweed control. Kim Patten and Chase Metzger, Washington State University Long Beach Research and Extension Unit, 2907 Pioneer Rd. Long Beach WA 98631 pattenk@wsu.edu

Although millions of dollars are spent annually on the chemical control of knotweed on public and private lands in the PNW, there have been few systematic assessments of the comparative efficacies of herbicides or herbicide timings for knotweed control. Replicated field trials with Bohemian knotweed (*Polygonum x bohemicum*) were conducted in 2005 and 2006 with various rates and timings (spring, summer and winter) of imazapyr, glyphosate, triclopyr, aminopyralid and imazamox. Herbicide trials were conducted during the early growth flush, April to May, to determine if efficacy could be achieved before the canopy reaches its full 4m height. Imazapyr (1.6 kg ae/ha) and aminopyralid (0.3 kg ae/ha) were more effective than glyphosate (9 to 22 kg ae/ha) or triclopyr (3.6 kg ae/ha) in preventing regrowth. Herbicides efficacy was reduced if applications were made too early during spring growth (~plant height <1.5 m). Additions of glyphosate to early season imazapyr did not enhance efficacy. Efficacy studies on summer timing (full size canopy) of herbicides indicated imazamox (0.56 kg ae/ha) was least effective (35% control), aminopyralid (0.36 kg ae/ha), imazapyr (0.56 kg ae/ha), and triclopyr (47 kg ae/ha) intermediately effective (87 to 95% control), and imazapyr (1.6 kg ae/ha) and glyphosate (87 kg ae/ha) most effective (>98% control). Triclopyr (27 to 60 kg ae/ha) and aminopyralid (0.3 kg ae/ha) applied to dormant basal buds in March resulted in nearly 100% control. The December timing was not as effective. *In situ* seed germination bioassays were conducted one year after treatment to assess residual herbicide activity across plots with high rates of imazapyr and triclopyr. None was found. Implications for new control opportunities will be discussed.

6. Ecological consequences of giant knotweed (*Polygonum sachalinense*) invasion into Pacific Northwest riparian forests. Lauren Urgenson and Sarah Reichard. University of Washington, College of Forest Resources, UW Botanic Gardens, Box 354115, Seattle, WA 98195-4115. lsu@u.washington.edu

Giant knotweed (*Polygonum sachalinense*) is a non-native invader of riparian corridors throughout North America and Europe. Knotweed invasion is suspected to alter critical riparian processes including forest and understory regeneration, streambank stability, soil nutrient cycling and allochthonous litter inputs. Currently, there is limited quantitative evidence of the level or significance of these suspected impacts. This research investigated the effects of knotweed invasion on 1) the composition and diversity of forest understory communities and 2) the quantity and nutrient quality of riparian leaf litter inputs into streams. There was a negative correlation between knotweed invasion and the species richness and abundance of native understory herbs, shrubs, and juvenile trees. Data also suggest that knotweed invasion alters stream nutrient subsidies from riparian litterfall. The carbon to nitrogen ratio (C:N) of senesced knotweed leaves was 52:1, a value 38 to 58% higher than dominant native riparian species. Analysis of nutrient re-absorption from senescing leaves revealed that knotweed reabsorbed 75.5% of its foliar nitrogen prior to litterfall. In contrast, native species reabsorbed 5 to 33%, thus contributing a greater proportion of their nitrogen resources to riparian soils and aquatic environments through leaf litter. Reductions in juvenile coniferous and broadleaf trees associated with knotweed invasion may limit development of overstory trees and alter the successional trajectory of these riparian forests. Loss of riparian trees can have long lasting and detrimental effects on bank stability, hydrology, nutrient loading, habitat quality and productivity of adjacent lotic systems. Additionally, leaf litter from riparian vegetation comprises a primary source of nutrients and energy in forested streams and backwater channels. By displacing native vegetation and altering the species composition and nutrient quality of litter inputs, knotweed invasion can affect the structure and productivity of riparian forests and adjacent aquatic habitats.

