Sandy River Riparian Habitat Protection Project
Report 2006

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Section 1. Introduction

The Project

The Sandy River Riparian Habitat Protection Project (SRRHPP) works to maintain and enhance the ecological integrity of the riparian habitat of the Sandy River Basin. The project combines education and landowner outreach with field treatment of select system modifying invasive species. Control efforts on a landscape scale have primarily focused on Japanese and giant knotweeds (*Polygonum sachalinense* and *P. cuspidatum*), with localized efforts on Scots broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus armeniacus*). However, increasing attention has been given to traveler's joy (*Clematis vitalba*), butterfly bush (*Buddleja davidii)*, English holly (*Ilex aquifoluim*), English ivy (*Hedera helix*), garlic mustard (*Alliaria petiolata*) and early detection of new species. The strengths of this program lie in its ability to apply both sound science and monitoring to weed control efforts and to build consensus and cooperation between landowners and stakeholders throughout the watershed. Through the efforts of the SRRHPP, successful and measurable conservation action is being taken on a watershed scale, while benefiting other regional control programs with its knowledge and expertise.

Location

The Sandy River Watershed (sub-basin to the Columbia River Basin) is located in the mid-eastern section of the Lower Columbia Ecological Province, within Multnomah and Clackamas Counties in Oregon (EPA Reach 17080001). It drains an area of approximately 508 square miles (330,000 acres). The Sandy River and many of its tributaries originate high on the slopes of Mount Hood. The Sandy River flows about 56 miles in a northwesterly direction and joins the Columbia River near Troutdale at Columbia River mile (RM) 120.5.

Landscape Overview

The Sandy River Watershed supports regionally significant populations of rare and characteristic wildlife. Among these are 22 species of state or federal concern, including Chinook and coho salmon and winter steelhead listed as threatened under the federal Endangered Species Act. Two major sections of the Sandy River Watershed are designated a federal Wild and Scenic River and/or an Oregon State Scenic Waterway.

The Sandy River Watershed (SRW) is the focus of large, ongoing conservation investments by several groups. Tens of millions of dollars have been or will be invested in the watershed over the next 25 years. The investor's goals include protecting fish runs and wildlife habitat throughout the watershed, replacing culverts (county and city governments), retiring roads (U.S. Forest Service), removing dams (Portland General Electric), and mitigating for dams (Portland Water Bureau). Partners are also working to acquire land for natural areas, including the Bureau of Land Management and Western Rivers Conservancy, who are acquiring key parcels in the middle Sandy, and the Metro Parks and Greenspaces program, which used funding from a 1996 bond measure to acquire key parcels in the Sandy River Gorge in the late 1990s. The Sandy River Basin Partners, a well-established and active partnership involving nearly all the key stakeholders, works to facilitate, coordinate and prioritize future restoration efforts.

The SRW includes the Portland region's water supply, the Bull Run Watershed, which is coming under pressure from the region's growing population. Stewardship of the habitat along the Sandy is essential, yet remains highly fragmented and a major management challenge. This is due in part to the fact that ownership and management of the SRW is divided between many agencies (BLM, Clackamas County, Metro, Multnomah County, Oregon Department of Fish and Wildlife, Oregon

State Parks, Portland Water Bureau, and the Forest Service among others) and more than 4,000 individuals and corporations.

Protection of riparian habitat and function are critical issues that will help determine the long-term health of the basin's aquatic ecosystem and much of its wildlife. Riparian habitat is vital to up to 90 percent of wildlife species and is an important determinant of fishery success through its direct influence on habitat, river dynamics and aquatic food chains. The Sandy River Watershed Council has prioritized protecting riparian habitat from invasive weeds in their Phase 1 watershed assessment and action plan. Planning documents from BLM, Metro, the Forest Service and the Sandy River Basin Partners all recognize the threat posed by invasive species.

The Sandy's tendency towards catastrophic flooding and its proximity to active nurseries and farms, as well as developed landscapes (Portland, Gresham, Sandy, the Hoodland Corridor and the growing urban/suburban fringe), make it particularly vulnerable to water quality issues and invasions of well-known noxious weeds such as Japanese and giant knotweed, English ivy, Himalayan blackberry, Scots broom and new species of horticultural origin.

Addressing invasive species threats requires significant coordination among landowners. Although the potential for great work on the ground exists, prior to the initiation of the SRRHPP there had been no catalyzing force organizing key regional players to work in tandem. The Sandy needs not only continued conservation attention from each organization, but a team approach with organizations willing to serve as leaders.

Knotweed's Threat To Riparian Ecosystems

Knotweed is a successful invader in riparian habitats throughout much of Europe and North America. A peculiar combination of life history features allow it to adapt to life in dynamic riparian and floodplain systems, including those in the Pacific Northwest. Knotweed evolved as a primary colonizer of volcanic slopes, and can rapidly colonize fresh sediment deposits and other low nutrient, disturbed sites such as cobble bars. It begins growth earlier than native competitors and, in Oregon, and may reach two to six meters in height by June. This early growth allows it to persist under a full deciduous canopy and effectively shade out slower growing and shade-intolerant native vegetation, including young willows, cottonwoods, alders, and other typical riparian species of our area. It can tolerate long periods of submersion and poor soils, allowing it to establish and grow on the lower banks of rivers and creeks where there is little competition. Although they do not appear to reproduce effectively by seed in the Pacific Northwest, invasive knotweeds have an extensive but fragile rhizome network, and reproduce effectively vegetatively, via root fragments as small as 1 centimeter.

With the loss of native riparian vegetation, and the inability of shade-intolerant species to thrive under a knotweed canopy, it is likely that several fundamental changes will occur as knotweed dominance increases. Although knotweed has an extensive root system, it has relatively few fine roots and thus provides poor bank-holding capacity. This will lead to more sediment in the water and broader, shallower, warmer waterways. Although knotweed can provide dense shade directly along the shoreline in summer, compared to an established forest canopy a knotweed canopy will allow increased solar radiation to penetrate the water, resulting in higher water temperatures. Because knotweed effectively excludes reproduction of most tree species, a knotweed-dominated system will eventually lose woody debris, a key component of healthy Pacific Northwest river systems. Finally, a monoculture of any kind is unlikely to provide high-quality habitat for most wildlife or support the native aquatic food chain. Changes in the aquatic food chain are in turn likely to result in the loss of aquatic invertebrate biodiversity and, in turn, the fish that depend on them.

Summary of Sandy River Knotweed Project by Field Season

For the last six years, the Sandy River Riparian Habitat Protection Project (SRRHPP) has combined controlled experiments testing treatment methods, with a landscape-level invasive species control and public outreach project. By applying an adaptive management framework, we have improved and refined our control strategies. Nevertheless, many questions remain unanswered and much information is still needed to effectively address the threat of knotweed. What follows is a year-by-year description of the project's evolution.

2001

In 2001, we attempted to comprehensively survey river mile 6 to 19, in addition to as much of the upper watershed as time and access allowed. We treated 2,990 patches of knotweed with spring and fall cutting, spraying, or both. Both triclopyr and glyphosate were used in foliar spray. We also collected the first year post-treatment data from a three-year experiment testing 17 control methods launched in 2000. Data suggested that glyphosate was less effective than triclopyr at killing individual knotweed patches.

Project structure	1 seasonal, 4 person AmeriCorps team (April – November)
Treatment methods employed (spring/fall)	Foliar Garlon /Foliar Garlon
	Stem-cut glyphosate / Foliar Garlon
	Manual cut / Foliar Garlon
	Foliar Garlon (1x)
Number of new microsites established	609
Number of patches treated	2,990
Number of stems treated	48,198
Number of sites with NNS	104
River stretch work focus: Treat	Sandy River (Rm 6 – 19), various private lands
Outreach & survey	Sandy River (Rm 19 –23), Cedar Creek, Salmon River, Gordon Creek
Experiment	Post-treatment data collection for 17 control method experiment.

2002

In 2002, we attempted to comprehensively survey the upper and middle Sandy River, in addition to completely resurveying and treating the lower 19 river miles. We expanded the complete inventory area on the Sandy River upstream to the Salmon River junction (RM 37), and surveyed significant portions of the Salmon River, Cedar Creek and all BLM lands on other tributaries. We treated 5,043 patches with manual cutting and foliar glyphosate. Second year post-treatment data was collected from the year 2000 control method experiment, and the data effectively ruled out cutting alone as an effective control strategy.

Project structure	4 seasonals, 4 person AmeriCorps team (50% time April – November)
Treatment methods employed (spring/fall)	Manual cut / Foliar glyphosate
	Manual cut (1x)
	Foliar glyphosate (1x)
Number of new microsites established	122
Number of patches treated	5,043
Number of stems treated	87,853
Number of sites with NNS	115
River stretch work focus: Treat	Sandy River (Rm 6 – 23), various private lands including tributaries
Outreach & survey	Sandy River (Rm 23 –38), Cedar Creek, Salmon River, Trout Creek, Still Creek, Wildcat Creek, Big Creek, Whiskey Creek
Experiment	Second year post-treatment data collection for 17 control method experiment.

2003

In 2003, we greatly reduced our efforts in the lower 19 miles and focused intensively on the middle and upper Sandy River and major tributaries, with a special effort to expand our access to private lands. We continued to survey the Salmon River and Cedar Creek, and added Hackett Creek and Still Creek. We treated 4,245 patches with stem injection of glyphosate and foliar spray. We also initiated a three-year control experiment testing stem injection rates with glyphosate.

Project structure	3 seasonals, 3 person AmeriCorps team (May - October)
Treatment methods employed	Foliar glyphosate (1x)
	Stem injection glyphosate w/ foliar glyphosate (1x)
Number of new microsites established	112
Number of patches treated	4,245
Number of stems treated	55,866
Number of sites with NNS	136
River stretch work focus: Treat	Sandy River (Rm 6 – 38), Cedar Creek, Salmon River

Outreach & survey	Sandy River (Rm >38), Cedar Creek, Salmon River, Hackett Creek
Experiment	Third and last year post-treatment data collection for 17 control method experiment. Initiated controlled stem injection experiment.

2004
In 2004, we attempted to survey and treat all remaining major tributaries in the Sandy River watershed. Surveys and treatments were performed on Still Creek, the ZigZag River, Bear Creek, Hackett Creek, the Salmon River, Wildcat Creek, Whiskey Creek, Badger Creek, Cedar Creek, the Bull Run River, and Lower Bear Creek. We surveyed and treated knotweed on the Sandy from river mile 7 through 44. The addition of 139 cooperating landowners allowed us to treat knotweed on many previously untreated lands. We treated 6,660 patches with stem injection of glyphosate and foliar spray. We obtained first-year results for the 2003 stem injection experiment suggesting that doses less than 5 ml were equally effective.

Project structure	3 seasonals, 3-person AmeriCorps team (January - December), and 1 short-term AmeriCorps person (May – October)
Treatment methods employed	Foliar glyphosate (1x)
	Stem injection glyphosate w/ foliar glyphosate (1x)
Number of new microsites established	188
Number of patches treated	6,660
Number of stems treated	94,048
Number of sites with NNS	223
River stretch work focus: Treat	Sandy River (Rm 6 – 43), Cedar Creek, Salmon River, Hackett Creek, Bear Creek, Whiskey Creek
Outreach & survey	Sandy River (Rm >38), Cedar Creek, Salmon River, Hackett Creek, Zigzag River, Mill Creek, Badger Creek, Upper Bear Creek, Whiskey Creek
Experiment	First year post-treatment data collection for controlled stem injection experiment.

2005
In 2005, we continued treating remaining patches on the Sandy River and attempted to survey and treat all remaining tributaries in the Sandy river watershed within the project area. Surveys and treatments were performed on Alder Creek, Badger Creek, Boulder Creek, the Bull Run River, Cedar Creek, Clear Creek, Hackett Creek, Henry Creek, Lower Bear Creek, the Salmon River, Still Creek, Upper Bear Creek, Walker Creek, Whiskey Creek, Wildcat Creek, and the ZigZag River. We surveyed and treated all known knotweed patches on the Sandy from river mile 7 through 44. The addition of 140 cooperating landowners on 185 properties allowed us to treat

knotweed on many previously untreated lands. We treated 4,497 patches with a stem injection of undiluted glyphosate and foliar spray with glyphosate (4%) and triclopyr (1%). Second-year stem injection results continued that stem injection rates of 1.5 or 3 ml per stem were as effective as 5 ml per stem.

Project structure	3 seasonals, 3 person AmeriCorps team (January – December) interns +1 short term AmeriCorps person (June-August)
Treatment methods employed	Foliar glyphosate (4%) with triclopyr (1%)
	Stem injection glyphosate w/ foliar as above.
Number of new microsites established	81
Number of patches treated	4,497
Number of stems treated	83,166
Number of sites with NNS	300
River stretch work focus: Treat	Sandy River (Rm 6 – 43), Cedar Creek, Salmon River, Hackett Creek, Bear Creek, Whiskey Creek, Alder Creek, Henry Creek, Mill Creek, Badger Creek, Lower Bear Creek, Upper Bear Creek, Walker Creek, Whiskey Creek, Wildcat Creek, Zigzag River
Outreach & survey	Sandy River (Rm >38), Alder Creek, Boulder Creek, Cedar Creek, Clear Creek, Salmon River, Hackett Creek, Henry Creek, Mill Creek, Badger Creek, Still Creek, Lower Bear Creek, Upper Bear Creek, Walker Creek, Whiskey Creek, Wildcat Creek, Zigzag River
Experiment	Second year post-treatment data collection for controlled stem injection experiment.

2006

In 2006, we again treated all known surviving patches on the Sandy and attempted to survey and treat all remaining tributaries in the Sandy river watershed within the project area. Landowner outreach, surveys and treatments were performed on Alder Creek, Badger Creek, Boulder Creek, the Bull Run River, Cedar Creek, Clear Creek, Hackett Creek, Henry Creek, Lower Bear Creek, the Salmon River, Still Creek, Upper Bear Creek, Walker Creek, Whiskey Creek, Wildcat Creek, and the Zig-Zag River. We surveyed federal lands at the mouth of the river, and surveyed and treated all knotweed on the Sandy from river mile 7 through 44 (the highest know knotweed location on the main-stem of the river). The addition of 89 cooperating landowners on 102 properties allowed us to treat knotweed on many previously untreated lands. A total of 5296 patches were treated, mostly with stem injection of glyphosate and foliar spray with glyphosate with Imazapyr. Table 2.1 presents a detailed summary of knotweed sites treated in the 2006 field season.

The main treatment method was an integrated approach combining stem injection with 3 ml undiluted glyphosate and foliar spray of 4 percent glyphosate and 1 percent imazapyr on stems too small to inject (see section 2 for details). There was an average of 64 stems per microsite in the 2006 field season, ranging from 0 stems to an estimated 3,000 stems at one upland site along Highway 26. In 2006 we dug up the rhizomes of some of those difficult to eradicate patches. Despite many years of treatment, some of the patches still had large amounts of living rhizome material.

Project structure	3 seasonals, 3 person AmeriCorps team (January – December), interns.
Treatment methods employed	Foliar glyphosate (4%) with Imazypyr (1%)
	Stem injection glyphosate w/ foliar as above.
Number of new microsites established	61
Number of patches treated	5,296
Number of stems treated	50, 843
Number of sites with NNS	375
River stretch work focus: Treat	Sandy River (Rm 6 – 43), Cedar Creek, Salmon River, Hackett Creek, Bear Creek, Whiskey Creek, Alder Creek, Henry Creek, Mill Creek, Badger Creek, Lower Bear Creek, Upper Bear Creek, Walker Creek, Whiskey Creek, Wildcat Creek, Zigzag River
Outreach & survey	Sandy River (Delta and Rm >38), Alder Creek, Boulder Creek, Cedar Creek, Clear Creek, Salmon River, Hackett Creek, Henry Creek, Mill Creek, Badger Creek, Still Creek, Lower Bear Creek, Upper Bear Creek, Walker Creek, Whiskey Creek, Wildcat Creek, Zigzag River.
Experiment	Partial post-treatment data collection for controlled stem injection experiment.

Section 2. Landscape-Level Treatment

Methods

Field Access

Surveys took place from rafts, inflatable kayaks and by foot. Because river levels decline throughout the field season, some areas must be surveyed twice. We targeted floodplains, side channels, debris piles and backwaters for the most intensive surveys. Newly identified knotweed sites are numbered, flagged and mapped onto aerial photographs and/or with a GPS unit.

