Sandy River Riparian Habitat Protection Project Report 2008

Jonathan Soll – Project Manager
Doug Kreuzer – Portland Preserves Land Steward
Jason Dumont – Portland Preserves Manager
Ian Matthews – Ecological Monitoring Specialist
Merrit Hoeh – Access and Outreach Specialist
Acknowledgements

We extend our heartfelt thanks to the many people and organizations that contributed to the success of the Sandy River Riparian Habitat Protection Project (SRRHPP) this year. For funding support we thank the Bureau of Land Management (BLM), Metro’s Nature in Neighborhoods Program, the Oregon Department of Fish and Wildlife Landowner Incentive Program, the Oregon Watershed Enhancement Board, the Oregon Department of Agriculture Weed Board, the United States Fish and Wildlife Service, Portland General Electric, the United States Forest Service. For in-kind support we thank the Clackamas Education Corps, East Multnomah Soil and Water Conservation District, Metro Parks and Greenspaces Program, the Multnomah Youth Corps, the Northwest Service Academy, Portland General Electric, Project YESS, and the Sandy River Basin Watershed Council. Special thanks go to the hundreds of private landowners who share our commitment to protecting the Sandy by allowing access to their property or by stewarding their own land.

The following individuals contributed their labor to the field and outreach effort. From Metro Parks and Greenspaces: Angie Kimpo and Chris Hagel. From The Nature Conservancy: Jason Dumont, Julie Flusche, Susan Garland, Merrit Hoeh, Joseph Karasek, Nadeem Kazmi, Doug Kreuzer, Ian Matthews, Daniel Miller, and Ian Shelledy.

Special thanks go to Julie DiLeone and Lucas Nipp from East Multnomah Soil and Water Conservation District (EMSWCD) who conducted knotweed outreach, surveys, and treatments on Beaver Creek this year and who have also taken leadership of a large-scale garlic mustard containment project.

Thank you all.
Methods ..................................................................................................................................... 45
Results ....................................................................................................................................... 46
Discussion ................................................................................................................................. 46

Section 7: Volunteers, Youth Crews, and Education-based Outreach .................................. 47
Introduction ............................................................................................................................... 47
Methods ..................................................................................................................................... 47
Results ....................................................................................................................................... 47
Discussion ................................................................................................................................. 48

Section 8. Conclusion .................................................................................................................. 49

Figures
Figure 2.0. Total Area of Knotweed Infestations Tracked from 2005 to 2008 ......................... 7
Figure 2.1 Stem Counts for Sites Treated in Both 2007 and 2008 ........................................ 12
Figure 2.2 Photoseries of Excavated 5ml + Spray Site that had No Stems Present in 2007 .... 16
Figure 2.3 Excavated Rhizome with Deformed Growth ...................................................... 16
Figure 2.4 Percent of Previously Treated Microsites with Deformed Growth since 2004 ...... 17
Figure 2.5 Japanese Knotweed Landscape Experiment Photo-monitoring Series BR05 .... 19
Figure 2.6 Japanese Knotweed Landscape Experiment Photo-monitoring Series MC43A .... 20
Figure 2.7 Japanese Knotweed Landscape Experiment Photo-monitoring Series SM105I .... 21
Figure 4.0. Dabney State Park Restoration Site 2 Before Treatment ........................................ 35
Figure 4.1 Dabney State Park Restoration Site 2 After Treatment .............................................. 35
Figure 4.2 Dabney State Park Restoration Site 3 Before Treatment ........................................... 36
Figure 4.3 Dabney State Park Restoration Site 3B After Treatment ........................................... 36
Figure 5.0 Contractors Conduct Manual Garlic Mustard Removal Along the Sandy River .... 40
Figure 5.1 Dabney State Park Garlic Mustard Site Before Treatment ........................................ 42
Figure 5.2 Dabney State Park Garlic Mustard Site After Treatment ......................................... 42

Tables
Table 2.0 2008 Field Season Summary Points .......................................................................... 4
Table 2.1 Property Ownership of Knotweed Microsites in the Sandy River Watershed .......... 7
Table 2.2 Status of 2008 Knotweed Treatments by River Stretch or Tributary ....................... 11
Table 2.3 Summary of all Sites Treated and Visited in 2008 ...................................................... 12
Table 2.4 Comparing Efficacy of Initial Treatment Method in Reducing Stem Count .......... 14
Table 2.5 Number of Sites with No New Stems (NNS) that had No Subsequent Re-growth .... 15
Table 2.6 2006 Excavation Sites Group Comparison ................................................................. 18
Table 2.7 2007 Excavation Sites Group Comparison ................................................................. 18
Table 3.0. Invasive Species Survey Datasheet ........................................................................ 24
Table 3.1. Results from 2007-2008 Invasive Species Surveys .................................................. 27
Table 3.2 Sandy Basin Invasive Plant Species Threat Score ...................................................... 28
Table 6.0: Private Landowner Permission Received for Knotweed and Invasive Surveys .... 46
Table 7.0: 2008 Volunteer Contribution to SRRHPP ................................................................. 47

Maps
Map 2.0 Knotweed Locations and Stem Counts in the Sandy River Basin for 2008 .......... 9
Map 3.0 English Ivy Infestations in the Sandy River (2007-2008) ....................................... 29
Map 3.1 English Holly Infestations in the Sandy River (2007-2008) .................................... 30
Map 3.2 Traveler’s Joy Infestations in the Sandy River (2007-2008) ..................................... 31
Map 3.3 Sandy Basin Invasive Species Threat Assessments (2007-2008) ......................... 32
Map 5.0 Garlic Mustard Locations in the Sandy Basin and Columbia Gorge (2008) .......... 43
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 cuspidatum* and *P. sachalinense*), with localized efforts on Scots broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*) and English holly (*Ilex aquifolium*). However, increasing attention has been given to traveler’s joy (*Clematis vitalba*), butterfly bush (*Buddleja davidii*), English ivy (*Hedera helix*), garlic mustard (*Alliaria petiolata*), periwinkle (*Vinca minor* and *V. major*), bouncing bet (*Saponaria officinalis*), pale yellow iris (*Iris pseudacorus*) and early detection of other invasive species. Follow-up restoration plantings have occurred at selected riparian sites. The strengths of this program lie in its ability to apply sound science and monitoring to weed control efforts and to build consensus and cooperation between landowners and stakeholders throughout the watershed. The SRRHPP is achieving successful and measurable conservation action 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 (325,000 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 three listed as threatened under the federal Endangered Species Act: Chinook salmon, coho salmon and winter steelhead. Two major sections of the Sandy River are federally designated as Wild and Scenic and one section is designated 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 investors’ 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 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 among 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, including The Nature Conservancy.

Protection of riparian habitat and function is critical for the long-term health of the basin’s aquatic ecosystem and much of its wildlife. Riparian habitat is vital to up to 90% 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, garlic mustard 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.

Project Products and Past Reports

For more information about past reports or project products, please see http://tncweeds.ucdavis.edu/esadocs/polycusp.html.
Section 2. Landscape Knotweed Control Efforts

Introduction

Knotweed’s Threat To Riparian Ecosystems
Capable of forming dense monocultures and permanently displacing native species in riparian and flood plain habitats, knotweed represents a major threat to the function of riparian areas and floodplains throughout the Pacific Northwest. Please refer to our SRRHPP Report 2007 available at http://tncinvasives.ucdavis.edu/esadocs/polycusp.html for an expanded narrative on knotweed’s threat.

Summary of 2008 Sandy River Knotweed Project Field Season
For the last eight years, the 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. For a year-by-year description of the project’s field season evolution, please refer to our SRRHPP Report 2007 available at http://tncinvasives.ucdavis.edu/esadocs/polycusp.html.

With the addition of work in the lower 3 mile stretch of Still Creek on USFS land, we have now surveyed and treated all riparian knotweed infestations on the main stem Sandy from river mile 2 through 44 (the highest known knotweed location on the main-stem of the river) and all major tributaries in the watershed. Landowner outreach, surveys and/or treatments were performed on Alder Creek, Badger Creek, Beaver Creek (conducted by EMSWCD), Big Creek, Boulder Creek, the Bull Run River, Cedar Creek, Clear Creek, Hackett Creek, Henry Creek, Lower Bear Creek, Pounder Creek, the Salmon River, Smith Creek, Still Creek, Upper Bear Creek, Walker Creek, Whiskey Creek, Wildcat Creek, and the Zig Zag River.

In 2008, we chose to forgo visiting knotweed sites in an 18 river mile reach of the main stem Sandy (from Revenue bridge [RM24] to Camp Angelos [RM7]) that we had treated for more than 5 years. Since much of the remaining knotweed was small and deformed, this decision will hopefully result in more easy to locate, treatable knotweed patches when we return to these sites in the 2009 field season. Table 2.0 presents a summary of our knotweed related work conducted in the 2008 field season.

Table 2.0 2008 Field Season Summary Points

<p>| Project structure | 2 fulltime TNC staff, 2 person AmeriCorps team (January – December), 2 short-term AmeriCorps LINKS members and volunteer interns. |
| Treatment methods employed | Foliar imazpyr (1 or 1.5%) |
| | Foliar glyphosate (5%) |
| | Stem injection (3ml glyphosate) w/ foliar as above. |
| | Manual digging of rhizomes |
| Number of new microsites established | 25 |
| Number of patches treated | 2,246 |
| Number of stems treated | 28,566 |</p>
<table>
<thead>
<tr>
<th>Number of previously treated sites with No New Stems (NNS)</th>
<th>138</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall percent reduction in number of stems for all sites from 2001 to 2008</td>
<td>89.6%</td>
</tr>
<tr>
<td>River stretch treatment work</td>
<td>Sandy River (RM 2 – 7, RM 24 - 43), Cedar Creek, Salmon River, Smith Creek, Pounder Creek, Hackett Creek, Bear Creek, Alder Creek, Henry Creek, Mill Creek, Badger Creek, Lower Bear Creek, Upper Bear Creek, Walker Creek, Whiskey Creek, Wildcat Creek, Zigzag River, Big Creek, Still Creek</td>
</tr>
<tr>
<td>River stretch outreach &amp; survey work</td>
<td>Sandy River (RM 2 – 7, RM 24 - 43), Alder Creek, Boulder Creek, Cedar Creek, Clear Creek, Salmon River, Smith Creek, Pounder Creek, Hackett Creek, Henry Creek, Mill Creek, Badger Creek, Still Creek, Lower Bear Creek, Upper Bear Creek, Walker Creek, Whiskey Creek, Wildcat Creek, Zigzag River, Big Creek</td>
</tr>
<tr>
<td>River stretch with no treatments in 2008</td>
<td>Sandy River (RM 7 – 24)</td>
</tr>
</tbody>
</table>

**Methods**

*Field Access*

Surveys took place from rafts, inflatable kayaks and by foot. We targeted floodplains, flood channels, debris piles and backwaters for the most intensive surveys on land. Newly identified knotweed sites were numbered, flagged and mapped onto aerial photographs by using a GPS unit.

