STATEWIDE KNOTWEED CONTROL PROGRAM

2011 Progress Report

March 2012

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Cover Photo: Courtesy of Pierce Conservation District. Photo taken on the upper Nisqually River of a patch of Bohemian knotweed.

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Executive Summary

The WSDA Knotweed Control Program is a key component of the intergovernmental effort to control invasive knotweed in Washington State. Knotweed includes four closely related noxious weeds that aggressively invade high value habitats and displace native vegetation. This program provides funding, coordination, and other resources to cooperators that conduct invasive knotweed control projects and has partnered with, or directly supported, tribal governments, local governments, non-governmental organizations, and other state agencies. The program maintains or creates green jobs across the state, benefiting the environment and economy of Washington, and has provided training and employment to many individuals since 2004.

WSDA serves as a clearinghouse for knotweed information and assists any group interested in control. WSDA works with groups throughout Washington to identify knotweed infestations, develop control projects, and secure grant funding. In order to minimize duplication of efforts by program cooperators, WSDA fulfills state-level environmental review requirements, coordinates Federal Clean Water Act permit compliance, provides public notification and education materials, and publishes required notices and maintains a database of known knotweed locations.

WSDA has received approximately $4 million for knotweed control since 2004. This funding has been critical for our program cooperators to secure additional resources by providing them with state-origin matching funds. In 2011, the WSDA Knotweed Control Program budget was $469,278, which allowed for the support of project activities in watersheds of 15 counties. This level of program support allowed cooperators to leverage additional funding from tribal, local, non-governmental, and federal sources to these knotweed control projects.

With the combination of funds available in 2011, approximately 1,100 acres of knotweed were treated with integrated pest management techniques, and project work occurred in 760 river miles for 1,413 landowners. In 2011, fifteen proposals requesting a total of $411,528 were submitted. WSDA furnished support to 14 of these projects and one biological control development project, providing a total of $319,278 for agreements and contracts.

WSDA will continue to support knotweed control as program funding allows. The funding outlook in 2012 appears stable. In the past, funding reductions have led to the abandonment of projects and reduced support for ongoing initiatives. In contrast, knotweed projects that have received stable funding have shown a vast decrease in knotweed presence. Stable funding will remain imperative to the success of knotweed control in Washington State.

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Introduction

This is a progress report for the Statewide Knotweed Control Program coordinated by the Washington State Department of Agriculture (WSDA) that describes the program framework, survey methods, treatment methods, project selection process, budget, and results for calendar year 2011.

This report presents the methods and results that are common to the knotweed projects that WSDA supports. The results are divided into a programmatic summary to describe the general activity level of program cooperators, and monitoring results that describe the changes at infested sites. Three program measures are used to describe the activity level of program cooperators: river miles, acres of knotweed treated, and the number of landowners assisted. These metrics allow for the comparison of activity level through time.

Analyzing the total acreage of knotweed treated by program cooperators on an annual basis is a reasonable method to describe the amount of area affected by knotweed, but it is not a precise way to detect the change that occurs within infested sites following herbicide applications. Due to this challenge, WSDA used monitoring plots to detect the within-site change of knotweed populations following annual treatment activities implemented by program cooperators since 2004. The trend of these data shows a significant decrease in knotweed following a series of annual treatments.

This trend of significant reductions is consistent with the results seen in all project areas. Across the state, the knotweed populations that persist in project areas have fewer stems per acre and the knotweed that is present exhibits reduced stem height, stem diameter, and overall vigor. As a result of program cooperator efforts, many native plants, including tree and shrub species, have reestablished in areas where they had previously been displaced. Sustained funding is critical to protecting these accomplishments and continuing to remove knotweed from valuable watersheds.

Budget reductions have previously resulted in the inability to support follow-up activities at project sites. When a site is left untreated, small amounts of living knotweed can return to original infestation levels in as few as three seasons, placing the site back on a path towards a monoculture of knotweed and subjecting the project area to the negative consequences of knotweed invasion.

The Problem

The invasive knotweeds are non-native plants that have been introduced to Washington State without the factors that keep their populations under control in their native range. Knotweed alters riparian vegetation communities, disrupts nutrient cycling, negates riparian restoration efforts, affects the recreational use of watercourses, and decreases property values. Knotweed has been reported in every county of Washington State. These plants are pioneer species that quickly colonize disturbed areas. Once knotweed becomes established, it is very difficult to remove, and single patches can persist for more than 100 years.

In the Pacific Northwest, knotweed spreads when roots and stems are moved by flowing water or human activities. Human activities include moving soil that contains knotweed plant material, mowing or cutting knotweed, or discarding knotweed plant material in vulnerable habitats.

Figure 1. Gravel bar in the Washougal River during summer flow (left) and winter flow (right) levels.

Figure 2. Knotweed plants sprouting from plant fragments deposited by flood water.

In river corridors, knotweed reproduces from fragments and seeds that travel downstream, affecting the gravel bars and riparian forests of entire river systems. Figure 1 shows natural flooding of a knotweed-infested gravel bar. This site served as a source for new infestations as knotweed stem and root fragments were transported downstream by the flowing water. Root and stem fragments as small as one inch can produce a new plant. As a result, one patch can be the source of many downstream populations.

Figure 2 shows knotweed sprouting from fragments deposited by flood waters in the Cowlitz River valley. If left untreated, these small plants will form multi-stemmed patches. When these patches coalesce, they exclude all other vegetation. Figure 3 shows the knotweed infestation of a riparian forest of the

Dickey River in 2005. Knotweed had displaced most of the understory plants at this site and occupied any opening created by natural disturbance.