Conducting invasive species control in remote areas is difficult because many areas are not accessible by vehicle and much of the riparian area cannot be realistically reached by foot. Other areas require walking one to three miles from the nearest road or trail.

Foot travel along heavily vegetated and often steep river and creek shorelines is difficult, and can limit access to a short stretch of a single side of the river on a given day. Traveling on rafts or inflatable kayaks allows many more sites to be visited, mapped and/or treated per day. Although during the summertime the Sandy is not an extremely dangerous river, there are significant technical and navigational challenges, especially when the transportation of herbicides is involved.

Monitoring and Terminology

The location of each knotweed site is recorded using an integrated GPS - Personal Digital Assistant (PDA), and on an aerial photograph when applicable. We have divided the Sandy River into 88 **macrosites**, or river sections, roughly corresponding to divisions between aerial photographs. Within a macrosite boundary, we have established knotweed microsites. A **microsite** is one or more patches of knotweed in a defined area. **Patches** are individual clumps or clones of knotweed, and are generally not tracked individually because of the high number present in the watershed (over 6,000 patches identified through the 2006 field season). Sites are numbered with a two-number code, macrosite-microsite (i.e. 20-01) in sequential order based on discovery within a given macroplot. The size or gross area of a given microsite varies greatly. For example, a microsite could consist of one patch with one shoot in a one m^2 area, or 80 patches on a distinct floodplain with a total of 900 shoots in a 1000 m^2 gross area. In the 2005 and 2006 field seasons, we recorded each knotweed site's **infested area**, defined as the area of land actually occupied by the knotweed canopy.

Each site is identified by a piece of plastic flagging with the date and plot identification number. A GPS point is collected at each microsite when it is first established. Gross area, infested area, stem number, number of patches, typical stem height, date, treatment method, herbicide used and site comments are recorded into a handheld PDA knotweed database in the field during each treatment visit to a microsite. (The detailed, step-by-step Knotweed Field Technology Tools User Guide is available upon request from The Nature Conservancy). In areas with very extensive knotweed infestations (thousands of stems in dozens or hundreds of patches), stem numbers were conservatively estimated and individual patches were not measured or labeled.

A **treatment** is any time data is collected at a microsite.

Treatment

Knotweed treatment methods vary from site to site and year to year. Factors such as patch size, patch location, time of year, and landowner preferences determine the treatment at a given site.

Generally, a knotweed treatment can be any combination of herbicide foliar spray, herbicide injection, spring manual cut and summer-fall herbicide foliar spray, manual digging, or survey without treatment.

We have altered our treatment protocol annually in response to monitoring data and research and have intentionally used multiple treatments in some years to test the efficacy of different methods on a larger scale. Each year we have discovered new, previously untreated sites. New sites are assigned to and receive a particular treatment and are monitored and treated annually thereafter. Annual follow-up monitoring and treatments are done according to the treatment protocol for each given year. Though there is some variety, our annual treatment protocols have included:

- 2001 Foliar (triclopyr 5%)
- 2002 Spring cut and fall foliar spray (3% glyphosate)
- 2003 3ml inject (% Product name) + foliar (5% glyphosate)
- 2003 5ml inject + foliar (5% glyphosate)
- 2003 5ml inject only
- 2004 5ml inject + foliar (8% glyphosate)
- 2005 5ml inject + foliar (glyphosate 8%)
- 2005 5ml inject + foliar (glyphosate 4% + triclopyr 1%)
- 2005 foliar (glyphosate 4% + triclopyr 1%)
- 2005 5ml inject only
- 2006 5ml inject + foliar (glyphosate 4% + imazapyr 1%)

For all years of the project, only glyphosate has been used on federal lands. No herbicide treatments have been employed on Forest Service lands.

Foliar Spray

For rugged field situations, especially involving river travel, the most convenient method for applying herbicide to knotweed foliage is to use plastic hand-mister spray bottles. These bottles are inexpensive and durable, and the spray diameter and droplet size are adjustable. For larger areas, we use 1.5-gallon hand carried chemical spray units, as well as backpack sprayers. Each year we modify or change our spray solution based on our latest information. In 2005, the main foliar spray treatment method utilized on knotweed sites was a single application herbicide treatment using 4 percent v/v glyphosate, and 1 percent triclopyr, with 1 percent v/v R-11 surfactant.

In 2006, early-season field observations of knotweed patches treated two or more times before 2006 were showing frequent survival of small, abnormally grown and mutated stems, indicating that the previous regimen of glyphosate and triclopyr was not substantially more effective than glyphosate alone at fully eradicating suppressed patches. Several partners involved in knotweed work around the Northwest recommended replacing triclopyr with imazapyr (brand name Habitat) herbicide to eradicate resilient patches of knotweed. Because of Habitat's aquatic label and low toxicity to animals, we decided to use this new herbicide on private and non-federal lands. Accordingly, we altered our tank mixture to 4 percent v/v glyphosate, 1 percent v/v imazapyr, and 1 percent v/v R-11 surfactant for the rest of the field season.

Herbicide Injection or Integrated Approaches

We have used direct stem injection or a combined technique of stem injection of large diameter stems and foliar spray of small diameter stems extensively throughout the SRW. Direct stem injection involves poking a small hole through both sides of a knotweed stem just below the first or second node and injecting 1 to 5 ml of undiluted glyphosate into the hollow chamber of each stem of sufficient diameter (3/4" or larger) in a knotweed patch. In 2006, stems with a large enough diameter were injected with 3 ml of glyphosate. Smaller stems received lesser amounts, depending on the capacity of the hollow chamber. Stems too small to accept glyphosate injections were treated with the herbicide foliar spray solution as described above. Every effort was made to treat every stem in a given patch. For very large patches (more than 1000 stems) or for patches in upland sites, we do not typically use the injection method. For these patches, we usually will only use foliar treatments.

Stem injection treatments were administered using a gun-like device acquired from JK International Injection Tools (www.jkinjectiontools.com). This injection tool can hold approximately 400ml of glyphosate in its canister. A measured dose, between 1 and 7 ml, can be delivered by pulling the trigger once the needle is inserted into the stem of a plant (Figure 2.0).

Figure 2.0 Stem injection

Digging and Rhizome Extraction

The 2006 field season also saw a new approach to treating knotweed in the Sandy River watershed. Several locations were picked early in the year where crew members would hand-dig knotweed stems and rhizomes. Great care was used in extracting as much plant matter as possible, and removing the debris from the site. Dig areas were inland sites with no risk of flood displacement. The hope in digging is to deplete root biomass and increase the shoot to root ratio, allowing more effective follow-up herbicide treatment for any surviving stems. First-year results for this treatment method will be available in the 2007 report.

Results

Watershed –wide results

From 2000 to 2006, surveys of the Sandy River watershed have identified 796 microsites containing more than 6,500 knotweed patches. Our treatment area encompasses more than 120 river and creek miles. Almost 38 percent of the microsites occur on public land, while the bulk of the stems and patches, 84 percent and 62 percent respectively, occur on private land where landowners have granted permission for us to treat knotweed on their property (Table 2.0).

Table 2.0 Property ownership status of knotweed site locations in Sandy River watershed

	Public Lands	Private Lands	Totals
Number of microsites	299	497	796
Number of initial knotweed patches	2529	4122	6651
Number of initial knotweed stems	56743	135444	192187

Sandy River tributaries containing knotweed include: Alder Creek, Badger Creek, Bear Creek, Beaver Creek, Cedar Creek, Hackett Creek, Mill Creek, Still Creek, the Salmon River, Walker Creek, Whiskey Creek, and the Zigzag river. The highest point on the watershed known to have a knotweed infestation is Still Creek, an important salmon-bearing tributary near the town of Rhododendron. Map 3.0 plots locations of infestations with recent stem counts.

In 2006, our team conducted intensive surveys on over 500 acres of land along the shorelines and floodplains of the Sandy Watershed. We found knotweed infestations covering 7,413 meters², or 1.83 acres – one-third of those values from 2005 (22,237m²; 5.4 acres) (Figure 2.1).

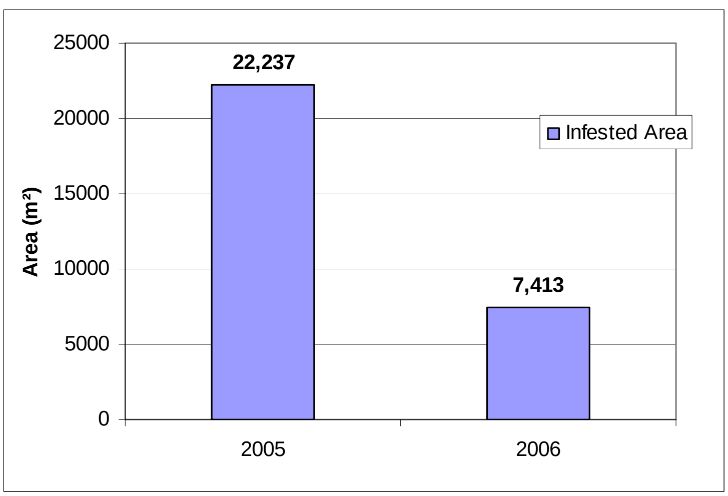
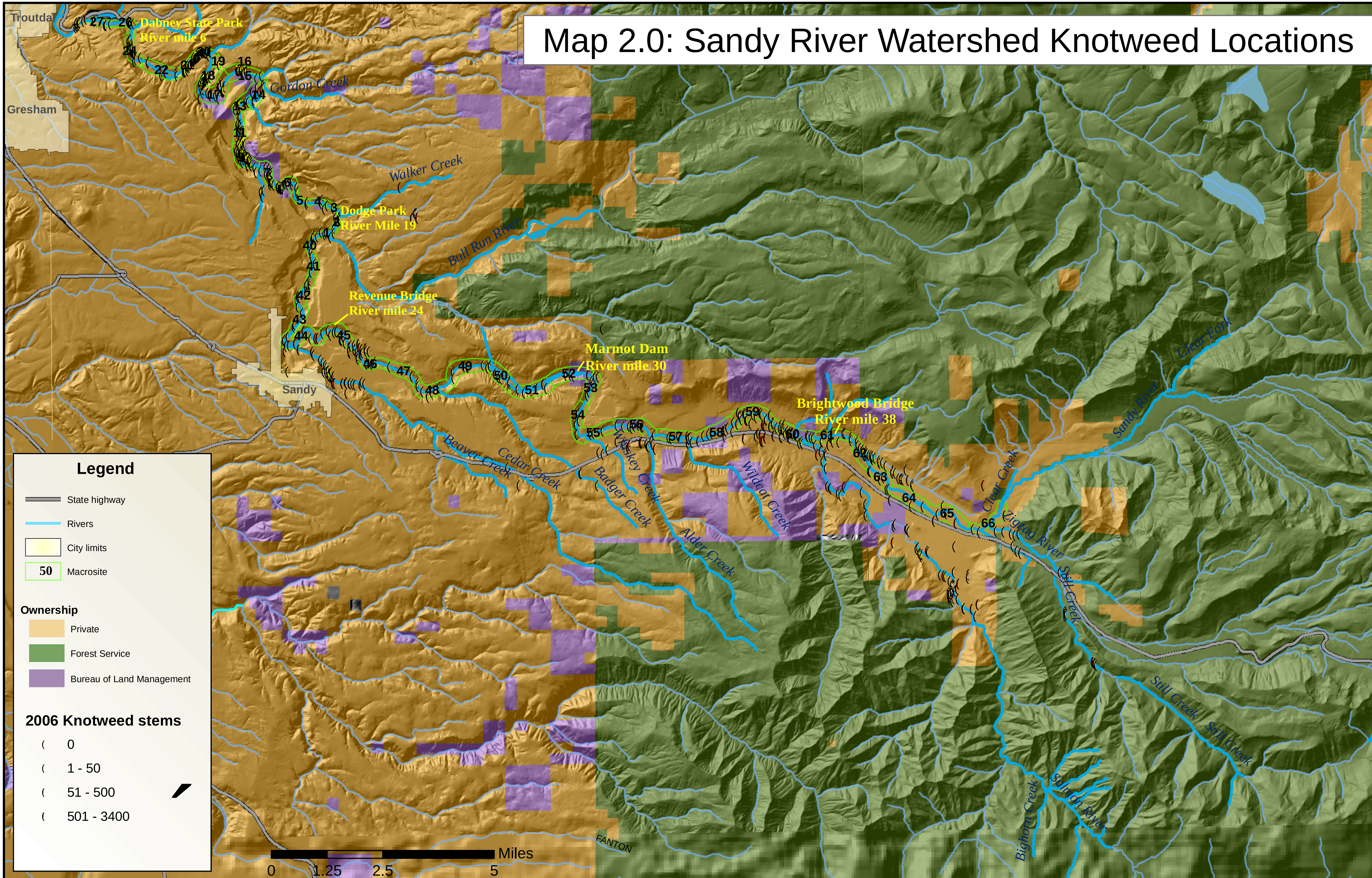


Figure 2.1 Knotweed Canopy Infestation in Sandy River Watershed 2005-06

From 2001 to 2006, a total of 796 knotweed microsites were established. Despite the discovery of new patches each year, the number of known stems in the watershed has decreased since 2004. The stem count for 2006 was 53 percent of the stem count for 2004. Between 2005 and 2006, the total number of stems treated decreased by 38.7 percent (Figure 2.2).



Map 2.0: Sandy River Watershed Knotweed Locations
Troutdale
Gresham
Sandy
Dabney State Park
River mile 6
Dodge Park
River Mile 19
Revenue Bridge
River mile 24
Marmot Dam
River mile 30
Brightwood Bridge
River mile 38
Gordon Creek
Walker Creek
Bull Run River
Beaver Creek
Cedar Creek
Badger Creek
Alder Creek
Wildcat Creek
Clear Creek
Zigzag River
Still Creek
Sandy River
Clear Fork
Salmon River
Bighorn Creek
FANTON
Legend
State highway
Rivers
City limits
50 Macrosite
Ownership
Private
Forest Service
Bureau of Land Management
2006 Knotweed stems
0
1 - 50
51 - 500
501 - 3400
Miles
0 1.25 2.5 5

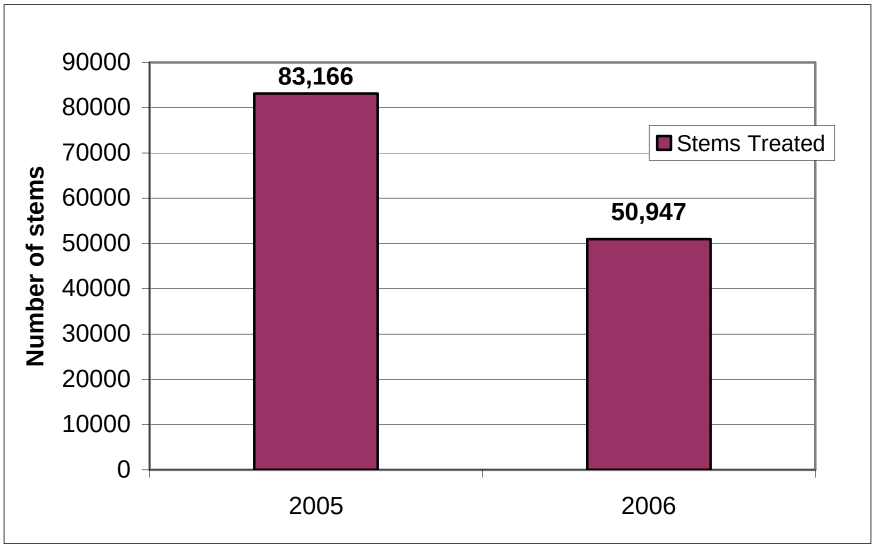


Figure 2.2: Total stems treated in the Watershed in 2005 and 2006

Since 2001, the total number of microsites visited has increased from 287 to 796, while stem counts in tracked sites have fallen in the years since 2001. The average stem count per microsite has decreased every year since cresting at 235 stems in 2002. In 2006, the average per microsite stem count of 64 was 73 percent smaller than in 2002 (Figure 2.3A).