*Monitoring and Terminology*

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 (often abbreviated as “site”) 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 (nearly 7,000 patches have been identified through the 2008 field season). The location of each knotweed site is recorded using an integrated GPS - Personal Digital Assistant (PDA), and aerial photograph when applicable. Sites are numbered with a two-number code, macrosite-microsite (i.e. 20-01) in sequential order based on discovery within a given macrosite. 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 m² area, or 80 patches on a distinct floodplain with a total of 900 shoots in a 1000 m² gross area. Starting in the 2005 field season, we have recorded the infested area of each knotweed site, defined as the area of land occupied by the knotweed canopy.

Each site is identified by plastic flagging with the date and plot identification number. A GPS point is collected at each microsite when it is first established or inserted on-the-fly on a GIS layer utilizing spatial reference data. 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. 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 visit is any time data is collected at a microsite and almost always coincides with a treatment.

**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, or manual digging.

We have altered our treatment protocol annually in response to monitoring data and research and have intentionally used multiple treatments in some years to compare 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.

**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 either 1.5-gallon hand carried chemical spray units or backpack sprayers.

In 2007, new research suggested that imazapyr was as effective on knotweed, was safe for use near water, and would not yield as much deformed regrowth as other herbicides. As a result, the primary herbicide formulation used in 2007 and 2008 field seasons included 1% or 1.5 % v/v imazapyr with 1 % v/v R-11 or LI700 surfactant. Throughout the project, only glyphosate has been used on BLM lands in accordance with a site specific EIS.

**Herbicide Injection or Integrated Approaches**

We have used stem injection or a combined technique of stem injection of large diameter stems and foliar spray of small diameter stems extensively throughout the SRW. (Refer to past reports for more details). 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). An injection tool gun manufactured by JK International was used to conduct this treatment.

In 2008, to save time, reduce herbicide load and minimize deformed knotweed regrowth in follow-up visits, we primarily used foliar treatment rather than the injection method.

**Digging and Rhizome Extraction**

Since 2006, select knotweed patches have been picked for hand-digging stems and rhizomes. Great care is used in extracting as much plant matter as possible. Field conditions allowing, we remove the debris from the site. Dig areas are often inland sites with little risk of flood displacement. The goal of digging is to diminish root biomass and increase the stem to root ratio, allowing a more effective follow-up herbicide treatment for any new stems.
Results

Watershed-wide results
From 2001 through 2008, surveys of the Sandy River watershed have identified 833 microsites containing nearly 7,000 knotweed patches. Over this eight year period, our treatment area has encompassed more than 120 river and creek miles. Approximately 64% of microsites and patches, and 74% of stems, occur on private land (Table 2.1).

Table 2.1 Property Ownership of Knotweed Microsites in the Sandy River Watershed

<table>
<thead>
<tr>
<th></th>
<th>Public Lands</th>
<th>Private Lands</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of microsites</td>
<td>296</td>
<td>537</td>
<td>833</td>
</tr>
<tr>
<td>Number of initial knotweed patches</td>
<td>2,565</td>
<td>4,404</td>
<td>6,969</td>
</tr>
<tr>
<td>Number of initial knotweed stems</td>
<td>57,578</td>
<td>160,507</td>
<td>218,085</td>
</tr>
</tbody>
</table>

The highest point on the watershed known to have a knotweed infestation lies within the Still Creek drainage, an important salmon-bearing tributary near the town of Rhododendron. (Map 2.0 plots locations of infestations with 2008 stem counts).

Figure 2.0. Total Area of Knotweed Infestations Tracked from 2005 to 2008

In 2008, we chose to focus our knotweed efforts on the mid to upper main stem Sandy, all tributaries and any new treatment areas added in the last 2 years, while forgoing visits to knotweed sites in the 18 river mile reach of the main stem Sandy River that we had treated for more than 5 years. Our team conducted intensive surveys on over 300 acres of land along the shorelines and floodplains of the Sandy Watershed during the 2008 field season. Since we began recording infested area for each knotweed site in 2005, the overall infested area of knotweed sites in the watershed has declined every year at previously treated sites.
We found previously treated knotweed infestations in 2008 covered a total of 1241 m², or only 0.31 acres – 6% of the values observed in 2005 (19,976 m²; 5 acres) (Figure 2.0). Furthermore, we treated an additional 4,770 m² or 1.2 acres of infested knotweed area at new sites in 2008: these new sites, about half located along Still Creek, account for 80% of the infested area treated in 2008. Between 2007 and 2008, the total number of stems treated decreased by 46.5% at sites visited in both years (Figure 2.1).
Map 2.0
Knotweed Locations and Stem Counts in the Sandy River Basin for 2008

Table 2.2 Status of 2008 Knotweed Treatments by River Stretch or Tributary

<table>
<thead>
<tr>
<th>River Stretch or Tributary within the Sandy River Watershed</th>
<th>Number of Microsites Treated in 2008</th>
<th>Total Infested Area (m²) in 2008</th>
<th>Number of Patches Treated in 2008</th>
<th>Number of Stems Treated in 2008</th>
<th>Overall Stem Reduction since Initial Visit</th>
<th>Average Number of Visits per Site 2001-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy RM* 2 - 7</td>
<td>25</td>
<td>4,175</td>
<td>193</td>
<td>9,824</td>
<td>76.5%</td>
<td>2.6</td>
</tr>
<tr>
<td>Sandy RM 24 - 29</td>
<td>45</td>
<td>53</td>
<td>139</td>
<td>632</td>
<td>92.0%</td>
<td>5</td>
</tr>
<tr>
<td>Sandy RM 29 - 38</td>
<td>77</td>
<td>101</td>
<td>314</td>
<td>1,243</td>
<td>95.4%</td>
<td>5.6</td>
</tr>
<tr>
<td>Sandy RM 38 - 44</td>
<td>15</td>
<td>13</td>
<td>28</td>
<td>186</td>
<td>96.8%</td>
<td>4.6</td>
</tr>
<tr>
<td>Alder Creek</td>
<td>5</td>
<td>4.6</td>
<td>7</td>
<td>73</td>
<td>86.7%</td>
<td>4.2</td>
</tr>
<tr>
<td>Badger Creek</td>
<td>3</td>
<td>1.5</td>
<td>3</td>
<td>22</td>
<td>75.3%</td>
<td>4.6</td>
</tr>
<tr>
<td>Lower Bear Creek</td>
<td>7</td>
<td>21</td>
<td>45</td>
<td>487</td>
<td>98.1%</td>
<td>5.1</td>
</tr>
<tr>
<td>Cedar Creek</td>
<td>40</td>
<td>359</td>
<td>295</td>
<td>3,140</td>
<td>80.5%</td>
<td>5.6</td>
</tr>
<tr>
<td>Hackett Creek</td>
<td>35</td>
<td>10</td>
<td>39</td>
<td>100</td>
<td>97.0%</td>
<td>4.8</td>
</tr>
<tr>
<td>Henry Creek</td>
<td>2</td>
<td>7.5</td>
<td>11</td>
<td>58</td>
<td>77.8%</td>
<td>6</td>
</tr>
<tr>
<td>Mill Creek</td>
<td>16</td>
<td>160</td>
<td>209</td>
<td>2,129</td>
<td>90.0%</td>
<td>4.8</td>
</tr>
<tr>
<td>Smith Creek</td>
<td>3</td>
<td>22</td>
<td>4</td>
<td>520</td>
<td>86.0%</td>
<td>1.6</td>
</tr>
<tr>
<td>Big Creek</td>
<td>2</td>
<td>7.5</td>
<td>2</td>
<td>73</td>
<td>79.3%</td>
<td>2</td>
</tr>
<tr>
<td>Upper Bear Creek</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>96.1%</td>
<td>5</td>
</tr>
<tr>
<td>Walker Creek</td>
<td>6</td>
<td>26</td>
<td>86</td>
<td>583</td>
<td>87.1%</td>
<td>5.3</td>
</tr>
<tr>
<td>Whiskey Creek</td>
<td>6</td>
<td>16</td>
<td>17</td>
<td>223</td>
<td>75.0%</td>
<td>3.8</td>
</tr>
<tr>
<td>Salmon River</td>
<td>73</td>
<td>301</td>
<td>505</td>
<td>2,240</td>
<td>92.5%</td>
<td>5.1</td>
</tr>
<tr>
<td>Zigzag River</td>
<td>7</td>
<td>8.2</td>
<td>8</td>
<td>87</td>
<td>91.8%</td>
<td>4.3</td>
</tr>
<tr>
<td>Still Creek</td>
<td>12</td>
<td>504</td>
<td>30</td>
<td>5059</td>
<td>NA</td>
<td>1</td>
</tr>
<tr>
<td>Non-riparian watershed sites</td>
<td>40</td>
<td>220</td>
<td>308</td>
<td>3,677</td>
<td>92.3%</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>Overall Totals</strong></td>
<td><strong>421</strong></td>
<td><strong>6,011 m²</strong></td>
<td><strong>2,246</strong></td>
<td><strong>28,566</strong></td>
<td><strong>89.6%</strong></td>
<td><strong>4.8</strong></td>
</tr>
</tbody>
</table>

*RM refers to river mile

The percentage of reduction in stem count compares the initial visit of a site to the most recent visit. (Table 2.2) Because the scope of the project has increased, the initial visit to a site could be in any year between 2001 and 2008, depending on when it was discovered. With the finalization of the USFS Mount Hood Region EIS in spring 2008, we were able to treat the known knotweed sites along the USFS Still Creek drainage for the first time. Through 2008, the entire Sandy River basin riparian area, including all of its rivers and tributaries, has been surveyed and/or treated by The Nature Conservancy with the exception of Beaver Creek which has been treated since 2007 by the EMSWCD.