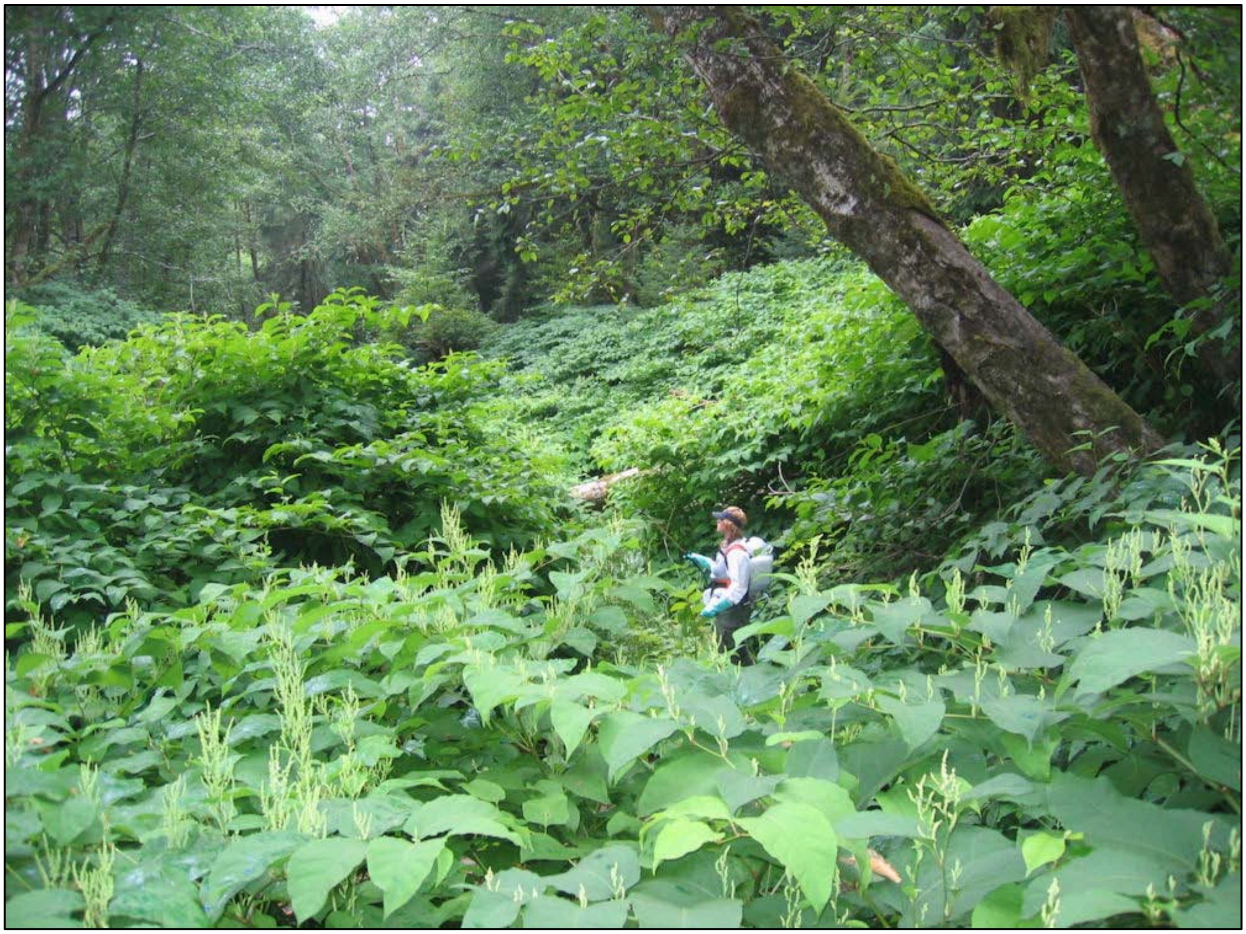

Figure 3. Riparian forest of the Dickey River infested by Bohemian knotweed (Photo courtesy of the National Park Service).

Riparian areas are transitional habitats located between terrestrial and aquatic ecosystems such as lakes or rivers. Riparian areas provide shade, nutrients, and large woody debris to both aquatic and terrestrial ecosystems. Over time, riparian areas that are occupied by early-successional native species such as alder, willow, and other shrubs, move toward a plant assemblage dominated by conifers. These functions take many decades to recover once impacted by any disturbance.

Substantial resources have been applied to the protection or restoration of riparian areas in Washington State for the benefit of fish, wildlife, and recreation. Many of these projects seek to reintroduce or protect riparian vegetation that is critical to self-sustaining ecological services of forests and streams. However, many of these projects are located in areas vulnerable to knotweed invasion. Knotweed infestations can ruin the sustainable benefits of these projects by out-competing the offspring of the native plantings and dominating the vegetation community in the long-term.

When sites are heavily infested by knotweed, there are fewer juvenile trees available to replace mature trees removed by natural disturbances such as wind, flood, or fire. Instead, the knotweed present in the understory fills any gaps that are created. Failure to control knotweed at these sites will result in a monoculture of knotweed that excludes all beneficial riparian vegetation in the future.

The lack of juvenile tree species in knotweed-infested riparian forests could also result in a decrease in large trees available to fall into the stream channel. These large pieces of wood, also known as large woody debris are important to the rivers and streams of the Pacific Northwest. Large woody debris creates pool habitats, retains spawning gravels, and provides cover for juvenile salmonids. The loss of large woody debris can disrupt natural processes, leading to a down-cutting of the stream bed, loss of side channel fish habitat, loss of pool habitat, decreased retention of spawning gravels, and decreased cover for juvenile salmonids and their prey. Depending on the time of year and salmon species, a decrease in the number of pieces and volume of large woody debris has been shown to decrease the number of salmon that utilize the section of stream lacking large woody debris. This could negatively impact efforts to restore salmon populations.