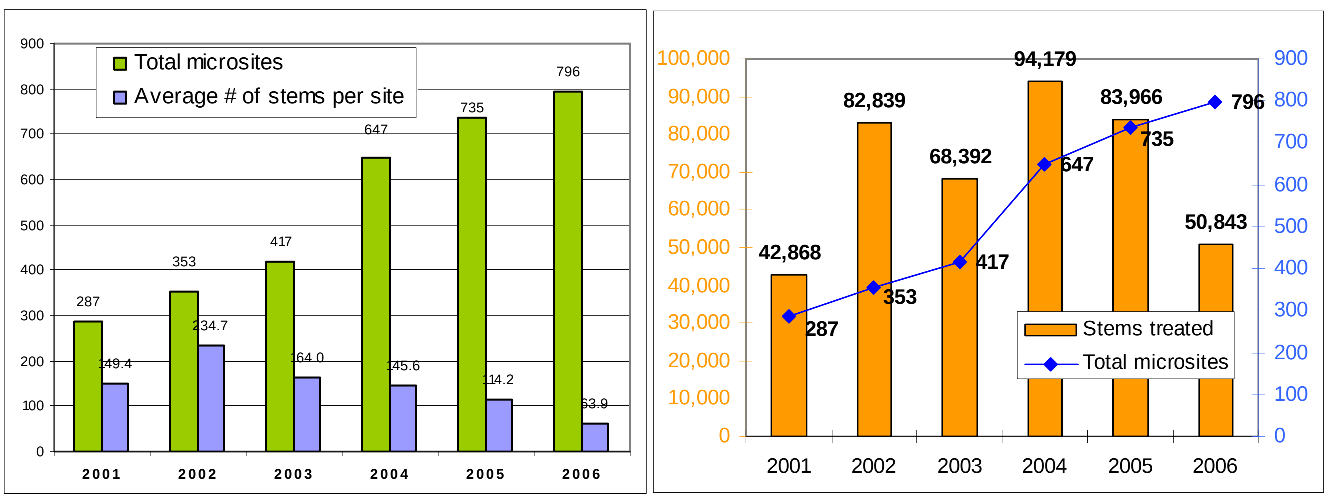


Figure 2.3A: Average number of stems per microsite over six years; B: total stems treated compared with number of microsites.

Table 2.1 Status of 2006 knotweed treatments by river stretch

River Stretch	2006 Microsites Treated	Infested area (m2) in 2006	Number of Patches Treated in 2006	Number of Stems Treated in 2006	% reduction from initial visit	average # of visits
Sandy RM 0 - 19	382	286.09	1444	5202	88.0%	6.41
Sandy RM 19 - 24	55	164	501	4136	73.0%	4.14
Sandy RM 24 - 29	32	73	219	1039	73.9%	3.38
Sandy RM 29 - 38	79	158.76	524	4200	84.8%	3.97
Sandy RM > 38	15	10.56	25	369	81.8%	2.86
Badger Creek	3	3	8	38	57.3%	2.66
Bear Creek	6	25.25	111	634	91.0%	4.00
Cedar Creek	38	2125.33	611	4510	51.6%	3.88
Hackett Creek	34	31.75	78	630	80.0%	3.13
Mill Creek	15	1725.6	380	11689	28.2%	3.11
Salmon River	68	184.8	567	3265	86.0%	3.36
Upper Bear Creek	2	5.5	16	65	68.3%	2.66
Whiskey Creek	5	23.75	14	263	67.4%	2.16
Zigzag River	7	3.55	12	66	91.5%	2.50
Walker Creek	6	45	75	1803	60.1%	3.37
Alder Creek	6	20.5	24	263	40.0%	2.28
Henry Creek	2	5.5	59	121	53.6%	4.00
Non-riparian watershed sites	31	2024.75	559	8257	54.6%	2.44
Still Creek (untreated)	9	451.5	39	4095	N/A	1.00
Mouth of Sandy(untreated USFS lands)	1	45	30	198	N/A	1.00
Totals	**796**	**7413.19**	**5296**	**50843**	**71.2%**	**3.12**

Generally, the areas that have been visited and treated more often show a larger percent reduction in stem counts than those treated less often. The majority of the microsites in the watershed are on the main stem of the Sandy River. While much knotweed still remains on the Sandy itself, more than half of the knotweed stems are found on smaller tributaries or non-riparian sites that have been discovered in the last two years.

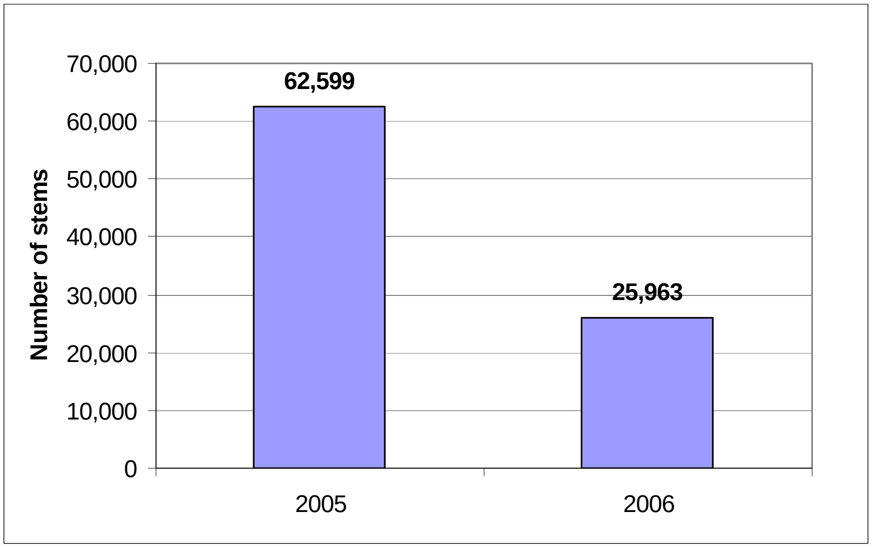


Figure 2.4: Stem counts for sites treated in both 2005 and 2006

For the 747 knotweed sites discovered prior to the 2006 treatment season, the initial stem count has declined from 176,705 stems at the first visit to 25,963 stems counted this year (Table 2.2). The overall number of stems for these sites has declined by 85 percent, while 375 sites showed no regrowth. Between 2005 and 2006, stem counts declined by 58.5 percent (Figure 2.4). Stem counts for a second visit in a given year are not reported because it is unclear whether stems remaining at a site are newly emerged stems, the same stems, post-treatment regrowth, or stems that were missed during treatment.

Table 2.2 Summary of all sites treated in prior field seasons and tracked through 2006

Initial visit stem count for all sites visited prior to 2006	176,705
2006 stem count for sites visited prior to 2006	25,963
Overall percent reduction in stem number	84.9%
Number of sites revisited in 2006	747
Number of sites with no 2006 knotweed regrowth	375
2005 Stem count for sites tracked 2005 to 2006	62,599
2006 Stem count for sites tracked 2005 to 2006	25,963
2005 to 2006 percent stem reduction	58.5%

Results from the Initial Study Area – the Sandy River Gorge

In 2001, 287 sites were established in the Sandy River Gorge (RM 6-19) and visited or treated at least once each year from 2001 to 2006. Of these sites, 196 have been successfully tracked through this year. Any sites at which our flagging or site descriptions have not led to positive site identification have been labeled as "not found." While it is likely that these patches have been completely eradicated, we are not 100 percent certain and have therefore left these patches out of this data summary. Because these patches are treated as unknown rather than eradicated, the results that follow are the most conservative approach to the data and probably underestimate the effectiveness of our treatment protocol.

We positively identified 196 knotweed microsites between 2001 and 2006 and treated them with herbicide at least once annually, for a total of six to eight treatments each. The total stem count for these sites in 2001 was 31,113. Though we used several different treatment combinations, the majority of these sites received a spring and fall foliar Garlon herbicide application treatment in 2001, followed by a spring manual cut and fall foliar glyphosate herbicide application treatment in the 2002 field season and then a single visit foliar glyphosate herbicide treatment in both the 2003 and 2004 field seasons. In 2005, a single foliar glyphosate (4%) with triclopyr (1%) mixture was applied. In 2006 single Foliar glyphosate (4%) with Imazapyr (1%) herbicide mixture was applied.

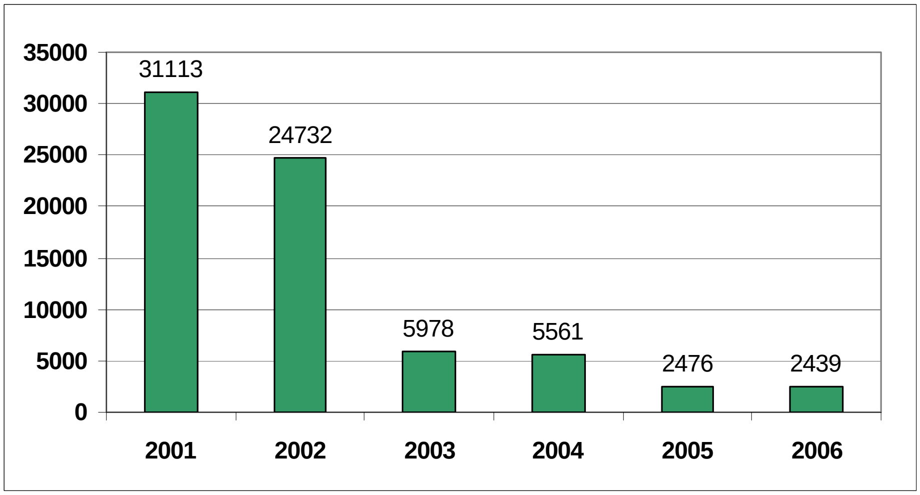


Figure 2.5: Stem counts in 196 tracked microsites over 6 years of study

The total stem count of 31,113 for all sites established in 2001 was reduced by 87 percent to 2,439 stems for the 196 sites in the 2006 field season (Figure 2.5). Although stem number did not drop significantly between 2005 and 2006, site numbers did continue to fall (Figure 2.6). In 2006, 156 (80 percent) of the original 196 total tracked sites had no knotweed regrowth (Figure 2.6). However, no microsite containing more than 300 stems in 2001 was eradicated by the end of the 2006 field season.

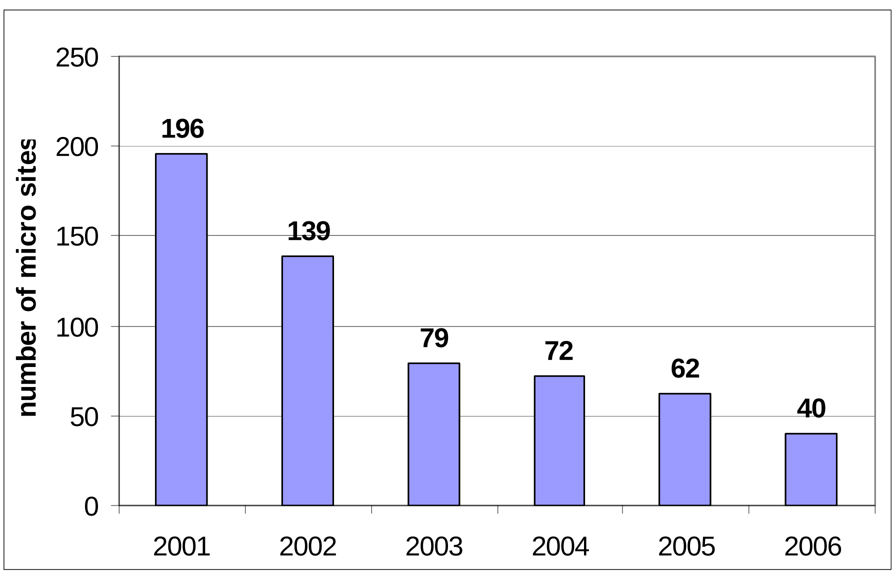


Figure 2.6: Number of 196 tracked microsites with knotweed in Sandy River Gorge

The total area infested by knotweed was reduced from 221.97 square meters in 2005 to 119.59 square meters in 2006 (Figure 2.7). This represents a 46 percent reduction in the infested area over one year. This figure and the eradication of 22 sites should be viewed in combination with the 1.5 percent reduction in stem count that was achieved on the same patches during the same period (Figure 2.5).

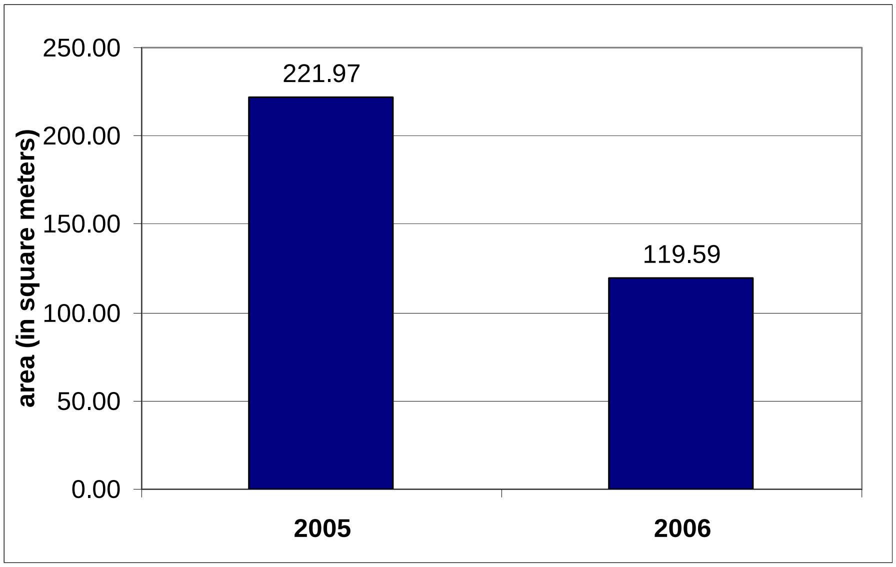
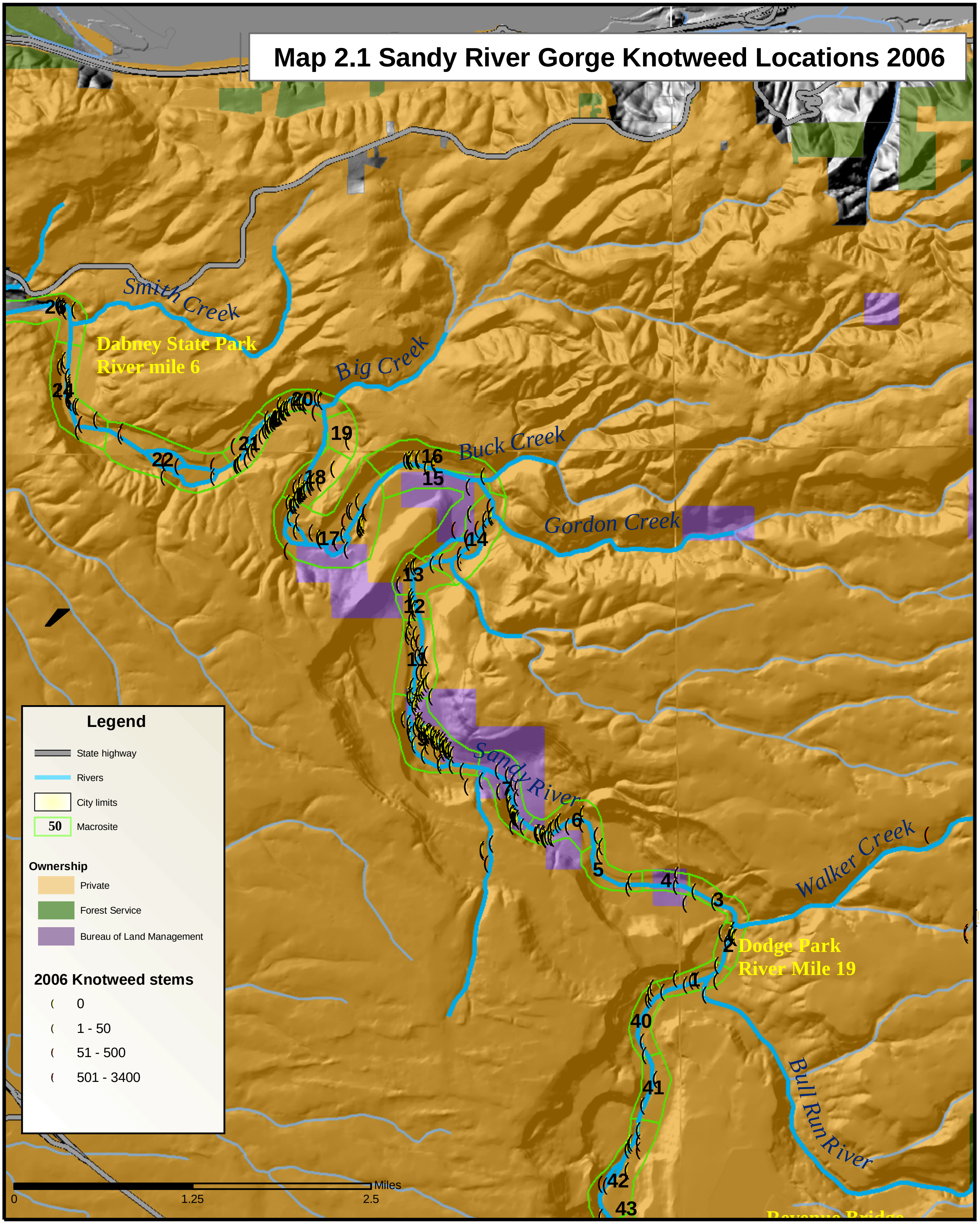


Figure 2.7: Infested area of knotweed in 2005 and 2006 in 196 tracked microsites


Map 2.1 Sandy River Gorge Knotweed Locations 2006
Smith Creek
Dabney State Park
River mile 6
Big Creek
Buck Creek
Gordon Creek
Sandy River
Walker Creek
Dodge Park
River Mile 19
Bull Run River
Legend
State highway
Rivers
City limits
50
Macrosite
Ownership
Private
Forest Service
Bureau of Land Management
2006 Knotweed stems
0
1 - 50
51 - 500
501 - 3400
Miles
0
1.25
2.5

Landscape Level Comparison of Initial Treatments

Each year we have altered our treatment methodology in order to determine the most effective method. Each year we have also discovered new, previously untreated patches of knotweed. The effects of the initial treatment of new patches have been followed from year to year in order to determine which initial treatment results in the best long-term stem reduction.