Generally, the areas that have been visited and treated more often show a larger percentage of reduction in stem counts than those treated less often. The majority of 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 treated this year were found at sites discovered in the last three years on smaller tributaries or non-riparian sites.

![Bar chart showing stem counts for sites treated in both 2007 and 2008](image)

**Figure 2.1 Stem Counts for Sites Treated in Both 2007 and 2008**

For the 386 knotweed sites discovered prior to the 2008 treatment season and revisited in 2008, the stem count has declined from 133,692 stems at the first visit to 13,914 stems counted this year (Table 2.3). The overall number of stems for these sites has declined by 89.6%. 138 of these sites had no above-ground growth observed in 2008. Between 2007 and 2008, the total number of knotweed stems in the basin declined by 46.5% (Figure 2.1). 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 re-growth, or stems that were missed during treatment.

**Table 2.3 Summary of all Sites Treated and Visited in 2008**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial stem count for all sites visited prior to 2008</td>
<td>133,692</td>
</tr>
<tr>
<td>Overall % reduction in number of stems for all sites 2001 to 2008</td>
<td>89.6%</td>
</tr>
<tr>
<td>Stem count for sites treated in 2007</td>
<td>25,999</td>
</tr>
<tr>
<td>Number of sites revisited in 2008</td>
<td>386</td>
</tr>
<tr>
<td>Stem count for sites re-treated in 2008</td>
<td>13,914</td>
</tr>
<tr>
<td>Number of revisited sites without re-growth of new stems</td>
<td>138</td>
</tr>
<tr>
<td>2007 to 2008 % reduction in number of stems</td>
<td>46.5%</td>
</tr>
</tbody>
</table>
Landscape Level Comparison of Initial Treatments

Each year we have altered our treatment methodology to determine the most effective method for treating knotweed in riparian systems. Since 2001, we have monitored the effects of the initial treatment on new patches from year to year in order to determine which initial treatment results in the best long-term stem reduction. Because treatments change from year to year, the percent reduction from years 2 through 5 take into account all of the various treatments used since that site was first established (Table 2.4). 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. It is also important to note that new knotweed plants may have populated historical sites from year to year, influencing the data to project a smaller reduction than is actually the case.

Summary of stem reduction by initial treatment type shows reliable declines of at least 38% in the first year by every method, and up to 93% reduction in the 2007 group of sites (5 sites, 3,654 total stems) treated with 3ml glyphosate injection and supplemental 1.5% imazapyr foliar spray. Only treatment groups with at least 5 sites were compared. Differences between treatment efficacies for the same treatment regimes may be attributable to variability in growing seasons, size of the plant’s rhizome structure, date and weather conditions at time of treatment, and differences in technique by field personnel treating patches. Between 2003 and 2004, the stem injection tools changed from using wire pokers and veterinary syringes to sophisticated herbicide injection guns. This may have increased the effectiveness of the stem injection treatments. It is also important to consider that in the ‘inject plus foliar’ groups, the percentage stem reduction could be influenced by the number of stems injected versus sprayed, which varies, depending on patch size and size of stems within the patch. Though no discernable trends or differences were detected when we examined the efficacy of treatment timing across the 2007 treatment groups, the 3% foliar triclopyr treatment group exhibited the lowest reduction in stems after 1 year with all treatments performed between September to mid October.
Table 2.4 Comparing Efficacy of Initial Treatment Method in Reducing Stem Count

<table>
<thead>
<tr>
<th>Initial Treatment and Year</th>
<th>Sites</th>
<th>Initial Stems</th>
<th>% Reduction Year 1</th>
<th>% Reduction Year 2</th>
<th>% Reduction Year 3</th>
<th>% Reduction Year 4</th>
<th>% Reduction Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002 foliar (triclopyr 5%)</td>
<td>8</td>
<td>1,375</td>
<td>45.5%</td>
<td>40.9%</td>
<td>56.1%</td>
<td>53.2%</td>
<td>79.0%</td>
</tr>
<tr>
<td>2002 spring cut and fall foliar (glyphosate 3%)</td>
<td>23</td>
<td>10,367</td>
<td>63.4%</td>
<td>76.9%</td>
<td>84.3%</td>
<td>76.1%</td>
<td>91.8%</td>
</tr>
<tr>
<td>2003 3ml inject + foliar (glyphosate 5%)</td>
<td>24</td>
<td>6,991</td>
<td>66.0%</td>
<td>80.4%</td>
<td>82.9%</td>
<td>94.8%</td>
<td></td>
</tr>
<tr>
<td>2003 5ml inject + foliar (glyphosate 5%)</td>
<td>27</td>
<td>7,194</td>
<td>63.5%</td>
<td>77.4%</td>
<td>82.5%</td>
<td>83.9%</td>
<td></td>
</tr>
<tr>
<td>2003 5ml inject only</td>
<td>8</td>
<td>1,017</td>
<td>68.6%</td>
<td>86.7%</td>
<td>95.0%</td>
<td>97.1%</td>
<td></td>
</tr>
<tr>
<td>2004 5ml inject + foliar (glyphosate 8%)</td>
<td>127</td>
<td>28,422</td>
<td>77.0%</td>
<td>89.3%</td>
<td>92.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004 5ml inject only</td>
<td>22</td>
<td>9,704</td>
<td>68.8%</td>
<td>91.8%</td>
<td>86.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004 foliar (glyphosate 8%)</td>
<td>26</td>
<td>5,927</td>
<td>66.1%</td>
<td>77.7%</td>
<td>92.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005 5ml inject + foliar (glyphosate 8%)</td>
<td>14</td>
<td>5,120</td>
<td>81.7%</td>
<td>86.9%</td>
<td>91.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005 5ml inject + foliar (glyphosate 4% + triclopyr 1%)</td>
<td>35</td>
<td>14,488</td>
<td>73.5%</td>
<td>87.9%</td>
<td>89.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005 5ml inject only</td>
<td>7</td>
<td>4,453</td>
<td>77.3%</td>
<td>92.5%</td>
<td>92.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005 foliar (glyphosate 4% + triclopyr 1%)</td>
<td>5</td>
<td>439</td>
<td>44.0%</td>
<td>83.4%</td>
<td>97.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006 3ml inject + foliar (glyphosate 4% + imazapyr 1%)</td>
<td>7</td>
<td>1,950</td>
<td>82.4%</td>
<td>81.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006 3ml inject + foliar (glyphosate 8% + triclopyr 0.5%)</td>
<td>5</td>
<td>455</td>
<td>82.6%</td>
<td>87.7%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006 3ml inject only</td>
<td>6</td>
<td>4,372</td>
<td>82.5%</td>
<td>88.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007 foliar (imazapyr 1%)</td>
<td>6</td>
<td>213</td>
<td>77.9%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007 foliar (imazapyr 1.5%)</td>
<td>10</td>
<td>8698</td>
<td>68.1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007 foliar (triclopyr 3%)</td>
<td>5</td>
<td>932</td>
<td>38.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007 3ml inject + foliar (triclopyr 3%)</td>
<td>5</td>
<td>948</td>
<td>70.4%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007 3ml inject + foliar (imazapyr 1.5%)</td>
<td>5</td>
<td>3,654</td>
<td>93.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Patch Eradication and Reemergence**

When no knotweed stems are found at a site in a given year, we record “no new stems” (NNS) for the stem count. Of the 386 previously treated microsites, 138 (36 %) were NNS sites in 2008 (Table 2.5). Though the number of NNS sites has increased steadily since the beginning of the project, no microsite containing more than 573 stems at the initial visit has been observed with NNS through the end of the 2008 field season. The average number of stems recorded in the field season prior to the no new stems visit was 19.9 stems (stdev 32.5). On average, NNS sites have been treated for 2.32 years prior to the observed NNS visit.

<table>
<thead>
<tr>
<th>Total # microsites (visited in previous years)</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td># NNS Sites</td>
<td>0</td>
<td>23</td>
<td>53</td>
<td>81</td>
<td>111</td>
<td>138</td>
</tr>
<tr>
<td>Percent of sites with NNS</td>
<td>0%</td>
<td>19%</td>
<td>20%</td>
<td>25%</td>
<td>31%</td>
<td>36%</td>
</tr>
<tr>
<td># of NNS sites with re-emergence noted in a subsequent year</td>
<td>0</td>
<td>12</td>
<td>22</td>
<td>32</td>
<td>24</td>
<td>NA</td>
</tr>
<tr>
<td>Percent of NNS sites with re-emergence</td>
<td>0</td>
<td>52.2%</td>
<td>41.5%</td>
<td>39.5%</td>
<td>21.6%</td>
<td>NA</td>
</tr>
</tbody>
</table>

While 36 % of the previously treated sites appeared dead this year, experience shows that patches where we observe no above-ground stems can re-sprout one, two or even three years later. Since 2001, we have observed 5 sites from our data that had NNS for 3 consecutive years and then produced stems in the vicinity of the old patch. We call this behavior re-emergence. Of the 111 NNS sites recorded in 2007, 21.6 % were observed with reemergent stems in 2008. Because patches may not reemerge for two or more years, the percentage of reemergent sites increases 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 2.2).
Figure 2.2 Photoseries of Excavated 5ml + Spray Site that had No Stems Present in 2007. Above-ground root crown material appears dead (left photo). Digging five inches below main root crown reveals a connected 6 foot long, 1 inch diameter living rhizome (center photo). Broken excavated rhizomes expose the orange, fibrous living tissue (right photo).