Knotweed can also have a negative effect on aquatic invertebrates that are the basis of the aquatic food chain by disrupting or altering the quality and timing of leaf litter inputs. This lowers the species diversity of invertebrates and negatively affects the organisms and processes that depend on them. Invertebrates are the primary food source of juvenile fish species.

Knotweed often negatively affects residential property and transportation infrastructure. Along right-of-ways, knotweed can grow through materials used for roadways, causing the need for expensive repairs. Knotweed patches also pose potential sight-distance hazards to vehicle operators due to rapid growth, affecting public safety on roadways (Figure 4).

Figure 4. This knotweed patch obscured the road sign on an annual basis and required increased site visits due to its vigorous regrowth.

Habitat modeling performed by WSDA indicates that knotweed currently occupies a small fraction of its potential habitat in Washington. However, there is evidence that knotweed populations outside of current project areas will continue to expand, and will eventually invade these suitable areas.

Trends in plant population growth can be identified using the cumulative number of herbarium specimens recorded over time. When the total number of records are viewed versus time, the trend of the data can be used to determine whether the populations are increasing, decreasing, or are stable. Figure 5 shows the cumulative areas infested by knotweed since 1936 based on regional herbarium records.

Although the absolute rate of spread cannot be calculated with the herbarium data, the trend suggests that knotweed populations are increasing exponentially in Pacific Northwest. The pattern in the data is consistent with population growth free of any natural suppression.

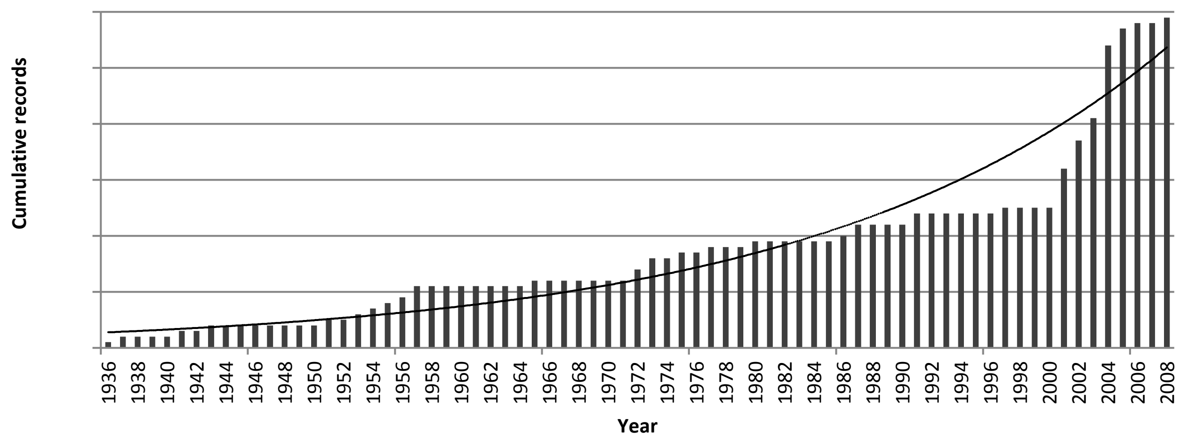

Figure 5. Cumulative area occupied by knotweed since 1936. Records were obtained from the Consortium of Pacific Northwest Herbaria for Japanese, giant, and bohemian knotweed.

The increase of knotweed populations will result in increased future control costs and increased costs associated with negative impacts caused by knotweed as these populations expand exponentially. The cumulative number of localities occupied by knotweed reported in regional herbaria has been increasing exponentially with a rapid expansion following 2000. The only way to reverse this trend is to implement an active control project.

The Plants

The invasive knotweed complex is comprised of four herbaceous perennial plant species from the buckwheat family (Polygonaceae) that are native to Asia. They are broadleaf plants that have green stems and reddish nodes (Figure 6). The plants were introduced to the United Kingdom and the United States as garden ornamentals in the early part of the 20th century. The four species are commonly referred to as Japanese, giant, Bohemian, and Himalayan knotweed. All four species occupy similar habitats and cause similar negative impacts. They are collectively referred to as knotweed in this report. The four species are alternatively placed in either *Polygonum* or *Fallopia* genus.

Figure 6. The green, bamboo-like stems of invasive knotweed.

- **Japanese knotweed** (*Polygonum cuspidatum* Sieb. & Zucc.) The leaves of this plant are blunt at the base and sharply tapered at the tip (Figure 7). The stems of this plant usually grow to 7 feet tall. Stem diameters range from one-half to one inch.

- **Giant knotweed** (*P. sachalinense* Schmidt) This is the largest of the four invasive knotweed species. It has large heart shaped leaves (Figure 7), stems that can grow up to 12 feet tall, and stem diameters up to two inches.

- **Bohemian knotweed** (*P. x bohemicum* Chrtek & Chrtkova) This is the hybrid produced by giant and Japanese knotweed. Leaf shape, stem diameter, and stem heights are variable, but are usually within the range of the smaller Japanese knotweed and larger giant knotweed. It is the most common invasive knotweed species in Washington State.

Figure 7. Leaves of three species of knotweed. From left to right are the leaves of giant, Japanese, and Himalayan knotweed.

- **Himalayan knotweed** (*P. polystachyum* Wall) has lance-shaped leaves that make it readily identifiable when compared to the other species (Figure 7). The stems of this plant usually reach one half inch in diameter, and four to five feet in height. It is most common in the coastal areas of southwest Washington.

All four species are listed as Class B noxious weeds on the Washington State Noxious Weed List (WAC 16-750-011). Class B noxious weeds are designated for control in regions of Washington State where they are not yet widespread. In regions where Class B noxious weeds are abundant, mandatory control is decided at the county level. In addition, all four species are included in the Washington State noxious weed seed and plant quarantine list (WAC 16-752-610). Under this rule, it is illegal to transport, buy, sell, or trade any of the invasive knotweed species.