Table 2.3: Comparing treatments used throughout study in effective stem reduction

Treatment	Sites	Initial Stems	%reduction year 1	%reduction year 2	%reduction year 3	%reduction year 4
2002 spray only	8	1375	45.45%	40.95%	56.07%	53.16%
2002 Spring cut and fall foliar spray	23	10367	63.40%	76.86%	84.34%	83.97%
2003 3ml inject + foliar (5% glyphosate)	24	6991	65.98%	80.39%	82.95%	
2003 5ml inject + foliar (5% glyphosate)	27	7194	63.48%	77.36%	82.54%	
2003 5ml inject only	8	1017	68.63%	86.73%	94.99%	
2004 5ml inject + foliar (8% glyphosate)	130	28390	76.97%	89.81%		
2004 foliar (8% glyphosate)	27	5960	66.31%	77.79%		
2004 5ml inject only	22	9704	68.77%	91.77%		
2005 5ml inject + foliar (glyphosate 4% + Garlon 1%)	48	15729	72.89%			
2005 5ml inject + foliar (glyphosate 8%)	14	5120	81.68%			
2005 5ml inject only	8	5205	76.75%			
2005 foliar (glyphosate 8%)	6	619	65.11%			

Summary of stem reduction by treatment type shows reliable declines of at least 63 percent by every method except the 2002 “spray only” treatment (Table 2.3). This result is largely due to small sample size and patches where the average stem count was initially low and net increase or decrease was a small number of stems but a large proportion of the total patch size. The low, long-term efficacy of the 2002 foliar spray treatment may be due to the type of plants now being sprayed: small plants exhibiting highly abnormal or epinastic growth or otherwise little surface area for herbicide absorption.

Some of the discrepancy between treatment efficacies may be attributable to variability in growing seasons as well as differences in field personnel treating patches. Between 2003 and 2004, the stem injection tools changed from using wire pokers and cattle syringes to herbicide injection guns and hand-held counters to track stem counts. Although the data are not clear on the subject, the percent of stems injected versus sprayed in ‘inject plus foliar’ groups might affect the success rate of the treatment. The average percent stem reduction calculated after the second year is also affected by a successive season’s treatment, but shows an increase in the knotweed mortality following subsequent treatments by all methods. To measure reduction for sites with multiple visits in a year, only the treatment with the highest stem count for each site has been included.

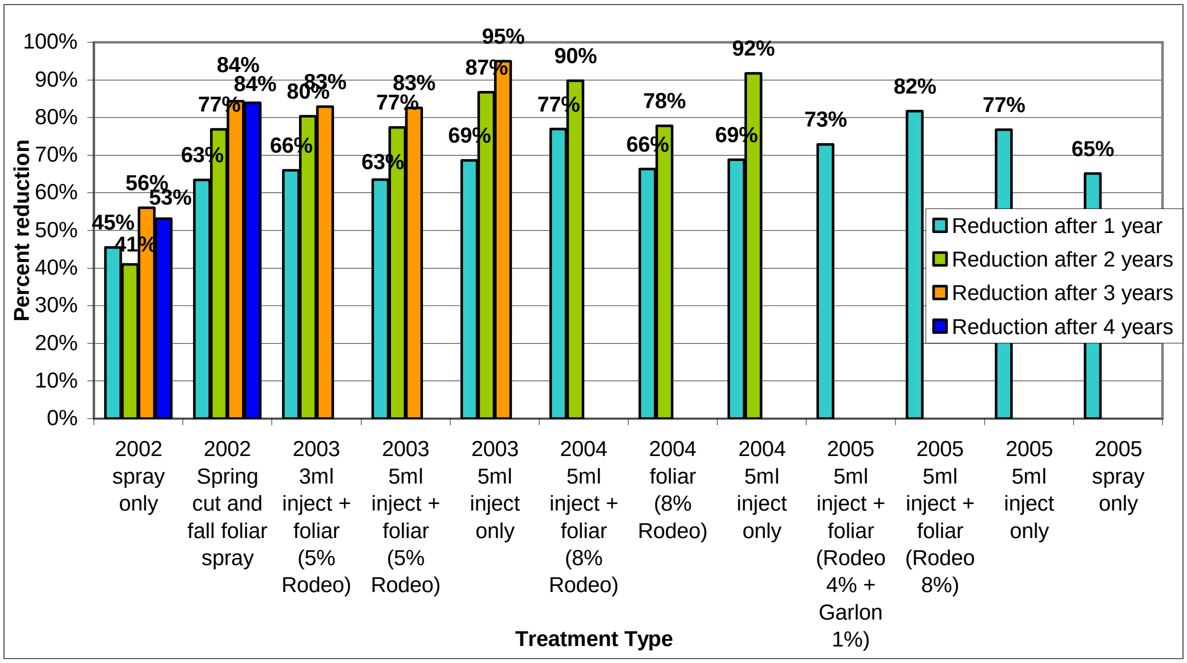


Figure 2.8: Stem Reduction by initial treatment type

All treatment types have decreased stem counts in knotweed patches. The most successful treatments have resulted in average stem reduction rates of between 73 and 93 percent after the second year of treatment.

Patch Eradication and Re-emergence

When no knotweed stems are found at a site in a given year, we record "no new shoots" (NNS) for the stem count. Of the 747 previously treated microsites, 375 (50 percent) were NNS sites in 2006 (Figure 2.9). The number of NNS sites has increased steadily since the beginning of the project.

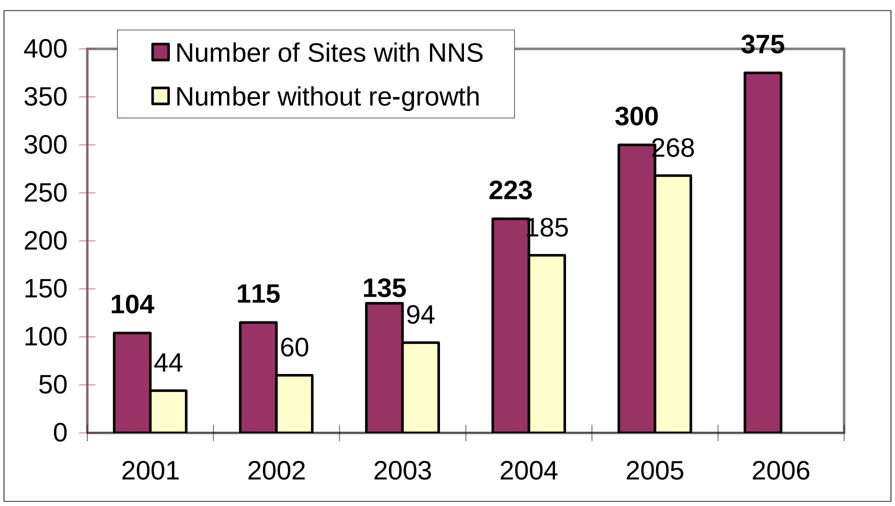


Figure 2.9: Percentage of sites with no new shoots (NNS) recorded that had no subsequent re-growth

While 50 percent of the previously treated sites appeared dead this year, experience shows that patches showing no above-ground stems one year can re-sprout one or two years later. We call this re-emergence. On average, 33 percent of the patches with NNS the previous year re-emerge.

Because patches may not re-emerge for two or more years, the percentage of re-emergences may increase with time.

Reasons for such apparent dormancy and recovery are unclear. It is clear, however, that herbicide treatments can greatly reduce or even eliminate above-ground growth while leaving some portion of the rhizome network dormant but alive (Figure 2.10). Herbicide treatments, especially glyphosate treatments, are also known to cause epinastic growth (Figure 2.10). Epinastic growth appears stunted or mutated and often lacks leaves or has small leaves without sufficient surface area for treatment with herbicides. Epinastic growth can be very small and difficult to recognize and locate.

To understand the threats of epinasty and re-emergence better, in 2006 the Nature Conservancy began excavating a subset of patches that displayed epinasty or NNS. More than half of the excavated patches contained large amounts of living rhizome tissue. Often, the living tissue extended deeper into the ground than we were able to dig.

Patches displaying significant epinasty are not likely to be eradicated even after several herbicide treatments. Anecdotal evidence demonstrates that if they re-sprout at all, NNS patches are likely to re-sprout with epinastic growth.

Figure 2.10: Epinastic growth on an excavated rhizome and growth from treated patch

In 2004, because the health and regrowth of previously treated patches seemed to be in significant decline, The Nature Conservancy began closely monitoring the health of each microsite at each treatment. Since 2004, the number of sites with a significant proportion of epinastic growth has increased by five times (Figure 2.11).

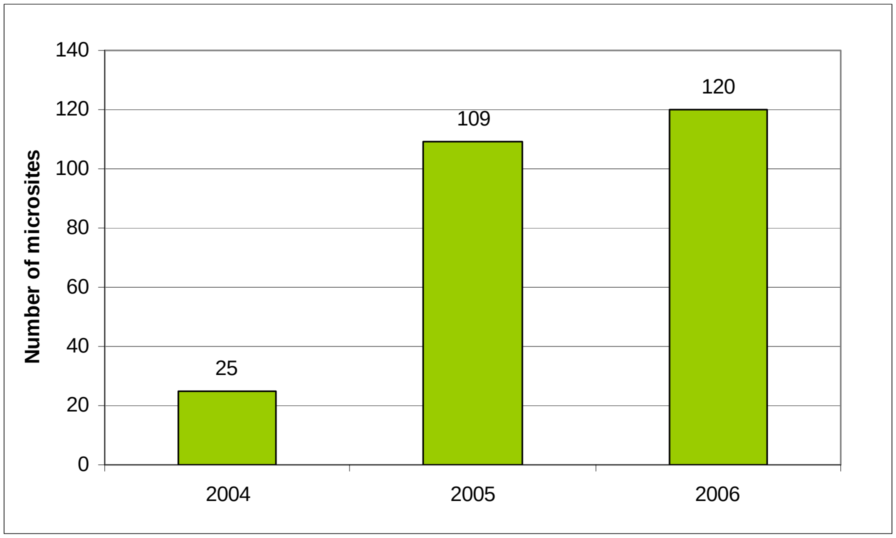


Figure 2.11: Number of microsites with epinastic growth over 3 years

Photo-monitoring

In order to more fully demonstrate the results of our knotweed control efforts, we took photographs of select microsites in the SRW in successive years. These images provide strong visual evidence for the efficacy of our methods, and indicate the progression of each documented site. Each of the following photographs was selected based on its representative quality, and our ability to document each microsite over a three-year period.

Microsite BR05 is an example of a reasonably successful site: after 2 years of treatment, we were able to replant the area with native vegetation, despite the presence of a small remainder of the original knotweed infestation. Site SR107C demonstrates the ability of knotweed to re-emerge two years following treatment, necessitating long-term monitoring and follow-up treatments.

Japanese Knotweed Landscape Experiment Photo-monitoring Series 2006
BR05

Photo 1: September 2004

Photo 2: August 2005

Photo 3: August 2006

Japanese Knotweed Landscape Experiment Photo-monitoring Series 2006

Brightwood Post Office
SM241A

Photo 1: September 2004

Photo 2: July 2005


Photo 3: 27 August, 2006

Japanese Knotweed Landscape Experiment Photo-monitoring Series 2006
Deadguy's
SR107C


Photo 1: 15 September, 2004


Photo 2: 28 September, 2005


Photo 3: 23 August, 2006

Japanese Knotweed Landscape Experiment Photo-monitoring Series 2006

MC45D

View A

16 May, 2005 (pre-treatment)

View B

16 May, 2005 (post treatment)

22 June, 2006

22 June, 2006

Japanese Knotweed Landscape Experiment Photo-monitoring Series 2006

Revenue Bridge Roadside


Photo 1: 6 July, 2005


Photo 2: 28 July, 2005


Photo 3: 23 August, 2006

Section 3. Controlled Experiments

A. Seventeen Treatment Method Knotweed Control Experiment, East Oxbow 2000-2003

Study area

The experiment took place in Oxbow Park on the Sandy River, Multnomah County, Oregon, at river mile 13. Soils at the study site are sandy and the entire site is subject to inundation during major flood events. In April 2000, 51 individual knotweed patches were identified within a 0.5-square-mile area. Each patch contained between 20 and 239 stems. Patches were numbered, permanently marked, and their locations recorded using a global positioning system. All sites are in full sun prior to bud break/leaf-out of deciduous trees in the spring. The degree of mid-summer shading varies between sites.

Methods

During the 2000 through 2003 field seasons, 17 treatment combinations were used and compared for controlling Japanese and giant knotweed. Treatments included manual control, two herbicides (glyphosate and triclopyr), two application methods (foliar spray and wick), three application timings (spring and fall, summer only, fall only), and combinations of manual treatment with herbicides (spring cut and fall herbicide, early fall cut and herbicide treatment of resprouting stems, late fall cutting and wicking, and late fall cutting to 1.5 meters tall and foliar herbicide). For manual control, each stem was cut monthly, at the top of root crown (if visible) or at the soil surface using loppers or pruning shears. For foliar spray application, upper leaf surfaces were sprayed using a low-pressure spray unit to "just wet" with a 5 percent solution of either glyphosate or triclopyr (Garlon 3A, reduced to 3 percent after year one). A non-ionic surfactant (R-11 for glyphosate in 2000 and 2001, Li-700 in 2002, Hasten for triclopyr) was added at a rate of one ounce per gallon. A small amount of herbicide dye was also added. For cut-stem (wicking) application, a 50 percent solution of triclopyr or glyphosate in water was applied to the stem surface immediately following cutting, using a weed wand (Ben Meadows) in 2000 and a hand – held plant mister in 2001 and 2002.

Table 3.0: Knotweed Treatment Key

Treatment Code	Spring Treatment	Fall Treatment	Treatment Method	Herbicide
MM	Monthly manual cutting at soil surface		Cutting	No
HHFG	Herbicide	Herbicide	Foliar	Garlon 3A
HHFR	Herbicide	Herbicide	Foliar	Rodeo
HHSG	Herbicide	Herbicide	Wick Cut Stem	Garlon 3A
HHSR	Herbicide	Herbicide	Wick Cut Stem	Rodeo
MHFG	Manual	Herbicide	Foliar	Garlon 3A
MHFR	Manual	Herbicide	Foliar	Rodeo
MHSG	Manual	Herbicide	Wick Cut Stem	Garlon 3A
MHSR	Manual	Herbicide	Wick Cut Stem	Rodeo
NHSG	None	Cut and Herbicide	Wick Cut Stem	Garlon 3A
NHSR	None	Cut and Herbicide	Wick Cut Stem	Rodeo
NHrFG	None	Cut Herbicide Resprout	Foliar	Garlon 3A
NHrFR	None	Cut Herbicide Resprout	Foliar	Rodeo
NHcFG	None	True No Cut Herbicide	Foliar	Garlon 3A
NHcFR	None	True No Cut Herbicide	Foliar	Rodeo
SFG	Summer Herbicide	No treatment	Foliar	Garlon 3A
SSG	Summer Herbicide	No treatment	Wick Cut Stem	Garlon 3A

Treatment Code Key:

- The first two letters reflect spring and fall treatments. N = no treatment, M = manual (hand cutting at ground level), H = Herbicide.
- The third letter(s) indicates herbicide treatment method. F = Foliar Spray, S = wicking the cut stem surface, A small "c" indicates the patch was cut down to 1.5 meters before fall spraying. A small "r" indicates the patch was cut and allowed to resprout for approximately 1 month prior to treatment.
- The fourth letter indicates the herbicide used, either R = Rodeo or G = Garlon 3A.