**Deformed Growth**

Herbicide treatments, especially glyphosate treatments, are known to cause deformed above-ground growth (Figure 2.3, right photo). Deformed growth appears stunted and often lacks leaves or has small leaves without sufficient surface area for treatment with herbicides. Knotweed with deformed growth can be very small and difficult to recognize and locate. Patches displaying significantly deformed above-ground growth are not likely to be eradicated even after several herbicide treatments. Qualitative evidence indicates that if they re-sprout at all, NNS patches are likely to re-sprout with deformed growth.

Figure 2.3 Excavated Rhizome with Deformed Growth (left photo) and close up of deformed above-ground growth on treated patch (right photo).
In 2004, because the health and regrowth of previously treated patches seemed to be in significant decline, we began more closely monitoring the health of each microsite at each visit. Since 2004, the percentage of sites with varying degrees of deformed growth has ranged from roughly 15.6% to 34.5% of previously treated sites in a given year (Figure 2.4). On average, 26.1% (stdev= 5.6) of the sites visited in the last 5 years had deformed growth. It should be noted that the main treatments performed on the landscape in 2003 and 2004 involved glyphosate herbicide while treatments in 2006 and 2007 primarily involved imazapyr foliar treatments. The 2008 field season showed a 43% reduction in the percentage of sites observed with deformed growth (15.6%) when compared with the 2007 field season (27.2%). This may be due to the change in herbicide.

![Figure 2.4 Percent of Previously Treated Microsites with Deformed Growth since 2004](image)

Starting in 2006, to better understand the threats of deformed knotweed and reemergence, we began excavating roots in a subset of patches that displayed deformed growth or NNS. Some of the excavated patches contained more than several linear feet of living rhizome tissue (Figure 2.3, left photo). Often, the living tissue extended deeper into the ground than we were able to dig in the time allowed.

**Excavation Treatment Sites**

Because herbicide treatment of small, stunted and/or deformed knotweed is apparently not effective in destroying the plant’s extensive living underground tissue, we excavated the crown and associated rhizome structure (when possible) in the 2006 field season of a select group of 14 previously treated sites (Table 2.6). The intent with excavation was to remove a significant amount of the living tissue from the plant and to stimulate the remaining rhizome structure(s) to produce more stems and associated “normal” foliage for treatment in follow-up field seasons. An additional 17 previously treated sites were excavated in the 2007 field season (Table 2.7). As a reference for the excavation sites, we chose a subset of other deformed and/or stunted knotweed sites that were comparable in stem count, but were treated with foliar herbicide, rather than excavated, in that given year.
Overall, the total number of stems for the 2006 excavated sites dropped by 29.9% one year after treatment while the total stem count at the 2006 deformed and stunted sites treated with foliar herbicide increased by 3.6%. The remaining stems at both of these 2006 groups were then treated with foliar herbicide applications in the 2007 field season. In 2008, two years after the initial excavation treatments, the total number of stems for the 2006 excavated sites had dropped by 76.2% while the total stem count at the 2006 deformed and stunted sites treated with foliar herbicide had only dropped by 34.0%. The percentage change in stem total was more similar between the 2007 dig sites (decreased by 34.4%) and the 2007 deformed and stunted sites (decreased by 26.9%) one year after treatment.

The total infested area for the 2006 excavated sites decreased by 37.8% one year after treatment while the infested area at the 2006 deformed and stunted sites increased by 10.7%. Similar differences in the change in infested area were observed between the 2007 excavated sites and the 2007 deformed and stunted sites treated with herbicide (Table 2.7). In 2008, two years after the initial excavation treatments in 2006, the overall infested area for the 2006 excavated sites had dropped by 70.2% while the infested area at the 2006 deformed and stunted sites treated with foliar herbicide group had dropped by only 4.9%.

Though comparing stems counts over time at deformed and stunted growth knotweed sites may not be a reliable indicator of control efficacy, there is a noted difference in infested area between the excavation sites and the deformed and stunted sites. This may indicate that excavating the rhizomes at deformed growth sites produces a more favorable response to herbicide treatments in subsequent seasons.

**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 to four year period.
September 2004: 2133 stem count prior to initial treatment, infested area was not measured. Treatment consisted of 5ml glyphosate injection and 5% glyphosate foliar spray.

August 2005: 741 stem count and 70 m² infested area prior to second treatment. Treatment consisted of 5 ml glyphosate injection and 4% glyphosate with 1% triclopyr foliar spray.

August 2007: 77 stem count, 7.9 m² infested area prior to fourth treatment. Treatment consisted of 1% imazapyr foliar spray.

August 2008: 63 stem count and 4 m² infested area prior to fifth treatment. Treatment consisted of 1% imazapyr foliar spray.

Figure 2.5 Japanese Knotweed Landscape Experiment Photo-monitoring Series BR05
May 2006: 3400 stem count, 800 m² infested area before initial treatment. Initial treatment consisted of spring cut.

June 2006: 2300 stems, 700 m² infested area prior to second treatment. Treatment consisted of 1.5% imazapyr foliar spray.

September 2007: 457 stem count, 120 m² infested area prior to third treatment. Treatment consisted of 3% triclopyr foliar spray.

September 2008: 373 stem count, 12 m² infested area prior to fourth treatment. Treatment consisted of 1.5% imazapyr foliar spray.

Figure 2.6 Japanese Knotweed Landscape Experiment Photo-monitoring Series MC43A
June 2006: 800 stem count, 120 m² infested area prior to initial treatment. Initial treatment consisted of 3ml glyphosate injection with supplemental 1.5% imazapyr foliar spray of smaller stems.

October 2006: follow-up spot spray treatment with 1.5% Imazapyr foliar spray of a few living stems.

May 2007: 11 stem count, 1 m² infested area prior to third treatment. Treatment consisted of 1.5% imazapyr foliar spray.

September 2008: 7 stem count, 2 m² infested area prior to fourth treatment. Treatment consisted of 1.5% imazapyr foliar spray.

Figure 2.7 Japanese Knotweed Landscape Experiment Photo-monitoring Series SM105I
Discussion of Knotweed Treatment

The Nature Conservancy’s effort to control knotweed in the Sandy River Watershed continues to produce measurable, positive results. For the first time since the start of the study, we can state with a high degree of confidence that, with the exception of the Sandy River Delta where only preliminary surveys have occurred, the surveying and inventory of knotweed throughout the watershed is complete. All riparian patches in the watershed above the Delta have been treated at least once and in most cases more than three times.

In 2008, we chose to focus our knotweed control efforts on the mid and upper main stem Sandy, all tributaries and any new treatment areas added in the last 2 years, while forgoing visits to knotweed sites in an 18 mile reach of the main stem Sandy River that we had treated for more than 5 years. Sites revisited in 2008 had 90% fewer knotweed stems than their initial counts. There was a 46.5% reduction just since 2007 and no knotweed grew in 36% of the microsites established in past years. Previously treated knotweed infestations visited in 2008 covered just 0.31 acres, only 6% of the infested area observed in 2005. Statistics like these demonstrate that our treatments are effective at reducing knotweed infestations.

Though the 2008 field season has not revealed any major discoveries, it has reemphasized several important trends and findings:

- We have not yet eradicated any patch over 573 stems through the use of any treatment regime, even after up to nine treatments;
- When multiple herbicide treatments do not eradicate a patch, regrowth is typically too small to be injected and sometimes cannot even be sprayed effectively;
- Glyphosate treatments seem to cause significant deformed and stunted growth (observed at roughly one sixth of all previously treated sites) with little treatable foliage area. After significantly reducing the use of glyphosate (both via injection and in foliar spray solution) over the last 2 field seasons, we have observed a 40% reduction in the number of sites with deformed growth compared to 2007;
- While many smaller patches have been eradicated completely, others have remained with very low stem counts or with significant deformation for several years;
- Patches with no above-ground growth can have significant underground living tissue;
- Patches that appear dead for one or more years can sometimes still produce above-ground growth;
- Measurements of the above-ground portion of knotweed does not necessarily accurately reflect living biomass below ground;
- Treating deformed and stunted growth with herbicides does not kill large knotweed rhizomes;
- Living knotweed patches treated for multiple years and then left untreated for 1 field season show clear signs of recovery;
- Excavating living rhizomes from previously treated, deformed plants may result in stems which respond more favorably to herbicide treatment in the following year.

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. The introduction of 1 to 1.5% imazapyr into the foliar treatment mixtures has yielded promising results with initial decreases in stem counts ranging from 68% to 93% across the 2006 and 2007 treatment groups. Though no discernable trends or differences were detected when we examined the efficacy of treatment timing across all 2007 treatment groups, on-the-ground observations indicate that early-season imazapyr treatments and late-season triclopyr treatments produce poor and/or extremely variable results. Generally speaking, each
year’s treatment has reduced the size of the knotweed infestation. The initial treatment of a site usually produces the largest decrease (ranging from 38% to 93%) of stem counts. Subsequent treatments provide progressively less control. Waiting to retreat sites until they present more treatable foliage may prove to be a more efficient and better use of resources. The recovery response of a large group of knotweed sites left untreated in the 2008 field season may shed light on this approach.

In the 2009 field season, we plan to revisit and treat the 18 mile reach of the main stem Sandy River (left untreated in 2008) as well as treat other select reaches of the watershed. Decisions for our treatment protocol will be based on the bulleted trends listed above. Although treatment plans for 2009 are still preliminary, these plans are likely to include:

- Spray, except where prohibited by law or landowner, healthy knotweed stems with either 1% or 1.5% imazapyr;
- Inject 3 ml glyphosate only in small patches (under 200 stems) that are near highly desirable vegetation or overhanging water;
- Collect data on but not treat deformed or stunted stems;
- Continue to dig up the rhizomes of select patches with substantial deformation to remove energy reserves and to hopefully stimulate more treatable stems in follow-up visits; and,
- Leave a substantial number of established, knotweed sites untreated and unvisited in specific reaches of the watershed.