Figure 8. Flowering knotweed in Skamania County.

Invasive knotweeds have extensive underground rhizome and root systems. They thrive in moist soil or river cobble, in full or partial sunlight, and are most common along rivers, creeks, beaches, and disturbed areas.

The aerial stems of knotweed emerge in spring and reach full height by early summer. The plants flower in late summer or early fall (Figure 8), and the aerial shoots die after the first frost leaving living underground root systems. The dead shoots persist through the winter, and can remain standing for several years (Figure 9).

Figure 9. Dead aerial stems of knotweed on the East Fork Lewis River in Clark County.

WSDA Knotweed Control Program

Since 2004, the Washington State Department of Agriculture has partnered with multiple organizations to locate and control knotweed in select watersheds across the state. Implementing annual field surveys and targeted herbicide applications has proven to be a very effective means of controlling knotweed. Program cooperators survey for knotweed by wading or boating streams and driving right-of-ways in each project area. The location of knotweed is documented, and this information is used to identify the ownership of affected parcels. Figure 10 shows crew members recording the location of a knotweed patch in the Upper Skagit River. Program cooperators provide educational materials and notification to each landowner prior to the performance of any control activities. Most landowners are familiar with the negative impacts of knotweed and welcome the assistance provided by program cooperators.

Figure 10. Crewmembers performing a survey of the Upper Skagit River.

Treatment methods are selected based on site and infestation characteristics according to integrated pest management (IPM) principles. An important IPM consideration for the program is the treatment of all known knotweed populations in the selected river corridor, starting at the upstream source of the infestation and working in a downstream direction. This strategy helps to ensure that untreated knotweed plant material will not re-infest treatment sites as it moves downstream.

Figure 11. Knotweed crewmember treating knotweed regrowth.

Treatments are conducted when the knotweed plants are actively growing. Figure 11 shows a crewmember making a targeted herbicide application to knotweed regrowth. All program cooperators apply formulations of the systemic herbicides imazapyr or glyphosate, alone or in combination. Foliar delivery of herbicide was the primary treatment method used by project cooperators in 2011. The use of herbicide has been proven to be the most effective treatment method.

Program cooperators use herbicides that are registered in Washington State for use in or near water. WSDA requires that all herbicide applications be made under the supervision of a licensed applicator. Funding to support the WSDA knotweed program helps to ensure that licensed and trained professionals make herbicide applications near water.

Biological Control Program

Dr. Fritzi Grevstad of Oregon State University has been working with an international group of scientists to develop a classical biological control program for the control of Japanese, giant, and Bohemian knotweed. In biological control, natural enemies from the weed's native range are introduced to the invaded range to provide long-term suppression of the plant population. Partners include the U.S. Forest Service Forest Health Technology Enterprise Team, Washington State Department of Agriculture, Oregon Department of Agriculture, Oregon State University, Cornell University, CABI- Biosciences United Kingdom, Washington State University Extension, Agri-Food Canada, and the BC Ministry of Forests.

Figure 12. Image of a *Aphalara itadori* on a knotweed plant.

Between 2007 and 2011, four natural enemies from knotweed's native range were tested as potential biological control agents (a leaf beetle, two moths, and a psyllid). Only one of these species was found to be suitably host specific, the psyllid *Aphalara itadori* (Fig. 12). Two different biotypes of the psyllid were evaluated—a northern biotype (from Hokkaido), collected from giant knotweed, and a southern biotype (from Kyushu) collected from Japanese knotweed. In 2011, the last of the pre-release laboratory testing was completed for both biotypes. The main set of host specificity tests involved caging adult psyllids onto 6 replicates of each of 70 different non-target plant species for a period of 5 days. Although eggs were laid on some of the non-target plant species, development of the insects did not occur on the vast majority of them. Three non-target plant species did support very low levels of development warranting further testing. The plants were *Fallopia cilinodis, Fagopyrum esculentum,* and *Muehlenbeckia axillaris*. The additional tests have shown that (1) the psyllids will tend to avoid these non-target plants when knotweed is also present and (2) they are not capable of sustaining a population on the non-targets, with one exception. In one replicate, the southern biotype of the psyllid was found to be capable of persisting for at least 3 generations when caged on *M. axillaris*. *M. axillaris* is an introduced ornamental plant with little economic value. Thus, the potential benefits of knotweed biocontrol greatly outweigh the small risk in this case.

The effectiveness of the two biotypes of psyllid was also evaluated. Both psyllid biotypes were effective at reducing the above- and below-ground biomass of knotweed in a 50-day exposure period in the greenhouse (Fig. 13). Feeding by psyllid nymphs slowed the growth of plants by killing the meristem tissue and causing necrosis of the leaves. Several plants died during this limited exposure period. The greatest mortality was found for the Hokkaido psyllid feeding on *F. sachalinensis* where 4 out of 6 potted plants died after a 50-day exposure period.