Thus, MM refers to manually treated plots (monthly cutting). MHFR means a plot was manually cut in spring and foliar sprayed in fall with glyphosate. NHcFG means a plot was untreated in the spring, then sprayed with Garlon in the fall after being cut to 1.5 meters. HHSG represents two stem treatments with Garlon.

For foliar applications (XXFX), upper leaf surfaces were sprayed using a low-pressure spray unit to "just wet" with a 5 percent solution of either glyphosate or triclopyr (Garlon 3A, reduced to 3 percent after year one). A non-ionic surfactant (R-11 for glyphosate in 2000 and 2001, Li-700 in 2002, Hasten for Garlon3A) was added at a rate of one ounce per gallon. A small amount of herbicide dye was also added.

For cut-stem (wicking) application (XXSX) we used a weed wand in 2000 and a handheld plant mister in 2001 and 2002. A 50 percent solution of triclopyr or glyphosate in water was applied to the stem surface immediately following cutting.

During late-season cutting and spraying resprouting stems (NHrXX), plants were cut in August and the resprouting stems were treated with herbicides in October.

True no-cut, herbicide application (NHcFX) was done in September. Foliar treated plants were cut to 1.5 meters in height and sprayed as above. Stem treatments were done as above.

Results

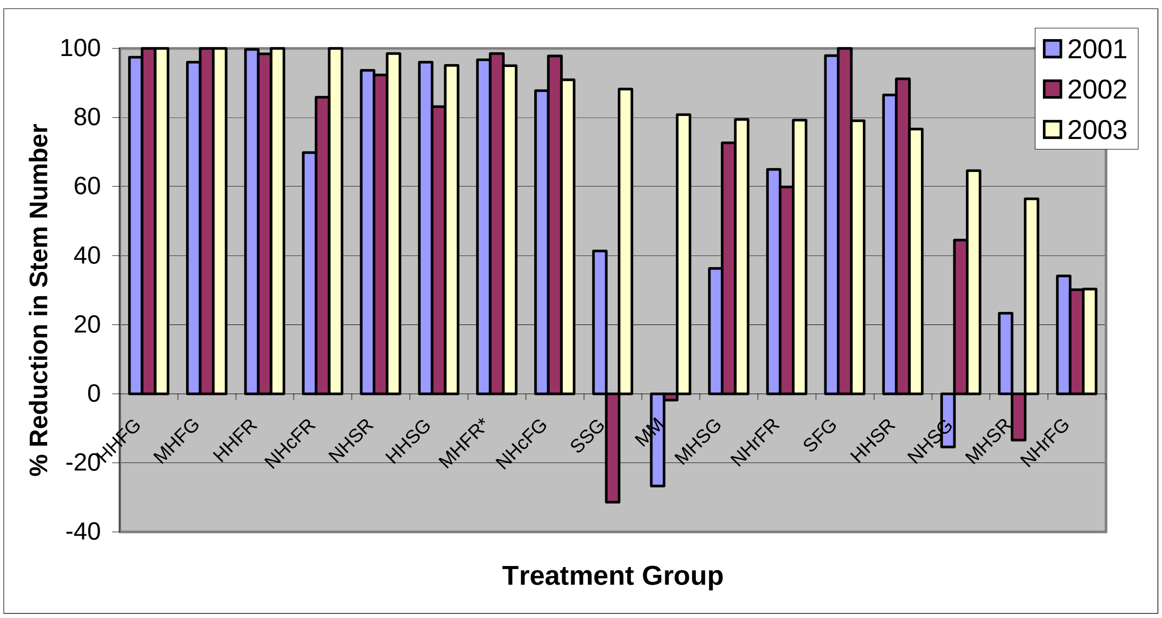


Figure 3.0: Comparison of 17 Control Methods for Japanese Knotweed; Summary Results 2000-2003, Mean Values by Treatment

Average overall reduction in stem count was 80 percent:

For the reasonably small patches that were tested, knotweed was effectively controlled within two field seasons of foliar spray treatment with triclopyr. Foliar treatment by glyphosate alone was less effective at fully eradicating most patches, requiring three or more annual treatments in nearly every case.

Although wicking type, cut-stem treatments did provide effective control, they are less effective and more time consuming than foliar applications, and do not appear to completely control knotweed, even after three field seasons.

Late summer-early fall foliar herbicide treatment was be combined with spring manual control without loss of treatment effectiveness, as compared to two herbicide treatments. For glyphosate herbicide, a late season cutting to 1.5 meters followed by foliar spray delivered effective control if repeated for several seasons.

Successful control based on cutting alone generally required more than three years, and/or involved cutting stems more than monthly for all but the smallest, least well-established patches.
Timing of herbicide treatment was important. The failure of the spring-fall foliar herbicide treatment to deliver benefits beyond the manual/herbicide combination was not surprising, since translocated herbicides generally do not give good control of deep-rooted perennial plants when applied during the early phase of rapid spring growth.

The success of some of the cut-stem (wicking) treatment offered a middle ground for individuals with particularly strong objections to herbicide spraying, or for sites where herbicide spraying was not appropriate (i.e. presence of rare or sensitive species). Care had to be taken, however, to treat every stem, and multiple treatments were necessary.

B. Stem Injection Experiment for Japanese and giant knotweed

Study Area

The experiment was conducted along the Clackamas River within the Willamette River Basin in Northwestern Oregon, in Clackamas county, about 30 miles southeast of Portland between July 2003 and July 2004.

Methods

Staff from The Nature Conservancy and Metro Parks and Greenspaces began an experiment to test effectiveness of the stem injection method of herbicide application on Japanese and giant knotweed. They conducted the treatments in July and September of 2003, with comprehensive follow-up treatment and data collection through August 2005 and spot follow-up in 2006.

Two main issues were addressed in the herbicide application experiment: application dosage and timing. Two sites, each with 30 patches of knotweed, were selected for treatment. Stem numbers varied from 23 to 185 stems at the first site, and from 21 to 114 stems at the second site. Neither site had been previously treated.

At each site the team collected stem numbers, typical stem diameters, typical height, patch sizes, shading, and general soil type, while also taking photographs. Patches were randomly assigned to one of four treatment groups (1.5 ml stem injection, 3 ml stem injection, 5 ml stem injection, or 5 ml stem injection plus foliar spray) or a control group.

Direct stem injection involves poking a 0.1 inch (0.2 cm) hole through both sides of a knotweed stem just below the first or second node. Then a small amount (1 to 5 ml) of undiluted glyphosate was injected downwards into the hollow chamber of the stem with a 14 gauge needle and a 60 ml syringe. Stems of 0.75 inches diameter were injected with 1.5 ml, those one-inch wide with 3 ml, and 1.25 inches with 5 ml. All smaller stems were foliar sprayed to “just wet” with 5 percent v/v solution of glyphosate herbicide with 1 percent Li-700 surfactant.

The first site was treated in July 2003, and the second was treated in September 2003. Initial post-treatment data was collected in August 2003 (for sites treated in July) and October 2003 (for sites treated in September). First-year data were collected in July 2004. All treatment sites were revisited in September 2004, and all remaining regrowth stems in the test plot were foliar sprayed using a tank mix of 8 percent v/v glyphosate with 1 percent LI-700. Second-year data was collected in late July/early August 2005.

Results

In all, stem injection and foliar spray treatments reduced the stem number, diameter, height and spread of knotweed patches. Treatment date (July vs. September) had no significant effect on stem reduction at any level of treatment ($P = 0.80$).

Two years after treatment, stem injection with glyphosate effectively reduced stem number in all treatment groups (ANOVA, $P<0.0001$) (Figure 3.1). Treatment group mean stem reductions ranged between 88.6 percent (± 28.2 percent) in the 5 ml group and 99.0 percent (± 1.6 percent) in the 5 ml plus foliar spray group, with an average of 94.5 percent (± 15.0 percent). Although the 5 ml plus foliar spray had the highest mean reduction in stem number in both years, the four treatment groups were not significantly different from each other (Tukey’s HSD, $P = 0.61$) (Figure 3.1).

In addition, new stems growing from treated patches were greatly reduced in diameter and height compared to control patches (Figures 3.2 and 3.3). The height of treated stems decreased 99.0 percent (± 3.0 percent), whereas control stem height increased by 133.0 percent (± 103.1 percent). Dose per stem had no clear effect on the height or diameter of the next summer's stems. However, stems in the 5 ml plus foliar spray treatment group were the most consistently small, with no stems greater than 0.5 m in height or 0.5 cm in diameter.

Treated stems also showed irregular growth, with excessive branching, narrow stems, twisted stems, or discolored leaves. In 2005, new stems grew less than one meter outside the 2003 patch boundaries in 23.4 percent of treated patches, while control patches had grown so that original boundaries were impossible to determine. In some cases, untreated patches adjacent to the target patches displayed reduced and/or abnormal growth following treatment.

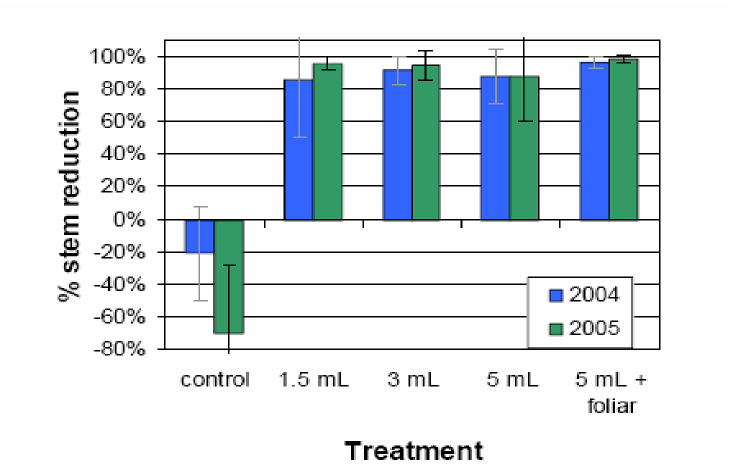


Figure 3.1. Effect of injected glyphosate volume and supplemental foliar spray on stem number reduction. Treatment group means with one standard deviation for 2004 and 2005.

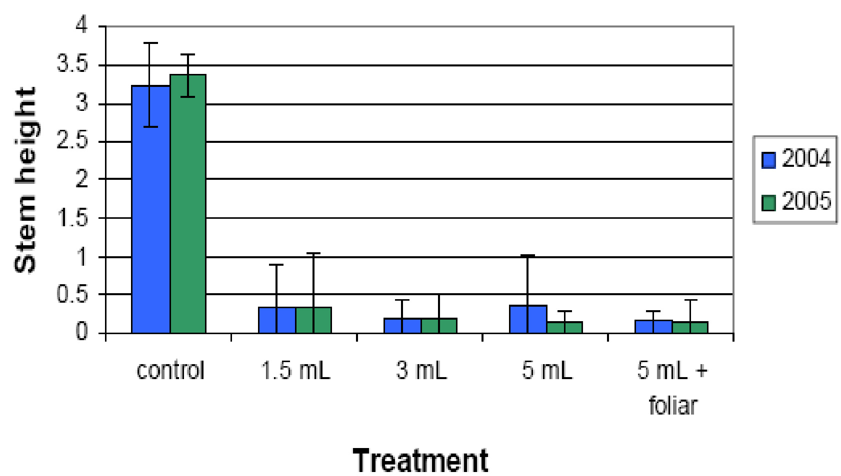


Figure 3.2: Stem height one and two years after treatment

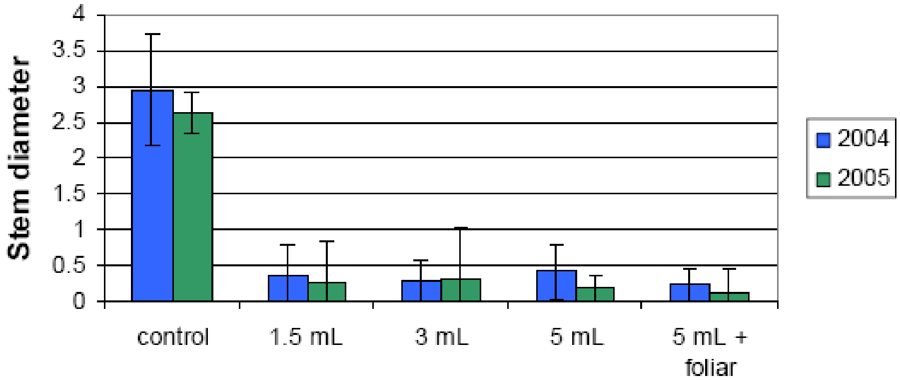


Figure 3.3: Stem diameter one and two years after treatment

2006 Stem Injection Experiment Update

In July 2006, The Nature Conservancy revisited all 30 of the September treatment sites. Stem counts for all treatment types were slightly higher than in the preceding two years. This suggests that those patches that were not eradicated may be slowly recovering.

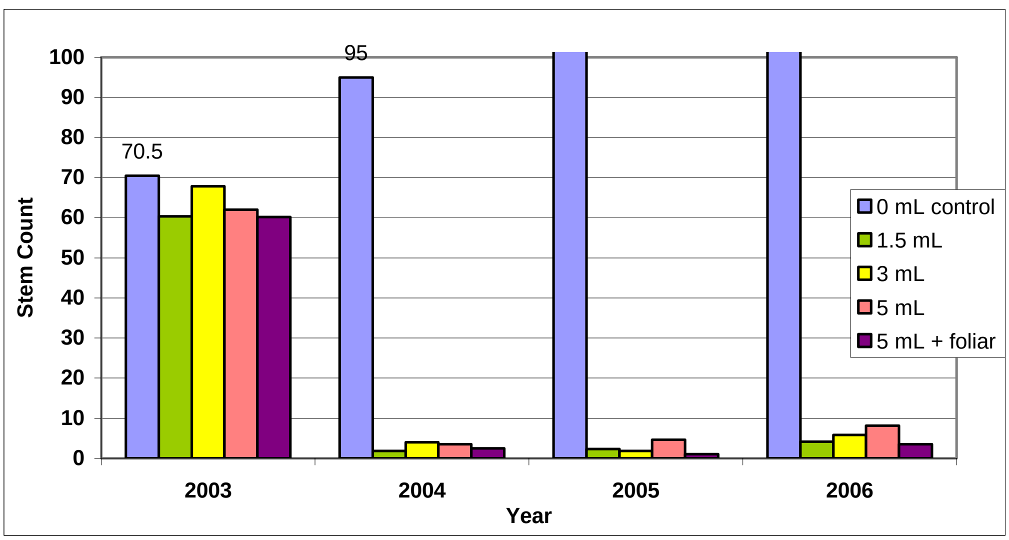


Figure 3.4: Stem counts in study plots over 4 years of injection experiment

Because of concerns that patches with no above ground stems may be dormant, staff excavated two sites and examined one that had been partially uprooted by floods.

The first patch excavated had two inches of dead rhizome material near the surface. Below two inches however, rhizome material was living. Rhizome material was living up to a depth of one foot, at which point the excavation became too difficult to continue.

The second patch excavated had a completely dead crown, but small rhizomes coming off of the crown were still living. The patch that had been partially uprooted by floods was completely dead.

Section 4. Discussion of Knotweed Treatment

The Nature Conservancy's effort to control knotweed in the Sandy River Watershed continues to produce positive and measurable results. For the first time since the start of the study, we can say with a high degree of confidence that with the exception of preliminary surveys in the Sandy River Delta, the surveying and inventory of knotweed throughout the watershed has been completed. All patches in the watershed above river mile 6, with the exception of a few on Forest Service land or in distant upland sites, were treated at least once during 2006. Sites revisited in 2006 had 85 percent fewer knotweed stems than their initial counts. Treatments performed in 2005 reduced the area infested by knotweed by 46 percent. No knotweed grew in 50 percent of the microsites established in past years. Statistics like these demonstrate that our treatments are effective at reducing knotweed infestation.