7. Developing a biological control program for invasive knotweeds. Fritzi Grevstad[1], Richard Reardon[2], Bernd Blossey[3], Richard Shaw[4], and Eric Coombs[5]. [1]Olympic Natural Resources Center, University of Washington, 2907 Pioneer Road, Long Beach, WA 98631; [2]Forest Health Technology Enterprise Team, U.S. Forest Service; [3]Department of Natural Resources, Cornell University; [4]CABI Biosciences, United Kingdom; [5]Oregon Department of Agriculture. grevstad@u.washington.edu

Aggressive, widespread, and difficult to control with conventional means, invasive knotweeds are suitable targets for classical biological control. In classical biological control, host-specific natural enemies (agents) from the weed's native range are introduced with the intent of establishing a permanent population that will provide sustained control of the weed. When successful, biological control is highly cost effective on a large scale. This biological control program would be especially so, because much of the initial work has already been carried out for a biological control program against knotweeds in the United Kingdom. Among the more promising candidate agents are a leaf-feeding chrysomelid beetle *Gallerucida bifasciata*, a sap-sucking psyllid *Aphalara itadori*, a stem-boring moth *Ostrinia* sp., and a leafspot pathogen *Mycosphaerella* sp. To ensure that these candidate biocontrol agents will be safe to introduce into North America, we will systematically test them for their ability to feed and develop on native and economically important North American plants with an emphasis on plants related to knotweed (family Polygonaceae). Testing of the beetle, *G. bifasciata* is currently being carried out in USDA-APHIS-certified quarantine facility located at Oregon State University with funding from the U.S. Forest Service's Forest Health Technology Enterprise Team. Biocontrol agent releases will take place only after review and approval by the Technical Advisory Group on Biological Control of Weeds and permitting from USDA-APHIS and individual states. Provided that the proper steps are taken to ensure host specific agents, biological control of weeds can be implemented with a high level of safety.

8. The role of temporal and spatial variability in the treatment of Bohemian knotweed (*Polygonum x bohemicum*) on the Hoh River, Washington, USA. D.R. Campbell[1,] T.A. Neel[2], and J. Silver[3]. [1]National Park Service, North Coast-Cascades Exotic Plant Management Team, Port Angeles, WA 98362; [2]National Park Service, North Coast-Cascades Exotic Plant Management Team, Marblemount, WA 98362; [3]10,000 Year Institute, Port Townsend, WA 98368
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Bohemian knotweed (*Polygonum x bohemicum*) is an aggressive invader of riparian areas on the Olympic Peninsula of Washington state. Vegetative reproduction and rapid growth allow knotweed to quickly invade new habitats. GPS data were collected during survey and treatment efforts on the Hoh River from 2002 to 2005. Subsequent analyses were performed to describe the spatial and temporal distribution of knotweed plants, and to address the role that plant morphology may play in distribution patterns. Initial nearest neighbor analysis indicated that the mean distance between knotweed locations increased from 2003 to 2005, but varied among knotweed growth-form classes: ramet, genet, or cluster. Further analysis showed that while the mean number of ramets around genets and clusters decreased, the mean distance between ramets and genets, and ramets and clusters, was similar year-to-year. This suggests that while the distance between knotweed neighborhoods increased, and the density of plants decreased over time, the distances between growth-forms stayed relatively constant. The *M* Function, a modification of Ripley's *K* Function, was used to identify spatial scales at which significant clustering of growth-forms occurred. Clustering intensity of knotweed plants varied by growth-form and year.

9. What is the threat from invasive knotweed seed production? Timothy W. Miller, Washington State University Mount Vernon Research and Extension Center, 16650 State Route 536, Mount Vernon, WA 98273. twmiller@wsu.edu

Invasive knotweeds in the Pacific Northwest are of four species: Japanese (*Polygonum cuspidatum*), giant or Sakhalin (*P. sachalinense*), Himalayan (*P. polystachyum*), and Bohemian (*P.* x *bohemicum*, a hybrid of Japanese and giant). Of these, giant reliably produces seed, Japanese produces seed if pollinated by another species, while Bohemian and Himalayan do not typically produce seed in Washington. In germination testing in Massachusetts, Forman and Kesseli (2003) reported Japanese knotweed seed collected in 1998 as ranging from 0 to 70% germinable (mean of 10% germinable), while 1999 seed ranged from 0 to 100% germinable (mean of 63% germinable). They further report that Japanese seedlings were found at several sites in Massachusetts, with several individuals surviving the subsequent winter. In non-replicated germination trials conducted at Washington State University, overwintered seed collected from giant knotweed stems on the Olympic Peninsula were approximately 60% germinable. Some seedling establishment was subsequently observed on gravel bars on the Quilcene River, although most plants observed arose from rhizomes. Japanese knotweed seed collected from female plants near Acme and in Marblemount, were not as highly germinable, with seed collected in the autumn near Acme being about 30% germinable the following spring. In a few dozen seed collected from a large Bohemian infestation near Randle, no seedlings were produced. Whether this resulted from non-viability or from dormancy was not determined. From these data, giant knotweed poses perhaps the greatest risk for seedling establishment in the Pacific Northwest, while establishment of Japanese knotweed hybrids should be considered as possible.