It appears there is no completely effective treatment method for eradicating persistent knotweed patches. Clearly, eradication of individual patches of knotweed is possible. However, eradication of all knotweed patches in a large watershed like the Sandy is highly unlikely due to the wide distribution, limited treatment window and tenacity of the plant. We believe that well-chosen follow-up treatments in select reaches each year may prove to be the most effective way of maintaining the high level of control we have achieved, while reducing any long term threats that knotweed poses to the overall watershed health.
Section 3. Invasive Species Surveys

Introduction

Purpose
During the 2008 field season we continued to implement the invasive plant survey program established in 2007. The surveys, conducted on lands adjacent to waterways, track the scale of infestation of eleven plant species considered potentially serious threats to riparian habitats, but whose population levels may still be controlled or limited. The invasive plant surveys offer a snapshot of the extent and distribution of invasive weeds in riparian areas throughout the watershed. Shared with our partners, this data will help guide management and future invasive species work in the basin.

Methods
To describe the extent of infestations at a given site, a qualitative value was assigned to each species (Table 3.0). Site boundaries were defined and tracked by tax lot using aerial maps and GIS software. The infestation designation for each of the eleven invasive species was estimated for each tax lot by combining the visual estimates of all crew members, since different areas of the site were surveyed by different members of the crew. Depending on topographic features (i.e. floodplain or homogeneous stretch of river bank), the size of the site or the proximity to one another, data for a set of adjacent tax lots may have been grouped. Some sites were only surveyed in the riparian margin along the waterway. These sites were marked “riparian” on the survey sheets.

<table>
<thead>
<tr>
<th>Site ID #</th>
<th>Date</th>
<th>Riparian</th>
<th>Entire Taxlot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasive Species Name</td>
<td>1: isolated patch</td>
<td>2: several small patches</td>
<td>3: small patches scattered throughout</td>
</tr>
<tr>
<td>Vinca minor and V. major - periwinkle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buddleja davidii - butterfly bush</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hedera helix - English ivy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clematis vitalba - clematis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ilex aquifolium - English holly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saponaria officinalis - bouncing bet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geranium lucidum - shining geranium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robinia pseudoacacia - black locust</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iris pseudoacorus - pale yellow iris</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alliaria petiolata - garlic mustard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brachypodium sylvaticum - false brome</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Monitoring
A total of 408 sites along the Sandy basin waterways were surveyed in 2007. In 2008, 512 sites were surveyed over an 8 month period from March to October. 47% of these were resurveys of sites surveyed in the 2007 field season. Two species, garlic mustard (Alliaria petiolata) and false brome (Brachypodium sylvaticum), were added to the survey datasheet for the 2008 field season. In 2009, survey work will target riparian sites not yet surveyed.
Results

We combined the survey data from the 2007 and 2008 field seasons, using the most recent data for resurveyed sites. Estimated levels of infestation ranged from 0.0% (false brome) to 61.4% (English ivy) (Table 3.1). We observed a correlation between the level of infestation and proximity to urban areas. Since our surveys often focused on the riparian area of a tax lot, the results must be considered preliminary.

The range of selected individual species was mapped to provide a visual interpretation of infestations in the Sandy Basin (Maps 3.0 – 3.2). Sites are determined by tax lot, and are color coded to reflect the level of infestation in a particular tax lot. Riparian area surveys are not distinguished from entire tax lot surveys, in part because this distinction was not recorded in the 2007 data.

In general, invasive species were more likely to be found in areas disturbed by development (i.e., along roadsides or residential / commercial / agricultural areas). In some instances, a spreading infestation was tracked back to a likely source population located on a developed private land parcel.

Because some of the reaches of the watershed have not yet been surveyed, the following results do not offer a comprehensive evaluation of the watershed…

English ivy (Hedera helix)
English ivy had the highest rate of occurrence, 61.4% of the sites surveyed (Table 3.1, Map 3.0). This highly invasive species is found throughout the Sandy basin, with the greatest abundance in the lower reaches and around residential communities. The seeds of English ivy are dispersed primarily by birds. Once established, English ivy can also reproduce vegetatively, rapidly creating dense mats that eventually climb trees by means of adventitious roots growing along the stem. English ivy is designated as a class “B” noxious weed by ODA.

English holly (Ilex aquifolium)
English holly is widely distributed throughout the watershed, occurring in 43.8% of sites surveyed (Table 3.1, Map 3.1). Since this plant does well in shady areas, it was typically found in upland riparian sites where overstory vegetation provided at least 50% canopy cover. English holly is spread by seed that is primarily dispersed by foraging birds. This woody invasive can also infest an area by sending out suckers that sprout into new trees.

Periwinkle (Vinca minor and V. major)
28.8% of sites surveyed were infested with periwinkle (Table 3.1). Infestations were generally found near residences and in many cases appeared to have been intentionally planted. Periwinkle can reproduce vegetatively by means of stolons, rooting at the nodes of the stems. Germination by seed has not been documented. This invasive plant can form dense mats in forest communities by outcompeting native understory plants.

Bouncing Bet (Saponaria officinalis)
The percentage of sites where bouncing bet was found was relatively high at 26.2% (Table 3.1). Bouncing bet was observed almost exclusively on sandy floodplains and river edges. This invasive plant reproduces by seed but can also spread vegetatively by means of rhizomes.

Traveler’s joy (Clematis vitalba)
Traveler’s joy is found in sporadic aggregations throughout the watershed, and was observed at 16.5% of sites surveyed (Table 3.1, Map 3.2). This invasive woody vine is often found growing alongside ivy in
open areas. Traveler’s joy moves through the riparian corridor by dispersing its seed by wind, water, people, and animals. Traveler’s joy is designated as a class “B” noxious weed by ODA.

**Butterfly bush** (*Buddleja davidii*)
Populations of butterfly bush were found in 7.3% of the sites surveyed (Table 3.1). Infestations of butterfly bush were generally found in open floodplains, or were planted in residential areas. Butterfly bush is a sun-loving woody shrub that disperses its seeds by wind, enabling it to rapidly colonize disturbed soils. Butterfly bush is designated as a class “B” noxious weed by ODA.

**Black locust** (*Robinia pseudoacacia*)
Black locust was observed infrequently (2.3% of the sites surveyed, Table 3.1) on floodplains and around structures on private properties. Black locust can reproduce by seed, but most frequently reproduces through the emergence of root suckers from older branch roots.

**Shining geranium** (*Geranium lucidum*)
Though only 1.8% of the surveyed sites were found to have shining geranium infestations (Table 3.1), the plant was dormant and likely undetectable at sites surveyed in the later half of our summer field season. While this invasive plant currently covers a relatively small area, patch size can rapidly increase manifold. Shining geranium has generally been observed along disturbed roadsides, or invading oak woodlands in wet, shaded habitat. This invasive plant reproduces by seed; once dry, the plant’s seed capsule explosively discharges its seeds, dispersing them across the landscape.

**Pale yellow iris** (*Iris pseudacorus*)
The number of occurrences of pale yellow iris is still small, at 1.4% of the sites surveyed (Table 3.1). The majority of the pale yellow iris populations observed were likely planted by landowners. Several patches, however, were found growing wild along the mid to lower Sandy River. Pale yellow iris reproduces by forming a thick mat of tuberous rhizomes that prevent the growth of other species. Additionally, its seed and rhizome fragments can be transported downstream, potentially infesting other areas. Pale yellow iris is designated as a class “B” noxious weed by ODA.

**Garlic mustard** (*Alliaria petiolata*)
Garlic mustard was added to the invasive species survey list in 2008 and was found on only 0.4% of sites surveyed (Table 3.1). However, most of the sites surveyed in 2008 were located in the upper watershed, while garlic mustard is known to infest large areas in the lower watershed. The percentage of garlic mustard occurring in the entire watershed is therefore significantly higher than this number suggests. Garlic mustard spreads by seed and rapidly colonizes disturbed areas. Once established, it can quickly penetrate undisturbed areas and suppress native vegetation, forming a monoculture. Because garlic mustard is considered a high level threat to the watershed, coordinated control efforts with EMSWCD began in spring 2008 (Please see Section 5 for details). Garlic mustard is designated as a class “B” noxious weed by ODA.

**False brome** (*Brachypodium sylvaticum*)
False brome was also added to the invasive species list in 2008 because it represents a very high threat to the region. Although it was not found on any of the sites surveyed in 2008, it has been found to the north and south of the Sandy River watershed (in the Eagle Creek and Clackamas watersheds, respectively), and is therefore likely to appear in the future. False brome is a grass whose seeds can be spread by humans and wildlife. False brome is designated as a class “B” noxious weed by ODA.
<table>
<thead>
<tr>
<th>Qualitative Description of Infested Area</th>
<th>Periwinkle (Vinca minor and V. major)</th>
<th>Butterfly bush (Buddleja davidii)</th>
<th>English ivy (Hedera helix)</th>
<th>Traveler’s joy (Clematis vitalba)</th>
<th>English holly (Ilex aquifolium)</th>
<th>Bouncing bet (Seponaria officinalis)</th>
<th>Shining geranium (Geranium lucidum)</th>
<th>Black locust (Robinia pseudoacacia)</th>
<th>Pale yellow Iris (Iris pseudacorus)</th>
<th>Garlic mustard (Alliaria petiolata)</th>
<th>False brome (Brachypodium sylvaticum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: no infestation observed</td>
<td>518</td>
<td>674</td>
<td>281</td>
<td>606</td>
<td>409</td>
<td>537</td>
<td>714</td>
<td>709</td>
<td>717</td>
<td>510</td>
<td>512</td>
</tr>
<tr>
<td>1: isolated patch</td>
<td>46</td>
<td>23</td>
<td>32</td>
<td>21</td>
<td>49</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2: several small patches</td>
<td>80</td>
<td>26</td>
<td>78</td>
<td>63</td>
<td>191</td>
<td>71</td>
<td>4</td>
<td>9</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3: small patches scattered throughout</td>
<td>50</td>
<td>2</td>
<td>150</td>
<td>15</td>
<td>68</td>
<td>96</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4: large patches found throughout</td>
<td>28</td>
<td>2</td>
<td>126</td>
<td>21</td>
<td>11</td>
<td>19</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5: dominates understory / overstory</td>
<td>6</td>
<td>0</td>
<td>61</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C: climbing trees</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Total number of sites where an infestation was observed</td>
<td>210</td>
<td>53</td>
<td>447</td>
<td>120</td>
<td>319</td>
<td>191</td>
<td>13</td>
<td>17</td>
<td>10</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Percentage of infested sites out of total sites surveyed</td>
<td>28.8%</td>
<td>7.3%</td>
<td>61.4%</td>
<td>16.5%</td>
<td>43.8%</td>
<td>26.2%</td>
<td>1.8%</td>
<td>2.3%</td>
<td>1.4%</td>
<td>0.4%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Invasive Species Threat Assessments

In 2008, a six member sub-group of the Sandy River Basin Partners (as briefly described in Section 4) developed a transparent and adaptable methodology for assessing the relative importance of control actions for different invasive species. The design is based upon similar methodologies used by USDA Aphids and Oregon Department of Agriculture, but is adapted to the needs and priorities of the Sandy Basin.