The 2006 field season illustrated several important trends:

- We have not yet eradicated any patch over 300 stems through the use of glyphosate even after six to eight treatments.
- When multiple herbicide treatments do not eradicate a patch, regrowth is typically too small to be injected.
- Glyphosate treatments seem to cause epinastic and stunted growth.
- While many smaller patches have been eradicated completely, others have remained, with very low stem counts or with significant epinasty, for years without dying. We are experiencing this on the watershed as a whole, in the initial study area, and in the controlled injection experiment.
- Patches with no above-ground shoots can have significant underground living tissue.
- Patches that appear dead can produce above-ground growth after one or more years of no visible stems.
- Measurements of the above-ground portion of knotweed do not necessarily relate to below ground biomass.
- The number of microsites with epinastic growth is increasing.
- Treating epinastic growth with herbicides does not kill large knotweed rhizomes.

A comparison of our herbicide treatment techniques to date indicates that while some initial treatments are more effective than others, all techniques deliver substantial levels of control. Generally, each year's treatment has reduced the size of the knotweed infestation. This trend, while continuing, seems to be slowing. The initial treatment usually produces the largest decrease in a given knotweed infestation. Subsequent treatments provide progressively less control. Although some patches continue to disappear, the 2006 stem count for the initial study area was only 37 stems (1.5 percent) less than the preceding year. This "leveling off" of our results can be seen in all of the areas in which we work.

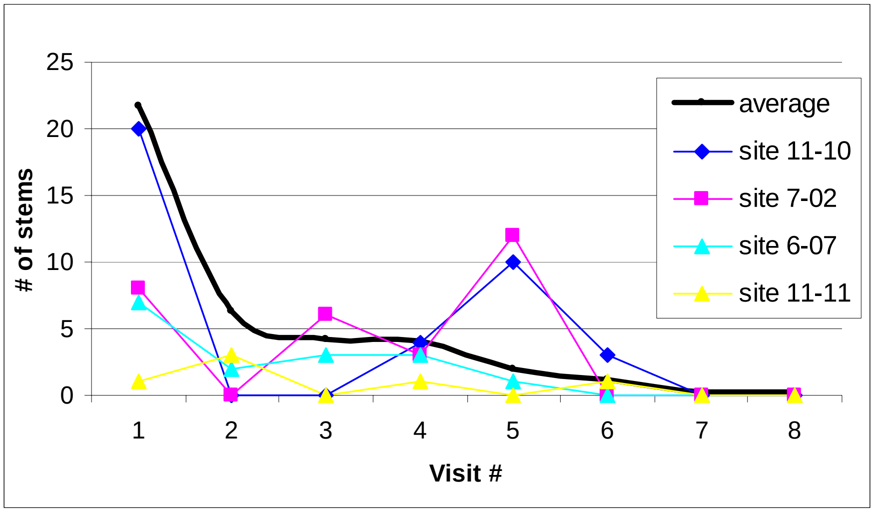


Figure 4.0: Stem counts of sample microsites compared with average over 8 visits

The average line in Figure 4.0 is a good representation of our knotweed control efforts as a whole. All of the lines on the graph approach 0 with significant variation from year to year, but never actually reach it for more than one year in a row.

Because near-eradication of patches is not an adequate result, we intend to change our treatment protocol for 2007. Decisions for the new protocol are based on the nine bulleted trends listed above. For 2007, we will:

- Inject all stems large enough for injection with 3 ml glyphosate unless legal limitations apply;
- Spray, except where prohibited by landowner, all healthy stems too small to inject with either 1 percent imazapyr, 2 percent triclopyr, or a combination of 1 percent imazypyr and 4 percent glyphosate;
- Count and measure the infested area for all stunted or epinastic stems but will not treat them with herbicides;
- Continue to dig up the rhizomes of select NNS patches or patches with substantial epinastic growth to better understand what is happening underground; and,
- Leave some patches with stunted growth entirely untreated in 2007.

Our hope is that the introduction of imazapyr into our treatment regime in 2006 will deliver better, longer lasting results in the long-term. The results produced by imazapyr will not begin to show until summer of 2007.

Key Questions

Further study of knotweed's underground rhizome network will be necessary for successful control and eradication. We must determine the degree to which knotweed can recover after multiple herbicide treatments. We also need to learn whether a few centimeters of dead rhizome tissue near the surface can prevent deeper living tissue from resprouting. Furthermore, how many years of NNS are necessary before we can deem a patch dead? Can environmental factors explain why some patches are eradicated after one treatment while others seem to never completely die? And finally, we must explore and test new herbicides that can translocate better through knotweed's immense rhizome network.

As always, we will continue to monitor the results of our control efforts to determine the most effective method for controlling knotweed. Clearly, we have made great progress in reducing the threat of knotweed to the Sandy River Basin. Knotweed, however, has proven itself to be one of the most difficult plants to eradicate. With continued study and new treatment protocol, we believe that many of the problem patches will be eradicated within two years.

Section 5. Field Treatment of Species Other Than Knotweed

Scots Broom

Scots Broom (*Cytisus scoparius*) has been identified by the Oregon Department of Agriculture as the single costliest weed in Oregon due to its effect of decreasing forest productivity. Once planted for erosion control, Scots broom has spread into many natural and semi-natural areas of the Pacific Northwest. Because it can convert meadows and open forests to dense shrublands, it represents a significant threat to some common habitats west of the Cascade Mountains. With support from our partners, The Nature Conservancy has been working to remove Scots broom in key ecological areas in the Sandy River Gorge since 1996.

Although controllable by manual or mechanical means, eradicating established Scots broom is a labor-intensive activity, especially in areas not accessible by heavy machinery. Furthermore, a plan must be made for the long-term. Scots broom seeds are extremely long-lived, persisting in the soil up to 50 years. Long-term control and effective restoration requires that once mature plants are removed, young plants must be removed prior to seed-set, thus hopefully allowing long-term recovery of native plants.

Site Selection and Field Treatment Methods

The combination of effective control through non-chemical means and inaccessibility of many of the work sites to machinery has made Scots broom control on the Sandy ideal for youth crew and community-based volunteer efforts.

Because of the widespread distribution of Scots broom in the Sandy River Gorge and the greater watershed, work has been limited to 13 key areas of ecological importance (see table 5.0?). Infestations on floodplains, meadows, and riverbanks were identified, and subsequently treated using manual removal methods. Youth crews, AmeriCorps teams, and volunteers all help with the manual removal of Scots broom. We treat each priority site as time, funding, and volunteer availability allows. Control efforts focus first on reproductive individuals, and then on plants of younger age.

Mature plants are cut using loppers and machetes, or if small enough, are uprooted by hand. Once mature plants have been removed, we attempt to prevent seed set in the future by removing seedlings and especially flowering individuals present at the site. Following up on initial Scots broom removal is critical due to its capabilities to produce hundreds of thousands of seedlings per acre. Seedlings typically mature within four years. Hand removal of the seedlings is an essential part of restoring an infested meadow, riverbank, or floodplain. Areas capable of the highest Scots broom seed production are cleared initially before moving on to areas with scattered, smaller plants. We direct our volunteers and workers to pull and uproot all Scots broom plants over 12 inches tall when working in areas cleared of mature Scots broom.

Monitoring

To document progress at a priority Scots broom site, The Nature Conservancy has set up photo monitoring points at the Cornwell Meadow complex, located near river mile 17. The 30-acre site is co-owned by ODFW, Metro, and the Conservancy. Photo monitoring has been conducted at this site to document our progress, and to represent overall work on Scots broom in the Sandy River Watershed. Sixteen photo markers were established in 1998, and photos were taken in two directions at each marker each year, with the exceptions of 2003 and 2004 (see the CD in the appendices for complete photoseries). Photomonitoring was skipped this year and will be conducted next in 2007, continuing an alternating cycle.

Plot-based sampling is another method of documenting progress of Scots broom removal. Sampling done at Cornwell in 2001 indicated that the population of Scots broom seedlings was between one and four million (95 percent confidence interval). Removal by work groups, employees, and volunteers of The Nature Conservancy since 2001 has made significant progress, and population sampling will be done again in following years to determine the approximate population of the remaining Scots broom seedlings.

Results

The Nature Conservancy has identified 13 priority sites in the Sandy River Gorge where we have focused our efforts on Scots broom removal. It is impossible to accurately estimate how many Scots broom plants were removed at all of the priority sites along the Sandy River. Photo monitoring can help show the progress of the removal work that is accomplished by staff, paid crews, and volunteers at select sites. But due to the nature of Scots broom and its ability to produce new seedlings each year, estimating the total acreage of areas worked on is one of the best methods of documenting results. In 2006, crews, staff, volunteers and partners helped to clear or continue treatment on over 37 acres of land infested with Scots broom.

Table 5.0 2005 Sandy River Scots Broom Priority Sites - All sites are located in the Sandy River Gorge (river miles 12-19), with the exception of Wood Duck Ponds, located near river mile 38.

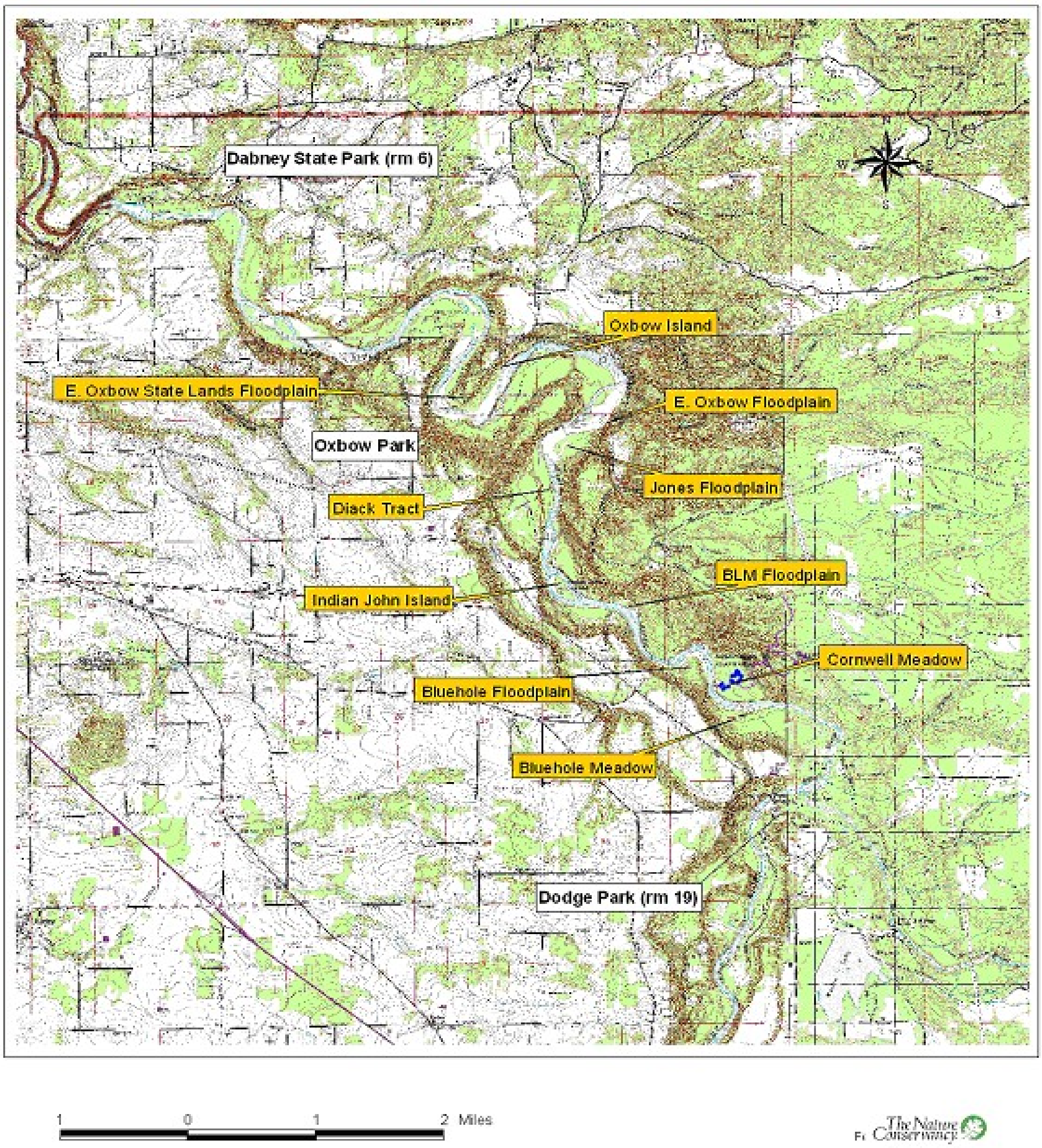
Site	Ownership	Size acres	Priority	Status
Partridge Trail, shoreline	BLM	2	High	All remaining mature plants along trail removed 2006
Bluehole Floodplain	TNC, BLM	3	High	Some mature plants removed 2006
Bluehole Meadow	TNC, BLM	2	High	All mature and most small plants removed 2006
Cornwell Meadow	TNC, Metro, ODFW	18	High	Any remaining mature plants, and many small plants 2006
Diack, Kingfisher tracts	TNC	1	High	Scattered mature plants removed 2006
Dispersed Sandy River Shoreline	BLM, Metro, ODFW, TNC, various private	1	High	Scattered patches 2006
East Oxbow Floodplain	Metro	2	High	Scattered mature plants removed 2006
East Oxbow State Lands Floodplain	Metro, ODFW, Oregon State Parks	0.5	High	Scattered mature plants removed 2006
Main Oxbow Floodplain	Metro	4	Medium	Oxbow staff working on this site
Jones Property Floodplain	Private - upriver seed source for Oxbow, Diack	1	Medium	Some mature plants removed 2006
Sandy River Islands (between Oxbow and E.Oxbow State Lands)	Metro, BLM , Oregon State Parks	0.5	High	Some mature plants removed 2006
Wood Duck Ponds, near Sandy/Salmon confluence.	BLM	3.5	High	All mature and immature plants removed 2006 continuing up shoreline of the Sandy river.

Example Site: Cornwell Meadow

The site that has received the most attention during this project is Cornwell Meadow (T1S, R4E, Section 24, see Map 5.0). Parts of the site have been acquired by ODFW, Metro, and the Conservancy over the last 20 years, and it represents the largest natural meadow in the lower Sandy River Watershed. Due to its deep layer of volcanic sand, the site supports a plant community more characteristic of middle-elevation, montane meadows than a typical low-elevation site. In 1996, most of the meadow was choked with so called “old-growth” Scots broom. Some plants exceeded three meters in height. All mature Scots broom plants were removed from the site by 1998. As expected, a huge crop of seedlings came up in 1999. As thousands of new seedlings emerge each year, work continues in the meadow removing all flowering plants and as many immature plants as time permits.

In 2006, volunteers and Conservancy staff continued to remove all plants large enough to produce seeds. During the season, Conservancy staff set up several more adopt-a-meadow volunteer stewards. Volunteers are given the task of clearing all mature and tall immature Scots broom from a particular meadow area. They return on a regular basis as their schedule allows. This approach has allowed volunteers to clear several meadows of Scots broom, without requiring staff to be present. During 2006 volunteers, spent over 250 hours removing thousands of Scots broom seedlings.

Removal of Scots broom by The Nature Conservancy will continue at Cornwell as well as the other areas listed in Table A as volunteer time and funding allow. Its removal is also taking place in other areas of the Sandy watershed by other groups in part due to outreach and education work done by the Conservancy. Individual landowners, summer camps, government agencies such as Metro and BLM, as well as various youth groups such as project YESS, and Multnomah Youth Corps are all working on clearing areas of Scots broom within the Sandy River Watershed.



Map 5.0 Sandy River Scots Broom Priority Worksites

Himalayan and Evergreen Blackberry

Blackberry (*Rubus armeniacus/discolor* and *Rubus laciniatus*) is so widespread we have not and will not attempt to map its distribution and will continue to limit work efforts to sites at which we were already engaged on other invasive species control or specific high-priority locations.

At priority sites, blackberry was controlled using manual removal techniques. Living or accumulated dead stems were cleared using machetes or loppers. Root crowns were then dug out with shovels, mattocks or pulaskis. Single-stem plants were frequently hand pulled. A combination of staff, AmeriCorps crews, local youth crews and volunteers were used to work on Himalayan blackberry.

Blackberry was often intermingled with knotweed infestations, and was often treated with a foliar solution of herbicide containing either glyphosate, imazapyr, or triclopyr and 1 percent Li-700 surfactant depending on the knotweed treatment of the particular day. If excess herbicide was left in the tank after treating all knotweed patches at a given site, we would then spray blackberry infestations before returning from the field. In places where this practice was done in previous seasons, blackberry is less abundant and even eradicated in select sites on some floodplains.