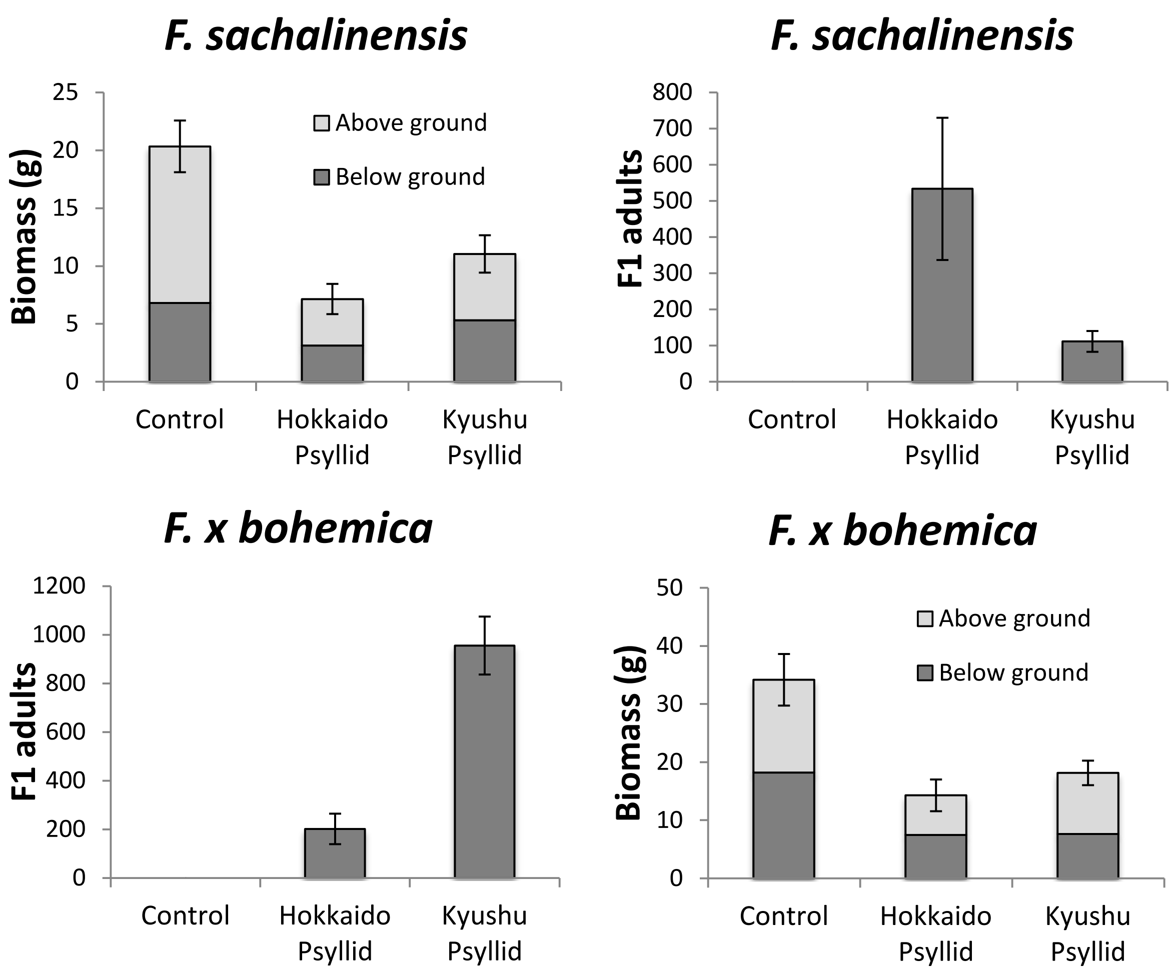

Figure 13. Final plant biomass (a) and numbers of F1 adults (b) on *Fallopia sachalinensis* and *F.* x *bohemica* after plants were initially exposed to 20 pairs of Hokkaido or Kyushu biotypes of *Aphalara itadori* and their offspring for 50 days. N=5 for *F. sachalinensis*. N=7 for *F.* x *bohemica*.

The two biotypes differed in their reproductive success on the different species of knotweed which is likely to influence population level effectiveness in the field. Experimental results indicate that the Kyushu biotype will have greater reproductive success on *F.* x *bohemica* and *F. japonica* than the Hokkaido biotype. The Hokkaido biotype will perform well on *F. sachalinensis* and on some populations of *F. x bohemica*. Thus the decision to use one or the other biotype in an area should depend on the knotweed population being targeted.

In anticipation of future releases of *Aphalara itadori*, genetic studies were carried out to characterize the target populations for biological control. Knotweed tissue samples were taken from 11 infested river systems in Oregon and Washington. Genotypes were determined by J. Gaskin of the USDA Agricultural Research Service in Sydney, MT using analysis of amplified fragment length polymorphism (AFLP). Although there was plenty of genetic diversity overall, a few genotypes dominated. Several heavily infested river systems, namely the Luckiamute, Lower Nehalem, Snoqualmie, Samish, and Skagit were dominated by one *F. x bohemica* genotype, which presumably spread by clonal reproduction. Other rivers were found to be a single *F. japonica* clone (e.g. the Nestucca River in Oregon) or a single *F. sachalinensis* clone (Big Creek in Oregon). In contrast, there were other river systems, such as the Nooksack and the Cedar Rivers in Washington, that had a high genetic diversity including many different genotypes of all three species.

All of the results from these investigations have been compiled into a report that will soon be reviewed by the Technical Advisory Group on Biological Control of Weeds and the U.S. Department of Agriculture for possible permitting and release of the biological control agent into North America.

Figure 14. Damage to giant knotweed caused by the psyllid *Aphalara itadori.*

2011 Project Selection

The organizations that implement knotweed control projects in Washington State are growing in both numbers and type. Many cooperative weed management groups have formed to combat invasive knotweed, bringing together landowners, land management agencies, tribal governments, county noxious weed control boards, fisheries enhancement groups, conservation districts, and other conservation organizations and citizen groups. With the increase in organizations involved in knotweed control comes an increase in need for funding to support cross-jurisdictional projects on the scale of whole river systems.

In 2011 stakeholders recommended that WSDA support projects that:

- protect previous accomplishments;
- can cost-effectively control knotweed populations; and
- will protect large, ecologically important areas.

In combination with these recommendations, WSDA used the project area's current infestation level, health of riparian areas, and the extent that requested funds would be used to leverage additional funding to rank proposals and develop a list of projects that would be supported.