10. Invasive knotweed control in King County, Washington. Sasha Shaw, King County Noxious Weed Program, Seattle, WA 98104-3855. Sasha.Shaw@METROKC.GOV

King County, Washington, in the central Puget Sound region of the Pacific Northwest, is heavily infested with Bohemian knotweed (*Polygonum* X. *bohemicum*) and has significant populations of giant, Japanese and Himalayan knotweed (*P. sachalinense*, *P. cuspidatum*, *P. polystachyum*). Natural resource managers, conservation organizations, and private citizens have become increasingly concerned with reducing the impact of knotweed in the county, but frequently are unable to effectively reduce the existing populations. In response, the King County Noxious Weed Program (KCNWP) has developed a knotweed strategy that combines education and strategic cooperative weed management projects. In 2001, the KCNWP completed a comprehensive roadside survey to assess the county-wide distribution of knotweed. The KCNWP then developed a plan of attack starting with the least-heavily infested watersheds and focusing on the riparian corridors where improvements in habitat quality would be the most significant. Starting in the fall of 2003, the KCNWP has worked on knotweed control projects on the Green, Middle Fork Snoqualmie, and South Fork Skykomish Rivers. Plans are being developed to include other waterways based on critical habitat, the existence of strong community and stakeholder support and financial resources. A key part of the strategy for all projects has been to bring as many stakeholders and property owners together as possible, combine resources, and coordinate efforts to maximize effectiveness. The projects underway in King County are all at different stages, but they share similar strategies, results and challenges and offer valuable lessons for future efforts.

11. Management of knotweed in the upper Skagit River basin of Washington. Melisa Holman, Bob Carey, and Peter Dunwiddie, Skagit Cooperative Weed Management Area, The Nature Conservancy. mholman@tnc.org

The Skagit Knotweed Working Group was formed in 2000 to begin a landscape-scale effort to control Japanese knotweed (*Polygonum cuspidatum*) and related congeners (knotweed) to help prevent degradation of riparian function and biological integrity in the Upper Skagit River Basin. Extensive surveys and outreach have taken place alongside a glyphosate-based treatment strategy. We report key findings based on five years of experience and data collection efforts: 1) Integrating manual and chemical control increases mortality by 16%. 2) Mortality is 35% lower for larger patches (>50 stems). 3) Regardless of patch size, mortality rates decrease as years of treatment increase. 4) An average of 16.5% of patches that appeared dead for one or more years experienced regrowth in subsequent years. These “resurrections” are more likely for large patches (>100 stems). These data suggest that it may be important to apply new treatment strategies to large patches and to patches that survive beyond one year of treatment. In addition, a large flood event in 2003 resulted in the rapid spread of knotweed in an eight mile segment of river floodplain from 15 patches to 200 patches. Our experience controlling knotweed in the upper Skagit underscores several fundamental tenets frequently advocated in controlling invasive species—the importance of thorough survey and early detection of infestations, a strategic focus on and rapid action to control all occurrences in source areas, the exploration of alternate treatment methods, and consistent follow up for several years to ensure that actions were effective and thorough.

12. Eradicating small knotweed patches without herbicide. Sally A. Nickelson, Watershed Ecologist, Seattle Public Utilities, 19901 Cedar Falls Road S.E., North Bend, WA 98045
Sally.Nickelson@Seattle.Gov

The >91,000-acre Cedar River Municipal Watershed is managed to supply Seattle's drinking water while restoring fish and wildlife habitat, natural ecosystem processes, and native biological diversity. Knotweed threatens all three of these restoration goals. Currently no herbicide is used within the watershed, so we are exploring alternative methods to eradicate small knotweed patches. In spring, 2004, we installed >31,000 square feet of geotextile fabric to cover numerous Bohemian knotweed patches on a deconstructed road through a wetland. We placed the fabric very loosely over the heavily infested areas, which allowed some growth under the cloth. This allowed us to maintain the cloth by simply walking over the fabric, stomping the new growth and breaking the stems. 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. In May 2006, we removed the fabric from three small patches and no growth of knotweed was observed during the remainder of the growing season. In 2007 we will remove fabric from larger areas and continue to monitor every three weeks. We anticipate we will need to continue monitoring the site for a minimum of five more years to ensure that we have completely eradicated the knotweed.