In areas where blackberry infestations are light or scattered along trails to work sites or preserves, we have made efforts to control these populations using foliar sprays of triclopyr (triclopyr at 3 percent solution with 1 percent R-11 surfactant). These efforts yield excellent control, and prevent small blackberry patches from becoming large infestations in the future.

Butterfly Bush

Butterfly bush (*Buddleja davidii*) is a relatively recent addition to the State of Oregon's Noxious Weed List (Class B). Buddleja plants have been found growing in many riparian areas in western Oregon, including several floodplains along the Sandy River.

Butterfly bush was first spotted along the Sandy in 2002, and several populations were mapped along with knotweed sites. The following year some of the smaller plants located near knotweed patches were treated with a foliar spray of 5 percent v/v glyphosate and 1 percent v/v Li-700 surfactant.

The foliar glyphosate applications appear to have been effective. While visiting knotweed sites during the 2006 field season, many of the treated butterfly bush plants appeared dead. Any remaining or new butterfly bush plants were treated with a foliar spray of glyphosate, imazapyr, or triclopyr and 1 percent Li-700 surfactant, the same treatment applied to knotweed plants too small to receive stem injections.

If excess herbicide was left in the tank after treating all knotweed patches at a given site, we would then spray Buddleja infestations before returning from the field. In places where this practice was done in previous seasons, Buddleja has been eradicated from select floodplains.

In June, our crew assisted a group from Metro Parks and Greenspaces with work at two Metro-owned floodplains along the lower Sandy near river mile 8. Our crew facilitated access to the sites using inflatable rafts, and the Metro employees and the contract crew they hired stump treated butterfly bush and traveler's joy (*Clematis vitalba*). The crew used chainsaws to cut through the weeds, and applied a solution of 8 percent triclopyr to the cut stems of the butterfly bush and Clematis. Two days were spent at the sites conducting this work back in June, and upon reviewing the sites in late September the work appears to have been effective. Follow-up monitoring next season should determine if future crews will be needed to control the invasives on the sites.

Canada Thistle

Canada Thistle (*Cirsium arvense*) is a common invasive in meadows and open spaces throughout much of North America. An infestation was taking over the meadow on the Conservancy-owned Diack preserve, located near river mile 14 along the Sandy. Mowing and cutting had been used in the past to try to control the thistle and Himalayan blackberry in the meadow, but with poor results. Herbicide was used to control the thistle beginning in 2005. Research on the internet showed that Transline (active ingredient chlopyralid) was successful at controlling Canada thistle. Multiple applications will likely be necessary, as the seed bank of Canada thistle can last in the soil for up to a decade. It is unlikely the seed bank at this particular site will last that long, as the mowing in previous years often took place before the thistles could set seed.

The herbicide Transline was used in a mixture of one ounce per gallon of water (~0.8 percent) with 1 percent R-11 as the surfactant. A total of nine ounces of Transline were sprayed on the plants that were scattered over six acres. Each thistle was sprayed from the bottom-most leaves to the top of the plant. The spraying, done during the first week of July, took about seven hours to finish with four people.

To accurately determine the success of our treatment, we employed local students from YESS (Youth Employment Support Services) to collect baseline thistle population data before the herbicide treatment last season in July of 2005. Follow-up monitoring in 2007 will determine the efficacy of the treatments the past two field seasons. The monitoring plan for the future is to involve students from local schools in the population counts. This will introduce students to scientific studies in a real world setting at a nature preserve. Photo monitoring was incorporated as well to illustrate the effects of the thistle work.

Section 6. Outreach

Introduction

No regional effort, including the Sandy River Riparian Habitat Restoration Project (SRRHPP), can succeed without broad support and participation from the local community, especially from private landowners. The public outreach component of the SRRHPP is designed to gain access to private lands for survey and control purposes, to mobilize agency and community action and to increase citizen understanding of watershed processes and functions. In 2006, we expanded the scope of our outreach and surveying on tributaries of the Sandy River, including Still Creek, the Upper Zigzag, the Upper Sandy, and the Sandy River Delta. To achieve the project goal of eradicating knotweed in riparian areas and floodplains, we began with the upper most tributaries of the Sandy River and systematically worked our way down stream to contact landowners and to gain their permission to survey for and control knotweed. This year we completed surveys of the uppermost inhabited reaches of each tributary in the basin.

The project provides regional leadership by sharing its information, materials, and project structure with up-and-coming knotweed programs. To this end, the SRRHPP organized and participated in a number of public events and meetings to raise awareness of the problems posed by invasive plants.

Methods

Private Landowner Outreach

The SRRHPP area includes at least 3,566 properties within 300 feet of the Sandy River and its tributaries. Landowner contact information is obtained from digital tax lot maps (Map 6.0). A four-stage strategy was used to attempt contact with landowners: mass mailing, direct contact (door-to-door), targeted mailings, and phone calls.

If a landowner does not respond to our mass mailing, we make an in-person visit. If the landowner is present, we inform him/her of the project and ask him to sign a landowner agreement form to survey and manage any knotweed infestations. We leave the landowner with an informational program letter (Figure 6.0), a copy of the landowner agreement form (Figure 6.1), and a knotweed brochure (Figure 6.2). If the landowner is not present, we leave the information with a handwritten note and a self-addressed stamped envelope on-site so that they may mail us a signed landowner agreement form or call with questions. We fill out a landowner contact form to record the initial outreach attempt (Figure 6.4). The owner's name, the coded property, and property information are entered into our landowner outreach database. After a landowner permission form is signed, we follow up with surveys and treatment, if necessary. All subsequent contact attempts are also recorded in the database.

In 2001, information about the project was mailed to all landowners within a quarter mile of the Sandy River and its major tributaries. Since this initial mailing, we have continued to utilize targeted mailings as the first attempt at contacting non-resident property owners. Mailings are also used as the second attempt at contact for those resident landowners who have not signed the landowner agreement form left at their property during the door-to-door outreach effort. Additionally, in 2006 we mailed information to landowners on whose properties we knew of or suspected a knotweed infestation. When direct outreach and mailings do not work, we attempt to call the landowner directly. A phone call followed by a mailing proved an effective means of gaining landowner permission.

Map 6.0. Sample Tax Lot Map

Figure 6.0 Private Landowner Outreach Letter

Date

Dear Property Owner,

Near your property on the Sandy River, we have found an extremely invasive weed called Japanese Knotweed. This plant is known to cause erosion, to crowd out native plants, and to threaten native fish populations. The Nature Conservancy is leading a multi-partner project to rid the Sandy River Watershed of Japanese knotweed (see enclosed brochure). Thanks to support from the Oregon Watershed Enhancement Board, Oregon Department of Fish and Wildlife, Bureau of Land Management, Portland General Electric, and the U.S. Forest Service we are able to offer **FREE assistance** to landowners. We would like to survey your property for this destructive weed.

Please help protect the Sandy River. So far more than 450 of your neighbors are helping, but without cooperation from landowners like yourself, our effort to protect the Sandy River watershed from this harmful weed will surely fail.

Enclosed are two copies of a form that, once signed, allows us access to survey your property, and, IF YOU WISH, manage any knotweed patches. **The form protects you from all liability** related to our work on your property. If this is acceptable, please sign one copy and return it to us using the self-addressed envelope. Please keep the other for your records. We promise to treat your property with as much respect as we treat our own, and abide by whatever rules you set.

If we are managing weeds on your property, we will either inject each stem, or spot spray each leaf with Rodeo or Aquamaster, herbicides approved for use near water. Our preferred management approach is to treat the plants once in summer or early fall.

With your permission, we will return at least once next year to determine the success of our treatment. If further treatment is found to be necessary at that time, we will also do that for free.

If you have any questions, please do not hesitate to contact either one of us.

Sincerely yours,

Jonathan Soll
Project Manager
503.802.8100

Jason Dumont
Project Outreach Coordinator
503.802.8100

Waterwav Reference #
Microsite Reference #
Date entered INT

Figure 6.1 Private Landowner Permission Form

Permission to Access Private Land

Project Name: Sandy River Riparian Habitat Protection

Land owner name(s):____

Mailing address:____

Property* location:____

Daytime telephone:____

Is Japanese knotweed growing on Property*? Yes___ No___ Unsure___

The purpose of this document is to authorize employees of The Nature Conservancy or its agents (agents) to enter or cross private property to conduct restoration and noxious weed removal activities (see section 1 below) and to absolve landowners from all liabilities related to actions conducted by TNC.

This agreement is entered into to accomplish the following tasks:

Control of invasive weeds (primarily Japanese and giant knotweed but may also involve Scots broom and/or Himalayan blackberry and/or English ivy) by hand removal or spot application of Rodeo or Aquamaster (glyphosate).

Provide access to work sites across owner's land by foot or vehicle.

The work will occur on lands owned by the cooperator at the above address(es) in __________________________ County(ies), Oregon.

The Nature Conservancy and its agents agree to hold landowners harmless for all claims, suits or actions of whatsoever nature resulting out of this cooperative agreement.

Permission is granted for 3 years or until formally revoked, either orally or in writing.

This agreement shall be effective upon the signature of all the parties listed below.

___________________________ ______________________________ ___________
Name of cooperating landowner Signature of landowner Date

___________________________ ____________________________ ____________
Name of TNC project sponsor Signature of TNC project sponsor Date

Figure 6.2 Knotweed Brochure

We Can Help

If you have questions about knotweed control, have knotweed on your property and want assistance, aren't sure if you have knotweed or would like to volunteer, please contact us:

Sandy River Watershed, OR
Jonathan Soll; *The Nature Conservancy*
503-230-1221; jsoll@tnc.org

Clackamas River Watershed, OR
Curt Zonick; *Metro Regional Parks & Greenspaces*
503-797-1729; zonickc@metro.dst.or.us

Clark County (WA) Weed Management
360-397-6140; philip.burgess@clark.wa.gov

Lincoln County (OR) Soil and Water Conservation District
541-265-9351

Siuslaw Soil & Water Conservation Dist. (W. Lane County, OR)
541-997-1272; wcsswcd@oregonfast.com

For other areas in Oregon, please contact
the Cascade Pacific RC&D (541-757-4807)
or the local Watershed Council.

In Washington, please contact
The Nature Conservancy at 206-343-4344.

Oregon Department of Agriculture 503-986-4621

Information Resources

These Internet sites provide information about knotweed and other invasive species:

- tncweeds.ucdavis.edu/esadocs/Polycusp.html
- www.co.clark.wa.us/environ/knotweed.pdf
- www.ecy.wa.gov/programs/wq/plants/weeds/aqua015.html

About The Nature Conservancy

The Nature Conservancy is a leading international, nonprofit organization that preserves plants, animals and natural communities representing the diversity of life on Earth by protecting the lands and waters they need to survive.
Visit us on the web at nature.org.

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

The printing and distribution of this brochure was made possible through generous funding by the Bureau of Land Management, Metro, the National Oceanic and Atmospheric Administration, the Oregon Department of Agriculture, the Oregon Watershed Enhancement Board and the U.S. Fish and Wildlife Service.

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Knotweed

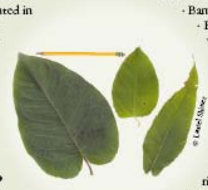
Without prompt and vigorous action, knotweed will take over entire riverbanks, displace native habitat, and damage the scenic and recreational quality of Northwest rivers.

Help Save Pacific Northwest Rivers from this destroyer of watersheds.

What is knotweed?

Japanese, giant and Himalayan knotweed are perennial plants native to Asia, but planted in gardens here. Common names include Mexican or Japanese bamboo, elephant ear and fleeceflower. By any name, they are noxious weeds and a critical threat to our rivers' health.

Scientific names include: *Polygonum cuspidatum, Fallopia* or *Reynoutria japonica, P. sachalinense,* and *P. polystachyum.*



Why is knotweed a problem?

Knotweed is fast growing and extremely aggressive. It invades river and creek banks, permanently displaces native vegetation, destroys critical fish and wildlife habitat and reduces recreational opportunities. Due to a huge and vigorous root system, large patches are very difficult to eradicate. Seasonal flooding continues to spread knotweed throughout many Northwest watersheds. Thousands of patches are known from the Clackamas, Sandy and Washougal Rivers alone.

What does it look like?

- Dense stands up to 12 feet tall
- Bamboo-like, green or reddish stems
- Bright green leaves 1 to 8 inches wide with smooth (not saw-toothed) edges
- Starts growth in April; full size by July
- Spikes of small, white flowers in late summer
- Dormant in winter, the dead, brown stems may remain standing

Where does it grow?

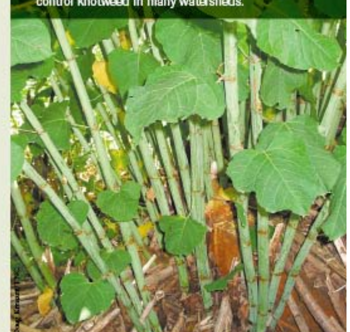
Knotweed thrives in any moist soil or river cobble, in full or partial sunlight. Most common in the flood plains along rivers and creeks, it also grows in roadside ditches, waste areas and beaches.

How does it spread?

In the Pacific Northwest, knotweed usually spreads when roots are moved by floods or in contaminated soil. Because root fragments as small as 1/2 inch can start new plants, even one patch can produce hundreds of new plants.

What is being done?

Concerned citizens, watershed councils, conservation organizations and public agencies are teaming up to control knotweed in many watersheds.



Bamboo-like stems and smooth-edged, heart shaped leaves of a Japanese knotweed plant.

Knotweed is an aggressive and destructive weed that spreads quickly, shades out native plants and destroys habitat. We need to act now! Within a few years it will be virtually impossible to control knotweed.

WHAT CAN I DO?

- **Check Your Property.** If you have knotweed, control it using the methods described here.
- **Call Us!** Many watershed groups offer **free knotweed control.*** For help or detailed control information, contact one of the groups listed on the back of this brochure.
- **Avoid Spreading Knotweed.** Be careful working around it as small fragments can get into machinery, dirt piles or the river and be moved to other areas.
- **Volunteer** with your local control program.

** Free knotweed control is currently available in the Sandy and Clackamas watersheds, and Lincoln and Grant counties.*

HOW CAN IT BE CONTROLLED?

Several treatment options are described here. Because of knotweed's tremendous ability to resprout following cutting, successful control usually requires herbicides. Please check with your local extension agent, weed board or the Department of Agriculture for information about the proper, safe and legal use of herbicides.

- **SPRAY HERBICIDE** containing glyphosate (e.g., Rodeo, Aquamaster, Roundup, Gly Star) on the leaves and stems in summer or early fall. To avoid spraying very tall plants, cut the stems once in May or June and allow the plant to regrow to about waist height. Most patches require more than one year of treatment.

Always read and follow directions on the product label and keep herbicides out of waterways. Desirable plants hit with spray will be injured or killed.

- **NON-SPRAY HERBICIDE METHODS** include injecting undiluted herbicide directly into the lower sections of every stem* or applying slightly diluted herbicide directly onto freshly cut stems.

**Please note: This promising new treatment is not yet legal in Oregon without special permit.*

- **MANUALLY PULL** or **DIG** surface roots of plants in loose soil. Check often for new sprouts and repeat. Or, **CUT** the stems close to the ground every two weeks throughout the growing season. Both methods will require several years of persistent treatment for successful control.

Cut stems or root fragments left on moist soil, in the river or in compost will regrow. Please dry or carefully dispose of all knotweed material.

Figure 6.3 Knotweed Wanted Poster

WANTED

FOR DESTRUCTION OF WATERSHEDS & WILDLIFE HABITAT

JAPANESE & GIANT KNOTWEED

Aliases: Mexican or Japanese bamboo, fleeceflower

DESCRIPTION

-Thick green to reddish stems that look similar to bamboo
-Large bright green leaves ranging from egg to heart-shaped with a pointed tip
-Sprouts in April, grows to 15 feet tall or more by July
-Spikes of white flowers appear from July to September.
-Seen in flood zones along rivers and creeks, also frequents ditches and yards

CAUTION

Considered *extremely invasive*. Knotweed usually spreads when roots are moved and often travels by waterways. Tiny root fragments can produce new plants.