In 2011, fifteen proposals requesting a total of $411,528 were submitted. WSDA furnished support to 14 of these projects and one biological control development project, allocating a total of $319,278 for agreements and contracts. Figure 14 shows the location and scope of the supported projects.

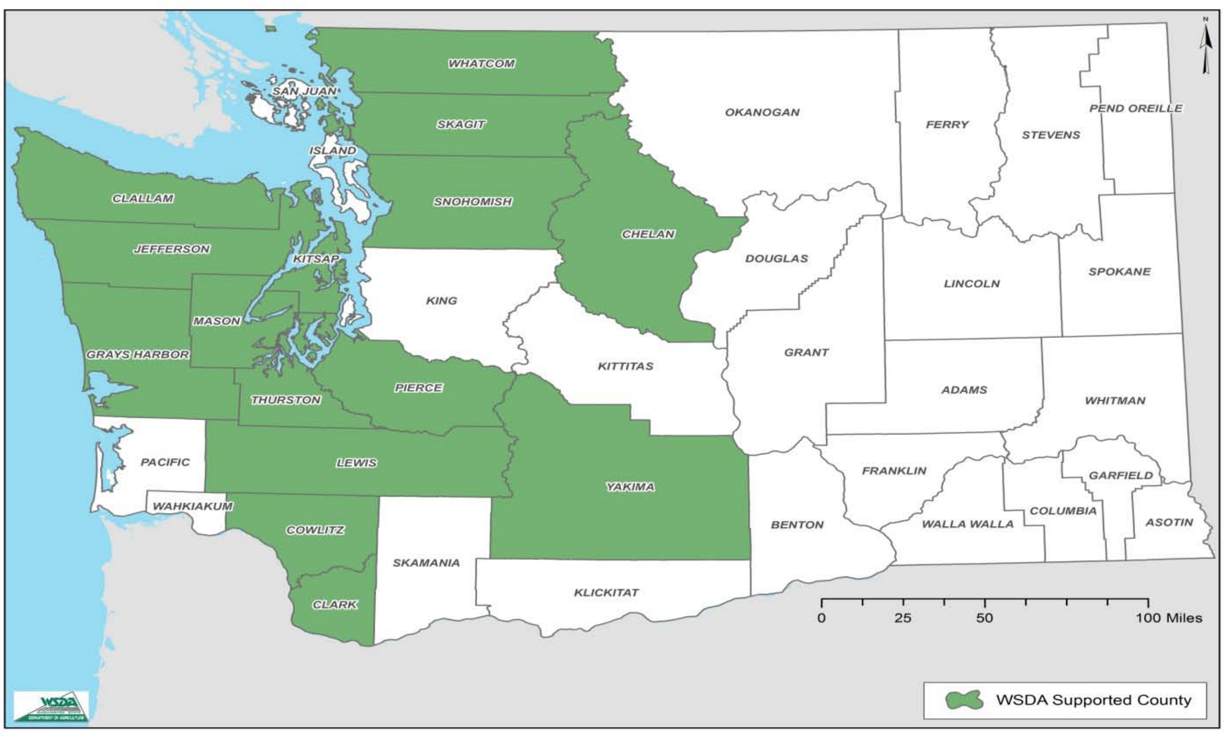

Figure 14. Map depicting the counties where WSDA supports knotweed control projects.

Budget

The Washington State Department of Agriculture has administered a knotweed control program since 2004 when the Legislature provided an appropriation of $500,000 per year for a pilot program in southwest Washington. Including that initial investment, WSDA has received around $4 million to control knotweed since 2004. This funding has been critical for the ability of our program cooperators to secure additional resources by providing them with state-origin matching funds.

In 2011, the WSDA knotweed control program budget was $484,278 (Table 1). WSDA provided $319,278 for contracts and agreements, $10,000 for a centralized herbicide purchase, and $140,000 for WSDA coordination. WSDA coordination expenses include agency administration costs, salaries and benefits for coordination, legal and clerical support, equipment costs, printing, and other goods and services.

Table 1. Estimated budget activity for the 2012 fiscal year.

Activity			Expenditure
Purchased Services			$319,278
	10,000 Years Institute	$23,585	
	Chelan County	$10,250	
	Clallam County/Jefferson County	$16,766	
	Clark County	$57,820	
	Cowlitz County	$5,176	
	Lewis County	$17,145	
	Oregon State University	$33,990	
	Pierce Conservation District	$28,500	
	Skagit Fisheries Enhancement Group	$10,250	
	Snohomish County	$6,500	
	Stilly-Snohomish Fisheries Enhancement	$3,969	
	Center for Natural Lands Management	$58,380	
	Hood Canal Salmon Enhancement Group	$28,750	
	Skagit County	$13,072	
	Yakima County	$5,125	
Herbicide			$10,000
Coordination			$140,000
Total			$469,278

Results

In addition to a biological control development project with Oregon State University, in 2011 WSDA provided resources to the 10,000 Years Institute, Skagit Fisheries Enhancement Group, Stilly-Snohomish Fisheries Task Force, The Nature Conservancy, Pierce Conservation District, and the noxious weed control boards of Chelan, Clallam, Clark, Cowlitz, Lewis, Skamania, Snohomish, Whitman, and Yakima counties to control knotweed.

These cooperators implemented knotweed control projects in watersheds of 15 counties. WSDA continued to support on-going projects and, for the first time, provided resources to the Chelan County Noxious Weed Control Board. The organizations that combined crew work in a shared project area are listed together. Table 2 is a summary of the work performed by program cooperators in 2011.

Table 2. Results by program cooperator for the 2011 control season.