13. Non-herbicidal treatments of Japanese and Himalayan knotweed on the Queen Charlotte Islands, BC. Mike Cheney, Northwest Invasive Plant Council, Box 556, Masset, BC V0T 1M0, Canada mcheney@xplornet.com

Japanese and Himalayan knotweed were introduced on the Queen Charlotte Islands/Haida Gwaii in the late 1950's. They are now a serious problem. The majority of the sites for both species are within 100 metres of the shoreline. Soil types include loam, sand, gravel and coarse rock ("rip-rap"). Treatment of invasive plants with herbicides is not permitted on the public lands of the Queen Charlotte Islands, so alternative methods for control are under development. Initial surveys of the local distribution of Japanese and Himalayan knotweed suggested a possible alternative treatment method. On sites found adjacent to salt water, Japanese and Himalayan knotweed do not penetrate into the *Leymus mollis* zone and a distinct line of demarcation can be observed between the knotweeds and halophytic plants (e.g., *Leymus mollis, Honckenya peploides, Cakile edentula).* Even where tidal action would not affect the growth of the Japanese and Himalayan knotweed, these species do not thrive in saline soil conditions where halophytes thrive. Various experimental treatment were developed using seawater spray during the growing season. In some circumstances this proved to be a very effective method. In every case, seawater was an effective defoliant. Soil density and porosity appear to be important determining factors in the successful use of this control method. Other alternative treatment methods have been successfully applied on Haida Gwaii, including light suppression, selective mechanical removal. Our poster will portray the various methods that we have used, along with illustrations and data on the results achieved.

14. Replacing knotweed with desirable vegetation in northern coastal Oregon. Glenn R. Ahrens, OSU Extension Service, 2001 Marine Dr., Rm 210, Astoria, OR 97103.
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Japanese knotweed and related hybrids have invaded riparian areas along most major streams in N. Coastal Oregon. Cooperative Weed Management efforts in the area include a program of surveys followed by treatments with herbicides, which has resulted in ~120 acres of knotweed patches under treatment since 2003. Results to date raise major questions for the future including: What are the most cost-effective herbicide treatments that minimize risks to the environment? What are the best long term restoration strategies for replacing knotweed with desirable vegetation? Herbicide injection is increasingly used, however costs per acre are very high and the risks of over-application or environmental contamination are not well-studied for injection. On some sites, aboveground regrowth has been reduced by >95% with herbicides during the first 2 years. After 3-4 years however, persistence of viable rhizomes observed via excavation and resprouting indicates that 100% kill is unlikely. Long-term success in replacing knotweed will require either continued maintenance treatments or establishment of dominant vegetation that completely suppresses or excludes knotweed. On suitable sites, well-demonstrated forest vegetation management strategies have much promise for long-term replacement of knotweed with dominant Douglas-fir, spruce, and hemlock, which produce very deep shade. This approach would require only early knotweed control (1-3 years of treatment) adequate for establishment of vigorous planted tree seedlings. More work is needed to identify plant species and communities with potential to suppress knotweed across the range of management situations.

15. The Nature Conservancy's Sandy River watershed knotweed control program: lessons from six years of landscape scale control. Jonathan Soll, Willamette Basin Conservation Director, The Nature Conservancy, 821 Se 14th Ave, Portland, OR 97214 jsoll@TNC.ORG

Japanese and giant knotweed (*Polygonum cuspidatum* and *P. sachalinense* respectively) represent a significant threat to the function of riparian areas and floodplains throughout the Pacific Northwest, due to their capacity for forming dense monocultures and permanently displacing native species in riparian and flood plain habitats. Knotweed is quarantined and listed as a class "B - Target" noxious weed in the state of Oregon, and has been documented in nearly every county west of the Cascades. The Nature Conservancy (TNC) has been conducting knotweed control experiments since 2000, and has engaged in a landscape-level control project over 70 river miles of the Sandy River watershed. TNC and partner studies and control efforts have considered the efficacy and cost of manual treatment, a variety of foliar and cut-stem type herbicide applications, and direct stem injection of the herbicide glyphosate with or without supplementation by foliar application of the herbicides glyphosate and triclopyr. Despite success locating and treating knotweed at 800 locations within the watershed and producing dramatic reduction in stem numbers on a landscape scale, significant control issues remain unresolved. The presentation will present a summary of results from 6 years of field work as well as present some of the remaining challenges to successful landscape scale control of this invasive pest plant group.