Four equally weighted elements of invasive species’ threat were chosen for assessing each species: ecosystem altering ability, reproduction capacity, current distribution, and current ease of control. For each of the threat elements, each species received a numerical score on a scale of 1 to 3, with 3 representing the highest negative impact (ecosystem altering ability, reproduction capacity, difficulty of control) or best opportunity for management (current distribution) (Table 3.2). Each participating Sandy basin partner evaluated each species independently. For each species, the values for each element were averaged and then rounded to create an overall adjusted threat score.

<table>
<thead>
<tr>
<th>Invasive Species</th>
<th>ecosystem altering ability</th>
<th>reproduction capacity</th>
<th>current distribution</th>
<th>current difficulty of control</th>
<th>average threat score</th>
<th>adjusted threat score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinca major - periwinkle</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1</td>
<td>1.38</td>
<td>1</td>
</tr>
<tr>
<td>Buddleja davidii - butterfly bush</td>
<td>1.17</td>
<td>2</td>
<td>2.83</td>
<td>1</td>
<td>1.75</td>
<td>2</td>
</tr>
<tr>
<td>Hedera helix - English ivy</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Clematis vitalba - traveler's joy</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1.17</td>
<td>2.29</td>
<td>2</td>
</tr>
<tr>
<td>Ilex aquifolium - English holly</td>
<td>1</td>
<td>1.17</td>
<td>1</td>
<td>1.17</td>
<td>1.09</td>
<td>1</td>
</tr>
<tr>
<td>Saponaria oficinalis - bouncing bet</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1.25</td>
<td>1</td>
</tr>
<tr>
<td>Geranium lucidum - shining geranium</td>
<td>2</td>
<td>3</td>
<td>1.83</td>
<td>3</td>
<td>2.46</td>
<td>2</td>
</tr>
<tr>
<td>Robinia pseudoacacia - black locust</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>Iris pseudacorus – pale yellow iris</td>
<td>2</td>
<td>2</td>
<td>2.67</td>
<td>2</td>
<td>2.17</td>
<td>2</td>
</tr>
<tr>
<td>Alliaria petiolata - garlic mustard</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Brachypodium sylvaticum - false brome</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

For each of the tax lot sites surveyed in our landscape invasive plant surveys, we took the level of infestation score (ranging from 0 to 5) for a given species and multiplied it by the corresponding adjusted threat score to generate an infestation threat value. One additional point was added to individual infestation threat values for climbing infestations. Finally, an overall infestation threat score for each site was calculated by totaling threat values for all species evaluated on a given site. Of the 728 sites surveyed between the 2007 and 2008 field seasons, infestation threat scores range from 0 (no threats) to 31 (extreme threat level). A graphical representation of the overall infestation threat scores across the riparian sites surveyed is displayed on Map 3.3.
Map 3.1
English Holly (*Ilex aquifolium*) Infestations in the Sandy River Basin (2007-2008)

Map Features
- Rivers and Streams
- Mt. Hood National Forest
- City Limits

Legend:
- No infestation observed
- Isolated patch
- Several small patches
- Small patches scattered throughout
- Large patches found throughout

English Holly (*Ilex aquifolium*) Infestations in the Sandy River Basin (2007-2008)

File: K:\Stewardship\Sandy\2008 Knotweed Report\InvasiveSpeciesMap\2008_holly_infestations.pdf
Clematis (Clematis vitalba) Infestations in the Sandy River Basin (2007-2008)

- No infestation observed
- Isolated patch
- Several small patches
- Small patches scattered throughout
- Large patches found throughout

Map Features:
- Climbing
- Rivers and Streams
- Mt. Hood National Forest
- City Limits


File: K:\Stewardship\Sandy\2008 Invasive Species Map\2008_clematis_infestations.pdf
Section 4. Site Based Restoration Initiatives

Introduction

Over the past 8 years, a coalition of natural resource managers called the Sandy River Basin Partners (SRBP) assessed watershed and aquatic conditions in the Sandy basin, identified specific restoration actions and developed an overall aquatic habitat restoration strategy. The group developed a hierarchical framework and action plan for implementing and restoring degraded aquatic and riparian habitats. The plan, which focuses primarily on restoring threatened fish populations, calls for diverse restoration actions including restoring connectivity to off channel habitats, road deconstruction, culvert replacement, and riparian vegetation restoration.

In 2008, The Nature Conservancy organized a sub-group of the SRBP to develop and implement a more comprehensive strategy for protecting and restoring vegetation communities. The strategy calls for restoring and protecting healthy, native riparian vegetation, stream shade, large-wood recruitment, habitat and channel complexity, and controlling erosion at prioritized large, undeveloped, natural areas throughout the basin. Many of these sites are, or will be, the location of in-stream habitat restoration work by partner organizations including the USFS and BLM.

Also in 2008, The Nature Conservancy began implementing four site-based restoration projects identified through planning efforts. These projects capitalized on existing partnerships and ongoing restoration activities to begin comprehensive site-based vegetation restoration. Lessons learned in the course of these projects will help inform and guide the larger and more numerous vegetation restoration activities that the SRBP will begin to implement in upcoming years.

Camp Angelos to Dabney State Park Site

This 450 acre site is located in the lower basin at the downstream end of the federal and state protected Wild and Scenic area along the main stem Sandy River. It is made up of public lands owned by Oregon Parks and Recreation Department, Metro, U.S. Department of Labor, and American Hellenic Society (a youth camp). The area is a center for education and recreation in the lower watershed and provides unique and valuable opportunities for community involvement. Significant development downstream and on both sides of the site combined with heavy recreational use and introductions of invasive species have left the site in a highly degraded state. Restoring and protecting the site will provide a buffer to protect large tracts of intact, undeveloped land upstream.

Over the past three years the area has been the focus of significant conservation investment by The Nature Conservancy, Oregon State Parks and Recreation, Metro Parks and Greenspaces, the Oregon State Weed Board, and the U.S. Forest Service. Initial control efforts of priority weeds including garlic mustard, Japanese knotweed, English ivy and traveler’s joy have been highly successful. However, control of these invasive species and establishment of native forest species will be a long-term endeavor and will requiring ongoing maintenance.

Between 2006 and 2007, Metro conducted initial and follow-up control of large intense infestations of English ivy and traveler’s joy on over 250 acres. In 2008, The Nature Conservancy and EMSWCD teamed up to conduct comprehensive control of garlic mustard over all 450 acres of the site. Additionally, The Nature Conservancy partnered with Oregon State Parks and Recreation to remove climbing ivy and clematis and Japanese knotweed from 190 acres of riparian and upland forests throughout the site. In this process, nearly 10 acres of Himalayan blackberries were also removed. Several monitoring plots were
established within floodplain benches where we documented the removal of English ivy from more than 370 trees and the removal of clematis from more than 70 riparian trees (Figures 4.0-4.3). Large, dense patches of ground ivy totaling more than six acres were also controlled. Three initial restoration areas totaling nearly three acres have been established and received comprehensive invasive species control. These sites will be replanted in winter of 2009.

Continuing control of knotweed, garlic mustard, traveler’s joy, English ivy, English holly, Scot’s broom, and blackberry will be needed for several years in order to establish native trees and shrubs. The Nature Conservancy, with adequate funding, will restore and install nearly 1/3 of a mile of riparian forest in and around Dabney State Park. Long-term efforts will focus on controlling invasive species populations, completing the installation of riparian buffers, increasing community support and involvement with the project, and maintaining project accomplishments.
Figure 4.0. Dabney State Park Restoration Site 2 Before Treatment

Figure 4.1 Dabney State Park Restoration Site 2 After Treatment
Figure 4.2 Dabney State Park Restoration Site 3B Before Treatment

Figure 4.3 Dabney State Park Restoration Site 3B After Treatment
**Lower Sandy River Gorge Site**

This 3800 acre site, located in the lower Sandy River Watershed, contains broad floodplains, key spawning habitats for threatened fish species and important travel corridors for wildlife, including black bear, bobcat, cougar, Roosevelt elk and black-tailed deer. The site is designated as both a Federal Wild and Scenic River and Oregon State Scenic Waterway. The site extends between 2 major recreation and public access destinations: Dodge Park and Oxbow Park. With significant public use in these two areas, plus development increasing along the margins of the river gorge, increased management of invasive species populations and recreation areas is necessary to maintain the area’s natural resources.