Program Cooperator	**Acres Treated**	**River Miles**	**Landowners Assisted**
10,000 Years Institute	0.02	30	10
Chelan County	1.0	87	100
Clallam County/Jefferson County*	780.0	80	378
Clark County	0.0	0.0	0
Cowlitz County	7.5	6.6	90
Lewis County	1.0	1.0	6
Pierce Conservation District	130.0	75	36
Skagit Fisheries Enhanement Group	1.3	88	22
Hood Canal Salmon Enhancement Group	23.9	19.0	150
Snohomish County	114.0	29	150
Sound Salmon Solutions	11.4	0.2	35
Center for Naturalized Management	10.0	204	135
Skagit County*	19.4	58	19
Yakima County	1.4	82	282
Total	**1,100.8**	**759.8**	**1,413**

* These groups worked in a shared project area with a combined crew

WSDA uses three metrics to track the progress of each project. The river miles column includes survey, treatment, and monitoring activities. In cases where our projects are focused on the treatment of upland knotweed populations in order to prevent the infestation of the shorelines of rivers, the river miles measured does not apply

Approximately 1,100 acres of knotweed were treated with IPM techniques in 2011. Project work occurred in 760 river miles for 1,413 landowners. Figure 15 shows one site in Skamania County where knotweed populations have been greatly reduced.

Figure 15. Knotweed control site in Skamania County showing typical results. Image on the left was taken in 2004, and the image on the right was taken in 2010 following annual treatment and the implementation of a restoration project by the Skamania County Noxious Weed Control Board.

Monitoring

Analyzing the total acreage of knotweed treated by program cooperators on an annual basis is a reasonable method to describe the amount of area affected by knotweed, but it is not a precise way to detect the change that occurs within infested sites following herbicide applications. Due to this challenge, WSDA uses monitoring plots to detect the within-site change of knotweed populations following annual treatment activities implemented by program cooperators.

The knotweed plants in these monitoring plots receive annual herbicide treatments that are the same as treatments in other parts of the project area. It is assumed that the results in the monitoring plots are representative of results outside of the plots. Due to annual die-back of knotweed stems, treatment effects are not apparent until the next growing season. Therefore, the metrics recorded at the monitoring plots describe the efficacy of treatments made one year prior.

One of the monitoring actions performed at these monitoring plots is to document the number of stems that appear within sections of the plot. These stem counts are normalized by dividing by the area they occupy, and a metric of stems per acre is calculated. Stems per acre has been used to describe and compare the vigor of knotweed growth at each monitoring plot. Figure 16 is a summary of these data, and spans 2004-2011. The knotweed populations in these monitoring plots were not treated in 2003, so the values calculated for 2004 represent the number of stems per acre of the original knotweed infestation.

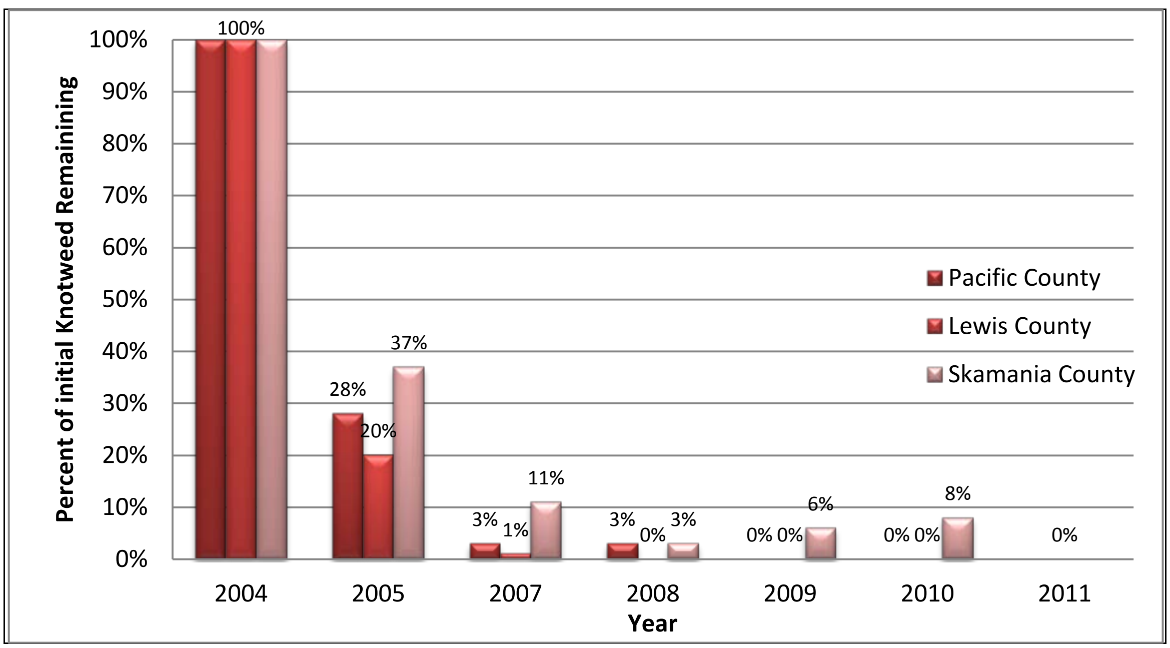

Figure 16. Percentage of stems-per-acre remaining at three permanent monitoring sites in Southwest Washington. These plots have received annual herbicide treatments since 2004.

In the chart, stems per acre have been transformed to a percentage of the stems per acre present before knotweed control was implemented. One hundred percent represents no change, and zero percent occurs when no knotweed is present within the sampling transect. No monitoring was performed in 2006.

The trend of this data shows a significant decrease in knotweed following seven years of annual treatments. Despite these dramatic reductions, some knotweed is still present at each monitoring site. At the sites where knotweed stem densities are reported as zero percent of the original infestation, knotweed may still be present, but not within the area of the plot that was sampled.