REWARD FOR ERADICATION

Figure 6.4: Landowner Contact Form

Waterway Ref #
Watershed

Private Land Knotweed Contact Form

Property Owner(s):	
Home Phone #	Daytime Phone #:
Email:	
Site Address:	Contact Address:
Date of first contact:	Method: Personal Left Info Mail Phone
Date of survey:	Knotweed on Property: Yes No

Directions:

Map of Site/Knotweed Location/Notes:

Recorded by:	Data Entry Date: INT:

Public Events
The Sandy River Riparian Habitat Protection Project shares its model for controlling a knotweed infestation on a watershed scale with other agencies and organizations by giving talks and participating in meetings. Any person, agency or organization interested in using materials developed by The Nature Conservancy may request brochures, posters and a CD with electronic formats to adapt to their local area. These materials are provided at no cost for small quantities and for a small fee for larger quantities. Additionally, we share knowledge and equipment resources with individuals who are interested in treating knotweed on their properties outside our project area.

The Nature Conservancy started the Knotweed Working Group (KWG) and continues to facilitate semi-annual meetings to discuss knotweed programs and share results. The KWG is comprised of individuals, agencies and concerned organizations from Western Oregon and Southwest Washington.

Results

Landowner Outreach
In 2006, 269 landowners were contacted and we received formal permission from 89. This brings the total cooperating landowners, for the years 2001 to 2006, to 446. We now have permission to treat knotweed on 645 individual private tax lots within the floodplain of the Sandy River (Table 6.0). As permission forms are valid for only three years, we renewed permission for 25 landowners in 2006.

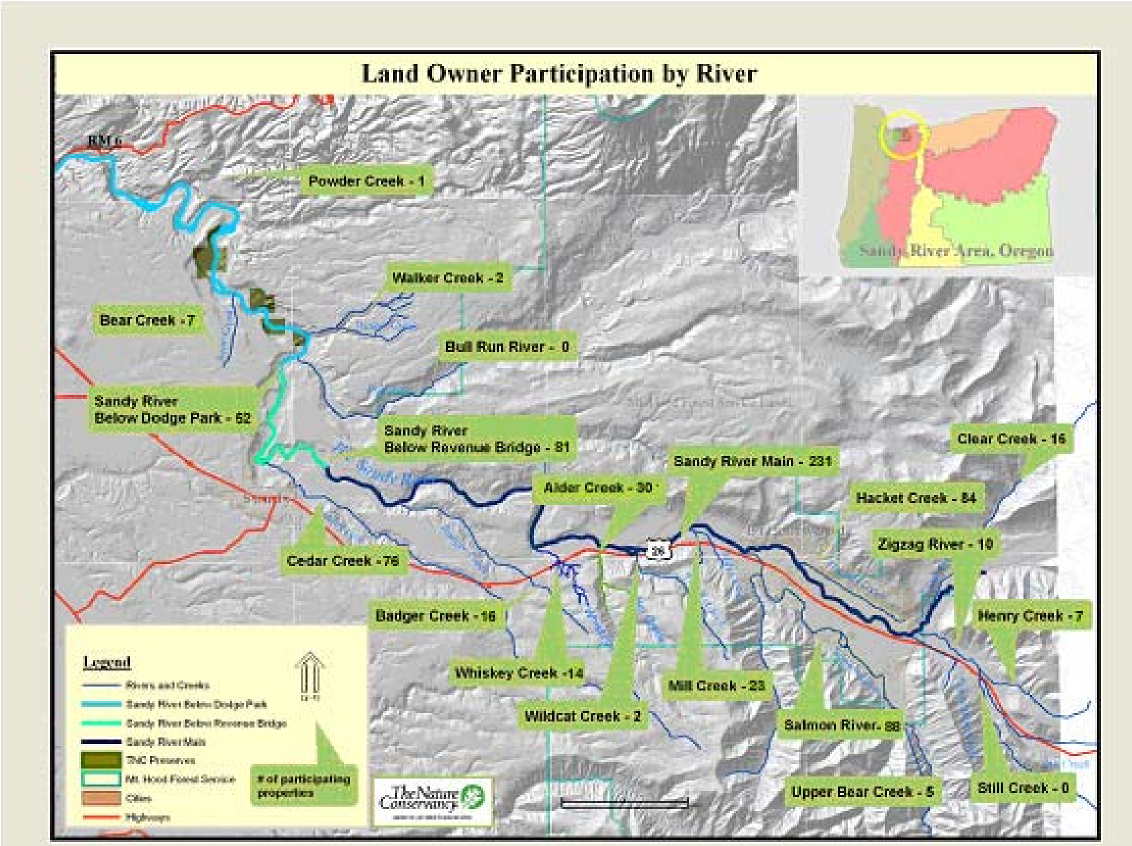
Table 6.0 Private Landowner Permission Received

Status	Contacted 2006	Received Permission 2006	Total Received Permission 2001 – 2006
Tax lots	327	102	645
Landowners	269	89	446

Public Events

In 2006, we presented information and lessons learned from our knotweed control work at five public events, including a Sandy River Basin Watershed Council meeting, a workshop on Invasive Plants for private landowners in the Sandy River Basin, the University of Washington's Invasive Plant Species in the Pacific Northwest Conference, the Oregon Whitewater Association, and the Children's Clean Water Festival. In total, our presentations reached over 500 people. In 2006, The Nature Conservancy facilitated two knotweed working group meetings which were attended by over 30 individuals. We distributed over 4,500 brochures and 10 posters at cost to more than eight different organizations and knotweed programs.

Map 6.1 Landowner Participation by River



Discussion

Landowner Outreach

The SRRHPP's outreach efforts on the Sandy River and its tributaries have been highly successful. In this year alone we increased the total number of properties for which we have permission to treat knotweed by 16 percent. We have now surveyed and received permission to treat property on every relevant tributary within the watershed (Map 6.1). The outreach campaign throughout the 2006 season involved over 800 hours of working door-to-door to inform landowners of the project and to ask them for permission to survey and control any knotweed found.

The number of landowners and tax lots we received permission from does not completely reflect the entire scope of our outreach effort. There were many landowners we contacted who were supportive of the project but had no knotweed on their properties. Many of these people allowed us to survey, but declined to sign a written landowner agreement form. Some landowners we contacted were aware of the knotweed infestation and supportive of our control efforts but preferred to manage infestations on their own and therefore decided not to sign the permission form.

Less than 10 properties remain that have known knotweed infestations, but permission to survey/treat has not been obtained. Those properties will be a high priority for our outreach efforts in 2007. Landowner outreach in 2007 will focus on maintaining positive working relationships with cooperating landowners as well as working with landowners to address new or existing invasive plant infestations.

Public Events

Public speaking events increased awareness about the importance of controlling knotweed. The Nature Conservancy has taken a leadership role as a regional provider of data and guidance on control methods and project structure. Facilitation of the knotweed working group helps to motivate and enhance action in watersheds throughout Oregon and southwest Washington. This year we provided support to many programs, including the Clackamas River Basin Council, Johnson Creek Watershed Council, Friends of Trees, and the Wetlands Conservancy as they began new knotweed control programs. We offered these groups information and educational resources, knotweed injection training, and the experience of joining us in the field for a treatment day. We plan to continue working in cooperation with other agencies, organizations, private citizens, schools, and the general public to successfully achieve our goals of controlling knotweed within the Sandy River Watershed and of leveraging public support of invasive species control efforts.

Section 7. Use of Volunteers, Youth Crews and Education-Based Outreach

Introduction

To effectively control invasive species, awareness needs to be raised about the threat they pose not only among government and private sector professionals, but with the general public as well. Community-wide education and outreach are essential to the long-term control of invasive plants and animals. Unless community members are fully aware of the threat posed by noxious weeds, they are unlikely to modify their selection of landscaping plants, participate in volunteer events, or support public funding for control programs. Because funding for invasive species control is scarce, it is necessary to develop low-cost methods of removal and public education. Volunteer participation gives us both a cost-effective means of completing necessary field work and an effective communication and outreach tool.

During the 2006 season, we involved community volunteers, interns and youth crews (AmeriCorps, alternative education service learning groups, and others) in our program to achieve these ends.

Methods

Because our outreach and education efforts bring us into contact with thousands of people each year, we have been able to recruit dozens of dedicated volunteers and youth crews. This year, we attended festivals, fairs, knotweed symposiums and working groups. We publicized our volunteer program through our website, newsletter, e-mail contact lists, and other volunteer list-serves and organizations. We contacted and sent information to colleges, schools, service-learning organizations and camps. These efforts created a diverse volunteer network that accomplished an important part of this season's field work. This network of informed and committed individuals forms the base of our community outreach program, and helps us not only to reach our immediate goals of invasive removal, but also to educate and involve others in their communities.

Our volunteer network purposefully includes people of different ages, abilities, and educational backgrounds. For highly dedicated individuals we set up an adopt-a-plot program that allows the individual to work on his/her own to restore a small section of the river. For members of the community with less free time, we organized regular work parties in highly impacted priority sites. We also took on interns, fee-for-service and volunteer youth crews, and a full-time, three-person AmeriCorps crew.

In keeping with our commitment to public education, we incorporate a service-learning component into every volunteer activity. As a rule, the service-learning component addresses the ecology of the work site and the Sandy River, and often includes practical lessons such as the effects of herbicide or how to set up photo-monitoring sites.

Results

Throughout 2006, we recruited and worked with 90 volunteers whose contribution totaled over 4,800 hours (Table 7.0). Because volunteers serving with our knotweed control program require considerable supervision and training from Conservancy staff, we focused our attention on those who were willing to make a long-term commitment to the project. Foremost among these were our three year-long AmeriCorps Northwest Service Academy members. These highly trained individuals worked full time and provided more than 3,000 hours of service. Because of the length of their tenure, they were able to assume leadership roles, work independently, and perform many of the functions of Conservancy staff. To supplement the full-time knotweed control staff, we brought on six volunteer interns who worked at least once a week during the field season and in total contributed more than 400 hours of work (equal to a full-time seasonal position for ten weeks). Additionally, our work parties and adopt-a-plot programs included more than 20 volunteers who contributed nearly 500 hours of work on our Sandy River preserves. One dedicated volunteer contributed over 330 hours of volunteer service to the Sandy River!

Table 7.0 Volunteer Contributions by Category, 2006

Volunteer Contributions by Category		
Volunteer Category	Number of Individuals	Hours Contributed
NWSA AmeriCorps	3	3262
Knotweed Interns	6	248
Work Parties	14	123
Adopt-a-Plot	8	366
Volunteer Youth Crews	22	132
Fee-For-Service Crews	37	519
Totals	90	4814

This season, we created or maintained partnerships with several education-based youth organizations including: AmeriCorps, Northwest Service Academy, Project YESS, Alpha High School, and the Multnomah Youth Cooperative. These groups provided over 50 volunteers who put in over 600 hours of work and cleared more than one acre of invasive species from the Sandy River riparian habitats.

Included in all parts of our volunteer program were learning opportunities designed to increase interest in both conservation and invasive weed management. Such service learning consistently increased the motivation, interest, and work ethic of our volunteers. Additionally, it served as a means for the proliferation of knowledge about invasive weeds and conservation in general.

Discussion

Our volunteers vastly increased both the scope and effectiveness of our knotweed control program while simultaneously stretching project dollars. At a conservative estimate of $10/hour for the average person, volunteers contributed $48,140 worth of labor to our project. This equals approximately 20 percent of the project's annual budget. Volunteer efforts allowed us to reach more sites, to survey more land, and to perform more invasive weed removal than we would have otherwise been able to accomplish. Because we worked with many dedicated long-term volunteers, we could empower individuals and groups to work independently of staff supervision. This allowed us to work on several projects simultaneously and to be more efficient in the field.

By combining volunteer events with education we were able to communicate the threat posed by invasive species to a large and diverse audience. As a result of such service-based learning, our volunteers were more motivated, became more efficient workers, and were better informed about ecological issues. While stretching funding and increasing the efficacy of the knotweed control program, our volunteers will serve as the future spokespeople for invasive species management and conservation.

Section 8. Restoration Plantings

Since November of 2005, The Nature Conservancy has performed restoration plantings in 8 locations throughout the watershed, effectively re-vegetating over 1,600 square meters of riparian area with over 700 native plants. All of our restoration plantings have been conducted at former knotweed infestation sites. In these areas, the knotweed has either been completely eradicated or has been reduced to a level requiring only occasional spot-spraying or manual removal for effective control.

Restoration plantings have been conducted on properties owned by the Bureau of Land Management, Clackamas County, and six private property owners. These sites are distributed throughout the watershed on Bear Creek, Cedar Creek, Hackett Creek, Mill Creek, the Sandy River, the Salmon River, and at the confluence of the Sandy and Salmon Rivers. Every effort is made to use local plant stock that is appropriate to the site. To determine which species of plants to use, we consider landowner preference and use, which species are already present in the area, and the local hydrology and soil type.

Because inappropriate selection of sites for restoration planting leads to wasted time, money and resources, The Nature Conservancy developed the following key for selecting restoration sites on the Sandy River:

1. Does the landowner desire replanting at the site?
Yes, go to 2.
No, do not replant.

2. Is the knotweed infestation eradicated or at such a low level that it can be spot-sprayed or manually removed without risk to surrounding vegetation?
Yes, go to 3.
No, do not replant.

3. Will the soil type and substrate allow for reasonably easy replanting?
Yes, go to 3.
No, do not replant.

4. Is the site surrounded primarily by other aggressive and invasive plants that are unrealistic to remove?
No, go to 5.
Yes, do not replant.

5. Can the site re-vegetate naturally and without replanting? Surrounding vegetation and the size of the site should be considered when answering this question.
No, go to 6.
Yes, do not replant.

6. Is the site accessible by vehicle and/or is transportation of plants to the site safe and manageable?
Yes, REPLANT.
No, do not replant.

Section 9. Conclusion

In 2006, the SRRHPP had six major accomplishments:

1. We completed an inventory of the knotweed infestations within the entire watershed. This will allow us to focus future efforts on control work and will free up nearly 15 percent more time for restoration and control efforts.

2. We completed landowner outreach efforts to the greatest degree possible. In 2006, for the first time, we were able to survey and treat along nearly all of the riparian areas in the watershed. Only a small handful of landowners have refused to cooperate with the project or have been non-responsive. Future outreach efforts will be conducted on a case-by-case basis when landowners change or new patches of knotweed are suspected. We will continue to work with cooperating landowners to address knotweed infestations as well as other invasive species of concern. Near completion of the landowner outreach efforts means not only that access to properties is secured, but that landowners throughout the watershed are aware of the threat of invasive species. This will facilitate location and treatment of future knotweed patches and other invasive species infestations.

3. Efforts to educate the public about the threat of knotweed and invasive plants in general are paying off. Many newly discovered knotweed patches are being brought to our attention by private landowners with whom we have talked in the past. Programs designed to control riparian weeds, and knotweed in particular, are popping up around the region. Our presentations, reports, and guidance are helping to inform an increasingly large community of land managers throughout the region. Our ability to provide professional-grade outreach materials allows other programs to have access to better, less expensive products to assist their efforts. The Nature Conservancy's regional leadership is facilitating the creation of well informed, successful control programs around the Northwest.

4. One half of the knotweed patches within the watershed had no visible regrowth this year. The level of the knotweed infestation in the watershed has been significantly reduced. The knotweed that remains is typically small and scattered. This means that in the future we will use far less herbicide than in the past. Treatment of remaining patches will require less time and fewer return visits. While we will need to resurvey the entire watershed to relocate and treat all remaining patches, significant time will be saved applying treatments themselves.

5. Initial and large-scale treatment of other invasive weeds in previously identified high-priority sites throughout the watershed has been accomplished. Ongoing efforts will be required to maintain the work that we've accomplished, but those efforts will be smaller and much less intensive than in the past.

6. We have begun restoration of sites previously dominated by knotweed. Replanting efforts will continue into the foreseeable future as more and more knotweed patches are eradicated. One surprising and positive result is that the majority of former knotweed sites are naturally re-vegetating themselves with native plants. This means that in many areas, our herbicide treatments are not prohibiting reintroduction of native plant species.

These accomplishments do not spell an end to the work of the SRRHPP. We must discover new techniques that will allow us to fully eradicate the most resilient knotweed patches. We also must arrive at a greater understanding of knotweed's rhizome network. More importantly, we must begin to look at invasive plants on a watershed scale. With less time being necessary for the surveying and outreach portions of our knotweed control efforts, we will begin to inventory and treat small infestations of other invasive plants. To accomplish this goal, in 2007 we will initiate an early detection/rapid response program using volunteers and landowners to locate and report new potential invasions of non-native plants. By taking advantage of the incredible community cooperation and support that have been created by this program, we can stop new invasions before they become large problems thereby ensuring the long-term health of the Sandy Basin's riparian areas.