Since 2000, The Nature Conservancy has been working throughout this site to control many large populations of knotweed. A long-term effort has been sustained to clear and then keep several meadows and shorelines free of Scot’s broom and Canada thistle. In 2008, The Nature Conservancy continued and expanded these efforts throughout these sites by clearing Scot’s broom and maintaining nearly 25 acres of meadows and shorelines. The Conservancy maintained three acres of upland meadow by chemically treating Canada thistle and manually removing encroaching blackberry vines. Garlic mustard, which had begun to show up along roadsides in the areas around Oxbow Park, was controlled first chemically then manually by staff from The Conservancy and East Multnomah Soil and Water Conservation District. On nearby private inholdings, initial removal of climbing English ivy and traveler’s joy on more than 40 trees over two acres was conducted this year. Follow-up control will be necessary in all areas for several years to maintain these sites.

In 2009, through a grant from OWEB, The Conservancy and Metro will begin conducting early-intervention treatments on all ivy, clematis and holly populations within the 3800 acre project area and develop a long-term strategy to continue such treatments. Treatment of Scot’s broom, Canada thistle and blackberry in previously cleared areas will be maintained and likely expanded in upcoming years. Additionally, significant vegetation restoration including the installation of riparian vegetation buffers on tributary and mainstem shorelines will likely occur in 2010 and beyond.

**Sleepy Hollow/Wildcat Creek Side Channel Complex Site**

This 244 acre site consists of a series of three long side channels and several wetland areas owned primarily by the BLM and a handful of private parties, many of whom we are already working with to address common restoration goals. The site also includes the lowest reach of Wildcat Creek, which together with nearby Alder Creek form a highly ranked sub-watershed for salmon recovery efforts in the Sandy River Basin Aquatic Habitat Restoration Strategy. Prime habitat for threatened fish species and an excellent series of off-channel habitats and beaver ponds, make the site important for long-term restoration. Because the southern portion of the site borders Highway 26, much of it has been disturbed by invasive species, infrastructure development, and logging practices. These areas will require significant invasive species control and restoration planting to improve habitat quality.

In 2008, The Nature Conservancy, BLM, and the Sandy River Basin Watershed Council teamed up to begin removal of several large patches of English ivy and Scot’s broom from the site. Over the course of the summer, youth and AmeriCorps crews removed climbing ivy from over 700 trees and removed over one acre of Scot’s broom. Additionally, BLM mowed several acres of Scot’s broom on a large floodplain at the upstream end of the site.

Between 2009 and 2010 we expect to remove the remainder of the climbing ivy from the site, and to conduct an initial treatment of all ground ivy on the site. Manual follow-up treatments of Scot’s broom populations will also occur as well as initial removal of yet another invasive policeman’s helmet (*Impatiens glandulifera*) and other priority invasive species. Long-term restoration plans will include thinning of five to ten acres of young hardwoods to release conifers. Wood will be piled for burning...
during the rainy winter months. We will control large-scale invasive species populations through manual removal and herbicide treatments. Replanting projects to restore riparian buffers and conifer recruitment will take place in late 2010, as will follow-up invasive species control.

**Sandy/Salmon Confluence Site**

This 185 acre site is located at the confluence of the Salmon and Sandy rivers. Ownership is largely public with management being conducted by BLM. This site is the location of significant ongoing conservation investment including invasive species control and restoration plantings. The site is currently accessible to the public, and significant upcoming improvements to public access will eventually make this one of the most important public access points in the basin. With wetlands and beaver ponds as well as historic floodplains that could potentially be reopened, protection and restoration of this site is a long-term priority.

In 2008, The Nature Conservancy, BLM and a local private landowner teamed up to conduct comprehensive Scot’s broom and English ivy removal across the entire site. In total, nearly four acres were manually cleared of ground ivy, more than 30 trees were cleared of climbing ivy and 50 English holly trees were cut-stump treated. Ongoing knotweed, and traveler’s joy control efforts have largely succeeded and require minimal maintenance each year. However, we anticipate significant need for follow-up control of English ivy infestations.

In 2009 and 2010, The Nature Conservancy will conduct comprehensive follow-up treatments of invasive plant populations at the site. Additionally, restoration plantings will be conducted in highly degraded riparian areas. This will include installation and maintenance of riparian buffers around degraded wetland and riparian areas.
Section 5. Garlic Mustard Containment Project

Introduction

Garlic mustard \textit{(Alliaria petiolata)}, a biennial plant native to Europe, has become established in forest and edge communities in the western part of the Columbia River Gorge National Scenic Area and in the lower Sandy River Watershed. With its ability to self-fertilize and its life cycle as an early spring bloomer, garlic mustard has the potential to displace native flora and eventually native fauna. It spreads by seed initially along roadsides and recreation and game trails before aggressively invading interior forest communities. As the majority of the Sandy River Watershed and Columbia River Gorge are prime habitat for this invasive plant, there is a very high likelihood that without prompt control it will quickly spread throughout its potential range.

With garlic mustard already well established in many areas, early detection and eradication of satellite populations has been identified as the primary goal. By preventing the plant from spreading to new areas and by eradicating outlier and edge populations, we hope to maintain or shrink the species' current distribution until an effective bio-control becomes available.

The Columbia Gorge Garlic Mustard Containment project is a cooperative effort between The Nature Conservancy and EMSWCD.

Methods

Mapping of roadside garlic mustard was conducted in 2006 and 2007 by EMSWCD. This mapping effort helped identify the sources of major infestations and the location of satellite populations, and suggested a long-term containment area. The containment area was subsequently defined by drawing an approximate line between large, well-established populations and smaller, newer outlier populations. The large populations of garlic mustard within the containment zone were and will continue to be treated only where they intersect with roadside right-of-ways and trailheads. The remainder of these large populations will be targeted for bio-control when it becomes available. All populations of garlic mustard found outside the containment zone were and will continue to be targeted for ongoing control and eradication.

Spring herbicide treatments were conducted at all previously identified and newly discovered garlic mustard populations outside of the containment area. Herbicide treatments were initiated as soon as rosettes began to bolt and continued as weather permitted until all sites had been treated or until it was too late to prevent seed set. An aqueous spray solution of 1.5 to 2% Garlon 3A, 1% MSO pro-concentrate, and 1% blue indicator die was used for all herbicide treatments. Due to garlic mustard’s staggered growth, the limited window of opportunity for spraying and the high likelihood of missing plants on the initial herbicide treatment, follow-up manual treatments were conducted. Manual treatments at each site occurred approximately one month after herbicide treatments. They were conducted only after the plant’s seedpods had developed to a level that made herbicide treatments ineffective at killing the plant. Manual control (Figure 5.0) involved extracting the plants, including the roots, placing them in garbage bags, and disposing of the bags in a landfill.

Fall follow-up treatment of rosettes was conducted at all sites with large, intense garlic mustard infestations and at sites whose populations did not receive a spring herbicide treatment due to late discovery.
Each taxlot where garlic mustard was found was established as a site. Patch size, percent cover, treatment date and method, and the location of the plants were recorded for each site where garlic mustard control was performed.

Figure 5.0 Contractors Conduct Manual Garlic Mustard Removal Along the Sandy River

Results

A total of 23.5 acres of garlic mustard on 108 different sites were treated in 2008. Overall, the infested area of garlic mustard infestations treated totaled more than 1.9 acres outside of the containment area. Control was performed on all but two targeted properties. Herbicide applications proved extremely effective at controlling large patches of garlic mustard (Figures 5.1 and 5.2).

One hundred and forty-three 30-gallon trash bags were filled with manually removed garlic mustard during this project. Fifty-nine of these bags were pulled as follow-up treatments at sites that had been sprayed. The other 84 bags were pulled at sites discovered after it was too late to use herbicide treatments.

Discussion

Given that this was the first large-scale attempt to control garlic mustard in the area, the initial efforts were reasonably successful. As our outreach efforts yielded additional access to lands not previously surveyed, we found that the plant was distributed over a larger area than expected and that some populations were very large. Nevertheless, in 2008, through a combination of herbicide and manual treatments, all populations of the plant existing outside of the containment zone were treated.

Several factors complicated our efforts to control the plant. Timely treatment of all state right-of-way populations of garlic mustard was difficult to coordinate. Training contractors and ensuring that the appropriate size of crew was present on each day was challenging as our first thorough survey work was
often conducted while treating the sites with contractors. The plant’s life cycle, including its early spring flowering and the short window of opportunity for treating the plant make thorough treatments a logistical challenge. However, with widespread public support for control of this plant, and with a successful first year of treatments complete, we expect future treatments to be easier and even more effective.

**Conclusions**

The borders of this containment zone will be held through annual treatment of all satellite populations outside of the containment zone and treatment of garlic mustard found in main vectors inside the containment zone. Annual efforts will continue as needed until eradication has occurred at target sites. Through these efforts, garlic mustard will be contained to the area where it is already well established, eradicated from the areas where it is sparsely established, and prevented from continuing to expand its range in the Columbia River Gorge and Sandy River Watershed. With an effective bio-control expected in the next few years, our efforts are helping to coordinate an effective management response, working to build awareness, and maintaining important natural resources.
Figure 5.1 Dabney State Park Garlic Mustard Site Before Treatment

Figure 5.2 Dabney State Park Garlic Mustard Site After Treatment
Section 6: Outreach

Introduction

Participation from private landowners is crucial to the success of the SRRHPP. Public outreach aims to gain access to private lands for survey and control of invasive plants, encourage participation by the local community and other agencies, and increase awareness of watershed ecology. This is accomplished through:

- Mailings, phone calls, and on-site visits to landowners
- The distribution of informational packets, brochures, and posters to those interested in receiving and/or using The Nature Conservancy materials
- Informational booths at local community events

In 2008, these methods were used to facilitate two distinct projects. The Columbia Gorge Garlic Mustard Containment project targeted Sandy basin landowners whose properties were known or suspected to have garlic mustard. This was a new undertaking for the SRRHPP and was done in partnership with EMSWD. The second project, a continuation from previous years, primarily targeted landowners whose properties were known or suspected to have Japanese knotweed. A secondary goal of this latter project was to conduct outreach and surveys on private properties that have been deemed potential priority sites by The Nature Conservancy and its partners for future restoration.