This trend of significant reductions, and persistence of a small amount of knotweed, is consistent with the results seen in all project areas. Across the state, the knotweed populations that persist in project areas have fewer stems per acre and the knotweed that is present exhibits reduced stem height, stem diameter, and overall vigor. Now that knotweed populations at the monitoring sites have been greatly reduced or eradicated, in 2012, WSDA plans to work with project partners to identify future monitoring needs.

Natural recolonization of treatment sites by native or non-native plants was noted at all monitoring plots. These results suggest that new vegetation will begin to move into treatment sites from the surrounding landscape after knotweed stem densities are reduced even if knotweed plants are still present in the treatment site. The need to reestablish native vegetation at treatment sites depends on the seed sources present and the restoration goals for the site.

Similar to the analysis carried out for regional herbarium records, knotweed locations in the Upper Skagit floodplain in Skagit and Whatcom counties were analyzed to determine the trend in their rate of spread and compared to the trend observed outside of current project areas. Figure 17 shows the trend in one section of the Upper Skagit River Watershed where knotweed has been monitored and treated since 2001. This project area was chosen for the analysis because the project was initiated in 2001, and is the oldest knotweed control project that WSDA is involved with. It was assumed that any trends resulting from knotweed control activities would be apparent in the 10-year-old dataset.

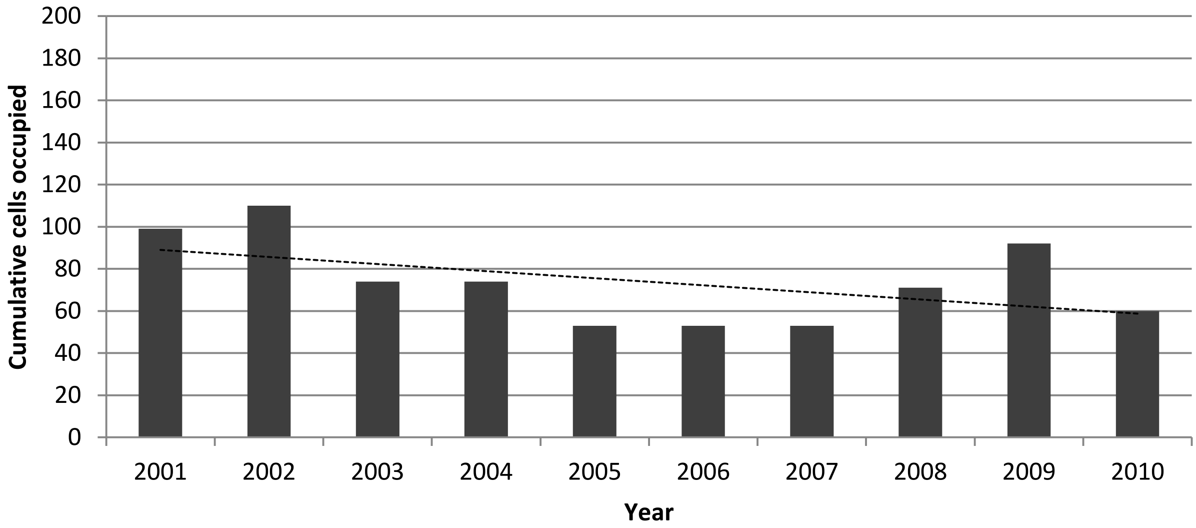

Figure 17. Cumulative 30 meter cells occupied by knotweed in the Upper Skagit River floodplain since 2001.

In contrast to the trend of exponential population growth observed in herbarium records, the number of sites occupied by knotweed within the control project boundaries is decreasing in the Upper Skagit River. In conjunction with this decrease in infested sites, the amount of knotweed within these sites has also been reduced. Figure 18 shows a site that is being colonized by native plants following the removal of invasive knotweed.

Figure 18. Native plants are moving back into this previously knotweed infested site in the Upper Skagit Watershed.

Similar results have been reported by other WSDA knotweed program cooperators, and the reduction in knotweed populations has allowed native plants and animals to move back into previously infested sites. The reestablishment of these native species helps to insure that the natural processes and functions that were interrupted by knotweed invasion are allowed to begin again. This will help to improve salmon habitat and water quality in the long term.

Outlook

The WSDA Knotweed Control Program is a key component of the intergovernmental effort to control knotweed in Washington State. This program provides funding, coordination, and other resources to cooperators that conduct knotweed control projects and partners with, or directly supports, tribal governments, local governments, non-governmental organizations, and other state agencies.

WSDA continues to work with program cooperators to develop sustainable knotweed control strategies. As in the past, state resources were utilized to leverage additional funding. Combining funding and resources from multiple sources allows program cooperators to implement projects on the scale of entire watersheds. In 2012, program cooperators will continue to place emphasis on landowner participation and education. This provides landowners and land managers with the knowledge and experience to be the long term stewards of their respective project areas.

WSDA will continue to support the development of biological control methods for knotweed. Typically, biocontrol agents do not reduce the populations of invasive plants as much as other control techniques. However, if self-sustaining populations of biocontrol agents can be developed in the future, this may constitute a cost-effective and self-sustaining suppression strategy for sites heavily infested by knotweed.

If left untreated, there is evidence that the small amount of live knotweed present at treatment sites can return to the original infestation level in as little as three seasons, eventually surpassing the infestation level present prior to any investments in knotweed control. This would result in the loss of progress toward long-term knotweed control, increased future control costs, degradation of environmental quality, and the alteration of the sustainable ecological services of invaded sites.

WSDA will continue to support knotweed control as program funding allows. The funding outlook in 2012 appears stable. In the past, funding reductions have led to the abandonment of projects and reduced support for ongoing initiatives. In contrast, knotweed projects that have received stable funding have shown a vast decrease in knotweed presence. Stable funding will remain imperative to the success of knotweed control in Washington State.