16. The Washington State program for the control of invasive knotweeds. Marshall Udo, Knotweed Control Coordinator, Washington State Department of Agriculture, P.O. Box 42560, 1111 Washington St. SE, Olympia, WA 98504-2560. MUdo@agr.wa.gov

Since 2004, the Washington State Department of Agriculture (WSDA) has used an annual appropriation of $500,000 to provide resources to county noxious weed control boards, tribal governments, the Washington State Parks and Recreation Commission, and one non-governmental organization for landscape-scale knotweed control projects. Projects that target Japanese (*Polygonum cuspidatum*), giant (*P. sachalinense*), Bohemian (*P. x bohemicum*), and Himalayan (*P. polystachyum*) knotweed are eligible to receive support. In 2004, program cooperators treated 325 acres of knotweed along 311 river miles in Southwest Washington. In 2005, the program was expanded statewide, and included tribal partners and additional county weed boards. In 2005, over 1,000 acres of knotweed were treated along 600 river miles. Approximately 646 acres of knotweed were treated in 2006. Project work occurred in 1,563.9 river miles, and was performed for 1,076 landowners. Program cooperators have reduced the amount of knotweed in each project area, and have expanded control activities into tributaries and downstream areas. In 2006, all known knotweed populations were treated in Yakima and Whitman Counties and in the riparian corridors of 24 river systems of Washington State.

Discussion Session. Moderated by Cathy Lucero, Clallam County Noxious Weed Control Board, 223 E. 4th, Suite 15, Port Angeles, WA 98362-3015. clucero@co.clallam.wa.us

POSTER SESSION

Prioritization of weed treatment sites on the Mt. Baker-Snoqualmie National Forest.

Ann Risvold and Laura Potash, USDA Forest Service, Mountlake Terrace, WA.

Geographic and climatic distribution of invasive knotweeds in British Columbia.

Linda Wilson[1], Susan Turner[2], Robert Bourchier[3], and Brian Van Hezewijk[3]. [1]Invasive Plant Ecology and Management, University of Idaho, Moscow, ID. [2]British Columbia Ministry of Forests, Kamloops, BC , Canada. [3]Agriculture and Agri-Food Canada-Lethbridge Research Centre, Lethbridge, AB Canada

Invasive knotweed treatment profile: a comparison of foliar herbicide application vs. hand pulling for the control of Bohemian knotweed (*Polygonum* x *bohemicum*).

Bill Wamsley and Jason A. Imes, Lewis County Noxious Weed Control Board, 351 NW North Street, Chehalis, WA 98532

17. Prioritization of weed treatment sites on the Mt. Baker-Snoqualmie National Forest. Ann Risvold and Laura Potash, USDA Forest Service, Mountlake Terrace, WA arisvold@fs.fed.us

In April 2005, the Mt. Baker-Snoqualmie National Forest completed an environmental assessment for proposed treatment of known infestations of invasive plants, including a strategy to treat new invaders. The initial analysis considered nearly 400 documented sites. Given constraints on staffing and budget, the 400 sites were eventually reduced to 91 of the highest priority sites, using a decision matrix developed by the Botany staff. This method assigns "weighted points" to individual infestations based on many factors, including Class of weed, whether the species is a new invader, the potential impact of the infestation, value of the habitat infested, extent of the infestation, location in the watershed, and sociopolitical considerations. This method allows for the most efficient use of limited funds to treat known infestations as well as new invaders.