Methods

Garlic Mustard

Initial mailings were sent to 251 landowners located along the Sandy River who were within 100 meters of a known garlic mustard site between river mile 3 and 7. Mailings included a brochure and two permission forms. The brochure provided detailed information on garlic mustard’s physical appearance, its negative effects on native species, and the project to control it. A permission form signed by a landowner allowed for access to the property for survey and treatment of garlic mustard by The Nature Conservancy, EMSWD, and our contractors. On-site outreach was performed to individuals who did not return a permission form. If the landowner was present we informed him of the project and asked him to sign an agreement form. If the landowner was not present the brochure, permission forms, and a handwritten note were left. Phone calls and additional on-site visits were often used as follow-up methods. Outreach attempts were recorded on contact forms and within a database. If a permission form was obtained, follow-up surveys and treatments, if necessary, were conducted.

Knotweed

Initial mailings were sent to 472 individuals throughout the Sandy River watershed who properties were known or suspected to have knotweed. Mailings included an informational program letter, the knotweed brochure, and two permission forms. A new permission form was used this year to allow for a greater number of invasive plants to be surveyed for and treated. On-site outreach and/or phone calls were made to 188 landowners. Outreach efforts were performed and recorded using the same methods as were used for garlic mustard.
Results

Garlic Mustard
Permission forms were obtained from 113 private landowners. Of those properties where garlic mustard populations were found all but two permission forms were acquired. These two landowners made the decision to not participate in the project.

Knotweed
New permission forms were obtained from 189 private landowners in 2008 (Table 6.0). Of these, 45 were received from new landowners. There are currently 293 active and cooperating landowners totaling 447 tax lots.

Table 6.0: Private Landowner Permission Received for Knotweed and Invasive Surveys

<table>
<thead>
<tr>
<th>Status</th>
<th>Permission Received 2008</th>
<th>Active Permission 2006 – 2008</th>
<th>Total Permission Received 2001 - 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Landowners</td>
<td>189</td>
<td>293</td>
<td>477</td>
</tr>
<tr>
<td>Tax Lots</td>
<td>303</td>
<td>447</td>
<td>646</td>
</tr>
</tbody>
</table>

Discussion

Garlic Mustard
Of the landowners contacted for the first time, 45% provided permission for further survey and treatment. However, this percentage does not accurately reflect the scope of outreach efforts. Many more private landowners were supportive of the project and allowed surveys to be conducted on their property by giving verbal permission. If garlic mustard was not found, a signed permission form was not pursued.

Our outreach efforts were also enhanced by a large amount of media coverage that developed as this project progressed. Articles appeared in the Gresham Outlook, The Statesman Journal, The Portland Tribune, and The Oregonian.

Next year, outreach efforts will be lead by EMSWCD. The Nature Conservancy will participate in limited outreach which will typically occur when new infestations are discovered.

Knotweed
Of the landowners contacted through outreach efforts, 40% gave permission for further survey and treatment. As was previously stated with garlic mustard, this percentage does not accurately portray the amount of outreach performed. Not included in these numbers are supportive landowners who gave verbal permission for surveying but did not have knotweed populations or who chose to manage infestations themselves.

Next year, outreach will focus on renewing expired permission forms throughout the watershed and updating other landowner permission forms with the new version. Outreach for invasive plant surveys will also continue to be conducted.
Section 7: Volunteers, Youth Crews, and Education-based Outreach

Introduction

Community-wide education and outreach are necessary to effectively control invasive species. When community members are made aware of the threats posed by noxious weeds, they are more likely to landscape with native plants, participate in volunteer events, and support public and private funding for control measures. Furthermore, volunteer participation provides a cost-effective means to complete field work while serving as an effective communication and outreach tool. In 2008, our program included volunteers, interns, and youth crews.

Methods

We use several methods to recruit volunteers and educate the public. We table at festivals and fairs, and we participate in knotweed symposiums and working groups. We also advertise to volunteer listservs and send information to be posted at colleges and science-learning organizations. We then match volunteers of different ages, abilities, and educational backgrounds with projects that fit their interests and availability. Highly dedicated individuals become part of our adopt-a-plot program where they restore small sections of the river on their own, interns work alongside field crew with other volunteers, and community members attend work parties at high impact sites. In addition, we incorporate a service-learning component into activities that address Sandy River ecology, herbicide effects, and plant monitoring.

Results

This year we advertised our program through The Nature Conservancy website, newsletter, and internal listserv. We also advertised through volunteer listservs and with organizations such as Volunteer Match, Hands on Portland, and CNRG. We sent information to be posted at Portland State University, Portland Community College, Lewis and Clark University, Reed College, and Oregon State University. We also tabled at City Repair’s 2008 Earth Day.

In 2008, we recruited and managed two full-time AmeriCorps volunteers, two part-time AmeriCorps LINKS volunteers, twelve adopt-a-plot volunteers, four interns, one large corporate group, two fee-for-service youth crews (Multnomah Youth Cooperative and Cascade Education Corps), and one volunteer youth crew (Project YESS). We also supported 49 individuals at four work parties. In total, we worked with 216 volunteers that contributed over 5400 hours (Table 7.0).

Table 7.0: 2008 Volunteer Contribution to SRRHPP

<table>
<thead>
<tr>
<th>Type of Volunteers</th>
<th>Number of Volunteers</th>
<th>Hours Contributed</th>
</tr>
</thead>
<tbody>
<tr>
<td>AmeriCorps</td>
<td>2</td>
<td>2046</td>
</tr>
<tr>
<td>LINKS AmeriCorps</td>
<td>2</td>
<td>469</td>
</tr>
<tr>
<td>Knotweed Interns</td>
<td>4</td>
<td>582</td>
</tr>
<tr>
<td>Work Parties</td>
<td>49</td>
<td>472</td>
</tr>
<tr>
<td>Adopt-a-plot</td>
<td>12</td>
<td>373</td>
</tr>
<tr>
<td>Corporate Volunteers</td>
<td>97</td>
<td>631</td>
</tr>
<tr>
<td>Volunteer Youth Crews</td>
<td>26</td>
<td>408</td>
</tr>
<tr>
<td>Fee-for-service Youth Crews</td>
<td>24</td>
<td>428</td>
</tr>
<tr>
<td>Totals</td>
<td>216</td>
<td>5409</td>
</tr>
</tbody>
</table>
Discussion

Working with volunteers increases both the scope and effectiveness of the invasive control programs while simultaneously stretching project dollars. At a conservative estimate of $11.00 per hour, this year’s volunteers contributed $59,499 to the SRRHPP. Volunteer efforts allow us to reach more sites, survey more land, and remove more invasive plants than could be accomplished by staff alone.

We are able to communicate the threat of invasive species to a large and diverse audience by combining volunteer events with education. This service-based learning increases the motivation, interest, and work ethic of our volunteers while informing individuals about ecological issues. Volunteers will take these lessons and continue to serve as spokespeople for invasive species management and conservation.
Section 8. Conclusion

Over the past 8 years, The Conservancy’s Sandy River Riparian Habitat Protection Project has invested heavily in landowner outreach, invasive species survey and control, and volunteer and citizen engagement. Over the course of this project, several basic lessons learned are worth noting:

- Though we have achieved a high level of control including a 90% reduction in knotweed stem number in the watershed, and reduced the overall infestation area to less than 5% of its original cover, the investment in time, energy and resources has been extensive. When considering an invasive species landscape level control project, planning for a long and sustained effort is critical to its success;
- Fund raising, in the form of grants, to sustain a long term restoration project is a highly competitive and exhaustive process that requires constant attention;
- Monitoring, research and sharing of results with the natural resource community and other land managers is important. These elements of restoration projects are often the first to be trimmed from a budget, yet can provide crucial guidance to project decisions and help inform others;
- Substantial private lands in a landscape level project can present challenges. Though we have been quite successful with our outreach efforts including securing working relationships with other 500 landowners, significant time and energy have been spent every year to maintain and build this community support. Furthermore, it only takes a handful of opposed landowners to jeopardize a watershed level control project;
- A clear leader committed to the areas of interest and who can work across multi-jurisdictional boundaries is necessary in landscape level projects.

Through our efforts, we have developed the relationships, on-the-ground experience, and credibility necessary to successfully implement basin-wide restoration projects. With our knotweed control efforts succeeding and requiring a smaller overall investment of time and resources, we are now shifting our focus towards restoring priority riparian and upland habitats in the basin.

A wide range of stakeholders including the Sandy River Basin Partners are or will soon be implementing large-scale habitat restoration projects. These projects include the removal of Marmot and the Little Sandy dams, the re-opening of several side channels along the Salmon River, large wood placement projects, dike and road removal, culvert replacement, acquisition of conservation easements on priority riparian properties, and many other projects. With a broad suite of restoration initiatives being planned and implemented, The Nature Conservancy’s role will transition in 2009 to coordinating, with a broad group of partner organizations, the implementation of large, long-term, site-based vegetation restoration projects. The 10 year Sandy Basin Anchor Habitat Restoration Project, as the site-based projects together are called, will:

- Establish 10 to 15 large, priority natural area restoration projects composed of public and private lands within portions of the river prioritized for recovery of salmon and steelhead populations;
- Work with at least 100 private landowners within priority areas to gain access to and restore vegetation on riparian properties;
- Work with the Sandy River Basin Partners to acquire or gain easements over some of the private riparian lands that fall within priority natural areas;
- Conduct priority invasive species control using a combined mechanical, manual and chemical approach at priority sites covering at least 5,000 acres;
• Conduct restoration plantings as needed in areas where invasive weeds have been removed or where riparian vegetation is degraded;
• Conduct riparian deciduous tree thinning and conifer release in natural areas to ensure long-term, large woody debris recruitment;
• Develop and implement a basin-wide invasive species control program;
• Develop and implement an active program for Early Detection and Rapid Response (EDRR) of invasive species; and,
• Work to promote a unified series of education kiosks and passive recreation areas at designated sites throughout the watershed to promote awareness and stewardship of the Sandy River Basin among local communities and school groups.

In addition to these initiatives, the project will continue to control knotweed throughout the Sandy River basin.