18. Geographic and climatic distribution of invasive knotweeds in British Columbia. Linda Wilson[1], Susan Turner[2], Robert Bourchier[3], and Brian Van Hezewijk[3]. [1]Invasive Plant Ecology and Management, University of Idaho, Moscow, ID. [2]British Columbia Ministry of Forests, Kamloops, BC , Canada. [3]Agriculture and Agri-Food Canada-Lethbridge Research Centre, Lethbridge, AB Canada. lwilson@uidaho.edu

In western Canada, there are three species of non-native, invasive knotweeds, including Japanese knotweed (*Fallopia japonica*), Giant knotweed (*F. sachalinense*), and Himalayan knotweed (*Polygonum polystachyum*). The hybrid between Japanese and Giant knotweed, Bohemian knotweed (*F.* x *bohemicum*) is also prevalent in coastal and inland regions. Although the extent of hybridizatioin is not known for knotweeds in British Columbia, it is likely that many populations, particularly those on Vancouver Island and the Sunshine Coast, are comprised of the hybrid, especially in locations where Japanese knotweed and Giant knotweed co-occur. An exception occurs on the Queen Charlotte Islands, where only Japanese and Himalayan knotweeds are known, and the hybrid is absent. In British Columbia, knotweeds occur predominantly along the coast, invading virtually all coastal habitat types. Several populations are known from the drier interior of the province, predominantly in the Interior Cedar Hemlock Zone in the Kootenay Region. Northern populations are also known from the Sub-Boreal Spruce Zone at Hazelton. The spread of Japanese knotweed in BC will be limited more by the length of the growing season, in degree days, than by minimum temperatures, based on climate simulations. The simulations also indicate that there are large areas of suitable habitat for Japanese knotweed in BC that have yet to be colonized based on current distribution data.

19. Invasive knotweed treatment profile: a comparison of foliar herbicide application vs. hand pulling for the control of Bohemian knotweed (*Polygonum* x *bohemicum*). Bill Wamsley and Jason A. Imes, Lewis County Noxious Weed Control Board, 351 NW North Street, Chehalis, WA 98532. wamsleyb@wsu.edu

Management of two invasive knotweed populations occurred from 2004-2006 as part of a statewide program. The hand pulling site is in a mixed stand of timber adjacent to a Forest Service road. A foliar herbicide application was made to a site adjacent to a lumber mill. Both sites are located in Southwest Washington. The metrics used for comparison are stem number, height and diameter, man-hours. Foliar herbicide (Imazapyr & Glyphosate) application resulted in a 99%, 50% and 66% reduction in stem number, height and diameter, respectively. Three man-hours have been invested in this site over 3 years. Hand pulling resulted in a 33%, 67% and 50% reduction in stem number, height and diameter, respectively, requiring 72 man-hours over 3 years. Recruitment of native plants has resulted in diverse herbaceous cover at the forest road site. Our work suggests control of bohemian knotweed can be achieved using either method profiled here. Hand pulling will require a commitment of multiple years to reach the management objective. Foliar herbicide treatment will reduce stand size in the short term but will require multiple years of follow-up treatment and monitoring. Major differences between the two methods are rapidity in which the objective can be achieved, cost in man-hours required to reach the goal and the rate at which native plant communities re-establish.

Cancelled paper

Effects of lowering pH on imazapyr control of Japanese knotweed (*Polygonum cuspidatum*).
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A Japanese knotweed (*Polygonum cuspidatum*) greenhouse study was installed in June, 2006 at the National Weed Management Lab in Fort Collins, CO. The objective of the study was to determine if three acidifying adjuvants improve the efficacy of imazapyr on resprouting knotweed. The study involved 9 – 10 month old plants that were clipped twice at ground line before application in August, 2006. Thirty two plants were propagated from Colorado rhizomes, and thirty two plants were propagated from Washington rhizomes. Imazapyr was applied at 87.5 g a.e. ha^{-1} in combination with a methylated seed oil (MSO Concentrate) at 5% v/v, and three separate adjuvants that lower the solution pH. The adjuvants included two numbered compounds from Loveland Products Inc. (LI-6169 and LI-6176) were mixed to a target pH of 1.9 and 3.6 for each adjuvant, and a commercial product LI-700 mixed to a target pH of 3.6. Stomatal results at 32 DAT show that foliar gas exchange responses to imazapyr plus adjuvants may be an early indicator for plant injury. Two imazapyr/adjuvant treatments reduced stomatal conductance, but at opposing pH levels, i.e. LI – 6169 at pH 1.9 and LI – 6176 at pH 3.6. The gas exchange rate was reduced approximately 36% when LI- 6169 (pH 1.9) was applied to the Colorado knotweed.